



ASTHMA IN CHILDREN: A CHRONIC CONDITION REQUIRING A MULTI-FACETED APPROACH

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“Asthma in Children: A Chronic Condition Requiring a Multi-Faceted Approach”

Abstract

Background

Asthma is a serious chronic disease with physical, academic, and economic consequences that affected more than 7 million children in 2010.¹ The physical consequences of asthma are estimated to have caused more than 1,700 childhood deaths between 2002 and 2007.² One of the ways to reduce the impact of asthma is to avoid triggers—including exercise, allergens, viral infections, excitement/stress, and environmental triggers such as air pollution, allergens, and cold weather—that exacerbate asthma symptoms.³ Unfortunately, many children are regularly exposed to potential triggers, which can have a negative impact on their health and well-being.⁴

Asthma also negatively impacts school attendance and school performance. Children with asthma are more likely to be absent when compared to their non-asthmatic peers, with more than 10.5 million missed days of school due to asthma in 2008.^{5,6} Furthermore, pediatric asthma costs the United States about \$27 billion every year, largely to due health care expenditures.⁷ In 2007, children experienced nearly 151,000 hospitalizations; 640,000 emergency department (ED) visits; and 6.7 million doctor visits that were asthma-related.^{8,9} While the impact of asthma is significant, affected children can manage the disease with proper medical care and by avoiding potential triggers.¹⁰ The Centers for Disease Control and Prevention (CDC) has reported that teaching people how to independently manage asthma is one of the most important aspects of controlling this disease.¹¹ Proper asthma management education can reduce the number of asthma-related deaths, hospitalizations, emergency room visits, and missed days of school.^{12,13}

A focus on children is important because this population is at a higher risk for poor asthma management, due in part to the disconnect that occurs between children and the adults supporting their asthma management. Properly managed asthma in children leads to improved health outcomes, contributing to decreased economic costs and improved quality of life.¹⁴ Technology provides an inexpensive, accessible conduit for educational programs; and with children's increased access to technology both in and out school, there is a valuable opportunity to incorporate these resources in asthma interventions, management, and education for this population. This paper aims to review the literature on asthma management programs for children, highlight successful interventions incorporating the use of technology, and discuss policies to aid in improved asthma management. We will also provide recommendations for asthma management programs, future research, and policy development.

Methods

A systematic review examining asthma management programs/policies that targeted school-age children was conducted. The terms “best/practices,” “asthma,” “school,” “education,” “interventions,” “public/policy,” and “children/pediatric” were entered into the PubMed database. Inclusion criteria for search results were: 1) topic, i.e., articles that addressed best practice for asthma management, and 2) population, i.e., interventions targeted toward children or adolescents. Our search yielded 2,381 articles meeting inclusion criteria. We then excluded articles that 1) were written in a language other than

English, 2) provided only vague descriptions of interventions, 3) focused primarily on chronic obstructive pulmonary disease (COPD) and other non-asthma respiratory diseases, and/or 4) did not characterize results. Using the exclusion criteria, our results narrowed to 44 articles.

Results

This review demonstrates that asthma management programs, which reportedly led to significant improvements in the targeted health-related outcomes, incorporated one or more of the components recommended by the National Heart, Lung, and Blood Institute (NHLBI) *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma*. The NHLBI states that effective asthma management requires 1) measures of assessment and monitoring of asthma severity and controls, 2) education supporting a partnership in asthma care, 3) control of environmental factors affecting asthma, and 4) pharmacologic therapy.¹⁵ Based on the articles reviewed, this paper demonstrates the possibility for innovative programs, particularly those using technology, to be used in schools. The results suggest that the NHLBI components as well as innovation should be considered critical to developing a successful asthma management program targeting children.

Discussion

Proper asthma management results in improved health outcomes for asthmatic children, leading to decreased absenteeism from school, decreased economic costs, and an improved quality of life.¹⁶ However, proper management requires multiple components addressing various aspects of this disease.¹⁷ This includes measures of assessment and monitoring of asthma severity and controls, education supporting a partnership in asthma care, control of environmental factors affecting asthma, and pharmacologic therapy.¹⁸ While interventions incorporating one or two of these components may still report positive outcomes, long-term sustainable effects are still a concern.^{19,20} Multi-faceted asthma management programs could encourage long-term use and improved health outcomes. Schools, in particular, provide a valuable opportunity to incorporate programs targeting school-age children because they allow families, school staff, clinicians, and school nurses to work together to manage asthma. The use of technology, such as Web-based education and monitoring, provides additional opportunity to develop programs that incorporate all of the NHLBI recommended components. Furthermore, policies that support multi-faceted asthma management, interventions, and education for children are crucial to improving management of asthma.

Introduction

Asthma is a serious chronic disease with many physical, academic, and economic consequences that impacted more than 7 million children in 2010.²¹ Asthmatic children face significant physical consequences affecting their quality of life, such as sleep disturbance and asthma attacks. These attacks range in severity from mild to life-threatening, and are estimated to have caused more than 1,700 childhood deaths between 2002 and 2007.²²

Children experience varying levels of asthma-related physical effects, the severity of which is influenced by other physiological and environmental factors. For example, overweight and obese children have an increased risk for asthma and more severe asthma symptoms.²³ Furthermore, triggers such as air pollution, exercise, allergens, cold weather, viral infections, excitement/stress, and tobacco smoke present a major concern for those diagnosed with asthma.²⁴ Triggers exacerbate asthma symptoms leading to an increased need for short-acting beta agonists (SABAs), which are typically used as “rescue” medication.²⁵ Unfortunately, many children with asthma frequently encounter triggers on a daily basis; almost one-third of asthmatic children are exposed to a smoker in the house, and more than one-half are exposed to furry pets at home.²⁶ Regular exposure to asthma triggers such as these can have a significant impact on a child’s health and overall well-being. Young children are at an increased risk for experiencing the negative health effects of asthma, since asthma exacerbations are common during early childhood and may lead to progressive loss of lung functions.²⁷ Furthermore, this population has an increased likelihood to experience more episodic disease patterns, which are not typically addressed by diagnostic asthma questionnaires that focus mainly on the chronic disease aspects. This presents a concern regarding asthma management, as insufficient understanding of the disease may lead to mismanagement of an individual’s asthma.

In addition to the physical consequences of asthma, it also negatively impacts school attendance and school performance. For example, asthmatic students are more likely to be absent when compared to their non-asthmatic peers, with more than 10.5 million days of school missed due to asthma in 2008.^{28,29,30} Even when asthmatic students are able to attend school, many still face difficulties: 40% of children with disabling asthma reported a limitation in their ability to engage in school activities.³¹ This decreased school attendance and participation likely contributes to decreased school performance among asthmatic students, and children with persistent asthma are at a particular risk compared to those with mild intermittent asthma. One study demonstrated an increased likelihood for these children to score below “Nearing Proficient” on the Missouri Assessment Program (MAP), a standardized test administered throughout Missouri schools to test performance on math, social studies, communication arts, and science.³²

Asthma also has a significant economic impact, costing the United States about \$27 billion every year.³³ Much of this cost is due to health care expenditures: in 2007, children experienced nearly 151,000 hospitalizations; 640,000 emergency department (ED) visits; and 6.7 million doctor visits that were asthma-related.^{34,35}

The impact of asthma is significant, and while there is no cure, affected children can manage the disease with proper medical care and by avoiding potential triggers.³⁶ The Centers for Disease Control and Prevention (CDC) has reported that teaching people how to independently manage asthma is one of the most important aspects of controlling this disease.³⁷ In fact, many pediatric hospitalizations may be avoided if parents and children were better educated about avoiding known disease triggers. However, proper asthma education also involves educating children on what their triggers are; often, there is only a modest correlation between self-reported triggers and true, objective allergy test results.³⁸ This discrepancy can be detrimental to asthma patients, who cannot successfully avoid triggers if the triggers are being misidentified. However, properly educating children through programs supporting proper trigger identification can prevent asthma symptoms arising solely from the fear and anxiety of perceived trigger exposure (for some, even the perception of an asthma trigger can elicit bronchoconstriction³⁹). Furthermore, asthma management education can reduce the number of asthma-related deaths, hospitalizations, emergency room visits, and missed days of school.^{40,41}

Asthma education programs targeting children and adolescents address many of the physical consequences of asthma and have the potential to improve health outcomes within this population. Successful programs have reported improved lung function, decreased the number of days with restricted activity, and increased feelings of self-control.^{42,43} A focus on children is important because this population is at a higher risk for poor asthma management. This is partly due to the disconnect that occurs between children and the adults supporting their asthma management; adherence to childhood asthma treatment is frequently poor, and parents often overestimate the amount of drug being utilized. This is not surprising since many young children—20% of 7-year-olds and 50% of 11-year-olds—are often left to take asthma treatment unsupervised, leading to poor inhaler-use technique.⁴⁴ This is concerning because non-adherence and poor practices of treatment regimens contribute to roughly half of patients' poor asthma control.⁴⁵ Proper asthma management is not the only area where reports from parents and their children differed. A University of Washington study also found discrepancies in sleep quality reports for asthmatic children. Parent-child reports were significantly different across all symptoms and sleep parameters for children with asthma, with parents reporting better sleep with fewer awakening and symptoms than their children.⁴⁶ Addressing these discrepancies and concerns through asthma management education targeting children has the potential to significantly improve the consequences of asthma. Children who are able to properly manage their asthma show improved health outcomes, contributing to decreased economic costs and an improved quality of life.⁴⁷

Children's increased access to technology both in and out of school provides a valuable opportunity to incorporate technology in asthma interventions, management, and education for this population. Over the last several years, the number of children in the United States with access to computer technology has significantly increased.⁴⁸ Many children have access to different types of technology outside of school, and a growing number of parents are providing their children with access to computers at home: surveys of 14 elementary schools found that approximately 80% of students and parents have access

to the Internet at home.^{49,50} Student access to technology extends into the classroom as well, and is even more prevalent in the school environment: as of fall 2002, 99% of schools in America had access to the Internet.⁵¹ Furthermore, use of educational technology is high, as 75% of elementary teachers reported that either they or their students used computers during school instructional time.⁵² With so many children able to access technology, there is much potential for using technology to provide asthma management tools and education to children on a large scale.

This paper aims to review the literature on asthma management programs for children, highlighting the successful interventions incorporating the use of technology; and to discuss implications and recommendations for asthma management programs, future research, and policy development.

Methods

We performed a systematic literature examining asthma management programs and policies that targeted school-age children. The terms “best/practices,” “asthma,” “school,” “education,” “interventions,” “public/policy,” and “children/pediatric” were entered into the PubMed database. Inclusion criteria for search results were: 1) topic, i.e., articles that addressed best practice for asthma management, and 2) population, i.e., interventions targeted toward children or adolescents. Our search yielded 2,381 articles meeting inclusion criteria. We then excluded articles that 1) were written in a language other than English, 2) provided only vague descriptions of interventions, 3) focused primarily on chronic obstructive pulmonary disease (COPD) and other non-asthma respiratory diseases, and/or 4) did not characterize results. Using the exclusion criteria, our results narrowed to 44 articles. The flow diagram below (Figure 1) depicts the literature search results.

Results

Key factors of asthma management

A 2007 National Heart, Lung, and Blood Institute (NHLBI) *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma* stated that effective asthma management requires 1) measures of assessment and monitoring of asthma severity and controls, 2) education supporting a partnership in asthma care, 3) control of environmental factors affecting asthma, and 4) pharmacologic therapy.⁵³

The first component—assessment measures and monitoring—encourages observations of an individual’s respiratory symptoms, sleep disturbance, medication use, and activity limitation.⁵⁴ These observations can be recorded through the use of routine self-assessments (Figures 2 and 3) that can then be brought to clinical appointments for monitoring and feedback from medical professions.⁵⁵ The second component—education supporting a partnership in asthma care—involves teaching children self-management skills and increasing the number of educational opportunities in the clinic or doctor’s office, during ED visits, and in school-setting interventions.⁵⁶ There are many resources

available to support this partnership in asthma care, including the development of an asthma action plan distributed during physician and/or ED visits (Figure 4 and 5).⁵⁷ The third component—control of environmental factors affecting asthma—requires first utilizing medical testing to properly assess allergens and then supporting the avoidance of trigger exposure whenever possible.⁵⁸ The fourth component—pharmacologic therapy—encourages asthma patients who seek consistent control of persistent asthma to use long-term control medication on a daily basis, to utilize spacers for all metered dose inhalers, and to use SABAs sparingly.⁵⁹

Our review of asthma management studies targeting children found that interventions reporting significant improvements in the targeted health-related outcomes often utilized one or more of these components. We highlight some of these interventions below and discuss relevant policies geared toward improving asthma management.

Interventions incorporating measures of assessment and monitoring

The following interventions focused on incorporating measures of assessment and monitoring of asthma severity and controls in order to improve asthma-related health outcomes among children. The Blue Angel for Asthma Kids program is an intervention that aimed to monitor daily asthmatic symptoms, provide information for an action plan, and enhance compliance of daily asthma control among children ages 6-12.⁶⁰ This Internet-based asthma intervention incorporated the use of Internet-based diary cards for symptom recording, a diary record for peak expiratory flow rate (PEFR), symptomatic support information, action plan suggestions, and telecommunication technologies for uploading and retrieving storage data for personal and physician use.⁶¹ These tools could also be used to assist medical doctors in diagnosing and treating asthma. Results showed that the program did improve PEFRs, adherence to medication, knowledge of self-management, and quality of life of caregivers, although daily participation in program declined over time.⁶²

Another study targeting inner-city children ages 8-16 examined the effectiveness of Health Buddy—a device that connects to a home phone in order to present asthma-related questions and information while recording a child's response—in enhancing children's self-management skills and reducing adverse asthma outcomes.⁶³ During the 90-day study, a standard asthma diary was compared to Health Buddy.⁶⁴ A nurse coordinator connected to the devices via the Internet sent daily questions regarding asthma symptoms, peak flow readings, medication and health services utilization, functional status, and educational trivia.⁶⁵ Using the phone buttons, individuals were then able to provide answers that were processed and sent to a secure website for the nurse coordinator to view. Immediate feedback was provided based off the answers given. While both the standard asthma diary and Health Buddy reported a decrease in asthma symptoms and in peak flow severity readings at the 6 and 12 week marks, the Health Buddy program reported more significant outcomes overall.⁶⁶ In addition, Health Buddy participants were significantly less likely to experience activity limitation during the trial, to report severe peak flow readings, and to make urgent calls to the hospital.⁶⁷ There were also significant improvements in self-care behaviors, including the use of asthma medication without reminders.⁶⁸ While 77% of all participants used their tracking system for 3 days a week or more, this level of adherence

was recorded more in the Health Buddy group (89% of 66 children) than in the asthma diary group (65% of 68 children).⁶⁹ While both groups declined in compliance rates over time, rates declined faster at earlier stages of the intervention for the asthma diary group.⁷⁰ These results suggest that Health Buddy can be more effective in self-management skills and asthma outcomes than an asthma diary.

These interventions highlight the use of technology to assist with asthma-related assessment and monitoring among children. Technology increases opportunities for recording and sharing symptoms with caretakers, as well as receiving prompt feedback and information from health care professionals.

Interventions incorporating education for a partnership in asthma care

The following interventions focused on the use of education to support a partnership in asthma care between children with asthma and their adult caregivers. In a study done by the University of Wisconsin, researchers conducted an eHealth intervention targeting both asthmatic children and their caregiver or parent with two different components.⁷¹ The first component, targeting children, provided asthma education in a game and audio format, and social support via a peer discussion group. Each child was also assigned an asthma case manager who had access to the child's well-being assessments on the eHealth program.⁷² The second component targeted the caregivers or parents of asthmatic children, and included online asthma education along with a peer discussion group.⁷³ Parents were also provided the email of their child's case manager, who would call them once a month to assess and discuss asthma management (Figure 6).⁷⁴ This eHealth intervention resulted in improved asthma control according to the Asthma Control Questionnaire (ACQ), but did not significantly improve medication adherence.⁷⁵ Social support in particular was shown to have a significant positive effect on asthma control.⁷⁶

Another study focused on supporting a partnership in asthma care aimed to identify an effective approach to asthma education for children and their caregivers.⁷⁷ Children visiting the ED were assigned to either 1) a control group who followed usual care recommendations from the patient's primary care physician or 2) an intervention group who participated in an interactive, small-group education program.⁷⁸ This education program was directed toward the parents of children ages 3-6, both the parents and children for the 7-11 age group, and children ages 12-16.⁷⁹ Each program, led by a nurse educator and a respiratory therapist team, consisted of a group of 6-8 participating families.⁸⁰ The small groups met for about 1.5 hours a week for four weeks, addressing different asthma management topics such as medication and triggers (Figure 7).⁸¹ This provided parents and children an opportunity to discuss asthma management, as well as to share their own successes and failures. Results showed that children in the intervention group made significantly fewer ED visits and reduced their likelihood of requiring emergency care by 38%.⁸² Furthermore, they required fewer courses of oral corticosteroids and reported significant improvements in their quality of life.⁸³

Another intervention aimed to improve asthma care management for asthmatic children between the ages 5-12.⁸⁴ Over the course of a year, nurses carried out a telephone intervention with parents that consisted of five stages: precontemplation, contemplation,

preparation, action, and maintenance (Figure 8).⁸⁵ Training for coaching focused on reducing the nurses' natural tendency to impose their own solutions on participants' problems, worked to increase the conversations' focus toward eliciting the parents' own reasons and readiness for change, as well as the parents' own ideas on how to implement changes.⁸⁶ Call frequency was dependent upon parent behavior and asthma control, with 54% of participants receiving a total of 4-8 calls.⁸⁷ Results showed that coaching was effective in promoting self-management behaviors in parents of children with asthma, and coached parents indicated an improvement in their child's asthma-related quality of life and a reduction in their child's asthma impairment.⁸⁸ The most progress occurred when nurses used an up-to-date asthma action plan (AAP) to manage asthma, while less progress occurred in developing a collaborative partnership between the nurse and child's pediatrician.⁸⁹

One study evaluated the effectiveness of a space adventure-themed computer game—*Air Academy: The Quest for Airtopia*—in improving asthma knowledge.⁹⁰ The six-week study targeted 87 fourth-grade students in three different classes, with one class serving as the control group.⁹¹ The intervention group played *Air Academy* for 20 minutes three times a week.⁹² The game covers the topics of asthma triggers, medications, symptoms, and maintenance, and includes videos and a “mission debriefing” stressing the importance of proper communication and dialogue between parents, students, nurses, and physicians.⁹³ Children in the intervention group gained significantly more asthma knowledge, which was retained over a four-week period.⁹⁴ In addition, three participants were subsequently diagnosed with asthma after discussing symptoms with their parents.⁹⁵

The Interactive Multimedia Program for Asthma Control and Tracking (IMPACT) program was another study that aimed to improve asthma management among children through the use of computer-based asthma education.⁹⁶ Children would complete the program, which involved a series of animated lessons, during regular appointments at a clinic. The lessons were about a minute in length and focused on the principles of asthma self-management, including 1) instructional and educational aspects of asthma control, 2) real-life scenarios and decisions about asthma prevention behavior, and 3) teaching exercises aimed at helping children learn how to accurately describe their symptom and medication use.⁹⁷ The IMPACT program tracked the educational progress of each child, recorded symptom levels, and documented medication use.⁹⁸ Results showed an increase in asthma knowledge, increased asthma control, and a reduced burden of asthma.⁹⁹

Education supporting a partnership in asthma care is commonly incorporated into asthma management programs, and involves teaching children self-management skills as well as increasing the number of educational opportunities in clinics, schools, etc.¹⁰⁰ An important aspect of this component is supporting collaboration between a child and their adult caretakers. While barriers such as distance can make collaboration between children, parents, caretakers, and health care providers difficult, technology could eliminate this a major concern.

Interventions incorporating proper control of environmental factors

The following interventions evaluate the effect of proper control of environmental factors

on asthma-related health outcomes in children. One example is from East Carolina University, which implemented the Eastern Carolina Asthma Prevention Program (ECAPP), an intervention targeting low-income, minority children in rural North Carolina.¹⁰¹ The ECAPP aimed to reduce self-reported asthma symptoms, improve breathing tests, and decrease the number of asthma-related ED visits.¹⁰² The program began with an environmental health professional conducting an indoor environmental assessment of asthma triggers.¹⁰³ The intervention group then received environmental products to assist in the cleaning and maintenance of the child's home environment, asthma education for participants and their caregivers, and follow-up calls every two weeks.¹⁰⁴ Results showed that the intervention groups' self-reported asthma symptoms decreased by 58%, rescue medicine use decreased by 76%, controller medicine use increased by 12%, and asthma-related ED visits decreased by 75%.¹⁰⁵ However, due to the small sample size and multi-level dimensions of the intervention, the exact impact of the environmental changes cannot be measured.

Another study examined the effects of a secret agent themed game, *The Asthma Files*, on 31 asthmatic participants ages 7-14.¹⁰⁶ The intervention aimed to increase knowledge of common environmental triggers and improve trigger identification through games and puzzles.¹⁰⁷ Participants were invited to enter their asthma symptoms—including peak flow and triggers—which were then used to generate a personalized asthma action plan.¹⁰⁸ Results demonstrated initial knowledge of asthma triggers among participants was low, and game exposure significantly increased trigger awareness.¹⁰⁹ *The Asthma Files* could be an additional tool to support asthma education regarding asthma trigger knowledge and identification.

Studies have been performed to evaluate the types and frequency of efforts by families to control environmental factors, and how their actions align with the current NHLBI asthma guidelines.¹¹⁰ The University of Michigan piloted a telephone-based survey conducted with a random, nationwide sample involving 896 asthmatic children ages 2-12.¹¹¹ Interviews were conducted with caregivers of affected children to ask about their child's asthma triggers and actions taken to rid the home of these triggers, as well as to collect information about demographics and health care utilization.¹¹² Some of the common triggers that were reported included plants, animals, dust, seasonal changes, and smoke (Figures 9 and 10).¹¹³ Furthermore, 81% of respondents reported taking at least one action to address environmental triggers; 42% of these actions were consistent with NHLBI guidelines, while 51% of actions had a neutral effect.¹¹⁴

Control of environmental factors, which can exacerbate asthma symptoms, is an important component of proper asthma management. However, controlling each of the environments to which children are exposed can be difficult. Focusing on locations where children spend a majority of their time, such as in schools and at home, can decrease asthma symptoms, increase the use of controller medicine, and decrease the use of rescue medication.

Interventions addressing the use of pharmacologic therapy

The following interventions address the use of pharmacologic therapy to improve health

outcomes among asthmatic children. One study conducted within the New York City public school system evaluated how health information technology and rescue medication order forms could be used to improve asthma care for students.¹¹⁵ This intervention consisted of using preprinted rescue medication order forms and using the Automated Student Health Record (ASHR) application to monitor care.¹¹⁶ The ASHR application was used to create daily asthma reports, and generated a list of students with asthma, according to severity of disease.¹¹⁷ This allowed nurses to easily identify students with poorly controlled asthma and conveniently access and evaluate their treatment plan. Furthermore, students that needed medication services were required to use a standardized Medication Administration Form (MAF) (Figure 11).¹¹⁸ The results of this study showed that the MAF preprinted rescue medication order led to improvements in subscribing medications and standardization of care.

Asthma medication may also play a role in asthma-related hospitalizations. Asthma symptoms can result in hospitalizations for affected children, with readmission rates between 15% and 30%.¹¹⁹ One study followed children who were hospitalized for asthma for one year, or until they were readmitted. Adult caregivers were provided a 134-question survey in order to evaluate their asthma knowledge, the child's medication adherence, trigger exposures, financial strain, predictors of asthma severity and self-efficacy—or the belief in one's ability to achieve a desired result—regarding their ability to control their child's asthma.¹²⁰ Increased asthma knowledge among caregivers and non-adherence to medication was correlated with a greater risk of readmission.¹²¹ While it is unclear why an increase in asthma knowledge resulted in a greater risk of readmission, it is evident that adherence to medication is an important aspect of proper asthma management.

Interventions incorporating multiple key components

The following interventions incorporated multiple key components of effective asthma management, including measures of assessment and monitoring of asthma severity and controls, education supporting a partnership in asthma care, control of environmental factors affecting asthma, and/or pharmacologic therapy.¹²²

A 12-week study was conducted to evaluate an asthma management intervention for students and their adult network members in two California middle schools.¹²³ Participants were randomized into one of two groups: Group 1 was provided with six weekly group-based skills trainings for the students followed by six weekly, targeted newsletters for their caregivers (Figure 12).¹²⁴ In contrast, Group 2 was provided with the group-based skills training only.¹²⁵ The weekly training for students of both groups included homework assignments and an asthma checklist.¹²⁶ Homework assignments were activities focused on increasing asthma management and knowledge, such as explaining asthma to someone, monitoring and recording peak flow, and examining the home environment for triggers.¹²⁷ In addition, students would complete the asthma checklists by recording their symptoms, activity limitations, and medication use.¹²⁸ Caregiver newsletters provided asthma information, such as how to maintain a proper home environment for children at risk.¹²⁹ This study reported positive results while incorporating all four recommended components of the NHLBI report. In both groups, adults reported an improved quality of life and access to asthma care resources among adolescents.¹³⁰ Self-efficacy also increased

significantly among Group 1 adults.¹³¹ Furthermore, adults in Group 2—who did not receive a newsletter—reported that their children took more responsibility for their asthma care.¹³² This may be an unintended consequence of an adolescent-only intervention, which may communicate to adults that they can assume less responsibility for asthma management.

One study aimed to connect potentially asthmatic children and their parents with health care providers through the use of videos, and to improve asthma management through the use of the *Watch, Discover, Think, and Act* game.¹³³ Initially, 21,000 students across 60 low-income schools in Texas were surveyed, and students with a probable asthma diagnosis were contacted.¹³⁴ Of those contacted, 982 students agreed to participate in the study.¹³⁵ Parents were then sent videos, in both English and Spanish, demonstrating how to initiate communication with a physician and develop an asthma action plan.¹³⁶ In addition, students were sent a CD-ROM of the *Watch, Discover, Think, and Act* game, which was developed through collaboration between Texas Children's Hospital and The University of Texas Health Science Center.¹³⁷ The game, which aims to provide asthma self-management skills training, features 18 real-world and 4 castle scenarios in which children can practice self-regulatory skills and review asthma-related tutorials.¹³⁸ Results demonstrated an increase in asthma-related knowledge, daily self-management, self-management of at-home episodes, and self-efficacy among participants.¹³⁹ However, the study reported a failure to create a meaningful connection between patients and health care providers.¹⁴⁰

The Community Asthma Initiative (CAI) is a program that worked to enhance the model of care for children who have previously been seen in the ED due to asthma.¹⁴¹ This program used a comprehensive approach to improve patients' number of asthma-symptom-free days and reduce their number of ED visits.¹⁴² The CAI improved traditional asthma care by providing nurse case management, home visits from a nurse or community health worker, asthma education, and environmental assessments and remediation.¹⁴³ This program incorporated multiple components of the NHLBI report, and saw a significant reduction in asthma ED visits, hospitalizations, limitation of physical activity, missed school, and parent/guardian missed days of work at 6 and 12 months of follow-up.¹⁴⁴ Feedback from participants showed that home visits were particularly important, because they allowed health professionals to provide in-home asthma education and address social and environmental obstacles to proper asthma control.¹⁴⁵

Asthma management programs incorporating multiple key components not only address the child's asthma-related knowledge, but also their perceived ability to utilize that knowledge on a daily basis (self-efficacy). Furthermore, by involving adult caretakers and addressing potential environmental concerns, the scope of influence broadens and there is an increased likelihood that the child and/or their has the knowledge, ability, and the confidence necessary for proper asthma management. These factors, in addition to proper pharmacologic therapy, are crucial to success. This is evident through multifaceted programs reporting many positive effects such as improved self-efficacy, knowledge, and management. These results are then correlated with improved health outcomes such as decreased ED visits, hospitalizations, and missed days of school.

Discussion

Conclusions

Proper asthma management results in improved health outcomes for asthmatic children, leading to decreased absenteeism, decreased economic costs, and an improved quality of life.¹⁴⁶ However, proper management requires multiple components addressing various aspects of this disease. This includes measures of assessment and monitoring of asthma severity and controls, education supporting a partnership in asthma care, control of environmental factors affecting asthma, and pharmacologic therapy.¹⁴⁷ For example, incorporation of a single component such as education into an asthma program is not enough to manage this disease; it is also important that children—with the support of their caretakers— adhere to a their medication schedule.¹⁴⁸

While interventions incorporating one or two of these components may still report positive outcomes, long-term sustainable effects are still a concern.^{149,150} Multifaceted asthma management programs, however, could encourage long-term use and improved health outcomes. Schools in particular provide a valuable opportunity to incorporate programs targeting school-age children. They allow for families, school staff, clinicians, and school nurses to work together to manage asthma. Additional opportunities for developing effective asthma management programs within schools include increasing the size of school health teams, providing children with educational services, expanding school asthma care services, and training school staff to recognize, respond to, and provide information about attacks.¹⁵¹

The use of technology provides an opportunity to develop programs, both within and outside schools, that incorporate all of the NHLBI recommended components. Web-based programs allow for immediate and secure assessment and monitoring of asthma severity, which can then be quickly shared with members of the child's care team, further supporting a partnership in asthma care. Web-based education, including games, allow for age-appropriate asthma management information to be easily distributed to a large number of children.

Future research and policy recommendations

More research should be conducted regarding pharmacologic therapy to ensure it is properly incorporated into asthma management programs. For example, one study done by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) researched the drug labeling of asthma medication for young children.¹⁵² The NICHD found that more information is needed to assist clinicians in the treatment of younger children considering the large burden of asthma in early childhood.¹⁵³ Age-specific drug formulations and outcome measures designed for young children could be important in reducing the risk of asthma exacerbations within this demographic.¹⁵⁴ Additional research could improve health outcomes within this population and encourage proper asthma management.

There are numerous opportunities for developing policies that support multifaceted asthma management, interventions, and education for children. For example, policies that

encourage information sharing between primary care physicians and school nurses would allow for more comprehensive care of affected students.¹⁵⁵ Health care specialists, such as clinicians and school nurses, can also provide expert guidance to school boards during policy development.¹⁵⁶ Additionally, there are opportunities for implementing policies that support the control of environmental asthma triggers. For example, the rate of asthma cases and exacerbations caused by traffic-related pollution could be decreased with the implementation of policies that discourage developers from building homes near busy roadways.¹⁵⁷ Policies incorporated into the school environment could also have a significant impact on health, especially considering the amount of time students spend in this environment. These policies should focus on reducing exposure to the pollutants, such as bus fumes, to which children are exposed.¹⁵⁸ Additional opportunities for developing policy include creating standards for building new schools that minimize common environmental triggers.¹⁵⁹ Decreasing levels of and exposure to asthma triggers would then result in improved health outcomes for asthmatic children.

Asthma is a serious health concern for millions of children across the country, and while it is not curable, multifaceted asthma management programs and policies have the potential to improve asthma management within this vulnerable population. However, programs and policies should consider each aspect of a child's environment—school, home, parents, etc.—in order to encourage proper education and management of this disease. Advancements in technology, especially within schools, continue to provide opportunities for positively impacting asthmatic children and their families throughout the United States.

Appendix

Figure 1. Literature search results

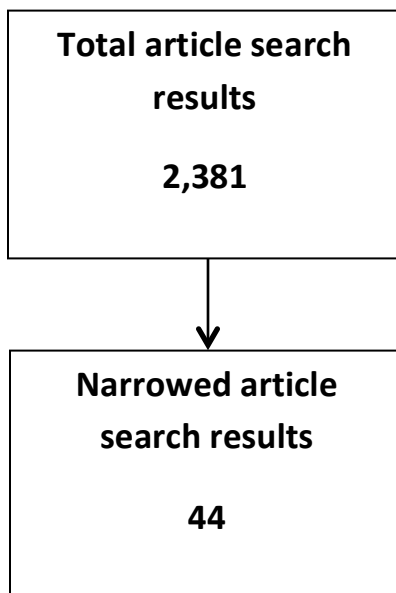


Figure 2. Validated instruments for assessment and monitoring of asthma¹⁶⁰

- Asthma Control Questionnaire (Juniper et al. 1999b)
- Asthma Therapy Assessment Questionnaire (Vollmer et al. 1999) (See below.)
- Asthma Control Test (Nathan et al. 2004) (See below.)
- Asthma Control score (Boulet et al. 2002)

ASTHMA THERAPY ASSESSMENT QUESTIONNAIRE[®] (ATAQ)

- In the past 4 weeks did you miss any work, school, or normal daily activities because of your asthma? (1 point for YES)
- In the past 4 weeks, did you wake up at night because of your asthma? (1 point for YES)
- Do you believe your asthma was well controlled in the past 4 weeks? (1 point for NO)
- Do you use an inhaler for quick relief from asthma symptoms? If yes, what is the highest number of puffs in 1 day you took of this inhaler? (1 point for more than 12)

Total points = 0–4, with more points indicating more control problems

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ASTHMA CONTROL TEST[™]

This survey was designed to help you describe your asthma and how your asthma affects how you feel and what you are able to do. To complete it, please mark an X in the one box that best describes your answer.

- In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work or at home?

All of the time	Most of the time	Some of the time	A little of the time	None of the time
▼	▼	▼	▼	▼
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
- During the past 4 weeks, how often have you had shortness of breath?

More than once a day	Once a day	3 to 6 times a week	Once or twice a week	Not at all
▼	▼	▼	▼	▼
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
- During the past 4 weeks, how often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?

4 or more nights a week	2 to 3 nights a week	Once a week	Once or Twice	Not at all
▼	▼	▼	▼	▼
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
- During the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as Albuterol, Ventolin[®], Proventil[®], Maxair[®], or Primatene Mist[®])?

3 or more times per day	1 or 2 times per day	2 or 3 times per week	Once a week or less	Not at all
▼	▼	▼	▼	▼
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
- How would you rate your asthma control during the past 4 weeks?

Not Controlled at all	Poorly Controlled	Somewhat Controlled	Well Controlled	Completely Controlled
▼	▼	▼	▼	▼
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

For information on the interpretation and scoring of the Asthma Control Test[™] (ACT[™]), visit www.qualitymetric.com/act


Source: Reprinted with permission from QualityMetric Incorporated, Asthma Control Test[™] Copyright © QualityMetric Incorporated 2002, 2004. All Rights Reserved.

CAUTION: The sample questionnaires in figure 3–8 assess only the impairment domain of asthma control and NOT the risk domain. Measure of risk, such as exacerbations, urgent care, hospitalizations, and declines in lung function, are important elements of assessing the level of asthma control.

Figure 3. Sample patient self-assessment sheet for follow-up visits¹⁶¹




Name: _____	Date: _____
Your Asthma Control	
How many days in the past week have you had chest tightness, cough, shortness of breath, or wheezing (whistling in your chest)?	_____ 0 _____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7
How many nights in the past week have you had chest tightness, cough, shortness of breath, or wheezing (whistling in your chest)?	_____ 0 _____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7
Do you perform peak flow readings at home?	_____ yes _____ no
If yes, did you bring your peak flow chart?	_____ yes _____ no
How many days in the past week has asthma restricted your physical activity?	_____ 0 _____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7
Have you had any asthma attacks since your last visit?	_____ yes _____ no
Have you had any unscheduled visits to a doctor, including to the emergency department, since your last visit?	_____ yes _____ no
How well controlled is your asthma, in your opinion?	<input type="checkbox"/> very well controlled <input type="checkbox"/> somewhat controlled <input type="checkbox"/> not well controlled
<div style="border-bottom: 1px solid black; width: 100%;"></div> Average number of puffs per day	
Taking your medicine	
What problems have you had taking your medicine or following your asthma action plan?	
Please ask the doctor or nurse to review how you take your medicine.	
Your questions	
What questions or concerns would you like to discuss with the doctor?	
How satisfied are you with your asthma care?	<input type="checkbox"/> very satisfied <input type="checkbox"/> somewhat satisfied <input type="checkbox"/> not satisfied
<small>*These questions are examples and do not represent a standardized assessment instrument. Other examples of asthma control questions: Asthma Control Questionnaire (Juniper); Asthma Therapy Assessment Questionnaire (Volmer); Asthma Control Test (Nathan); Asthma Control Score (Boulet)</small>	

Figure 4. Asthma action plan¹⁶²



Asthma and Allergy
Foundation of America

**CHILD CARE ASTHMA/ALLERGY
ACTION CARD**

ID
Photo

Name: _____

Grade: _____ DOB: _____

Parent/Guardian Name: _____

Address: _____

Phone (H): _____ (W): _____

Parent/Guardian Name: _____

Address: _____

Phone (H): _____ (W): _____

Other Contact Information: _____

Emergency Phone Contact #1 _____

Name

Relationship _____ Phone _____

Emergency Phone Contact #2 _____

Name

Relationship _____ Phone _____

Physician Child Sees for Asthma/Allergies: _____

Phone: _____

Other Physician: _____

Phone: _____

DAILY ASTHMA/ALLERGY MANAGEMENT PLAN

- **Identify the things that start an asthma/allergy episode**
(Check each that applies to the child)
- Animals — Bee/Insect Sting — Chalk Dust — Change in Temperature
- Dust Mites — Exercise — Latex — Molds
- Pollens — Respiratory Infections — Smoke — Strong Odors
- Food: _____
- Other: _____
- Comments: _____

- **Peak Flow Monitoring** (for children over 4 years old)
- Personal Best Peak Flow reading: _____
- Monitoring Times: _____

- **Control of Child Care Environment** (List any environmental control measures, pre-medications, and/or dietary restrictions that the child needs to prevent an asthma/allergy episode.) _____

• **Daily Medication Plan for Asthma/Allergy**

	Name	Amount	When to Use
1			
2			
3			
4			

OUTSIDE ACTIVITY AND FIELD TRIPS The following medications must accompany child when participating in outside activity and field trips:

	Name	Amount	When to Use
1			
2			
3			

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ASTHMA EMERGENCY PLAN

Emergency action is necessary when the child has symptoms such as _____

or has a peak flow reading at or below _____

- **Steps to take during an asthma episode:**
 1. Check peak flow reading (if child uses a peak flow meter).
 2. Give medications as listed below.
 3. Check for decreased symptoms and/or increased peak flow reading.
 4. Allow child to stay at child care setting if: _____
 5. _____
 5. Contact parent/guardian
 6. Seek emergency medical care if the child has any one of the following:

→ No improvement minutes after initial treatment with medication.

→ Peak flow at or below _____

→ Hard time breathing with:

- Chest and neck pulled in with breathing.
- Child hunched over.
- Child struggling to breathe.

→ Trouble walking or talking.

→ Stops playing and cannot start activity again.

→ Lips or fingernails are gray or blue.

← **IF THIS
HAPPENS, GET
EMERGENCY
HELP NOW!** →

ALLERGY EMERGENCY PLAN

- **Child is allergic to:** _____
- _____
- _____
- **Steps to take during an allergy episode:**
 1. If the following symptoms occur, give the medications listed below.
 2. Contact Emergency help and request epinephrine.
 3. Contact the child's parent/guardian.
- **Symptoms of an allergic reaction include:**
(Physician, please circle those that apply)

→ **Mouth/Throat:** itching & swelling of lips, tongue, mouth, throat; throat tightness; hoarseness; cough

→ **Skin:** hives; itchy rash; swelling

→ **Gut:** nausea; abdominal cramps; vomiting; diarrhea

→ **Lung*:** shortness of breath; coughing; wheezing

→ **Heart:** pulse is hard to detect; "passing out"

*If child has asthma, asthma symptoms may also need to be treated.

• **Emergency Asthma Medications:**

	Name	Amount	When to Use
1			
2			
3			
4			

• **Special Instructions:** _____

• **Emergency Allergy Medications:**

	Name	Amount	When to Use
1			
2			
3			
4			

• **Special Instructions:** _____

Physician's Signature _____ Date _____

Parent/Guardian's Signature _____ Date _____

Child Care Provider's Signature _____ Date _____

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Figure 5. Alternate asthma action plan¹⁶³

Asthma Action Plan

For: _____ Doctor: _____ Date: _____
 Doctor's Phone Number _____ Hospital/Emergency Department Phone Number _____

GREEN ZONE

Doing Well

- No cough, wheeze, chest tightness, or shortness of breath during the day or night
- Can do usual activities

And, if a peak flow meter is used,

Peak flow: more than _____
 (90 percent or more of my best peak flow)

My best peak flow is: _____

Before exercise ☐ _____ ☐ 2 or ☐ 4 puffs _____ 5 minutes before exercise

Take these long-term control medicines each day (include an anti-inflammatory).

Medicine	How much to take	When to take it
_____	_____	_____
_____	_____	_____

YELLOW ZONE

Asthma is Getting Worse

- Cough, wheeze, chest tightness, or shortness of breath, or
- Waking at night due to asthma, or
- Can do some, but not all, usual activities

-Or-

Peak flow: _____ to _____
 (50 to 79 percent of my best peak flow)

First Add: quick-relief medicine—and keep taking your **GREEN ZONE** medicine.
 _____ (short-acting beta₂-agonist) ☐ 2 or ☐ 4 puffs, every 20 minutes for up to 1 hour
 or Nebulizer, once

Second If your symptoms (and peak flow, if used) return to **GREEN ZONE** after 1 hour of above treatment:
☐ Continue monitoring to be sure you stay in the green zone.

-Or-

If your symptoms (and peak flow, if used) do not return to **GREEN ZONE** after 1 hour of above treatment:
☐ Take: _____ (short-acting beta₂-agonist) ☐ 2 or ☐ 4 puffs or ☐ Nebulizer
☐ Add: _____ (oral steroid) mg per day For _____ (3–10) days
☐ Call the doctor ☐ before/ ☐ within _____ hours after taking the oral steroid.

RED ZONE

Medical Alert!

- Very short of breath, or
- Quick-relief medicines have not helped, or
- Cannot do usual activities, or
- Symptoms are same or get worse after 24 hours in Yellow Zone

-Or-

Peak flow: less than _____
 (50 percent of my best peak flow)

Take this medicine:

☐ _____ (short-acting beta₂-agonist) ☐ 4 or ☐ 6 puffs or ☐ Nebulizer
☐ _____ (oral steroid) mg

Then call your doctor NOW. Go to the hospital or call an ambulance if:

- You are still in the red zone after 15 minutes AND
- You have not reached your doctor.

DANGER SIGNS

- Trouble walking and talking due to shortness of breath
- Lips or fingernails are blue

Take ☐ 4 or ☐ 6 puffs of your quick-relief medicine AND

Go to the hospital or call for an ambulance _____ NOW!
 (phone)

Figure 6. Parents' home page of the Comprehensive Health Enhancement Support System (CHESS)¹⁶⁴

Living with **ASTHMA**

You are Here: Asthma Home

Asthma Topics

- About Asthma
- Taking Medications
- Managing Triggers
- My Child's Asthma
- Healthy Parenting
- Health Care System
- Social, Financial, Legal

Services

- Asthma Manager
- Reading Room
- Action Plans
- Learning From Others
- Self Help Tools
- For Kids

My Calendar

Text Size: A / A

My Goal for My Child:

Keep up with school work

Elisha's Picks

- How can I work with the school regarding my child's asthma?
- How can a school nurse help manage my child's asthma?
- Managing Asthma at School
- Tips on Keeping up with Make Up Work
- Becky's Personal Story: Dealing with school personnel

[See all of Elisha's picks](#)

My Reminders

- 05/27 04:15 PM Tyrone doctor
- 05/30 08:00 PM Akisha case manager phone call
- 05/31 Akisha Set traps
- 06/01 02:30 PM Akisha school

Remember your Medications!

New day, same meds. Remind your child to take controller medications EVERY day.

New Messages

Discussion Groups: 0

Case Manager: 4

My Links

- My CHESS Links
- See All of My CHESS Links
- My Outside Links
- Click here to add links

Case manager

Figure 7. Intervention documents used¹⁶⁵

Session	Title	Content
1	What is asthma?	<p>Basic epidemiology and pathophysiology</p> <ul style="list-style-type: none"> • Chronic disease • “Sensitive” airways • Inflammation vs. bronchospasm • Causes of asthma vs. myths <p>Goals of management</p> <ul style="list-style-type: none"> • Introduction to steps in achieving control <p>Warning signs of an acute episode of asthma</p> <ul style="list-style-type: none"> • Common symptoms • Early warning signs
2	Asthma triggers and avoidance	<p>Common asthma triggers</p> <ul style="list-style-type: none"> • Trigger definition • How to identify triggers • Common triggers (smoke, allergens, viral infections, irritants, exercise, emotions, weather, medicines) <p>Avoidance and control strategies</p> <ul style="list-style-type: none"> • Trigger actions (identify, avoid, control) • Consideration of different environments (home, school, friends) <p>Using an asthma diary</p>
3	Asthma medications	<p>Types of medications, correct use of medications</p> <ul style="list-style-type: none"> • Goals of medications • How do different medications work (what they do, how fast they do it) • Side effects <p>Demonstration and evaluation of inhaled delivery device technique</p> <p>Use of an asthma action plan</p> <ul style="list-style-type: none"> • What is an action plan (sample plans and how to use) • How to work with your physician to develop and use a plan
4	Asthma self-management	<p>Definition of self-management</p> <p>Review of steps to achieve asthma control</p> <p>Use of peak flow meters</p> <p>Importance of partnering with your doctor</p> <p>Ways to keep learning about asthma</p> <p>Asthma scenarios with problem solving</p> <p>Final questions</p>

Figure 8. Coaching strategies by stage¹⁶⁶

Stage	Coaching Strategies
Precontemplation	<ul style="list-style-type: none"> • Assess knowledge, attitudes, and beliefs about desired asthma care behavior. • Create supportive climate for change by accepting present decision not to change now. • Extend availability to assist in the future if the decision is made to engage in desired asthma. • Present low-key information based on existing asthma care knowledge to inspire thinking about change. • Introduce the idea of a strong personal motivator, something a person wants badly enough to make the effort to change. • If the parent seems overwhelmed, help elicit barriers getting in the way of parent performing the desired asthma care behavior.
Contemplation	<ul style="list-style-type: none"> • Discuss the motivation to perform the desired asthma care behavior. • Assist in identifying benefits of performing the desired asthma care behavior. • Focus on most meaningful personal benefit for the parent and/or child. • Assist in identifying barriers to performing the desired asthma care behavior. • Help discover possible solutions for each barrier. • Suggest small, achievable steps to making a change.
Preparation	<ul style="list-style-type: none"> • Discuss successes and failures with earlier attempts to perform desired asthma care behavior. • Assist in developing achievable short-term and long-term goals related to performing the desired asthma care behavior. • Stress the importance of choosing a goal for which there is a high degree of confidence. • Plan follow up to track success with the goal and support change. • Recommend eliciting support from family and friends for attempting to perform the desired asthma care behavior.
Action	<ul style="list-style-type: none"> • Offer praise and recognition for performing the desired asthma care behavior. • Emphasize benefits to performing the desired asthma care behavior. • Check on goals consistently. • Recommend journaling of successes/failures in performing the desired asthma care behavior. • Reinforce self-confidence. • Put parent in a role model situation for demonstrating an effective asthma care behavior. • Discuss potential for relapse and coping strategies. • Strategize how to handle challenging situations as a relapse prevention plan.

Maintenance	<ul style="list-style-type: none"> • Offer praise and recognition for performing the desired asthma care behavior. • Listen to success story related to performing the desired asthma care behavior. • Encourage sharing of story with others. • Discuss staying motivated to perform the desired asthma care behavior. • Discuss potential for relapse and coping strategies. • Look to the future. Assist in identifying potential barriers to performing the desired asthma care behavior and possible solutions.
-------------	--

Figure 9. General categories and frequency of reported environmental triggers¹⁶⁷

Trigger	Frequency	Examples of Parent Description
Plants	307 (34%)	Trees, grass, weeds, hay, ragweed leaves
Animals	274 (31%)	Cats, dogs, other pet dander, horses, birds, feathers
Dust	261 (29%)	Dust, dust mites, stuffed animals, dust from vacuuming
Weather/Change of season	242 (27%)	Humidity, cold air, dry weather, heat, rainy weather, fog
Smoke	215 (24%)	Cigarette smoke, tobacco
Mold	160 (18%)	Mold, mildew, fungus
Acute illness	142 (16%)	Colds, viruses, respiratory infections, sinus drainage
Chemicals/odors	72 (10%)	Perfume, scented candles, paint, car fumes, house cleaners
Specific foods	87 (9%)	Popcorn, nuts, dairy, milk, soy, peanuts
Activity	66 (7%)	Too much activity, overexertion, sports
Air quality	28 (3%)	Bad air quality, smog, lack of fresh air
Emotions	9 (1%)	Getting upset, crying, stress, anxiety, being scared
Medications	8 (0.9%)	Penicillin, sulfa drugs, erythromycin
Cockroaches	6 (0.6%)	Cockroaches, roaches
Fabric	3 (0.3%)	Cotton, wool
Menstrual cycle	2 (0.2%)	First day of period

Figure 10. Five most common types of actions to address environmental triggers¹⁶⁸

Action described by parent	Overall frequency, n (%)	Percentage of these children who had trigger for which action was recommended or reasonable
Purchasing special air filters	224 (25%)	157/224 (70%)
Reducing child's exposure to dust	201 (22%)	81/201 (40%)
Using specialized vacuum for cleaning	150 (17%)	53/150 (35%)
Purchasing special bedding (e.g., mattress covers)	139 (16%)	67/139 (48%)
Increasing cleaning of house in general	113 (13%)	69/113 (61%)
Reducing exposure to animals	96 (11%)	58/96 (60%)

Figure 11. NYC Department of Education health forms¹⁶⁹

*Confidential information should not be sent by e-mail.

Rev 4/14

Asthma in Children: A Chronic Condition Requiring a Multi-Faceted Approach

ASTHMA

MEDICATION ADMINISTRATION FORM - OFFICE OF SCHOOL HEALTH
Authorization for Administration of Medication to Students for School Year 2014-2015

Student Last Name	First Name	MI	Date of birth ____/____/____	School
-------------------	------------	----	------------------------------	--------

PARENT/GUARDIAN'S CONSENT AND AUTHORIZATION

I hereby authorize the storage and administration of medication, as well as the storage and use of necessary equipment to administer the medication, in accordance with the instructions of my child's physician. I understand that I must provide the school with the medication and equipment necessary to administer medication, including non-Ventolin inhalers. Medication is to be provided in a properly labeled original container from the pharmacy (another such container should be obtained by me for my child's use outside of school); the label on the prescription medication must include the name of the student, name and telephone number of the pharmacy, licensed prescriber's name, date and number of refills, name of medication, dosage, frequency of administration, route of administration and/or other directions; over the counter medications and drug samples must be in the manufacturer's original container, with the student's name affixed to that container. I understand that if I provide an asthma inhaler, it must be supplied in its original and UNOPENED medication box. I further understand that I must immediately advise the principal and/or his/her designee(s) especially the school nurse of any change in the prescription or instructions stated above.

I understand that no student will be allowed to carry or self-administer controlled substances.

I understand that this Authorization is only valid until the earlier of: (1) June 26, 2015 (This prescription may be extended through August if the student is attending a New York City Department of Education (the "Department") sponsored summer instruction program); or (2) such time that I deliver to the principal or his/her designee(s) and nurse a new prescription or instructions issued by my child's physician regarding the administration of the above-prescribed medication. I also authorize OSH to contact the last treating physician of record if I do not provide an updated MAF for the subsequent school year, to expedite processing and provide continuity for medication administration. By submitting this MAF, I am requesting that my child be provided with specific health services by the Department and the New York City Department of Health and Mental Hygiene ("DOHMH") through the Office of School Health ("OSH"). I understand that part of these services may entail an assessment by an OSH physician as to how my child is responding to the prescribed medication. Full and complete instructions regarding the provision of the above-requested health service(s) are included in this MAF. I understand that the Department, DOHMH and their agents, and employees involved in the provision of the above-requested health service(s) are relying on the accuracy of the information provided in this form. It is my intention that my child will be provided with health service(s) according to the information and instructions that are provided in this MAF. I further understand that the Department, DOHMH and their agents are not responsible for any adverse reaction to this medication.

I recognize that this form is not an agreement by the Department or DOHMH to provide the services requested, but, rather, my request, consent and authorization for such services. If it is determined that these services are necessary, a Student Accommodation Plan may also be necessary and will be completed by the school.

I hereby authorize the Department, DOHMH and their employees and agents, to contact, consult with and obtain any further information they may deem appropriate relating to my child's medical condition, medication and/or treatment, from any health care provider and/or pharmacist that has provided medical or health services to my child.

SELF-ADMINISTRATION OF MEDICATION: Initial this paragraph for use of an epinephrine, asthma inhaler and other approved self-administered medications:

_____ I hereby certify that my child has been fully instructed and is capable of self-administration of the prescribed medication. I further authorize my child's carrying, storage and self-administration of the above-prescribed medication in school. I acknowledge that I am responsible for providing my child with such medication in containers labeled as described above, for any and all monitoring of my child's use of such medication, as well as for any and all consequences of my child's use of such medication in school. I further hereby authorize the Department, DOHMH, their agents and employees; including the principal, his/her designee(s), school nurse and my child's teacher(s), to administer such medication in accordance with the instructions of my child's physician should my child be temporarily incapable of self-administering such medication. I understand that the school nurse will confirm my child's ability to self-carry and self-administer in a responsible manner with the school. In addition, I agree to provide "back up" medication in a clearly labeled bottle to be kept in the medical room in the event my child does not have sufficient medication to self-administer.

_____ I also authorize the principal, his/her designee(s) and school nurse to store and/or administer to my child such medication in the event that my child is temporarily incapable of self-storage and self-administration of such medication.

_____ I hereby certify that I have consulted with my child's health care provider and that I authorize the Office of School Health to administer stock Ventolin in the event that my child's asthma prescription medication is unavailable.

You must send your child's Personal Metered Dose Inhaler (MDI) with your child on a school trip day in order that he/she has it available.

The stock Ventolin is only for use while your child is in the school building.

Parent/Guardian's Signature		Print Parent/Guardian's Name	
Date Signed ____/____/____		Parent/Guardian's Address	
Telephone Numbers: Daytime (____) ____-____ Home (____) ____-____ Cell Phone* (____) ____-____			
Parent/Guardian e-mail address*			
Alternate Emergency Contact's Name		Contact Telephone Number (____) ____-____	
DO NOT WRITE BELOW - FOR DOE AND DOHMH ONLY			
Received by: Name		Reviewed by: Name	
Date ____/____/____		Date ____/____/____	
Self-Administers/Self-Carries: <input type="checkbox"/> Yes <input type="checkbox"/> No		Services provided by: <input type="checkbox"/> Nurse <input type="checkbox"/> DOHMH Public Health Advisor <input type="checkbox"/> School Based Health Center <input type="checkbox"/> DOE School Staff	
Signature and Title (RN OR MD):			

*Confidential information should not be sent by e-mail.

Figure 12. Group session and newsletter topics¹⁷⁰

Group Session Topics	Newsletter Content	Evaluation Components
<ul style="list-style-type: none"> • What is asthma and how did I get it? 	<ul style="list-style-type: none"> • Introduction to the program 	<ul style="list-style-type: none"> • Responsibility for care (RC)
<ul style="list-style-type: none"> • Holler. Stop. Six-pack. Chill: signs and symptoms of an attack and knowing how to respond 	<ul style="list-style-type: none"> • What is asthma, including from a perspective of an adolescent 	<ul style="list-style-type: none"> • Outcome expectancies (OE)
<ul style="list-style-type: none"> • How do medicines prevent attacks? 	<ul style="list-style-type: none"> • Preventing attacks by identifying triggers and using a peak flow meter 	<ul style="list-style-type: none"> • Self-efficacy through managing and preventing attacks (SE)
<ul style="list-style-type: none"> • Stopping asthma before it stops you: action planning and using a peak flow meter 	<ul style="list-style-type: none"> • Controlling attacks via medication management 	<ul style="list-style-type: none"> • SE
<ul style="list-style-type: none"> • How can I avoid triggers and asthma attacks? 	<ul style="list-style-type: none"> • Improving communication with others 	<ul style="list-style-type: none"> • SE
<ul style="list-style-type: none"> • Getting the help you need: how to talk to parents, friends, doctors, and school personnel 	<ul style="list-style-type: none"> • Maintaining changes through reinforcement 	<ul style="list-style-type: none"> • OE, RC, impact of illness on family

Endnotes

-
- ¹ Centers for Disease Control and Prevention (CDC), “Asthma’s Impact on the Nation,” http://www.cdc.gov/asthma/impacts_nation/asthmafactsheet.pdf.
- ² Sarah Beth L. Barnett and Tursynbek A. Nurmagambetov, “Costs of Asthma in the United States: 2002-2007,” *J Allergy Clin Immunol* 127 (January 2011): 145-152, doi:10.1016/j.jaci.2010.10.020.
- ³ Dipak Kanabar, “Asthma in Children,” in *ABC of Asthma 2000*, J. Rees and D. Kanabar.
- ⁴ Ibid.
- ⁵ Ibid.
- ⁶ Anastasios Tsakiris, Maria Iordanidou, Emmanouil Paraskakis, Angellos Tsalkidis, Alexandros Rigas, Stelios Zimeras, Charis Katsardis, and Athanassios Chatzimichael, “The Presence of Asthma, the Use of Inhaled Steroids, and Parental Education Level Affect School Performance in Children,” *BioMed Research International* (June 2013): 762-805, doi: 10.1155/2013/762805.
- ⁷ CDC, “Asthma’s Impact.”
- ⁸ Margaret Jean Hall, Carol J. DeFrances, Sonja N. Williams, Aleksandr Golosinkly, and Alexander Schartzman, “National Hospital Discharge Survey: 2007 Summary,” *U.S. Department of Health and Human Services: National Health Statistics Reports* 29 (October 2010): 1-8.
- ⁹ CDC, “National Hospital Ambulatory Medical Care Survey, 2010,” National Center for Health Statistics.
- ¹⁰ Ibid.
- ¹¹ Ibid.
- ¹² Ibid.
- ¹³ Fredic Wolf, James P. Guevara, Cyril M. Grum, Noreen M. Clark, and Christopher J. Cates, “Educational Interventions for Asthma in Children,” *Cochrane Database System Rev.* 1 (October 2003), doi:10.1002/14651858.CD000326.
- ¹⁴ Zheng Li, I-Chan Huang, Lindsay Thompson, Sanjeev Tulic, Shih-Wen Huang, Darren DeWalt, Dennis Revicki, and Elizabeth Shenkman, “The Relationships Between Asthma Control, Daytime Sleepiness, and Quality of Life Among Children with Asthma: A Path Analysis,” *Sleep Medicine* 14 (July 2013): 641–647, doi:10.1016/j.sleep.2013.04.002.
- ¹⁵ National Heart, Lung, and Blood Institute (NHLBI), “Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma,” National Asthma Education and Prevention Program, 2007 (August).
- ¹⁶ CDC, “Asthma’s Impact.”
- ¹⁷ NHLBI, “Expert Panel Report 3.”
- ¹⁸ Ibid.
- ¹⁹ Ren-Long Jan, Jiu-Yao Wang, Mei-Chih Huang, Shin-Mu Tseng, Huey-Jen Su, and Li-Fan Liu, “An Internet-Based Interactive Telemonitoring System for Improving Childhood Asthma Outcomes in Taiwan,” *Telemedicine Journal and E-Health* 13 (June 2007): 257–268, doi:10.1089/tmj.2006.0053.
- ²⁰ Sylvia Guendelman, Kelley Meade, Mindy Benson, Ying Qing Chen, and Steven Samuels, “Improving Asthma Outcomes and Self-management Behaviors of Inner-city Children: A

Randomized Trial of the Health Buddy Interactive Device and an Asthma Diary,” *Archives of Pediatrics & Adolescent Medicine* 156 (February 2002): 114–120,

doi:10.1001/archpedi.156.2.114.

²¹ CDC, “Asthma’s Impact.”

²² Barnett and Nurmagambetov, “Costs of Asthma.”

²³ Pei-Ching Liu, Gail M. Kieckhefer, and *Advanced Nursing* 69 (July 2013): 1446–1465, doi: 10.1111/jan.12129.

²⁴ Kanabar, “Asthma in Children”

²⁵ Michael D. Cabana, Kathryn K. Slish, Toby C. Lewis, Randall W. Brown, Bin Nan, Xihong Lin, and Noreen M. Clark, “Parental Management of Asthma Triggers Within a Child’s Environment,” *The Journal of Allergy and Clinical Immunology* 114 (August 2014): 352–357, doi: 10.1016/j.jaci.2004.04.047.

²⁶ Ibid.

²⁷ Stanley J. Szeffler, James F. Chmiel, Anne M. Fitzpatrick, George Giacoia, Thomas P. Green, Daniel J. Jackson, Heber C. Nielsen, Wanda Phipatanakul, and Hengameh H. Raissy, “Asthma Across the Ages: Knowledge Gaps in Childhood,” *Journal of Allergy and Clinical Immunology* 133 (January 2014): 3–14, doi: 10.1016/j.jaci.2013.10.018.

²⁸ Ibid.

²⁹ Sheniz Moonie, David A. Sterling, Larry W. Figgs. and Mario Castro, “The Relationship between School Absence, Academic Performance, and Asthma Status,” *Journal of School Health* 78(3) (February 2008); 78(3): 140–148.

³⁰ Tsakiris et al., “The Presence of Asthma.”

³¹ Paul W. Newacheck and Neal Halfon, “Prevalence, Impact, and Trends in Childhood Disability Due to Asthma,” *Archives of Pediatrics & Adolescent Medicine* 154 (March 2000): 287–293, doi:10.1001/archpedi.154.3.287.

³² Moonie, “The Relationship Between.”

³³ CDC, “Asthma’s Impact.”

³⁴ Hall et al., “National Hospital Discharge Survey.”

³⁵ CDC, “National Hospital Ambulatory Medical Care Survey.”

³⁶ Ibid.

³⁷ Ibid.

³⁸ Ibid.

³⁹ Thomas Janssens and Thomas Ritz, “Perceived Triggers of Asthma: Key to Symptom Perception and Management,” *Clinical and Experimental Allergy* 43 (September 2013): 1000–1008, doi: 10.1111/cea.12138.

⁴⁰ Ibid.

⁴¹ Wolf et al., “Educational Interventions.”

⁴² James P. Guevara, Fredric M. Wolf, Cyril M. Grum, and Noreen M. Clark, “Effects of Educational Interventions for Self Management of Asthma in Children and Adolescents: Systematic Review and Meta-analysis,” *British Medical Journal* 326 (June 2003): 1–6, doi:10.1136/bmj.326.7402.1308.

⁴³ Wolf et al., “Educational Interventions.”

⁴⁴ Andrew Bush and Sejal Saglani, “Management of Severe Asthma in Children,” *Lancet* 376 (September 2010): 814–825, doi: 10.1016/S0140-6736(10)61054-9.

⁴⁵ Ibid.

⁴⁶ Tsakiris et al., “The Presence of Asthma.”

⁴⁷ Li et al., “The Relationships Between Asthma Control.”

⁴⁸ Sharon Judge, Kathleen Puckett, and Sherry Mee Bell, “Closing the Digital Divide: Update from the Early Childhood Longitudinal Study,” *The Journal of Educational Research* 100 (September-October 2006): 52-60.

⁴⁹ Emory H. Woodward and Natalia Gridina, “Media in the Home 2000: The Fifth Annual Survey of Parents and Children,” *Philadelphia: Annenberg Public Policy Center, University of Pennsylvania* (2000): 11.

⁵⁰ Quianta Moore and Ashleigh Johnson, “Web-based School Health Promotion Tool Study,” *Rice University* 2014. ***In progress.***

⁵¹ Anne Kleiner and Laurie Lewis, “Internet Access in U.S. Public Schools and Classrooms: 1994-2002,” *U.S. Department of Education, Washington, DC: National Center for Education Statistics* (2003).

⁵² Lucinda Gray, Nina Thomas and Laurie Lewis, “Teachers’ Use of Educational Technology in U.S. Public Schools: 2009,” *National Center for Education, Statistics Institute of Education, U.S. Department of Education* (May 2010): 1-70.

⁵³ NHLBI, “Expert Panel Report 3.”

⁵⁴ Ibid.

⁵⁵ Ibid.

⁵⁶ Ibid.

⁵⁷ Asthma and Allergy Foundation of America (AAFA), “Child Care Asthma/Allergy Action Card,” 2010.

⁵⁸ NHLBI, “Expert Panel Report 3.”

⁵⁹ Ibid.

⁶⁰ Jan et al., “An Internet-Based Interactive Telemonitoring System.”

⁶¹ Ibid.

⁶² Ibid.

⁶³ Guendelman et al., “Improving Asthma Outcomes.”

⁶⁴ Ibid.

⁶⁵ Ibid.

⁶⁶ Ibid.

⁶⁷ Ibid.

⁶⁸ Ibid.

⁶⁹ Ibid.

⁷⁰ Ibid.

⁷¹ David Gustafson, Meg Wise, Abhik Bhattacharya, Alice Pulvermacher, Kathleen Shanovich, Brenda Phillips, Erik Lehman, Vernon Chinchilli, Robert Hawkins, and Jee-Seon Kim, “The Effects of Combining Web-Based eHealth With Telephone Nurse Case Management for Pediatric Asthma Control: A Randomized Controlled Trial,” *Journal of Medical Internet Research* 14 (July 2012): doi: 10.2196/jmir.1964.

⁷² Ibid.

⁷³ Ibid.

⁷⁴ Ibid.

⁷⁵ Ibid.

⁷⁶ Ibid.

⁷⁷ Wade T.A. Watson, Cathy Gillespie, Nicola Thomas, Shauna E. Filuk, Judy McColm, Michelle P. Piwniuk, and Allan B. Becker, "Small-group, Interactive Education and the Effect on Asthma Control by Children and Their Families," *CMAJ: Canadian Medical Association Journal* 181 (September 2009): 257–263, doi: 10.1503/cmaj.080947.

⁷⁸ Ibid.

⁷⁹ Ibid.

⁸⁰ Ibid.

⁸¹ Ibid.

⁸² Ibid.

⁸³ Ibid.

⁸⁴ Lisa M. Swerczek, Christina Banister, Gordon R. Bloomberg, Julie M. Bruns, Jay Epstein, Gabriella R. Highstein, Patricia A. Jamerson, Randall Sterkel, Sterkel Wells, and Jane M. Garbutt, "A Telephone Coaching Intervention to Improve Asthma Self-Management Behaviors," *Pediatric Nursing* 39 (May-June 2013): 125–130.

⁸⁵ Ibid.

⁸⁶ Ibid.

⁸⁷ Ibid.

⁸⁸ Ibid.

⁸⁹ Ibid.

⁹⁰ Barbara P. Yawn, Pamela J. Algatt-Bergstrom, Roy A. Yawn, Peter Wollan, Mark Greco, Marie Gleason, and Leona Markson, "An In-School CD-ROM Asthma Education Program," *Journal of School Health* 70(4) (April 2000): 153-159, doi: 10.1111/j.1746-1561.2000.tb06462.x.

⁹¹ Ibid.

⁹² Ibid.

⁹³ Ibid.

⁹⁴ Ibid.

⁹⁵ Ibid.

⁹⁶ Santosh Krishna, Benjamin D. Francisco, E. Andrew Balas, Peter König, Gavin R. Graff, and Richard W. Madsen, "Internet-Enabled Interactive Multimedia Asthma Education Program: A Randomized Trial," *Pediatrics* 111 (March 2003): 503–510, doi: 10.1542/peds.111.3.503.

⁹⁷ Ibid.

⁹⁸ Ibid.

⁹⁹ Ibid.

¹⁰⁰ NHLBI, "Expert Panel Report 3."

¹⁰¹ Gregory D. Kearney, Lisa C. Johnson, Xiaohui Xu, Jo Anne G. Balanay, Kevin M. Lamm and Daniel L. Allen, "Eastern Carolina Asthma Prevention Program (ECAPP): An Environmental Intervention Study Among Rural and Underserved Children with Asthma in Eastern North Carolina," *Environmental Health Insights* 8 (2014): 27–37, doi: 10.4137/EHI.S16430.

¹⁰² Ibid.

¹⁰³ Ibid.

¹⁰⁴ Ibid.

¹⁰⁵ Ibid.

¹⁰⁶ Amy McPherson, "The Asthma Files: Evaluation of a Multimedia Package for Children's Asthma Education," *Paediatric Nursing* 14 (March 2002): 32-35, doi: 10.7748/paed2002.03.14.2.32.c787.

¹⁰⁷ Ibid.

¹⁰⁸ Ibid.

¹⁰⁹ Ibid.

¹¹⁰ Cabana et al., "Parental Management."

¹¹¹ Ibid.

¹¹² Ibid.

¹¹³ Ibid.

¹¹⁴ Ibid.

¹¹⁵ Oxiris Barbot, Roger Platt, and Carole Marchese, "Using Preprinted Rescue Medication Order Forms and Health Information Technology to Monitor and Improve the Quality of Care for Students With Asthma in New York City Public Schools," *The Journal of School Health* 76 (August 2006): 329-332, doi: 10.1111/j.1746-1561.2006.00122.x.

¹¹⁶ Ibid.

¹¹⁷ Ibid.

¹¹⁸ Ibid.

¹¹⁹ Katherine A. Auger, Robert S. Kahn, Matthew M. Davis, and Jeffrey M. Simmons, "Pediatric Asthma Readmission: Asthma Knowledge Is Not Enough?" *The Journal of Pediatrics* 166 (January 2015): 101-108, doi:10.1016/j.jpeds.2014.07.046.

¹²⁰ Ibid.

¹²¹ Ibid.

¹²² NHLBI, "Expert Panel Report 3."

¹²³ Jennifer L. Terpstra, Laura J. Chavez, and Guadalupe X. Ayala, "An Intervention to Increase Caregiver Support for Asthma Management in Middle School-Aged Youth," *Journal of Asthma* 49 (April 2012): 267-274, doi:10.3109/02770903.2012.656866.

¹²⁴ Ibid.

¹²⁵ Ibid.

¹²⁶ Ibid.

¹²⁷ Ibid.

¹²⁸ Ibid.

¹²⁹ Ibid.

¹³⁰ Ibid.

¹³¹ Ibid.

¹³² Ibid.

¹³³ Ross Shegog, L. Kay Bartholomew, Guy S. Parcel, Marianna M. Sockrider, Louise Mâsse, and Stuart L. Abramson, "Impact of a Computer-assisted Education Program on Factors Related to Asthma Self-Management Behavior," *Am Med Inform Assoc.* 8 (Jan-Feb 2001): 49-61, doi: 10.1136/jamia.2001.0080049.

¹³⁴ Ibid.

¹³⁵ Ibid.

-
- ¹³⁶ Ibid.
- ¹³⁷ Ibid.
- ¹³⁸ Ibid.
- ¹³⁹ Ibid.
- ¹⁴⁰ Ibid.
- ¹⁴¹ Elizabeth R. Woods, Urmi Bhaumik, Susan J. Sommer, Sonja I. Ziniel, Alaina J. Kessler, Elaine Chan, Ronald B. Wilkinson, Maria N. Sesma, Amy B. Burack, Elizabeth M. Klements, Lisa M. Queenin, Deborah U. Dickerson, and Shari Nethersole, "Community Asthma Initiative: Evaluation of a Quality Improvement Program for Comprehensive Asthma Care," *Pediatrics* 129 (March 2012): 465–472, doi: 10.1542/peds.2010-3472.
- ¹⁴² Ibid.
- ¹⁴³ Ibid.
- ¹⁴⁴ Ibid.
- ¹⁴⁵ Ibid.
- ¹⁴⁶ CDC, "Asthma's Impact."
- ¹⁴⁷ NHLBI, "Expert Panel Report 3."
- ¹⁴⁸ Auger et al., "Pediatric Asthma."
- ¹⁴⁹ Jan et al., "An Internet-based."
- ¹⁵⁰ Guendelman et al., "Improving Asthma."
- ¹⁵¹ Lisa Cicutto, Melanie Gleason, and Stanley J. Szefer, "Establishing School-centered Asthma Programs," *Journal of Allergy and Clinical Immunology* 136(6) (December 2014): 1223-1230.
- ¹⁵² Szefer et al., "Asthma Across the Ages."
- ¹⁵³ Ibid.
- ¹⁵⁴ Ibid.
- ¹⁵⁵ Jessica P. Hollenbach and Michelle M. Cloutier, "Implementing School Asthma Programs: Lessons Learned and Recommendations," *Journal of Allergy and Clinical Immunology* 134 (December 2014): 1245-1249, doi:10.1016/j.jaci.2014.10.014.
- ¹⁵⁶ Auger et al., "Pediatric Asthma"
- ¹⁵⁷ Sylvia J. Brandt, Laura Perez, Nino Künzli, Fred Lurmann, and Rob McConnell, "Costs of Childhood Asthma Due to Traffic-Related Pollution in Two California Communities," *European Respiratory Journal* 40 (August 2012): 363-370, doi: 10.1183/09031936.00157811.
- ¹⁵⁸ Hollenbach and Cloutier, "Implementing School Asthma Programs."
- ¹⁵⁹ Ibid.
- ¹⁶⁰ NHLBI, "Expert Panel Report 3."
- ¹⁶¹ Ibid.
- ¹⁶² AAFA, "Child Care."
- ¹⁶³ NHLBI, "Asthma Action Plan," 2007 (April).
- ¹⁶⁴ Gustafson et al., "The Effects."
- ¹⁶⁵ Watson et al., "Small-group, Interactive Education."
- ¹⁶⁶ Swerczek et al., "A Telephone Coaching Intervention."
- ¹⁶⁷ Cabana et al., "Parental Management"
- ¹⁶⁸ Ibid.

¹⁶⁹ NYC Department of Education, “Medical Forms Packet, 2014-2015,”
<http://schools.nyc.gov/Offices/Health/SchoolHealthForms>.

¹⁷⁰ McPherson, “The Asthma Files.”