



INDOOR ASTHMA TRIGGERS

A Time Tool Resource from the American College of Preventive Medicine

The following resource document provides the evidence to support the health professional e-mail version of the Indoor Asthma Triggers Time Tool. Links within the health professional document connect to this Resource. The following bookmarks are available to navigate the Resource document.

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IMPACT OF ASTHMA

Introduction

Asthma is an environmental disease caused in most patients by the chronic inhalation of allergens. There are many different types of indoor and outdoor allergens and the exact sensitivities to these vary between people. [1]

- Thorough, sustained allergen removal is the safest and most cost-effective means of treating asthma and should be undertaken in every patient. [1]
- Environmental control should be addressed with every asthmatic regardless of perceived or actual allergic sensitivity, both because allergy testing has a significant false-negative rate and because prolonged exposure to allergens will likely produce new sensitivities. [1]

Prevalence and Significance

Since 1980, asthma prevalence, hospitalization, and mortality have been increasing in the United States [2].

Asthma is the most common chronic childhood disease in the United States -- Nine million U.S. children under 18 (12%) ever diagnosed with asthma. As age increases, the percentage ever diagnosed increases. [3]

- Boys more likely than girls to have ever been diagnosed (15% and 9%, respectively). [3]
- Children in poor families more likely to have been diagnosed than children not poor (14% vs 12%). [3]
- Almost 4 million children (6%) had an asthma attack in previous 12 months. [3]
- Children in fair-poor health were 7 times as likely to have had an asthma attack in past 12 months as children in excellent-very good health (29% and 4%). [3]

The 2003 California Health Interview Survey found that 7.3% of adults and 10.4% of children had active asthma. [4]

It is more common in inner cities; asthma was reported by 41% of households in two Buffalo inner-city neighborhoods. [5]

Diagnosis increased 75% between 1980 and 1999, 160% in preschool children, and children dying from asthma tripled. [6]

- Leading cause of school absences, 14.7 million missed days in 2002 -- more than 3 times the rate of children without asthma, [7]
- 3.5 million physician visits, 658,000 ER visits and nearly 200,000 hospitalizations each year for children under 15 (3rd ranking cause), [8]
- Over 8.7 million annual prescriptions for children under age 17 (1999), [8]
- \$3.2 billion per year -- the estimated cost of treating asthma in those under 18, [9]
- Overall -- \$14 billion in health care costs, 2 million ER visits and 5,000 deaths per year. [10]

Low-income populations, minorities, and children living in inner cities experience more ER visits, hospitalizations, and deaths due to asthma than the general population. [11]

- African American children are twice as likely to have asthma as are white children and are 6 times as likely to die from it. [12]

During 1987--1998 in King County, Washington, childhood asthma admissions increased 53%, and overall childhood hospitalization rates for asthma increased 17%. [13]

- In 1998, for children aged 1--4 years, the hospitalization rate for asthma was 2.8 times higher than the rate for children aged 5--9 years and 4.8 times higher than the rate for children aged 10--17 years
- Hospitalization rate for children aged 5--9 years was 1.7 times higher than the rate for those aged 10--17 years
- During 1987--1998, hospitalization rates for asthma increased 34% in children aged 1--4 years and 17% in children aged 5--9 years; rates in children aged 10--17 years showed no significant change.
- Hospitalization rates for asthma among children residing in areas where poverty was greatest were significantly higher than rates among children residing in other areas. [13]

Asthma is costly—for children, families, the health care system, and communities.

- The National Center for Education in Maternal and Child Health estimates that the loss of adult productivity associated with parents staying home from work to care for children with asthma is more than \$1 billion a year. [14]
- The physical, emotional, and psychological stress caused by frequent asthma attacks can also take a toll on children and their parents.

Factors that put children at greater risk:

- Pound for pound, breathe more air than adults, due to growth and higher metabolism.
- Resting infant takes in twice as much air per pound of body weight as adult; would inhale proportionally twice as much of an airborne toxin as an adult.
- Children spend more time on floor and ground, where allergens are concentrated.
- Growth and development makes them more vulnerable to environment,
- Can be exposed to environmental toxins even before birth. [15]

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ASTHMA CONTROL

There is no cure, but it can be controlled by taking medication and by avoiding contact with environmental triggers for asthma. Environmental triggers include cockroaches, dust mites, furry pets, mold, tobacco smoke, and certain chemicals. [16,17]

Mounting evidence suggests that indoor allergens and irritants contribute to childhood asthma. National asthma guidelines highlight the importance of their reduction as part of comprehensive asthma treatment.

Early intervention is important -- A growing body of evidence shows that intervention during the early years of asthma symptoms can reduce later disease. [18]

- The inflammation in the airways of a child who has asthma can result in long-term changes—called “remodeling”—of the child’s airways.

GUIDELINES

Successful asthma management has 4 components:

1. Regular assessment and monitoring,
2. Control of factors that trigger symptoms and disease severity,
3. Pharmacologic therapy,
4. Educating the child, the family, and other caregivers (daycare providers, teachers, school nurses, camp counselors, coaches) to adhere to a written asthma management plan that includes daily management and how to handle asthma episodes. [19]

According to the National Asthma Education and Prevention Program Expert Panel: [20]

- For successful long-term asthma management, it is essential to identify and reduce exposures to allergens and irritants and to control other factors that trigger symptoms.
 - Within homes and other indoor environments, the primary allergens are animal allergens, house-dust mites, cockroach allergens and molds; the main irritant is tobacco smoke.
 - Ask about second-hand smoke exposure!
- All patients should be queried about exposures to inhalant allergens, and those with persistent asthma should be evaluated for sensitization to environmental allergens.
 - Skin or in vitro tests for patients exposed to perennial allergens are essential to justify the expense and effort involved in implementing environmental controls.

Environmental control measures should be considered first-line treatment measures.

- Of the four modes of treating allergic disease, avoidance or separation of the allergic patient from the allergen is most effective and least expensive. [21]
- It can produce changes in disease activity and symptoms that can be beneficial before any medical intervention is implemented. [21]
- Accurate quantification of the levels of allergen in indoor environments should be the first step; allows the asthma patient/family to monitor the effectiveness of remedial actions. [22]
- Contact local public health department for resources to assist measuring allergens.

Guidelines outline 6 competencies that practitioners need to develop to manage indoor asthma triggers: [23]

1. Knowledge of the triggers -- both in general as well as specific to the community
2. Ability to identify the triggers -- do an environmental assessment; allergy testing and when, where to refer to specialist
3. Ability to recommend interventions -- provide accurate information about the benefits and harms of products and services for control of environmental triggers
4. Ability to counsel caregivers and patients -- counseling about reducing indoor triggers, including behavioral issues
5. Be able to communicate effectively -- deal with language, education barriers; have a system to follow patients; referral to an asthma educator or other community services
6. Be an advocate for community -- know resources available, develop collaborations; support no smoking initiatives

POSITION STATEMENTS

The need for improvements in health professionals' environmental health knowledge has been expressed by leading health institutions, including the IOM, the AMA, and others. [24-28]

Recognizing the need:

- the **Ambulatory Pediatric Association** issued a list of competencies for specialists in pediatric environmental health. [29]
- The **American Academy of Pediatrics** published a book on the identification, prevention, and treatment of childhood environmental health problems, which states that, "Avoiding environmental allergens and irritants is one of the primary goals of good asthma management." [30]
- The **American Academy of Allergy Asthma & Immunology** created an environmental management of asthma online continuing education program for its health care provider members. [31]

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IMPORTANCE OF INDOOR AIR QUALITY

There is growing evidence that the indoor environment plays an important role in the pathogenesis of childhood asthma. [32]

- Indoor air pollution has long been the Cinderella of the environmental world: left at home, out of sight and out of mind. But as our knowledge of indoor pollution grows, policy-makers are realizing that improving indoor environments can deliver big gains for public health. [33]

Indoor air quality is important, because anything we breathe can potentially affect our health.

- Attention has focused on sick building syndrome, chemical sensitivities, and mycotoxicosis, but there is actually little evidence that these conditions adversely affect human health.
- In contrast, real health issues have been shown to exist regarding indoor air triggers of allergies and asthma -- severe allergic symptoms and also priming individual susceptibility to simultaneous or subsequent exposure to other outdoor allergens. [34]

Indoor air poses a greater risk than outdoor air because of the higher levels of toxins in the confined space, and the significant amount of time that people spend indoors. [35]

- Homes typically have small volumes and low air exchange rates, thus indoor pollutant concentrations, such as SHS, can be very high and can persist at measurable levels indoors for many hours. [36]
- EPA studies have shown that levels of air pollutants *indoors* may be anywhere from 2 to 5 times greater than outdoors, and in some cases more than 100 times greater. [37]
- More than half of our intake of air over a lifetime comes from our home. [38]
- Many children, especially in urban areas, spend more than 90% of their time indoors. [38]
- Greatest exposure to indoor allergens is in the home, but other public places where children spend a large amount of time, such as school and day care centers, may also be sources of significant allergen encounters. [39]

When there is a family history of allergy, levels well below currently suggested threshold levels of allergens may cause sensitization. [40]

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PREVALENCE OF INDOOR ASTHMA TRIGGERS

A large proportion of asthmatic children and young adults are sensitive to indoor triggers. [41,42]

- Dust mites, pests (particularly cockroaches), mold, pet dander, and tobacco smoke are the most common triggers. And, they are substances to which, if present, children are exposed to daily. [43]
- Not only can these triggers cause severe allergic symptoms but they also heighten sensitivity to outdoor allergens. [44]

As a general rule, allergy becomes a more important part of asthma with each year of age from preschool up to about age 10-12, at which point roughly 80-90 percent of asthmatic children will have allergic triggers. [45]

Exposure to environmental triggers in the home is common -- families of children with asthma reported: [46]

- Second hand smoke - 30%,
- Household pests - 18%,
- Furry pets - 59%,
- Carpeting in child's bedroom - 78%,
- Forced-air heat - 58%.
- No mattress (65%) or pillow (84%) covers.

While specific exposures vary with demographic and socioeconomic variables, all children are at risk.

Another study of over 1000 homes with a child with asthma found that most homes had multiple allergen burdens in excess of concentrations thought to be associated with sensitization and exacerbation of asthma: [47]

- 86% of the homes had at least one allergen at the lower cut point, and
- 49% of homes had two or more allergens at the lower cut point.
- 58% had at least one allergen at the upper cut point, and
- 20% had two or more allergens at the upper cut point.
- Mite and cockroach allergens had distinct and opposite associations with socioeconomic factors and population density -- higher income and lower population density area with fewer people per homes and rooms was associated with elevated dust mite, cat, and dog allergens and low cockroach allergen.
- Lower income, living in a multifamily home in a high population density area with more people per room, was associated with elevated cockroach allergens and lower dust mite, cat, and dog allergens.

About 80% of the U.S. population is exposed to house-dust mites (Nelson and Fernandez-Caldas 1995), 60% to cat or dog, and a much smaller percentage to both animals. Cockroaches are a consideration only in the inner city and southern parts of the United States. [48]

Many low-income urban children live in indoor environments that place them at substantial risk of ongoing exposure to asthma triggers. Substandard housing and lack of resources often underlie these exposures. [49]

- Asthma was reported by 41% of households in two Buffalo inner-city neighborhoods. Smoking, pets, humidifier, and cockroaches were all significantly associated with asthma in the home. [50]
- In the CDC-funded Inner-City Asthma Study -- 61% of children were exposed to aeroallergens in their home to which they were sensitized. [51]
- In a cohort of inner-city adults who had been hospitalized with asthma, 94% of those who were evaluated for allergen sensitization were sensitized to at least one antigen: [52]
 - 91.5% to dust mites,
 - 90.5% to outdoor allergens,
 - 77.9% to cats,
 - 69.5% to dogs,
 - 68.4% to molds, and
 - 61% to cockroaches.

There are marked differences in the types of allergens present in homes within communities, but not necessarily in the overall burden of allergen exposure.

- More than 80% of childhood asthmatics are allergic to one or more inhalant allergens. In a study of homes in the Boston area, the proportion of homes in the highest level of exposure was 42% for dust mite allergen, 13% for cockroach allergen, 26% for cat allergen and 20% for dog allergen. [53]
- Homes in the high-poverty area were more likely to have high cockroach allergen levels than homes in the low-poverty area [51 vs. 3%; OR, 33], but less likely to have high levels of dust mite allergen (16 vs. 53%; OR, 0.2). Lower income, less education, and black or Hispanic ethnicity were associated with a lower risk of high dust mite levels and a greater risk of high cockroach allergen levels. [53]

Coexistence of exposures is common; patients reporting environmental tobacco smoke (ETS) exposure also reported greater exposure to cockroach allergen and mold than those not reporting ETS exposure. [54]

Children's greatest exposure to indoor allergens is at home, but other public places where they spend a large amount of time are important too.

- A study that examined elementary schools in different geographic areas, found that dust mite, cat, and cockroach allergens were present in all schoolrooms and all sites at varying levels by season and by type of room. [55]

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THE LINK TO INDOOR TRIGGERS

It has been clearly shown that: 1) allergens increase the risk of developing respiratory symptoms, 2) they can aggravate many (sensitized) asthma patients, and 3) avoidance measures can reduce allergen levels.

- Allergen avoidance can produce changes in disease activity and symptoms that can be beneficial before any medical intervention is implemented. [56]

The National Academy of Sciences Institute of Medicine convened experts to review the evidence on the relationship between indoor air pollution and asthma. Some of the key findings of their report, *Clearing the Air*, include: [57]

- Indoor environments play an important role in the growing asthma problem.
- Exposure to secondhand smoke and indoor allergens -- dust mites, animal dander, cockroaches and mold -- can exacerbate asthma symptoms.
- Exposure to dust mites and secondhand smoke in preschool children can cause asthma.

It is important to minimize exposure to indoor allergens. It is the most effective and least expensive approach to asthma control.

- Quantifying levels of allergens in indoor environments, combined with the patient's indoor exposure pattern and sensitivity enables a customized management avoidance plan. [58, 59]
- Contact local public health department for assistance.

Exposure in infancy may be important in the development of asthma. [60]

- High levels of house dust mite antigen and environmental tobacco smoke are especially risky in infants. [60]
- Smoking cessation for everyone in household is vital.
- But early dog and cat allergen exposure might lead to sensitization and to persistent wheeze in subgroups defined by maternal atopy. [61]
- Levels well below currently suggested threshold levels may cause sensitization in children with a family history of allergy. [62]
- Allergic diseases can be reduced, for at least the first 8 years of life, by dust mite avoidance in infancy -- should be considered for prevention of allergy in high-risk infants. [63]

The chronic course of asthma throughout the school years is largely determined by continuing allergic airway inflammation in the first 3 years of life. [64]

- Reduced lung function usually becomes apparent in children with persistent asthma when they reach school age. [64]
- Sensitization to perennial allergens (eg, house dust mite, cat and dog hair) in the first 3 years of life was associated with loss of lung function at school age. In contrast, 90% of non-atopic children with wheeze lost their symptoms at school age and retained normal lung function at puberty. [64]

Increasing concentrations of allergens and irritants leads to an increase in symptoms.

- In a longitudinal study, a doubling of indoor fungal exposure was associated with greater than 50% increase in risk of asthma attacks in the next 12 mos. [65]
- A doubling of dust mite floor levels was associated with 73% increased odds of doctor-diagnosed asthma and a 64% greater odds of persistent bronchial hyper-reactivity. [65]
- Asthma symptoms, pulmonary function, and need for medication in mite-sensitive asthma patients correlates with the level of house-dust mite exposure. [60]
- Higher levels of cockroach allergen in bedrooms was associated with more asthma symptoms in the homes of low-income Chicago children. [66]

Allergen exposure also favors the transfer of nasal inflammation to lower airways, which obviously complicates asthma. [67]

- The combination natural virus infection and real life allergen exposure in allergic asthmatic children has been shown to increase the risk of hospital admission. (OR 19.4). [68]

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PRACTICE PATTERNS

Guidelines recommend that all patients with persistent asthma be evaluated for sensitization to environmental allergens. But, in reality, many children with asthma and their families are not receiving adequate counseling about environmental interventions from health care providers or other sources. [69]

- Families are not well informed about environmental control, nor are they taught how to do it. This could be explained by the focus on medical management that many providers are trained to give to patients. [70]

Over half of asthma patients (55%) have inadequate control. [71]

- Only 35% with poorly controlled asthma, and 25% of patients with controlled asthma, had ever received a personalized action plan from a physician. [71]
- Patients with uncontrolled asthma reported significantly higher rates of health care use. [71]

Many asthma patients are not being evaluated for indoor triggers.

In a cohort of inner-city adults hospitalized with asthma: [72]

- Only 60% had ever been evaluated for allergen sensitization.
- Only half of patients found to be sensitized to allergens were given any avoidance-abatement advice.
- In this population, the quality of allergen sensitization evaluation, avoidance education, and patient adherence with recommendations was suboptimal.

Parents of children with asthma in reported: [73]

- Fewer than half (45%) reported ever receiving written instructions regarding trigger avoidance, only about 1 in 10 reported receiving them in the past year.
- However, 4 in 10 reported discussing triggers in the home environment with a clinician in the previous 6 months.

Others are not using appropriate strategies to reduce triggers

In a nationwide sample of parents of 896 children with asthma, 80% of parents could identify at least 1 asthma trigger. 82% had attempted an environmental control measure. [74]

- However, half of the actions initiated were not specifically endorsed by current guidelines. [74]
- Improving awareness about recognized methods to address triggers may help families use more effective measures.
- Clinicians should not assume that they can predict which families will be more or less likely to attempt environmental control, but should provide education regarding effective environmental measures for all families with potentially modifiable

BARRIERS TO IMPROVING TRIGGER CONTROL

Three major barriers stymie efforts to improve trigger control:

1. **The lack of research showing that it really can make a difference.** Has led many practitioners to discount home trigger control interventions. But, it was not because good studies showed no effect -- it was because good quality studies had not been done. This is changing. [75]
 - Studies show that remedial actions taken at home can reduce exposures but not necessarily symptoms. However, it is more a dearth of research rather than evidence of no association. [76]
 - It may also be that simple interventions alone, such as allergen-impermeable mattress covers to reduce exposure to dust mite allergens, offer little benefit by themselves, but are more effective when part of a more comprehensive approach; evidence is mounting that multifaceted, home-based interventions that focuses on multiple exposures do provide clinical benefits. [77]
2. **Practitioners often do not follow the guidelines** for managing asthma -- guidelines that stress trigger control, and patient education to foster a partnership among patients, family members, and clinicians. [78]
 - Many practitioners remain unaware of or are unfamiliar with the guidelines. [78]
 - Others believe it is futile to teach families how to reduce indoor asthma triggers, that families who are most affected by asthma have the least control over their living environments. [78]

3. **The lack of adequate, affordable, healthy housing** in the U.S. presents a huge barrier to the reduction of indoor asthma triggers. [79]
 - o Families with limited incomes face limited choices about where to live. They often feel helpless to confront landlords about housing conditions. [79]

A fourth barrier may be physician training -- fewer than one-fifth were trained in taking an environmental history. [80]

WHY THE LACK OF EVIDENCE?

Clinical trials of allergen avoidance tend to be small and findings inconsistent.

- o Two large double-blind, placebo-controlled studies on the use of encasings (mattress, pillow and duvet) as a single intervention in adults with asthma failed to show a difference between groups over a 12-month period. Studies such as these have led many clinicians to be skeptical about recommending changes that they know will be difficult to achieve anyway. [81]

There are several possible explanations for studies that fail to show a positive impact: [77, 82]

- o methodological issues (type of intervention, sample studied, severity of symptoms, outcomes evaluated, tests used, and so on)
- o poor adherence to the intervention,
- o presence of other allergens/non-specific agents in the home,
- o other exposures to allergens outside the home,
- o difficulty distinguishing the efficacy of a single intervention compared to others used (e.g., drugs, immunological)
- o length of follow-up; some triggers persist in the home long after interventions to remove them

A multifactorial disease, such as asthma, is extremely difficult, if not impossible, to prevent by eliminating only one risk factor. It should not be surprising that monotherapy studies often do not yield clinically relevant effects. [77, 83]

- o Fortunately, the trend is toward multifaceted interventions, which have been shown to yield better, and more consistent, results.

Ultimately, it is more an issue of a lack of quality, well controlled research rather than evidence of no association. [76]

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EFFECTIVENESS OF INTERVENTIONS TO REDUCE INDOOR TRIGGERS

An accumulating body of knowledge indicates that measures of allergen avoidance, when strictly applied for a sufficient period of time, can indeed reduce asthma symptoms, need for medication, and airway hyperresponsiveness. [84]

Collaborative Interventions with Home Visits are Beneficial

Review of over 400 asthma programs by EPA, the Asthma Health Outcomes Project (AHOP), found that environmental control programs produce the best outcomes when they build strong connections between front-line health care providers and local communities. [85]

In a study supported by the NIAID, nurse practitioners helped over 1,000 high-risk families who had children with asthma institute environmental controls in their homes. The intervention led to a striking reduction in asthma symptoms, improved QOL, and increased school attendance among the children. [86]

- More specifically, the intervention group experienced a 30% decrease in asthma-related hospitalizations and unscheduled pediatric and ER visits.
- This study showed that by addressing asthma triggers in the homes of inner-city children and taking aggressive action, the disparities in hospitalizations and deaths related to asthma can be reduced.

Reductions in triggers of asthma have been difficult to achieve in inner cities. But, an individualized, home-based, comprehensive approach was shown to work in a one-year intervention in 7 cities (Inner-City Asthma Study); resulted in:

- Decreases in exposure to indoor allergens, including cockroach and dust-mite allergens, and
- reduced asthma-associated morbidity. [87]
- Reductions in the levels of cockroach allergen and dust-mite allergen on the bedroom floor were significantly correlated with reduced complications of asthma. [87]
- And it was cost-effective. [88]

The Seattle-King County Healthy Homes Project is another example of a multi-faceted home intervention, this one led by community health workers. [89]

- Included assessment, individualized action plans, education, social support, encouragement, materials to reduce exposures (including bedding encasements), roach and rodent eradication, and advocacy for improved housing conditions. Addressed all major triggers.
- More intense counseling led to greater improvements in measurements of triggers and behaviors, and reduced asthma symptom days and urgent health services use while improving caregiver quality-of-life score. [89]

In another study, monthly home visit counseling (at least 1 hr) reduced the frequencies of asthma attacks ($p < 0.000001$), required theophylline dosages ($p < 0.0005$), and levels of allergens ($p < 0.0005$) in both atopic and non-atopic patients, compared to regular counseling (10 min in office). [90]

An intensive 3-month intervention led by a Family Coordinator in an urban Latino and African-American community provided education based on a readiness-to-learn model resulted in:

- significant improvements in knowledge, beliefs, self-efficacy, self-regulatory skills, and adherence, as well as decreases in symptom persistence and activity restriction. [91]

In a randomized controlled trial of a one-year tailored, multifaceted environmental intervention to reduce environmental pollutant and allergen exposure in the homes of asthmatic children living in the inner city, a home-based education program with cockroach and rodent extermination, mattress and pillow encasings, and high-efficiency particulate air cleaner resulted in the following: [92]

- Levels of particulate matter declined by up to 39% in the treatment group but increased in the control group.
- Cockroach allergen levels decreased by 51% in the treatment group.
- Daytime symptoms increased in the control group and decreased in the treatment group.

A Comprehensive Approach is More Effective

Asthma is a multifactorial disease; that is, it can be caused by several underlying factors. They often exist in combination. Therefore, it is extremely difficult, if not impossible, to improve by eliminating only one factor.

- This has led to the realization that multifaceted interventions are more effective than monofaceted interventions.
- In a meta-analysis of 10 prospective birth cohorts (a total of 3473 children) -- the odds of developing asthma was 0.73 with multifaceted interventions vs 1.22 in monointervention studies in patients younger than 5 years; over 5, the OR was 0.52 vs 0.93. [93]
- A multifaceted approach has a much greater chance of being successful than a monofaceted approach. [93]

A multifaceted intervention program carried out in high risk infants reduced the prevalence of asthma at 7 years of age -- prevalence of pediatric allergist-diagnosed asthma was significantly lower in the intervention group than in the control group (14.9% vs 23.0%). [94]

- The prevalence of asthma (defined as wheeze without colds and the presence of bronchial hyperresponsiveness) was also significantly lower in the intervention group compared with the control group (12.9% vs 25.0%) [94]

An intervention including an action plan, education, and individualized problem solving and remediation of moisture problems resulted in a significant decrease in symptom days compared to an intervention including cleaning only. [95]

- The more intense intervention also resulted in a lower rate of exacerbations. Construction remediation aimed at the root cause of moisture, combined with a medical/behavioral intervention significantly reduced symptom days and health care use for asthmatic children living in homes with a mold problem. [95]

Another multifaceted intervention study, with the intervention tailored to the child's sensitization status and home environment (including environmental tobacco smoke), resulted in significant reductions in emergency room visits and symptoms in the active group. [96]

- This study suggests that simpler interventions can be effective in children, but the older the age the more multifaceted the intervention must be.

The Earlier the Intervention, the Better

A recent study confirmed a preventive effect of HDM allergen avoidance measures in higher risk infants on the development of asthma by 8 years of age. [97]

- The adjusted odds ratio was 0.24 in those with low dust mite exposure in infancy.

The absence of roaches and the use of dust mite covers were positively associated with QOL in pediatric and adult participants. [98]

- Frequent bed sheet washing was not, however.
- These findings confirm existing wisdom on roaches and dust mite covers but raise questions about bed sheet washing recommendations.

Reducing house-dust mite exposure reduces asthma symptoms, nonspecific bronchial hyperresponsiveness, and evidence of active inflammation. [99]

It takes patience and persistence.

- It takes time for allergen avoidance measures to take effect. 1 to 2 months are required to eliminate roaches, and an additional 4 to 6 months are required to remove residual allergen. [100]
- Once allergen levels have been reduced, continued efforts are necessary to maintain the home free of allergen sources.

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COMMUNITY PROGRAMS TO IMPROVE HOUSING

Childhood asthma is a growing public health concern in low-income urban communities because many low-income urban children with asthma live in indoor environments that place them at increased risk of ongoing exposure to asthma triggers. [101]

- Substandard housing and lack of resources are the underlying problems.
- Initiatives involving health educators, outreach workers, medical providers, health care insurers, housing agencies, and elected officials are needed to improve the situation. [101]

The interventions that have been found to work most consistently are home visitation programs and home modification, such as installment of window guards and carpet removal. [102]

- Altering the home environment to protect the health of children requires cooperation between doctors and public health agencies; residential hazards must be dealt with in an integrated manner and not focused on one disease process or one method at a time.

Optimal control of indoor triggers requires the family to take a major role. [103]

- Reducing triggers can have an immediate impact on a child's health; and it gives practitioners an opportunity to create a stronger partnership with the family, which will carry over into other aspects of care, such as better adherence to medication regimens. [103]
- The worst situations are often poorer people who own their houses, because they can't afford to deal with repairs...fundamentally, it's a problem of poverty. [103]

Environmental Health Watch, an environmental justice organization in Ohio, has been addressing housing issues for more than two decades, first tackling lead poisoning prevention and then the presence of asthma triggers, especially pest infestations.

- Cockroaches are among the most common allergenic pests and their presence has been strongly associated with the severity of asthma symptoms. Partnering with a local asthma coalition, the local housing authority and cockroach experts, Environmental Health Watch implemented an integrated pest management plan directed at low-income housing units in Cleveland. [103]

Creating healthier building standards is another strategy. About 13 years ago, a one-time project to build a healthy home launched a nationwide movement that continues today -- the Health House program of the American Lung Association. [104]

- Now, the association trains builders across the nation to build houses that limit indoor air pollution and exposure to asthma triggers and allergens.
- CDC has helped develop a training curriculum targeting environmental public health workers and housing professionals via the National Healthy Homes Training Center and Network.
- They have partnered with Boston Public Health Commission and housing providers, with funding from HUD, to remove hazards from children's homes -- improving ventilation, pulling up carpets, pest control.
- For many low income families the "best medical intervention I can offer them is better housing. Often, medication only treats the symptoms of disease and not the underlying problem...but by only treating with medication, we're just putting a Band-Aid on the wound."

The American Lung Association of Minnesota has created a program to better connect housing and public health. [104]

- Program identifies children from limited-income families who have moderate to severe asthma through referrals; appoints a team to conduct an environmental assessment.
- The team, made up of an asthma educator and public health inspector, examines the home for asthma triggers and makes modifications for free.
- Many modifications are simple, such as covering bedding in allergy-free encasements, and some are more complicated, such as structural renovations to remove mold from under a kitchen sink.
- Preliminary data is showing decreases in hospitalizations, emergency room visits, unscheduled physician visits and school absences. And, the cost of modifications averages half that of an emergency room visit.

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THE NEED FOR COALITIONS

Coalitions are a powerful way to control asthma. They bring together all the stakeholders addressing the problem, including individual practitioners, clinics, public health agencies, hospitals, health care plans, schools, parents, child-care providers, housing and environmental organizations, researchers and community-based organizations. [105]

Combined clinical and public health approaches are necessary to control asthma. [105]

- o No single professional can provide the necessary level of medical care, care coordination, legal services, family support, and advocacy that overburdened families require.
- o Solving the problem of housing-related asthma triggers is the best example -- it requires collaboration from all service providers who have relationships with families to support the needed changes.
- o To build community and institutional support, professionals must know what others offer and what families are doing.

The use of coalitions has been proven to be an effective way to improve the management of complex chronic diseases like asthma, in which efforts are often fragmented. [105]

Support for smoke-free initiatives is important -- can lead to reduced ETS exposure.

Two models of coalitions provide great examples:

- o The Allies Against Asthma coalitions for community action, and
- o The Chronic Care Model that can be used in individual practices.

Allies Against Asthma

A group of 7 coalitions established to lead the integration of asthma control. Their activities include the use of community health workers (CHWs) and nurses for care coordination, program cross-referral, and clinical quality improvement. [106-108]

- o Work together and independently, to identify various aspects of inefficient, inconsistent, and/or fragmented care in their communities, and they have led efforts to improve the quality of care and promote change in the system of care.
- o Use an interdisciplinary collaborative approach to design strategies and have demonstrated a range of interventions that have led to coordinated improvements in asthma management.
- o Have implemented a broad range of activities to reduce or remediate indoor exposure to asthma environmental triggers for children with asthma including education and trigger remediation, physician and other health care provider education, and policy efforts to improve air quality in homes and schools. [109]

The community health worker (CHW) program is a key part of each coalition's community action plan. It fills a vital gap in education and outreach to community members in their homes. [110]

- o Using an asthma action plan, CHWs function as extensions of and links to clinicians, providing basic education and care coordination in a supportive, family-friendly setting, context, and location.
- o They rely heavily on relationship building and family empowerment to assist families in improving asthma control. The coalition framework helps integrate the CHW program into other services and resources in the community.

Health care providers play a key role in promoting and participating in coalition activities.

- Barriers to participation include lack of time, concern about coalition effectiveness, and unfamiliarity with community-based approaches to health issues. [111]
- Despite this, coalitions have been successful at involving health care providers through presentations showing the need for improved asthma care, identification of clinicians involved in caring for children with uncontrolled asthma, and education regarding the benefits of participation. [111]

Providers report that their participation in asthma coalitions helps them develop collaborative relationships with other agencies, increases their professional knowledge and skills in asthma management, and improves access to priority populations. [111]

Allies Against Asthma websites:

<http://www.asthma.umich.edu/>

The official site -- Includes the Asthma Health Outcomes Project, a range of documents to support those developing and implementing asthma programs:

<http://aaa.sph.umich.edu/index.jsp>

The Allies Against Asthma Resource Bank -- a centralized database for sharing information about resources, tools and materials that may be useful to coalitions and community programs addressing asthma, including:

- 1) Materials to educate individuals about asthma,
- 2) Resources to help implement asthma intervention programs,
- 3) Evaluation/survey instruments to measure asthma-related activities or outcomes,
- 4) Materials to assist community coalition efforts.

The Chronic Care Model

The Chronic Care Model, developed at Group Health Cooperative in Seattle offers a transdisciplinary, systemic approach to high-quality care for patients with any chronic disease, including asthma. [112]

- The model consists of six elements: (a) the community, (b) the health system, (c) delivery system design, (d) decision support, (e) clinical information systems, and (f) self-management support. [113]

Self-management support is the central component

- It involves a strategy to empower and prepare families to take on the management of their child's asthma -- education, offering self-management options, setting goals, ongoing support, problem-solving, and follow-up. [113]

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MODEL FOR BUILDING COLLABORATIONS FROM THE MEDICAL OFFICE

The Chronic Care Model can be used to develop partnerships with families to improve control of indoor triggers. [114]

- Collaborations are enhanced through the use of an asthma tool card that serves as a reminder of the overall goal -- control of indoor environmental triggers.
- The more the patient/family hear the message about trigger control, the more likely they are to take action.
- Teachers, home visitors, health-care workers, lawyers, etc can use this tool card to provide families with constant educational reminders about ways to reduce indoor asthma triggers.
- It fosters communication between professionals across disciplines.

EXAMPLE OF A REMINDER CARD THAT COULD BE USED:

Goal: Work together to improve environmental control of the indoor air environment to reduce asthma triggers.

Questions to Assess Environment:

(Reminder: Think of a child in more than one environment on any given day.)

- a. Where does the child spend time, in what settings, and with whom?
- b. Are there changes that can be made in any of these places?
- c. What are the families' beliefs and values in relation to the needed changes?
- d. What kind of assistance does the family/caregiver need to improve the environment?

Suggestions to Assist Family/Caregivers:

- The Asthma Management Team can review and monitor self-management techniques.
- Home visits may complete and monitor environmental assessment.
- Use pictographs to explain location and control of asthma triggers.
- Document trigger management plan as part of overall case management.
- Communicate with asthma educator (or person in that role) of any changes, special needs

Stress the Three Cs of What to Do:

- 1. Cover** -- Cover bedding and food.
- 2. Clear** -- Clear the air of environmental tobacco smoke, rugs, and stuffed animals.
- 3. Clean** -- Clean the home environment regularly, especially bedding, toys, and areas where mold, dust mites, and pet dander can accumulate.

Keep in Mind the Three Cs of How to Implement Indoor Air Trigger Plans:

- 4. Collaboration** -- Work in partnership with families and community agencies. Recognize and solicit their knowledge and experience
- 5. Cultural and Linguistic Competency** -- Learn about the values, beliefs and the social context of the family in a nonjudgmental way. Ask about cultural, social, and financial barriers to implementing changes. Provide information in the language and formats preferred by families. Use trained interpreters appropriately. Document cultural beliefs and practices to impact case management.
- 6. Community Connections** -- Identify and partner with resources in the community.

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TRIGGER REDUCTION STRATEGIES

FROM THE EXPERT PANEL REPORT AND THE EPA [115, 116]

Need to Reduce Exposure

The first and most important step in controlling indoor triggers is to reduce exposure.

Animal dander:

- Remove animal from house or, at a minimum, keep animal out of patient's bedroom and seal or cover with a filter air ducts that lead to bedroom.
- Weekly washing of the pet may help, as well as keeping pet off upholstered furniture and out of carpeted rooms.
- Vacuum carpets, rugs and furniture two or more times per week.

House-dust mites:

- **Essential:** Encase mattress in an allergen-impermeable cover; encase pillow in an allergen-impermeable cover or wash it weekly; wash sheets and blankets on the patient's bed in hot water weekly (water temperature of > 130 °F is necessary for killing mites).
- **Desirable:** Reduce indoor humidity to less than 50%; remove carpets from the bedroom; avoid sleeping or lying on upholstered furniture; remove carpets that are laid on concrete; minimize stuffed toys and wash weekly in hot water.
- Remove dust often with a damp cloth; vacuum carpet and fabric-covered furniture often to reduce dust build-up (vacuums with high efficiency filters or central vacuums may be helpful); people with asthma should not be present when vacuuming.

Cockroaches:

- Remove places in your home where pests can hide; seal cracks or openings around or inside cabinets.
- Try using poison baits, boric acid or traps first before using pesticide sprays.
- Do not leave food or garbage exposed; clean all food crumbs or spilled liquids right away; wash dishes promptly; keep counters, sinks, tables and floors clean and clear of clutter.
- Store food in airtight containers.
- Store trash in containers with lids that close securely, and remove trash daily; remove piles of boxes, newspapers and other hiding places for pests from your home.

Indoor mold:

- Need to not only remove mold, but also eliminate sources of moisture -- fix leaky plumbing and eliminate sources of moisture associated with mold growth
- Clean moldy surfaces -- wash mold off hard surfaces and dry completely; absorbent materials, such as ceiling tiles and carpet, may have to be replaced.
- Reduce indoor humidity to less than 50%; humidity can be measured by hygrometers which are available at local hardware stores.
- Keep drip pans in air conditioner, refrigerator and dehumidifier clean and dry.
- Use exhaust fans or open windows in kitchens and bathrooms when showering, cooking or using the dishwasher; vent clothes dryers to the outside.

Tobacco Smoke:

- Choose not to smoke in your home or car and don't allow others to do so. Limit visits to areas where smoking occurs.

Nitrogen Dioxide:

- Properly ventilate rooms where fuel-burning appliance is used; vent to the outside if possible.
- Have heating system -- including furnace, flues and chimneys -- professionally inspected and cleaned annually.

- Open the flue on your fireplace before lighting to ensure that smoke escapes through the chimney; make sure doors are tight fitting on wood-burning stove; follow manufacturer's directions for starting, stoking and putting out the fire.
- Follow the manufacturer's directions for proper fuel use on unvented kerosene or gas space heaters; keep heater properly adjusted; open a window slightly or use an exhaust fan in the room while using the heater.
- Install and use an exhaust fan over a gas stove and vent it outdoors.

Monitor effectiveness of interventions:

- Simple things like rescue medication use, peak flow readings - or (for severe cases) acute / emergency care visits - can provide powerful feedback to the patient / family / caregivers that the effort is paying off.
- Lack of response or worsening can indicate need for additional intervention.

115. *National Asthma Education and Prevention Program, Clinical Practice Guidelines Expert Panel Report 2: Guidelines for the Diagnosis and Management of Asthma* NIH, NHLBI, NIH Public No. 97-4051 Jul 1997
<http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf>

116. EPA: <http://www.noattacks.org>

INDOOR TRIGGER ASSESSMENTS (Examples)

For Home Visits: EPA Asthma Home Environment Checklist [117]

- The EPA provides a checklist designed for home visits -- provides a list of questions with action steps for each positive response:

QUESTIONS TO ASK:

- What type of building do you live in?
- Own or rent?
- Anyone smoke in house or car?
- Does asthma seem to get worse around a cat or dog (or other warm-blooded pet)?
- Does asthma seem to get worse around chemicals or products with strong odors (cleaners, air fresheners, paints, adhesives, cosmetics, etc)
- Does the heating or cooling system use filters?
- Does the heating system burn fuel (such as gas or oil)?
- Use any other heating sources (i.e., wood burning stove or fireplace, unvented kerosene or gas space heater)
- Air conditioning window unit?
- What does child with asthma sleep on? (mattress, couch, etc)
- Type of bedding used? (blankets, sheets, pillows, comforter, sleeping bag, bedspread, etc)
- Type of flooring present?
- Upholstered furniture present?
- Stuffed toys around?
- Type of window coverings used?
- Gas cook stove used?
- Any water damage, leaks, moisture problems?
- Smell mold or mildew anywhere, esp bathrooms?
- Any standing water present in house anywhere?
- Use a humidifier in house?
- Are all appliances (stoves, dishwasher, washing machine, clothes dryer) vented?
- Bathrooms vented?
- Any sign of cockroaches or rodents (eg, droppings, caught in trap, etc)?
- Any food crumbs or unsealed food around?
- Any holes or gaps around exterior of house (esp pipes) that could allow rodents in?

117.

http://permanent.access.gpo.gov/websites/epagov/www.epa.gov/asthma/images/home_environment_checklist.pdf

Environmental History Form for Pediatric Asthma Patient [118]

- o From National Environmental Education and Training Foundation (NEETF)
- o Specify that questions related to the child's home also apply to other indoor environments where the child spends time, including school, daycare, car, school bus, work, and recreational facilities.

Follow up/ Notes

| | |
|---|--------------------|
| Is your child's asthma worse at night? | Yes /No / Not sure |
| Is your child's asthma worse at specific locations? If so, where? _____ | Yes /No / Not sure |
| Is your child's asthma worse during a particular season? If so, which one? _____ | Yes /No / Not sure |
| Is your child's asthma worse with a particular change in climate? If so, which? _____ | Yes /No / Not sure |
| Can you identify any specific trigger(s) that makes your child's asthma worse? If so, what? _____ | Yes /No / Not sure |
| Have you noticed whether dust exposure makes your child's asthma worse? | Yes /No / Not sure |
| Does your child sleep with stuffed animals? | Yes /No / Not sure |
| Is there wall-to-wall carpet in your child's bedroom? | Yes /No / Not sure |
| Have you used any means for dust mite control? If so, which ones? _____ | Yes /No / Not sure |
| Do you have any furry pets? | Yes /No / Not sure |
| Do you see evidence of rats or mice in your home weekly? | Yes /No / Not sure |
| Do you see cockroaches in your home daily? | Yes /No / Not sure |
| Do any family members, caregivers or friends smoke? | Yes /No / Not sure |
| Does this person(s) have an interest or desire to quit? | Yes /No / Not sure |
| Does your child/teenager smoke? | Yes /No / Not sure |
| Do you see or smell mold/mildew in your home? | Yes /No / Not sure |
| Is there evidence of water damage in your home? | Yes /No / Not sure |
| Do you use a humidifier or swamp cooler? | Yes /No / Not sure |
| Have you had new carpets, paint, floor refinishing, or other changes at your house in the past year? | Yes /No / Not sure |
| Does your child or another family member have a hobby that uses materials that are toxic or give off fumes? | Yes /No / Not sure |
| Do you use a wood burning fireplace or stove? | Yes /No / Not sure |
| Do you use unvented appliances such as a gas stove for heating your home? | Yes /No / Not sure |
| Does your child have contact with other irritants (e.g., perfumes, cleaning agents, or sprays)? | Yes /No / Not sure |
| What other concerns do you have regarding your child's asthma that have not yet been discussed? | |

118. <http://www.neefusa.org/health/AsthmaHistoryForm.doc>

RESOURCES

Coalitions:

A site that profiles several community coalition approaches around the country:

- http://www.pediatricasthma.org/community_coalitions

EPA Resources:

- General Trigger control - <http://www.noattacks.org/> [1-866-NO-ATTACKS]
- Indoor Environments Program - www.epa.gov/iaq
- Indoor Air Quality Publications - www.epa.gov/iaq/pubs
- Biological Pollutants - www.epa.gov/iaq/biologic.html
- Asthma and Indoor Environments - Publications and Resources - <http://www.epa.gov/asthma/publications.html>
- Asthma and Indoor Environments - Health Care Professionals - <http://www.epa.gov/asthma/hcprofessionals.html>

Intervention programs, see the following:

EPA Asthma Program --

- <http://www.epa.gov/iaq/asthma>

Children's Hospital Philadelphia, Asthma In-Home Intervention --

- <http://www.epa.gov/asthma/pdfs/chop.pdf>

PATIENT HANDOUTS

A variety of patient education materials available from a number of organizations are available at:

http://www.neetf.org/Health/asthma_resources.htm

A good simple one-page handout from the EPA:

- "Clearing the Air of Asthma Triggers -- Tens Steps to Making Your Home Asthma Friendly"

http://www.epa.gov/iaq/asthma/pdfs/10_steps_en.pdf

A two-page handout from the National Asthma Education and Prevention Program:

- "How to Control Things That Make Your Asthma Worse"

<http://www.nhlbi.nih.gov/health/prof/lung/asthma/practgde/practgde.pdf>

From the NIH -- Information about asthma:

- "Facts about Asthma"

http://www.nhlbi.nih.gov/health/dci/Diseases/Asthma/Asthma_WhatIs.html

Specific issues

Schools:

- [National Asthma Education and Prevention Program Resolution on Asthma Management at School](#)
- [Asthma and Physical Activity in the School](#)
- [How Asthma-Friendly Is Your School?](#)

Child care facilities:

- [How Asthma-Friendly Is Your Child-Care Setting?](#)

Dust Mites:

- <http://www.niehs.nih.gov/airborne/prevent/mites.html>

Pets:

- <http://www.niehs.nih.gov/airborne/prevent/pets.html>

Cockroaches:

- <http://www.niehs.nih.gov/airborne/prevent/roach.html>

Mold:

- <http://www.niehs.nih.gov/airborne/prevent/mold.html>

Smoking:

- <http://www.niehs.nih.gov/airborne/prevent/smoke.html>

FOR HEALTH CARE PROVIDERS

GUIDELINES:

National Asthma Education and Prevention Program, Clinical Practice Guidelines Expert Panel Report 2: Guidelines for the Diagnosis and Management of Asthma NIH, NHLBI, NIH Public No. 97-4051 Jul 1997

See: Component 2 Control Of Factors Contributing To Asthma Severity

- <http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf>

Pediatric Asthma: Promoting Best Practice – Guide for Managing Asthma in Children.

American Academy Of Allergy, Asthma and Immunology

- <http://www.aaaai.org/members/resources/initiatives/pediatricasthmaguidelines/default.stm>

Guidelines for Health Care Providers -- Environmental Management of Pediatric Asthma.

The National Environmental Education & Training Foundation, August 2005

- http://www.neefusa.org/health/Asthma_Guidelines.pdf
- 6 competencies that HCP need to develop to manage environmental triggers

BOOK:

American Academy of Pediatrics Handbook of Pediatric Environmental Health

- www.aap.org/bst
- Comprehensive handbook written for pediatricians.

ASSESSMENT:

U.S. Environmental Protection Agency. Asthma Home Environment Checklist. February 2004. Publication EPA 402-F-03-030. Available at:

- <http://permanent.access.gpo.gov/websites/epagov/www.epa.gov/asthma/resources.html>

Children's Hospital Philadelphia, Asthma In-Home Intervention (includes an assessment)

- <http://www.epa.gov/asthma/pdfs/chop.pdf>

CME Course:

American Academy of Allergy, Asthma and Immunology. Online course on the Environmental management of asthma. Available at:

- http://www.aaaai.org/members/cme_ce/environmental_management/notice.asp

Association of Clinicians for the Underserved -- <http://www.clinicians.org>

- CME program information -- http://www.clinicians.org/programsandservices/asthma/asthma_brochure.doc

ORGANIZATIONS:

National Institute of Environmental Health Sciences. Asthma and Allergy Prevention:

- <http://www.niehs.nih.gov/airborne/prevent/alert.html>

National Environmental and Training Association -- Resources for Environmental Management of Pediatric Asthma

- 16 pages of links to various documents, broken down into searchable topics
- For HCP: Federal government, non-government associations, medical organizations, clinical practice guidelines, books, manuals, presentations
- For patients: general info and info on individual triggers; also includes info on outdoor triggers
- <http://www.neefusa.org/health/AsthmaResources.pdf>

American Academy of Allergy, Asthma and Immunology -- www.aaaai.org

American Academy of Pediatrics -- www.aap.org

American College of Allergy, Asthma, and Immunology -- www.aaai.org

American Lung Association -- www.lungusa.org

Kaiser Permanente -- www.kaiserpermanente.org

National Asthma Education and Prevention Program -- <http://www.nhlbi.nih.gov/about/naepp/>

Association of Clinicians for the Underserved -- <http://www.clinicians.org>

FOR PRODUCTS TO REDUCE EXPOSURE TO ALLERGENS

- For information about companies that distribute products to help reduce allergen exposure, contact the Asthma and Allergy Foundation of America at 800-727-8462 or the Allergy and Asthma Network/Mothers of Asthmatics at 800-878-4403.