

CATCHING YOUR BREATH:

Strategies to Reduce Environmental Factors
that Contribute to Asthma in Children

A Report from the Working Group of Representatives
from State Health and Environmental Agencies



ASSOCIATION OF STATE AND
TERRITORIAL HEALTH OFFICIALS

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ECOS
444 N. Capitol Street NW, Suite 445
Washington, DC 20001
Phone: 202.624.3660

ASTHO
1275 K Street NW, Suite 800
Washington, DC 20005
Phone: 202.371.9090

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Members of the Working Group of Representatives from State Health and Environmental Agencies

- **Henry Anderson, MD**, Chief Medical Officer, Wisconsin Department of Health and Family Services
- **Wayne Ball, PhD**, Program Manager, Environmental Epidemiology Program, Utah Department of Public Health
- **Leslie Best**, Director, Division of Health Risk Reduction, Pennsylvania Department of Health
- **Michele Brown, JD**, former Commissioner, Alaska Department of Environmental Conservation
- **Amanda Burkett**, Chief, Indoor Environments Section, Ohio Department of Health
- **Mercita Clelan**, Program Development Manager, Pennsylvania Department of Health
- **Carmine DiBattista**, Chief, Air Management Bureau, Connecticut Department of Environmental Protection
- **Maureen Edwards, MD MPH**, Medical Director, Center of Maternal and Child Health, Maryland Department of Health and Mental Hygiene
- **Monty Elder, MS REHP**, Environmental Program Manager, Oklahoma Department of Environmental Quality
- **Marie Erickson**, Nurse Consultant, Maryland Department of Health and Mental Hygiene
- **Mary Lou Fleissner, DrPH**, Director, Environmental Epidemiology and Occupational Health, Connecticut Department of Public Health
- **Andrea Hoffman, MPA LBSW**, Iowa Asthma Control Program Coordinator, Iowa Department of Public Health
- **Tamara Johnson**, Children's Environmental Health Coordinator, Indiana Department of Environmental Management
- **Lori Kaplan, JD**, Commissioner, Indiana Department of Environmental Management
- **Robert King**, Assistant Deputy Commissioner, South Carolina Department of Health and Environmental Control
- **Daniel Luttinger, PhD MBA**, Chief, Toxicological Assessment Section, New York Department of Health
- **Dale Morse, MD MS**, Director, Office of Science and Public Health, New York Department of Health
- **Karen Pearson, MS**, former Director, Public Health Division, Alaska Department of Health and Social Services
- **Claire H. Prince, JD**, Program Manager, South Carolina Department of Health and Environmental Control
- **Kristin Ryan**, Director, Environmental Health Division, Alaska Department of Environmental Conservation
- **Lynn Schuster, RN BSN MSN FNP**, Director, School Health, Tennessee Department of Health
- **Peter Simon, MD MPH**, Assistant Medical Director, Rhode Island Department of Health
- **Paula Smith**, Director, Planning and Assessment Office, Indiana Department of Environmental Management
- **Nancy Sutley**, Deputy Secretary for Policy and Intergovernmental Relations, California Environmental Protection Agency
- **Richard Valentinetti**, Director, Air Quality Division, Vermont Agency of Natural Resources
- **William Vance, PhD**, Assistant Secretary for Children's Environmental Health, California Environmental Protection Agency
- **Jean Woodward**, Asthma Coordinator, Bureau of Environmental Health and Safety, Idaho Division of Health
- **Robert Zimmerman**, Director of Strategic Initiatives, Office of the Secretary, Delaware Department of Natural Resources and Environmental Control

ECOS Staff

- **A. Christine Eppstein, LL.B LL.M**, Senior Project Manager

ASTHO Staff

- **Patricia I. Elliott, JD MPH**, Senior Director, Environmental Health Policy
- **Becky Smullin, MPH**, Analyst, Environmental Health Policy

Project Technical Consultant and Facilitator

- **Amy D. Kyle, PhD MPH**, Consulting Scientist

About ECOS and ASTHO

Environmental Council of the States (ECOS)

The Environmental Council of the States (ECOS) is the national non-profit, non-partisan association of state and territorial environmental commissioners, who are responsible at the state level for managing implementation of environmental programs delegated to them under federal statutes by the U.S. Environmental Protection Agency (EPA). ECOS seeks to improve the environment of the United States by providing for the exchange of ideas, views and experiences among states, fostering cooperation and coordination in environmental management, and articulating state positions to Congress and EPA on environmental issues. This mission is advanced through an established network of committees, forums and work groups – all led by state commissioners – and often by working in coalition with other groups to advocate on behalf of the states on environmental matters. Currently, 50 states and territories are ECOS members.

Association of State and Territorial Health Officials (ASTHO)

The Association of State and Territorial Health Officials (ASTHO) is a national non-profit organization representing the state and territorial public health agencies in the United States, U.S. Territories, and the District of Columbia. ASTHO's members, the chief health officials of these jurisdictions, are dedicated to formulating and influencing sound public health policy, and to assuring excellence in state-based public health practice. ASTHO, a national 501(c)(3) membership organization, was incorporated in 1942 as a public health and policy-making resource for its members, Congress, the Administration, national organizations, and the general public. Members provide leadership in the development and coordination of public health policy; they are poised to affect change and reform in public health policy, on the state, national, and local levels.

Table of Contents

Executive Summary.....	5
Introduction	6
Vision Statement and Goals	8
Action Agenda.....	9
1. Enhancing Coordination and Joint Action	9
2. Actions and Practices to Reduce Environmental Factors that Contribute to Childhood Asthma in Homes.....	11
3. Actions and Practices to Reduce Environmental Factors that Contribute to Asthma in Schools and Childcare Centers.....	14
4. Actions and Practices to Reduce Outdoor Environmental Factors that Contribute to Asthma.....	17
5. Collection, Use and Integration of Health and Environmental Data	20
6. Research.....	23
Next Steps.....	24
References Cited	25
Appendix I: Workshop Presenters.....	29
Appendix II: Registered Workshop Participants.....	32

Executive Summary

Asthma is a major public health problem of increasing importance to state health and environmental agencies. Nearly one in 13 children in the United States has asthma, making it the most common chronic disease among children. Low-income populations, minorities, and individuals living in urban areas appear to be at greatest risk for developing asthma. Asthma affects children and their families: disrupting daily routines, limiting activities, and interrupting sleep. The economic cost of asthma is enormous. In 2000, an estimated \$12.7 billion was spent on asthma in the United States.

Although the cause of asthma in children is uncertain, environmental factors are thought to contribute to the development of asthma or to trigger attacks. Indoor environmental factors include allergens produced by dust mites; cockroaches; fungi (including mold) and dampness; animal dander, environmental tobacco smoke, and indoor pollutants including building products and combustion byproducts. Outdoor environmental factors of concern include ozone, particulate matter, sulfur dioxide, nitrogen dioxide, diesel particulates, traffic-related pollution, hazardous air pollutants, pollen, and fungi (including mold).

Project Description

The *Catching Your Breath* report contains a vision statement and action agenda that were developed by over 250 representatives of state health and environmental agencies to identify steps states can take to address asthma in children in indoor home environments, schools and childcare facilities, and outdoor environments. Although the focus of this document is on environmental factors that contribute to asthma in children, it is also critical to ensure that every child has medical care and active support to manage their asthma.

This project was sponsored by the Environmental Council of the States (ECOS) in cooperation with the Association of State and Territorial Health Officials (ASTHO) and the State of Alaska. Funding was provided by the U.S. Environmental Protection Agency's (EPA) Offices of Children's Health Protection and Air and Radiation, and the Centers for

Disease Control and Prevention's (CDC) National Center for Environmental Health.

Summary of Recommended Strategies

To ensure that asthma poses no barriers to a healthy and active life for every child, state health and environmental agencies need to work collaboratively to address environmental factors that contribute to asthma in children. As a general principle, to improve the environmental health status of children, more attention is needed on the environments where children congregate, such as homes, schools, and childcare facilities. Design, maintenance, and cleaning of buildings are important, as are strategies that reduce outdoor pollutants such as diesel exhaust and air pollution. Additionally, states could help create focused research strategies to better elucidate the relationships between environmental factors and childhood asthma and to identify the most effective interventions.

The report identifies six areas of opportunity for state action, compiled into an action agenda. This document is intended to serve as a menu or blueprint for state action to decrease environmental factors that contribute to asthma in children. The areas for action are:

- Enhancing coordination and joint action of health and environmental agencies
- Reducing environmental asthma factors in homes
- Reducing environmental asthma factors in schools and childcare centers
- Reducing outdoor environmental asthma factors
- Collecting, using, and integrating health and environmental data
- Continuing research into causes, triggers, and effective asthma control strategies.

Introduction

This report contains a vision statement and action agenda developed by representatives of state health agencies and state environmental agencies to identify steps that states can take to address indoor and outdoor environmental factors that contribute to asthma in children.

The process began at the first national meeting of health and environmental agencies in San Diego on August 7-8, 2001, and continued through a series of four workshops held between May and October 2002. About 250 individuals participated in this process, including representatives of 40 state health and environmental agencies, as well as several federal agencies, non-governmental organizations, academic institutions, and other groups. This project was sponsored by the Environmental Council of the States (ECOS) in cooperation with the Association of State and Territorial Health Officials (ASTHO) and the State of Alaska with funding assistance from the United States Environmental Protection Agency and the Centers for Disease Control and Prevention.

The purpose of this document is to identify steps that state health agencies and state environmental agencies can take to reduce indoor and outdoor environmental factors that contribute to asthma in children. This agenda is intended to provide a blueprint consisting of concrete, workable actions to produce results. It presents the results of a state-initiated process to generate a unified agenda. It also includes recommendations to federal funding agencies and partners.

All states face constraints on resources and have differing needs and concerns. This document is intended to describe fruitful areas for action and not to bind states to

specific commitments. Some states may address some areas while other states emphasize others.

While children are the focus of this strategy document, asthma is also a very important disease for adults. The strategies identified in this document will also reduce environmental factors that contribute to asthma in adults.



Next Steps

This report was produced by a working group of representatives from state health and environmental agencies organized through a cooperative project by ECOS and ASTHO. It is being made available for states to use in developing their asthma prevention and control programs. It will undergo further review and discussion within the larger memberships of ECOS and ASTHO and may, in some form, be considered for formal action by those organizations in the future. At this point, the report represents the views and conclusions of the working group.

The action agenda also includes recommendations for actions that ECOS and ASTHO can take to advance the action agenda and to enhance coordination and cooperation between environmental and health agencies. Members of the working

group expect to present the components of the action agenda at relevant meetings and forums.

Asthma in Children in the United States

Asthma is a priority for attention because it is the most common chronic disease in children [1] and because it has been steadily increasing. In the United States, nearly one in 13 children has asthma [2]. In 2001, the Centers for Disease Control (CDC) reported that 6.3 million children under age 17 had asthma [3]. In 2001, 4.2 million children had experienced an asthma attack during the previous year [3]. Children in urban areas appear to be at the greatest risk [4]. Children ages five to 14 are at the greatest risk of any age group for asthma. Asthma affects children and their families by interrupting sleep, limiting activity, and disrupting routines [2].

The cost of asthma is enormous, estimated in 2000 to be \$12.7 billion for the United States [5]. Asthma is responsible for about 1% of expenditures for health care in the United States [6].

Indoor environmental factors are thought to contribute to the development of asthma or to trigger attacks [7]. These include allergens produced by dust mites [8-11]; cockroaches [11-13]; fungi (including molds) and dampness [14-17]; animal dander [9, 11], environmental tobacco smoke [11, 18, 19]; and indoor pollutants including building products [20, 21] and combustion byproducts.

Outdoor air pollutants and biological agents also contribute to asthma. Outdoor environmental factors of concern include ozone, particulate matter, sulfur dioxide, nitrogen dioxide [22-25], diesel particulates [26, 27], traffic-related pollution [28], and hazardous air pollutants [29]. Biological agents of concern include pollen and fungi (including mold).

It is not certain what causes the onset of asthma in the first place, though genetics may predispose an individual to asthma. Different researchers have come to different conclusions [30-32]. Environmental factors may contribute to the onset of asthma, probably in conjunction with genetic factors [33-36]. Because the triggers are better understood than the causes, much of the focus is on the reduction of exposure to triggers. However, the ultimate goal is primary prevention and reduction in the development of asthma in the first place.

The cost of asthma was \$12.7 billion in 2000.

Vision Statement and Goals

Vision Statement

Ensure that asthma poses no barriers to a healthy and active life for every child.

Commitments from state agencies responsible for health and environmental protection are required for the identification and implementation of actions to address environmental factors that contribute to disease. This document identifies ways that state environmental and health agencies can work together specifically with regard to environmental factors that contribute to asthma in children. The need for such cooperation and engagement extends to all areas of environmental health. The participants recognize that agencies with responsibilities for education, housing, energy, and transportation also play an important role.

This document focuses on environmental factors that contribute to asthma in children. This is the joint purview of the health and environmental agencies. However, it is also critical to ensure that every child has the medical care and active support to manage their asthma, and it is important and appropriate that many organizations and agencies are focusing on these issues.

As a general principle, to improve the environmental health status of children, more attention must be paid to the environment in places where children congregate. As the field of occupational health and safety addresses places where workers congregate, a similar focus needs to be brought to the places where children congregate. Schools and childcare centers might be considered to be the workplaces of children. Planning and management for such areas should integrate environmental quality

as a key component. The venues where children spend their time need to be specifically recognized and addressed when environmental exposures and risks are assessed.

It is a critical priority in this strategy, as in other contexts, to address significant disparities in severity and prevalence in asthma between racial/ethnic and income groups.

Goals

- A.** Develop the means to enhance coordination between health and environmental agencies and other partners. Promote communication, joint action, and sharing of resources between individuals, organizations, and agencies.
- B.** Identify the spectrum of individuals, organizations, and agencies that can improve the health of children by reducing indoor and outdoor environmental factors that contribute to asthma; educate them on best practices and methods, using culturally competent approaches and strategies. Educate the public about the significance of the problem.
- C.** Reduce or eliminate the exposure of children to factors that contribute to asthma in indoor and outdoor environments.
- D.** Establish systems to analyze and track the burden of asthma, as well as environmental factors that contribute to asthma.
- E.** Support continued research to determine the causes and triggers of childhood asthma and to identify effective ways to reduce them.

Action Agenda

The working group of state health agencies and state environmental agencies has identified opportunities for state actions and recommendations for actions by ECOS, ASTHO, the U.S. Environmental Protection Agency (EPA), and the Centers for Disease Control and Prevention (CDC). This agenda covers the six areas noted below and offers recommendations for future steps:

1. Enhance coordination and joint activities
2. Actions and practices for homes
3. Actions and practices for schools and childcare centers
4. Actions and practices for outdoor environments
5. Collection, use, and integration of data
6. Research

1. Enhance Coordination and Joint Activities

Introduction

In many states, responsibilities for health and for environment are vested in different agencies. Even in states where health and environment authorities are in the same organization, differences in background, training, interest, vocabulary, and priorities can make it difficult to achieve effective cooperation and joint action. People are busy. Cooperation and coordination do not occur without some impetus. It is important to understand and overcome such barriers to achieve the best results for the environment and health. Agencies need joint projects and agendas and a willingness to engage. It can

help to pick specific topics and actions to work on and get started.

Integration requires an equal commitment from both parties. Venues for meetings by commissioners provided by ECOS and ASTHO are helpful. A parallel process is needed in individual states.

Reducing indoor and outdoor environmental factors that contribute to asthma in children will require engagements of a wide array of partners. Health, environment, education, housing, transportation, and energy sectors are all needed to contribute to solutions. Action is needed at many levels including the individual, family, neighborhood, school district, county, state, and nation. Participation of territories and tribes will also be important.

Strategies should be geared towards building support in state governments. Combined efforts of health and environmental agencies and constituencies could be more effective than individual efforts. Other communities may also be engaged, including, for example, labor and business.

The demands placed on health and environmental agencies can be expected to continue to grow in complexity as environmental health tracking receives more emphasis and as more individuals, communities and groups seek answers to questions about relationships between the environment and disease. It may be informative to more fully investigate the impetus among community groups toward health tracking and the interest in better investigation of clusters. Some of this arises from a perception that only limited information is provided to the public and that agencies are not completely forthcoming. In addition to tracking, there

may be ways to provide information that are informative and helpful to the public through other means. Improving risk communication skills may be one such area. Consideration of how to address cumulative impacts is another area where additional partners or authorities are needed.



In some states, environmental agencies may have difficulty gaining attention of health agencies. In other states, the reverse may be true. Attention may be enhanced through times of crisis, though even this can lead to useful results that last over a longer term. Capacity building and training is needed in some states, and federal support in both the health and environmental sectors is important. Capacity building is needed for tracking as well. Recent federal initiatives to enhance coordination between EPA and CDC are very positive steps and should be expanded to allow for better coordination of funding to states. ASTHO and ECOS could help by sponsoring or providing a forum for discussions on how to integrate programs. Such issues might appropriately be addressed in agency strategic plans.

Environmental agencies and health agencies can learn from each other's strengths. Some agencies have greater experience and

capacity in working with communities. Problem solving can be limited by a solely regulatory focus. To some extent this can be addressed by taking different approaches within current regulatory and programmatic limits. However, highly prescriptive elements of federal mandates can create obstacles.

Obtaining expertise on how to understand community concerns and ways in which to address them can be helpful. Community relations and risk communication issues are difficult. Environmental concerns from communities' perspectives are broader and not limited by the jurisdiction of agencies. People may be concerned about all aspects of their environments, not just the ones for which agencies have regulations.

Some agencies have more of a research focus and need to think more about how to practically apply and use the information they collect. Some agencies have a practice and tradition of making all data available to the public, while others view theirs as proprietary. These important differences and perspectives need to be addressed.

Action Agenda Elements

A. ECOS and ASTHO should promote continued exchange between health and environmental agencies.

- ECOS and ASTHO should continue to work on bridging gaps between environmental and health agencies.
- ECOS and ASTHO should promote continued and expanded information exchange and engagement between state health agencies and state environmental agencies (and their federal counterparts).
- ECOS and ASTHO should develop more formal and on-going ways to foster information exchange and develop strategies for joint action.

- ECOS and ASTHO should play a role in organizing the states to participate in the discussions about the direction of environmental public health tracking and developing a national framework.
- ECOS and ASTHO should select another topic area that spans the interests and authorities of state health and environmental agencies, in conjunction with the states, and replicate the development of a state-initiated and state-led agendas to address that topic .
- ECOS and ASTHO should continue to work with state health and environmental agencies to develop a national network for environmental public health tracking, and develop a strategy to make use of available tracking technology to produce worthwhile results.
- ECOS and ASTHO should hold a conference after 12 to 18 months to assess progress on implementing the action agenda; to take advantage of opportunities to promote reduction of environmental factors that contribute to asthma in children; and to provide an opportunity for state health and environmental agencies to meet.

Education, outreach, and training across disciplines are needed to address healthy indoor environments.

B. States should foster communication.

State health and environmental agencies should foster communication between health and environment in each state. Agencies should take advantage of opportunities presented by recent Environmental Public Health Tracking initiatives to define approaches to track and appropriately link environmental factors and related health outcomes in ways that are informative to the

public and to public policy. The topic of asthma and children should be identified as a priority. Other opportunities to foster communication may also be beneficial.

C. The State Working Group recommends that CDC and EPA take the following actions:

Sponsor regional meetings for health and environmental agencies to promote communication and coordination, as noted in the previous item.

Design funding programs and instruments to make it easier for and, in fact to encourage, state health agencies and environmental agencies to work together. As much as possible, reduce barriers in funding agreements, policy directives, and similar instruments that inhibit such collaborations.

2. Actions and Practices to Reduce Environmental Factors in Homes

Introduction

A typical American spends about 90% of his or her time indoors [37]. Effects of polluted air inside homes and other buildings may pose serious health risks particularly among those who spend the most time indoors – young children, the elderly, and those with chronic respiratory conditions [38]. Indoor exposures may include biological contaminants (such as animals, cockroaches, dust mites, molds) or chemical contaminants (such as pesticides, formaldehyde, environmental tobacco smoke) [7]. While research has not yet fully explained the rise in the incidence of asthma, there is general agreement that controlling indoor exposures is an important protective measure.

Effective interventions to address asthma appear to require strategies that extend beyond medical care and into the realm of behavior and lifestyle modification, education, housing, environmental concerns and other community resources [39]. Interventions to improve the quality of

health care services need to be coupled with environmental control of the indoor exposures that have been shown to worsen asthma [39].



Indoor exposures impact diverse types of buildings where children congregate, including a child's home, school, and childcare. Individuals living in public or rental housing may not have control over parts of their indoor environment that would be desirable to modify such as carpeting, excessive moisture, and comprehensive pest management [7]. Collaboration among building owners, care givers, the medical community, and health, environmental and housing authorities is needed to address the design and function of indoor environments [7]. Likewise, education, outreach and training across disciplines are needed to address healthy indoor environments.

More than 10 million American children under the age of five are exposed to cigarette smoke in their homes [38]. Research has shown that there is a causal relationship between environmental tobacco smoke (ETS) exposure and exacerbations of asthma in preschool-aged children [7].

The quality and organizational structure of state indoor environmental programs vary significantly from state to state [37]. States with strong indoor environmental programs

generally have a funding mechanism, upper management program support, and/or full time staff dedicated to indoor environmental efforts [37]. Asthma transcends traditional bureaucratic boundaries presenting both opportunities and challenges for states and communities to build capacity to address indoor environmental issues and asthma.

Action Agenda Elements

A. Develop an “institutional home” for indoor air quality.

States need to develop institutional capacity to address indoor environmental issues. The promotion of healthy indoor environments and improved indoor air quality needs an institutional advocate in state government. States also need to identify and obtain resources to address these issues.

B. Reduce environmental triggers of asthma in homes.

Identify and reduce relevant triggers that exacerbate asthma in the homes of children. Emphasize primary prevention to the extent possible. Develop approaches that integrate medical visits and home interventions by encouraging medical providers to include assessment of environmental triggers of asthma during patient visits and that follow up with assistance to families in their homes as needed. Educate people to address asthma triggers in their own homes. Communicate approaches that are simple and steps that are achievable. Use communication strategies that are appropriate to their audiences.

C. Coordinate in-home assessments.

Help families of children with asthma to address indoor triggers including dust mites, cockroaches, animal dander, and dust in their homes.

Coordinate efforts to offer in-home assistance on environmental factors that contribute to asthma in children with programs addressing other environmental

factors or conditions in homes, such as lead poisoning prevention programs or indoor air quality initiatives. Promote sharing of resources devoted to home visits across programs and allow families to work with one contact rather than multiple contacts.

Ensure that agency staff receive appropriate training and tools to address asthma and to provide referrals to available resources while visiting or inspecting homes, foster care settings, workplaces, and other buildings for indoor air quality, basic health and safety, or for other purposes. Train staff to recognize asthma triggers, provide educational materials, and recommend resources to resolve serious problems.

D. Address building factors in housing.

Work with state health, environmental, housing agencies, and local code enforcement departments to advocate for healthy housing.

Take actions to work with owners of housing to achieve appropriate ventilation and sealing of buildings to prevent access by insects and rodents and to prevent inappropriate moisture accumulation.

Work with housing authorities to identify and implement effective strategies to improve building conditions to reduce asthma triggers in housing, particularly low-income housing, which is often most impacted. Consider models developed in lead remediation programs including use of “safe houses” for relocation of families during remediation activities.

Design and implement strategies that reduce conditions that cause mold, as well as remove existing mold without making conditions worse, and prevent its formation in the first place. “Healthy Homes” initiatives provide useful models.

Promote integrated pest management approaches in homes to reduce pesticide use and eliminate cockroaches, mice, and other vectors that contribute to asthma.

Consider means to address particular needs of transient populations.

E. Reduce exposure to environmental tobacco smoke (secondhand smoke).

Eliminate children's exposures to environmental tobacco smoke through approaches that combine smoking cessation for individuals and control of smoking in indoor environments. Design and implement strategies to promote elimination of smoking in environments, including in homes and vehicles, where children are present.

F. Promote use of building materials that do not introduce environmental contaminants to the home.

Develop and implement strategies to encourage use of building materials and furnishings that do not off-gas substances, such as formaldehyde or particles that are thought to contribute to asthma. Work with manufacturing associations, building and architect associations, and local governments to develop codes and practices that promote the use of low- or non-emitting materials and to reduce emissions from existing materials (through means such as sealing of surfaces). Undertake public education about the significance of building materials to indoor air quality and about products that do not diminish indoor air quality, to help people make good choices for their own homes.

G. Conduct education and outreach.

Develop and implement education programs to provide families of children with asthma with a general awareness of asthma and specific information about how to identify and reduce triggers, recognize attacks, and take appropriate action.

Ensure that programs are competent in the diverse languages and cultures of their audiences.

3. Actions and Practices to Reduce Environmental Factors in Schools and Childcare Centers

Introduction

Indoor air quality is a public health issue. Poor environmental conditions exist in many classrooms. Schools are an important environment for children. Children spend approximately 15% of their time in school [40].

Indoor asthma triggers – fungi (including mold), dust mites, cockroaches, and animal dander – are often present in schools, along with chemicals and air pollutants. Environmental factors of concern can originate from both inside and outside schools. Building factors, such as the presence of dampness and adequacy of ventilation, affect the environmental factors in the school environment. Repair of existing problems and maintenance to prevent future problems are needed.

Products used by adults may introduce contaminants into children’s environments. Many interventions are simple and inexpensive. Actions to improve air quality in Los Angeles classrooms cost only \$200 on average. Proper design of new schools and school renovations would ensure good ventilation, prevent accumulation of water, and result in conditions unfavorable to asthma triggers and favorable to cleaning.

Children spend approximately 15% of their time in school. Actions to improve air quality in Los Angeles classrooms cost only \$200 on average.

The school environment is linked to student achievement and school performance. For example, excess moisture in buildings contributes to poor health outcomes for students and staff and is likely to impact the ability of students to learn. Student

performance is the primary concern of education departments and school leaders.

Schools provide a challenging institutional environment. Understandably, the primary focus of school staff is on education rather than on environmental and health conditions, and they may have little training or capacity to address such issues. Limited resources are available to address environmental conditions indoors or outdoors.



School health programs are most often oriented toward hygiene and health education, not toward environmental health. However, there are resources that can be drawn upon. School nurses contribute to asthma management and patient education and can contribute to efforts to address environmental conditions.

Some school districts have coordinators for integrated pest management that could be useful existing resources. “Coordinated school health teams” (defined in CDC policies) exist in some schools or school districts to attend to health needs of students, including those with asthma. Such teams may contribute to reducing the impact of environmental factors on children with asthma if they have an understanding of the key issues, access to best practices, and influence over the solutions.

Current methods of funding schools and school maintenance have contributed to poor environmental quality in schools due to lack

of timely and effective maintenance and cleaning. Current fiscal policies may be an impediment to good environmental quality in schools because maintenance and cleaning are inadequately funded. This may be because maintenance and cleaning is funded from an operating budget that also funds instructional programs and consequently does not receive sufficient funding due to competing priorities. Moreover, building construction is often funded from a separate capital budget.

Childcare facilities pose a different set of challenges.

Childcare facilities are also important environments for children. Many of the factors that contribute to asthma in childcare facilities are the same as those in schools, while others are more similar to those in homes. Existing initiatives and activities do not meet the needs in this area. There is a great need for information on conditions, facilities, and needs. Agencies need to know what is occurring now, what the key needs are, how they can be met, and how environmental health can be addressed given the marginal financial viability of many childcare facilities.



Childcare facilities pose a set of challenges that are different in many ways from those in schools, including financial conditions that are often marginal, high turnover in staff, wide range of types and sizes of facilities, and much lower levels of public involvement and oversight. The state agency with the most contact with childcare centers

is typically the one charged with state licensing of such facilities.

Action Agenda Elements

A. Encourage collaboration among health, environmental, and education sectors to support a common vision encouraging healthy learning environments.

Create or enhance linkages at the state and local level between health, environmental, and education agencies (including school boards, associations of school boards, school superintendents, associations of school superintendents, departments of education, buildings and grounds' administrators, entities responsible for managing facilities, and teachers' organizations) to achieve a shared vision of good environmental conditions in schools necessary to promote health and learning, and that build on the common interest in ensuring the health and well-being of children.

B. Promote policies and plans for indoor air quality and environmental health in schools and childcare settings, including use of EPA's "Tools for Schools" approach.

Work with education departments and school districts to ensure that policies for actions to achieve good air quality and good environmental health conditions in schools are developed and that plans are developed for each school. Identify and strengthen the guidelines and requirements with which schools need to comply. Take into account the particular needs and conditions at individual schools. Address the key elements of operation and maintenance, indoor air quality, asthma management, design, testing and commissioning of new schools. Include a process to respond to complaints. Promote use of EPA Tools for Schools materials.

C. Funding of school maintenance is an overarching structural concern.

Develop an approach to gaining a thorough review of this issue by appropriate parties with expertise in public finance and school funding. The appropriate role of federal, state, and local entities in ensuring adequate funding for maintenance and cleaning of school buildings, and alternative strategies for achieving adequate funding should be examined.

D. Fix building problems.

Ensure that building-related problems in schools that contribute to poor air quality or asthma triggers are fixed. Link renovations and construction projects to indoor environmental quality assessments, such that they address environmental factors in their design and implementation. Link funding sources to efforts to improve indoor environments, making state and federal resources available to school districts.

Communicate the public health significance of performing key repairs.

E. Maintain buildings to contribute to high performing schools.

Promote good building maintenance and cleaning to protect children and staff and to ensure good learning environments. Communicate that cost savings can be attained by performing maintenance in a timely manner compared to the cost of repairs needed to remedy problems created by lack of maintenance. Support adequate funding for maintenance and custodial staff.

F. Prevent future problems: design and construct schools for good environmental health.

Ensure sound design and construction to provide good environmental conditions in schools, using designs and practices such as those developed through the California

Collaborative for High Performing Schools or EPA's guidelines for new schools.

G. Link to existing resources promoting healthy schools.

Identify existing resources that contribute to promoting healthy conditions in schools and integrate such resources into strategies for schools.

Investigate potential sources of reimbursement for services offered in schools that reduce the effects of asthma on children.

H. Address environmental health needs in childcare facilities.

Work with agencies with responsibilities for licensing, registration, and regulation of childcare facilities to promote attention to environmental conditions in childcare centers.

Bring together agencies with responsibilities for licensing, registration, regulation, and basic health and safety inspections for childcare facilities. These entities may have the only government access to such facilities. It may be helpful to include partners such as parents, the Asthma and Allergy Foundation of America, Child Care Resources and Referral, Association for the Education of Young Children, Healthy Child Care American, and American Academy of Pediatrics.

Support sharing of information about and possible adoption of successful programs such as Indiana's Five Star Program for childcare facilities.

I. Promote education and training.

In cooperation with education authorities and healthcare providers, develop and implement education programs for personnel at childcare centers and schools to improve the indoor environment to reduce triggers and to support effective action in case of

attacks, including those that may occur during extra-curricular activities.

Ensure that appropriate agency staff members receive proper training and tools to address asthma and to provide referrals to available resources while inspecting schools, childcare centers, workplaces, and other buildings for indoor air quality, basic health and safety, or for other purposes. Train staff to recognize and, where possible, reduce asthma triggers; provide educational materials or a similarly structured comprehensive approach to maintenance of indoor air quality; and recommend resources to resolve more serious problems.

Educate the public about environmental health needs in schools and childcare facilities, including the need for good indoor air quality, and the need to obtain sufficient funding on a consistent basis to provide good environmental health conditions.

Research issues associated with policy options for increasing subsidies for providing care in schools and childcare settings for children with asthma. Consider all social, health, legal and economic implications of options for possible funding sources or other incentives, including those that might be available by classifying severe childhood asthma as a disability under federal law.

4. Actions and Practices to Reduce Outdoor Environmental Factors

Introduction

Several common air pollutants have been linked to the exacerbation of asthma as reflected in increased hospitalizations [41], increased visits to emergency rooms for asthma for children and adults [42-45], increased symptoms, increased use of medication (such as inhalers) [46], and decreased lung function.



Exposure to particulate matter has been associated with several measures of increased asthma, including increased visits to emergency rooms [48, 49], increased symptoms [22, 50, 51], increased bronchitis in children with asthma [52], increased medication use [22], and reduced lung function in asthmatics [53]. Nitrogen dioxide (NO₂) may aggravate asthma as reflected by increased hospitalizations [54] and increased symptoms in adults [55] and children [52], especially African-American children [22]. Exposure to traffic may also contribute to asthma [56, 57]. Diesel exhaust and hazardous air pollutants are also of concern. Ozone may also contribute to the development of asthma. The risk of developing asthma was increased for children playing sports in communities with higher concentrations of ozone, but not in communities with lower concentrations of ozone [35, 47].

Four kinds of biological particles are of concern: pollen, fungal spores (which includes mold), bacteria, and endotoxin. Pollen can contribute to asthma [58-60]. Fungi spore concentrations have been associated with increased asthma symptoms [58]. Individual types of spores, but not overall spore counts, have been related to hospital admissions for asthma for children. Mold spore concentrations have been associated with asthma symptoms [22], inhaler use [61], increased emergency room visits [62], and mortality [63].

It is important to focus on the implementation of the National Ambient Air Quality Standards for the four criteria pollutants that have been shown to contribute to asthma – particulate matter, ozone, NO₂, and SO₂. While some states have adopted standards that are more stringent than those currently in effect at the federal level (because of concern that the federal standards may not be fully protective of health for all populations), the standards that have been adopted pose significant issues for implementation. Focusing on strategies that can achieve these standards is the most important next step. Reductions in pollutants that contribute to asthma in children will also benefit adults with asthma and reduce other health effects.

Action Agenda Items

A. Build support for efforts to reduce outdoor environmental factors that would lead to a reduction in asthma.

Educate the public and policy makers about the research on relationships between exposure to air pollutants and asthma and the need for control measures to reduce environmental factors.

Develop and implement tracking programs that show links between exposure to air pollutants and asthma and that are also useful and understandable to the public.

B. Reduce pollution.

Air pollution contributes to a variety of adverse health effects. It is important to move forward with control strategies that reduce emissions. Clearly articulate the rationale for control, based on research on health effects associated with exposure to air pollution, integrate the available information into a case for control that can be made convincingly to policy makers, and make the case. Implement policies and strategies to achieve compliance with the National Ambient Air Quality Standards (NAAQS) that have been adopted.

C. Take immediate steps to reduce diesel emissions, particularly in children's environments.

Reduce idling of diesel vehicles that leads to releases in places where children congregate such as schools and bus stops.

Encourage school districts or other responsible entities to implement programs to reduce emissions from diesel school buses. The principal strategies are retrofits of diesel buses with particle traps and use of ultra low sulfur fuels (less than 15 ppm of sulfur) or replacement of diesel buses with compressed natural gas (CNG) and cleaner diesel engines.

Support funding of programs, (such as the EPA's *Clean School Bus USA* program) that retrofit diesel buses to reduce emissions, as well as other diesel control measures deemed important by states. Seek alternative funding sources for retrofit of diesel buses, including use of supplemental environmental penalties (SEPs).

D. Educate the public about risks from wood and trash burning.

In many areas, burning of wood and trash in woodstoves and in fireplaces contributes to a significant air pollution burden that is often not recognized by the public. Research is needed to identify the components of wood smoke and to determine their health effects. Public education is needed to alert the public to the health risks posed by burning wood and the conversion of schools to heating by wood burning.

Though most areas prohibit open burning of trash and use of burn barrels, prohibitions are not always enforced. A national education campaign is needed to alert the public to the highly toxic chemicals and particulate matter released by burning wood and trash.

E. Address hazardous air pollutants.

Though currently available research on the health effects of hazardous air pollutants is largely limited to occupational and animal studies, available evidence suggests that hazardous air pollutants like formaldehyde and acrolein pose a concern and deserve greater attention. They are a concern in both indoor and outdoor environments. Studies are needed on health effects.

Support and expand efforts such as the National Air Toxics Assessment to characterize ambient concentrations of hazardous air pollutants through modeling based on emission inventories, rather than through monitoring, to achieve results at an affordable cost far less than what would be incurred to run a representative national monitoring network. Use existing monitoring networks to validate models and identify trends.

F. Forecast air quality and forecast days that pose health risks and disseminate this information in ways that help people take actions to protect their own health and reduce activities (such as vehicle use and burning) that cause air pollution.

Pursue forecasting of air pollution. For states already forecasting ozone concentrations, consider expanded dissemination of results.

Develop messages about health and air quality that are simple but sophisticated and target specific time and days as much as possible. Avoid conflicting warnings for different kinds of chemical air pollutants and biological agents that would decrease exposure to one harmful agent while increasing exposure to another. Develop approaches to provide integrated guidance to people with asthma that considers all of the relevant factors. Target schools and childcare centers to receive such advice. Identify best practice methods for incorporating these warnings into daily activities.

Move monitoring methods toward real time air monitoring and reporting, to provide information to the public and to provide data needed for forecasting. Encourage efforts to promote and accelerate this transition. Conduct research to develop better methods for forecasting of ambient counts of pollen grains and fungal spores (including molds).

Encourage collaboration between health and environmental agencies to make the best use of environmental data and craft informative and effective health messages.

Use air quality data available from monitoring programs to better portray and understand long-term exposures and health effects.



G. Site places and facilities where children congregate.

Take actions to see that places and facilities where children congregate are not sited near freeways or areas of traffic congestion or in areas with other environmental hazards. This could be done through criteria or requirements placed on funding measures such as bonds.

Relocate facilities in areas of high environmental risk if possible. In the many cases where this is not possible, look for ways to mitigate adverse environmental factors through building design, operation, and management practices involving ventilation, cleaning, etc.

H. Reduce pollen grains in developed areas and research biological agents.

Pollen grains appear to contribute to asthma. In some urban areas, pollen grains come from species of plants introduced into landscaping that are not native vegetation. Guidance for low pollen plantings (known as “sneeze-less” landscaping, available from the American Lung Association), particularly near places and facilities frequented by children, should be developed. Take into consideration other components of environmental sustainability such as water use; implement such approaches in public parks and playgrounds; and make information available to consumers at venues such as plant stores and nurseries.

I. The working group recommends that EPA take these actions:

Reduce diesel emissions in categories of vehicles exempted from state regulation (e. g. locomotives, ships). Address “interstate” heavy-duty vehicles.

Develop controls for off-road diesel sources. Assess and address aircraft emissions, including both commercial and military.

Develop a research strategy for irritants that contribute to asthma that would be useful in developing health-based reference concentrations, limits, or goals.

When reviewing national ambient air quality standards, particularly for pollutants that have been shown to contribute to asthma in children (ozone, particulate matter, sulfur dioxide, nitrogen dioxide), explicitly consider the protection of children. Ensure that the standards are reflective of current research and are protective for children with regard to asthma, as well as for other sensitive groups such as elderly people.

Develop and disseminate methods and approaches for monitoring and forecasting ambient concentrations of pollutants

including particulate matter and biological agents.

5. Collection, Use, and Integration of Health and Environmental Data

Introduction

To address environmental factors that contribute to asthma, states need to obtain and use appropriate data and information about environmental factors and their sources and about the burden of asthma in their communities.

A standard definition of what constitutes asthma is needed for diagnosis and reporting.

There are significant needs for advancements in data collection and analysis from both a health perspective and an environmental perspective. For example, on the health side, there is no standard definition of what constitutes asthma that is widely used in diagnosis and in reporting. Some data sources use medical records, which rely on coding of diagnoses by clinicians, while others rely on interviews with patients or parents of children to report who may be considered to have asthma. When working on data sources and systems, it is important to ensure privacy and confidentiality for individuals.

On the environment side, considerable data are collected about the six criteria air pollutants, but these are typically analyzed and presented in only two forms: determinations of whether areas have achieved “attainment” with air quality standards, or in the form of the air quality index. Neither appears to be ideal for describing air quality conditions that contribute to asthma attacks.

There is a need for greater discussion between environmental and health agencies on what the data needs are, how they can best be met, what existing data sources are based on, and what their strengths and

limitations are. Collaboration of environmental and health data experts on using environmental and health data is needed because each understands the needs of their disciplines, the limitations of their data, and appropriate analytic methods. The best strategy may be to integrate the use of data, through joint planning of data collection and joint analysis, rather than the data itself.



The discussion of environmental health tracking has focused on identifying linkages between environmental data and health data with one goal being to better define relationships between environmental exposures and health outcomes. While such relationships may be identified through surveillance activities, it is more likely that they will be discovered through well-designed research studies. Such studies have provided the knowledge available to date about relationships between air pollutants and asthma causation and exacerbation, for example. It may create false expectations to suggest that similar results are likely to be obtained from surveillance activities, even those that link or overlay environmental and health data. Moreover, it may not be

necessary to establish such relationships everywhere.

While there are limits to the use of linking health and environmental data in establishing relationships between environmental factors and asthma, the ability to describe both environmental conditions and frequency of disease in communities is extremely valuable to properly inform the public. Environmental health tracking initiatives can be particularly effective in this regard. It is important to present data so that people can understand the impact.

Some of the community demand for more data about health outcomes and the environment appears to be driven by a sense that diseases are being caused by environmental factors and that these relationships are not being adequately addressed. There is a concern about clusters of diseases, including cancer. Communities are reaching their own conclusions about what is affecting their health. When thinking about data needs and data systems, it is important to consider what is needed to answer questions and respond to concerns. While some questions may not be able to be addressed through scientific methods, it is important to engage with concerned communities, build relationships, and provide as much information as possible. It is also important to develop better methods for investigating clusters and for communicating with communities.

Much existing data, with a modest effort, could be refined and put into forms that would be understandable to the public and could help to advance an agenda to reduce environmental factors that affect asthma in children. It is important to develop data that can “make the case” in each state. Integrating health and environmental data can contribute to this. States need similar, workable methods and approaches to data integration.

When developing a data system, it is important to be clear about what questions are being asked and to carefully consider whether a proposed data source and system can answer them. It requires, for example, a different quality of data to determine whether the prevalence of asthma is getting “better or worse” than to provide a good estimate.

The methods used for monitoring key criteria air pollutants, particularly ozone and particulate matter, are going through a conversion to “real-time” data collection. This will provide new opportunities and challenges for both environment and health agencies, as it will allow for a greater ability to forecast and report high pollution conditions and it will also provide richer data that may be amenable to analysis in ways that are more compatible with needs of the health agencies.

Action Agenda Elements

A. Assess data availability in each state.

As a starting point, it may be valuable, in each state, for the health agency and the environmental agency to work together to identify what data are currently being collected, how these data can be obtained, and what these can and are being used for.

B. Develop data about asthma prevalence in each state.

A minimum approach for surveillance of asthma would include tracking deaths using vital statistics data (though this is not particularly relevant for children), tracking serious cases using hospitalization and emergency room visits data, and tracking prevalence using the Behavioral Risk Factor State Survey results (BRFSS). It may be appropriate to recommend use of Medicaid data, particularly regarding office visits and pharmaceutical use. A standard definition needs to be used by all states. It may be appropriate to incorporate a definition of asthma such as one developed by the

Council of State and Territorial Epidemiologists.

C. Develop methods to better represent air quality with regard to asthma.

Proper means for using environmental data, particularly air quality data, to best represent potential risks for asthma, need to be developed. This could include different reporting or time-averaging periods, for example. Data for other environmental factors such as hazardous air pollutants, pollen, fungal spores including mold, and indoor contaminants such as environmental tobacco smoke also need more attention.

Data should be gathered, analyzed, and presented at the “smallest” level, in a way that allows for it to be aggregated up to higher levels. This applies to geographic area, time, and age of people.

Consider the locations of affected populations when siting air monitors. Consider modifying monitoring locations where appropriate to better characterize environments where children spend time.

D. Develop standard definitions, terms, and data standards that states can use to promote consistency and comparability.

Data should be collected in ways that allow comparisons to be made between areas and over time.

The working group recommends that ECOS and ASTHO seek resources and then sponsor future work to support the state health and environmental agencies to determine the availability of existing data, ascertain how it can be used, identify options for development of new sources of data, and to address needs for standard definitions, terms, and data systems. Alternative data technologies would also be a relevant subject. Such work may best be carried out through the formation of working groups that can involve a subset of the states and work directly with experts.

Development of case studies or training materials that help states share lessons learned may also be helpful.

E. Use focused research studies to elucidate relationships between environmental factors and asthma causation and exacerbation.

6. Research

Introduction

A research strategy is an integral part of the prevention, intervention, and mitigation of asthma in children. There is much we do not know about childhood asthma and the factors that contribute to it. There is much to learn about control strategies and approaches. Research is needed in these areas. EPA has recently released a research agenda for asthma, and this is an important step. Research can be funded to a limited extent by states, but major initiatives require federal support. Evaluation and testing of intervention and education programs is a critical need to ensure that resources are devoted to efforts that will achieve results. Evaluation is a critical need in every element of this agenda.

Action Agenda Elements

A. Determine the relationship between environmental factors and induction and exacerbation of asthma.

Additional studies on the relationships between both induction and exacerbation of asthma and environmental factors, as well as other potential causes, are needed. Such studies should be of sufficient size and duration, and consequently have sufficient power, to detect effects that exist and to tease out the combination of factors that appear to contribute to asthma.

B. Ensure continuity of funding for centers studying the health effects of particulate matter.

C. Determine the efficacy and the cost of programs and projects intended to reduce exposures to environmental factors that contribute to asthma.

Additional studies are needed to determine the efficacy of programs that reduce exposures to asthma triggers and the cost-effectiveness of various strategies. Programs that conduct such interventions should be funded and required to conduct evaluations of their effect.

D. Develop improved methods for monitoring to obtain better data at less cost.

In order to increase the value of data collected, research on improvements to monitoring methods and techniques is needed. At the same time, there is a need for decreasing the cost of obtaining and analyzing these data. Improvements in value of data, combined with decreases in cost, have been obtained for monitoring for particulate matter. Further improvement of technology could continue to add value to air monitoring programs.

E. Support the infrastructure necessary to support long-term research to identify environmental causes of asthma and other diseases.

F. Conduct research to determine the effects of asthma on the performance of children in school and in other arenas and the costs that asthma imposes.

G. Develop a sound information base on environmental conditions and factors that contribute to asthma in childcare centers.

Research on conditions in childcare centers and needs for intervention are needed. A national assessment may be required.

Next Steps

The working group of representatives from state health and environmental agencies has made this report available for states to use in developing their asthma prevention and control programs. The following next steps are recommendations from the working group for ECOS, ASTHO, and EPA to advance the action agenda and enhance coordination and cooperation between state health and environmental agencies.

1. The state working group will forward this final report to ECOS and ASTHO for review by the appropriate policy committees. This would include the Children's Environmental Health Work Group at ECOS and the Environmental Health Policy Committee of ASTHO. The action agenda will be proposed for consideration and adoption by ECOS and ASTHO.
2. ECOS will implement an award program for pilot projects for states that propose projects to carry out components of this agenda. Some funding has been obtained for this purpose.
3. EPA has indicated that it will brief its interagency forum on children's environmental health about the action agenda, the need for further support for integration of state health and environmental agencies' work, and the needs for funding for implementation.
4. The state working group suggests that ECOS and ASTHO develop an inventory of data systems available in states relevant to the issues raised in this process, make it available to states, and ask each state to select one or more step(s) they could take to advance the Action Agenda.
5. ECOS will revise the matrix of state asthma programs to include all of the elements identified in the action agenda, update it, and make it available to states.
6. ECOS and its consultants and partners will update the web-based toolbox of resources to reflect new resources identified through the development of the action agenda and the workshops. The briefing documents to summarize the technical information presented at each workshop will be completed.
7. The state working group will identify and implement means such as email updates to retain and engage participants in these discussions.
8. Participants in the process, including working group members, are encouraged to provide briefing and reports to key state and regional officials and other organizations with an interest in this issue. ECOS and ASTHO will assist states by developing presentation materials and by coordinating participation in key national forums.

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Appendix I: Workshop Presenters

Surveillance and Environmental Data Workshop: May 30-31, 2002, Providence, RI

Carmine DiBattista, MS, Chief, Air Management Bureau, Connecticut Department of Environmental Protection

Carol Blaisdell, MD, Chief, Pediatric Pulmonary/Allergy and Associate Professor of Pediatrics, University of Maryland, Baltimore

Dave Brown, ScD, Public Health Toxicologist, North East States for Air Use Management (NESCAUM)

Terrence Fitzgerald, MD, Medical Director, Connecticut Division, Oxford Health Plans

Betsy Frey, MS, Environmental Scientist, Air Quality Management, Delaware Department of Natural Resources and Environmental Control

John Fulton, PhD, Associate Director of Health, Rhode Island Department of Health

Norma Helmig, Chief, Bureau of Health Resources Statistics, Missouri Department of Health and Senior Services

Rick Kreutzer, MD, Chief, Environmental Health Investigations, California Department of Health Services

Mary Alice Lee, PhD, Assistant Director, Children's Health Council

Diane McNally, MS, DUR Coordinator, University of Maryland, School of Pharmacy, Center on Drugs and Public Policy

Jeanne Moorman, MS, Survey Statistician, Centers for Disease Control and Prevention

Ruth Quinn, Childhood Asthma Project Manager, Baltimore City Health Department

Peter Simon, MD MPH, Assistant Medical Director, Rhode Island Department of Health

Johanna Steper, Manager of Data Processing, New York State Department of Health

Alvaro Tinajero, MD MPH ScM, Senior Epidemiologist, Rhode Island Department of Health

Richard Valentinetti, MPH, Director, Air Quality Division, Vermont Agency of Natural Resources

Robert Zimmerman, Director of Strategic Initiatives, Office of the Secretary, Delaware Department of Natural Resources and Environmental Control

Indoor Environments Workshop: June 26-27, 2002, Charleston, SC

Maureen Edwards, MD MPH, Medical Direction, Center of Maternal and Child Health, Maryland Department of Health and Mental Hygiene

Marie Erickson, Nurse Consultant, Maryland Department of Health and Mental Hygiene

Traci Hardin, MPH, Family Connection of South Carolina

Tamara Johnson, Children's Environmental Health Coordinator, Indiana Department of Environmental Management

Robert King, Assistant Deputy Commissioner, South Carolina Department of Health and Environmental Control

Ed Norman, Program Supervisor, NC Division of Environmental Health

Kathie Reed, Project Administrator, Division of Health Promotion and Analysis, South Carolina Department of Health and Human Services

Routt Reigard, MD, Professor and Director of Pediatrics, Medical University of South Carolina

Emma Marie Thomas, DDS, Deputy Director,
Office of Health Homes and Lead Control, U.S.
Department of Housing and Urban Development

Katy Wynne, EdD MSW, Policy Coordinator,
Tobacco Control Program, South Carolina
Department of Health and Environmental
Control

Schools and Childcare Facilities Workshop: September 18-20, 2002, Indianapolis, IN

Steve Ashkin, President, The Ashkin Group

Gail Beeman, MD MHPE, Physician Consultant,
Memphis City Schools Coordinated Health
Program

Loren Belida, AIA, Senior Vice President,
Architecture, The Turner Group

Jay Brakensiek, MS MA, Office of
Environmental Health and Safety, Los Angeles
Unified School District

Linda Caldart-Olson, RN MS, School Nursing
and Health Services Consultant, Wisconsin
Department of Public Instruction

Dale Dorschner, Action Supervisor, Indoor Air
Programs, Minnesota Department of Health

A. Christine Eppstein, LL.B LL.M, Senior
Project Manager, Environmental Council of the
States

John Hamilton, Secretary, Family and Social
Services Administration, State of Indiana

Brian Higginbotham, General Manager, Durham
School Services, Everett School District,
Washington State

Rebecca Hudlow, Director of Health Services,
Eden Prairie Schools and National Association
of School Nurses

Peggy Jenkins, Manager, Indoor Exposure
Assessment, California Air Resources Board

Tamara Johnson, Children's Environmental
Health Coordinator, Indiana Department of
Environmental Management

Lori Kaplan, JD, Commissioner, Indiana
Department of Environmental Management

Marian Levy, DrPH RD, Director of Grants and
Research, Methodist Le Bonheur Health Care

Sharon Petronella, PhD MS, Assistant Professor,
University of Texas, Medical Branch

Julie Slavens, State Attorney, Indiana School
Boards Association

Eileen Storey, MD, Associate Professor,
University of Connecticut Health Center

Brad Turk, Building Scientist and President,
Mountain West Technical Associates

Lani Wheeler, MD, Medical Officer, CDC-
DASH and Anne Arundel County Maryland

Greg Wilson, MD, Commissioner, Indiana
Department of Health

Outdoor Environments Workshop: October 16-17, 2002, Sacramento, CA

Alberto Ayala, California Air Resources Board

James Black, Air Quality Modeling Supervisor,
New Hampshire Department of Environmental
Quality

Harriet Burge, Environmental Health, Harvard
School of Public Health

Maureen Edwards, MD MPH, Medical Director,
Center of Maternal and Child Health, Maryland
Department of Health and Mental Hygiene

Paul English, PhD MPH, Chief, Epidemiology
and Investigations Unit, California Department
of Health Services

Robert Fletcher, Chief, Planning and Technical
Support Division, California Air Resources
Board

Michelle Fancucchi, PhD, School of Veterinary
Medicine, California National Primate Research
Center, University of California, Davis

Larry Green, Executive Director, Yolo-Salono
Air Quality Management District

Michael Lipsett, MD JD, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency

Helene Margolis, Assistant Director, Children's Environmental Health Center, California Environmental Protection Agency

Melanie Marty, PhD, Chief, Air Toxicology and Epidemiology, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency

Kevin Reilly, DVM, Deputy Director of Prevention Services, California Department of Health Services

Christine Sansevaro, Environmental Engineer, Office of Ecosystem Protection, United States Environmental Protection Agency

Nancy Sutley, Deputy Secretary for Policy and Intergovernmental Relations, California Environmental Protection Agency

Ira Tager, MD MPH, Professor of Epidemiology, School of Public Health, University of California, Berkeley

Lynn Terry, MS, Deputy Executive Officer, California Air Resources Board

Wendy Umino, Principal Consultant, Office of California State Senator Martha Escutia

William Vance, PhD, Assistant Secretary for Children's Environmental Health, California Environmental Protection Agency

Peter Venturini, Chief, Stationary Source Division, California Air Resources Board

Michael Ziolkowski, Meteorology and Technical Services Manager, Fire Protection Program, Oregon Department of Forestry

Appendix II: Workshop Participants*

Rosalind Abernathy, Arkansas Department of Health	William Bonta, California Department of Health Services
Kelly Albright Raatz, Minnesota Department of Health	Leslie Boss, Centers for Disease Control and Prevention
Henry Anderson, Wisconsin Department of Health and Family Services	Jessie Bosseau, Vermont Department of Health
Mike Aplin, Resource Conservation Commission	Jay Brakensiek, Los Angeles Unified School District
Stephen Ashkin, The Ashkin Group	Barbara Brooks, Hawaii Department of Health
Leslie K. L. Au, Hawaii Department of Health	Michele Brown, Alaska Department of Environmental Conservation
Robert Axelrad, U.S. Environmental Protection Agency	Carolyn Brown, Alaska Division of Public Health
Wayne Ball, Utah Department of Public Health	Dave Brown, Coordinated Air Use Management
Mary Evelyn Barnes, Mississippi Department of Environmental Quality	Mary Burg, Washington Department of Ecology
Loren Belida, The Turner Group	Harriet Burge, Harvard School of Public Health
Leslie Best, Pennsylvania Department of Health	Amanda Burkett, Ohio Department of Health
James Black, New Hampshire Department of Environmental Services	Sara Burr, Wisconsin Department of Natural Resources
Elizabeth Blackburn, U.S. Environmental Protection Agency	Karen Burrell, Oregon Health Division
Carol Blais dell, University of Maryland School of Medicine	Linda Caldart-Olson, Wisconsin Department of Public Instruction
Patricia Bloomgreen, Minnesota Department of Health	Craig Cavannagh, South Carolina Department of Health and Environmental Control
Richard Bode, California Environmental Protection Agency	William Chaplin, South Carolina Department of Health and Environmental Control
Linda Bonanno, New Jersey Department of Environment Protection	Ron Clark, Indiana Department of Health
	Mercita Clelan, Pennsylvania Department of Health

* This list includes only the names of those workshop participants who were pre-registered.

Joel Cohen, CRB

Cherryl Connelly, National Association of City and County Health Officials

Gregory Crawford, Centers for Disease Control and Prevention

Lindsay Dearborn, New Hampshire Department of Health and Human Services

Allen Dearry, National Institute of Environmental Health Sciences

Nina DeConcini, Oregon Department of Environmental Quality

Tricia Delaby, Family Development Services, Inc.

Michael Depa, Michigan Department of Environmental Quality

Carmine DiBattista, Connecticut Department of Environmental Protection

Dale Dorschner, Minnesota Department of Health

Ann Duncan, Tennessee Department of Health

Frances Dwyer, Massachusetts Department of Public Health

Bonnie L. Eastman, American Lung Association, Sacramento-Emigrant Trails

Maureen Edwards, Maryland Department of Health and Mental Hygiene

Monty Elder, Oklahoma Department of Environmental Quality

Joe Eldridge, New Jersey Department of Health and Senior Services

Cheryl Ellemberg, New York Department of Health

Patricia I. Elliott, Association of State and Territorial Health Officials

Darise Ellis, U.S. Environmental Protection Agency, Region III

Paul English, California Department of Health Services

A. Christine Eppstein, Environmental Council of the States

Marie Erickson, Maryland Department of Health and Mental Hygiene

Rick Eskin, Maryland Department of Health and Mental Hygiene

Myron Falken, Minnesota Department of Health

Michelle Fanucchi, University of California, Berkeley

Katherine Feldman, California Department of Health Services

Terrence Fitzgerald, Connecticut Division, Oxford Health Plans

Catherine Fitzsimmons, Iowa Department of Natural Resources

Mary Lou Fleissner, Connecticut Department of Health

Robert Fletcher, California Environmental Protection Agency

Joe Francis, Nebraska Department of Environmental Quality

Saul Franklin, Massachusetts Department of Public Health

Elizabeth Frey, Delaware Department of Natural Resources and Environmental Control

John Fulton, Rhode Island Department of Health

Judith Ganser, Indiana State Department of Health

Wayne Garfinkel, U.S. Environmental Protection Agency, Region IV

Charleen Gorrell, California Department of Health Services

Peggy Graddy, Missouri Department of Health

Shelley Green, California Environmental Protection Agency

Melanie Gunnell, Utah Department of Health

Traci Hardin, Family Connection of South Carolina, Inc.

Lorna Hardin, American Lung Association of San Diego and Imperial Counties

Mason Harris, South Carolina Department of Health and Environmental Control

Norma Helmig, Missouri Department of Health and Senior Services

Casey Herget, North Carolina Division of Public Health

Winston Hickox, California Environmental Protection Agency

Brian Higginbotham, Durham School Services/Everett School District, Washington

Andrea Hoffman, Iowa Department of Public Health

Donna Hogle, Indiana Family and Social Services Administration

Polly Hoppin, Tellus Institute

Edward Horn, New York State Department of Health

Jim Howard, California Department of Health Services

Rebecca Hudlow, Eden Praerie Schools

Steve Hui, U.S. Environmental Protection Agency

Mary Lee Hultin, Michigan Department of Environmental Quality

Mary Ann Hurrele, Indiana State Department of Health

Crystal James, Council of State and Territorial Epidemiologists

Charles James, South Carolina Department of Health and Environmental Control

Peggy Jenkins, California Environmental Protection Agency

Mimi Johnson, California Department of Health Services

Grantland Johnson, California Health and Health Services Agency

Tamara Johnson, Indiana Department of Environmental Management

Carl Johnson, New York Department of Environmental Conservation

William L. Jones, U.S. Environmental Protection Agency, Region IX

Roger Kanerva, Illinois Environmental Protection Agency

Lori Kaplan, Indiana Department of Environmental Management

Heidari Khosrow, South Carolina Department of Health and Environmental Control

Christine Kielb, New York State Department of Health

Janice Kim, California Environmental Protection Agency

Robert King, South Carolina Department of Health and Environmental Control

Robert Knorr, Massachusetts Department of Public Health

Paul Koval, Ohio Environmental Protection Agency

Merrill Krenitz, Arizona Department of Health Services

Rick Kreutzer, California Department of Health Services

Amy D. Kyle, Consulting Scientist

Judith Lake, San Diego Air Pollution Control

Lodie Lambright, Rhode Island Department of Health

Philip Landrigan, Mount Sinai School of Medicine

Allison LaPointe, Vermont Department of Health

Mary Alice Lee, Children's Health Council

Chung-Won Lee, Utah Department of Health

Bill Leston, Colorado Department of Public Health and Environment

Marian Levy, Methodist Healthcare

Michael Lipsett, California Environmental Protection Agency

Daniel Luttinger, New York State Department of Health

Janet Macher, California Department of Health Services

Stephen Majkut, Rhode Island Department of Environmental Management

Julie Malanga, Paradise Valley Hospital

David Mannino, Centers for Disease Control and Prevention

Helene Margolis, California Environmental Protection Agency

Melanie Marty, California Environmental Protection Agency

Diane McNally, University of Maryland School of Medicine

Sandy McNeel, California Department of Health Services

Jerry Medinger, Wisconsin Department of Natural Resources

Hans Messersmith, Indiana Department of Health

Mark Miller, California Environmental Protection Agency

Doriane Miller, Robert Wood Johnson Foundation

Doriane C. Miller, Robert Wood Johnson Foundation

Dianne Minasian, South Carolina Department of Health and Environmental Control

Jeanne Moorman, Centers for Disease Control and Prevention

Lee Morrow, Indiana State Department of Health

Dale Morse, New York State Department of Health

Michael Moser, Kansas Department of Health and Environment

Venkat Mulpuri, West Virginia Department of Health and Human Resources

Linda Murchinson, California Environmental Protection Agency

Connie Musgrove, U.S. Environmental Protection Agency

Ed Norman, North Carolina Division of Environmental Health

David Nunez, California Department of Health Services

Laura Oatman, Minnesota Department of Health

Jim O'Hara, Health-Track

Florence O'Leary, Illinois Department of Human Services

Bart Ostro, California Environmental Protection Agency

David Palmer, Texas Natural Resource Conservation Commission

Pankaja Panda, Maryland Department of Health and Mental Hygiene

Catherine Parker, Asthma Alliance of Indianapolis, Marion County

Jerome Paulson, Children's Environmental Health Network

Karen Pearson, Alaska Department of Health and Social Services

Dennis Perrotta, Texas Department of Health

Sharon Petronella, University of Texas, Medical Branch

Rachel Pinrelas, Say San Diego Inc.

Carlos Porras, Communities for a Better Environment

Shankar Prasad, California Environmental Protection Agency

Claire Prince, South Carolina Department of Health and Environmental Control

Virginia Pullins, Family Development Services, Inc.

Ruth Quinn, Baltimore City Health Department

Stephen Quirk, Iowa Department of Public Health

Bertha Ramirez, American Lung Association of San Diego and Imperial Counties

James Raymond, South Carolina Department of Health and Environmental Control

Stephen Redd, Centers for Disease Control and Prevention

Margaret Reed, Boston Public Health Commission

Katy Reed, South Carolina Department of Health and Environmental Control

Kevin Reilly, California Department of Health Services

Beth Resnick, Johns Hopkins University Center of Excellence

Edd Rhoades, Oklahoma Department of Health

Jay Ringerberg, Nebraska Department of Environmental Quality

Jill Rogers, Delaware Division of Public Health

Linda Rosen, Hawaii Department of Health

Betsy Rosenfeld, U.S. Department of Health and Human Services, Region I

David Rowson, U.S. Environmental Protection Agency

Richard Rumba, New Hampshire Department of Health and Human Services

John Ruyack, Indiana State Department of Health

Kristin Ryan, Alaska Department of Environmental Control

Christine Sansevero, U.S. Environmental Protection Agency, Region I

Jonine Schanfeld, Massachusetts Department of Public Health

Paula Schenck, UCHC

Martin Schock, North Dakota Department of Health

David Schor, Nebraska Department of Health and Human Services

Lynn Schuster, Tennessee Department of Health

Leslie Seffern, Washington State Office of the Attorney General

Will Service, North Carolina Department of Health and Human Services

Rachel Shapiro, Oregon Department of Human Services

Elizabeth Shevi, Minnesota Pollution Control Agency

Dorothy Shimer, California Environmental Protection Agency

Anne Siefer, South Carolina Department of Health and Environmental Control

Peter Simon, Rhode Island Department of Health

Julie Slavens, Indiana School Board Association

Mary Smith, U.S. Environmental Protection Agency

Paula Smith, Indiana Department of Environmental Management

Becky Smullin, Association of State and Territorial Health Officials

Deb Sottolano, New York Child Health Information System

Johanna Steper, New York Department of Health

Donald Stern, Virginia Department of Health

Robin Stevens, South Carolina Department of Health and Environmental Control

Laurie Stillman, U.S. Department of Health and Human Services, Region I

Eileen Storey, University of Connecticut Health Center

Sacsy Suckcharoum, American Lung Association of San Diego and Imperial Counties

Maryann Suero, U.S. Environmental Protection Agency, Region V

Nancy Sutley, California Environmental Protection Agency

Kathy Sykes, U.S. Environmental Protection Agency

Ira Tager, University of California, Berkeley

M.L. Tanner, South Carolina Department of Health and Environmental Control

Karen Teliha, Indiana Department of Environmental Management

Lynn Terry, California Environmental Protection Agency

Mildred Thompson, Policy Link

Ulder Tillman, Delaware Division of Public Health

Angela Tin, Illinois Environmental Protection Agency

Alvaro Tinajero, Rhode Island Department of Health

Dennis Treacey, Virginia Department of Environmental Quality

Ramona Trovato, U.S. Environmental Protection Agency

Feng Tsai, California Department of Health Services

Brad Turk, Mountain West Technical Associates

Wendy Umino, Office of California State Senator Martha Escutia

Mittsy Vailes, Wisconsin Department of Natural Resources

Richard Valentinetti, Vermont Agency of Natural Resources

William Vance, California Environmental Protection Agency

Peter Venturini, California Environmental Protection Agency

Winona Victory, U.S. Environmental Protection Agency, Region IX

Samara Viner-Brown, Rhode Island Department of Health

Elizabeth Vowels, Oregon Department of Environmental Quality

Lisa Waddell, South Carolina Department of Health and Environmental Control

Robert Wahl, Michigan Department of Community Health

Wendy Walker, Iowa Department of Natural Resources

Timothy Wallace, Florida Department of Health

Patricia Waniewski, New York State Department of Health

Richard Weiss, California Department of Health Services

Cassandra Welch, American Lung Association

Carol Rowan West, Massachusetts Department of Environmental Protections

Dane Westerdahl, California Environmental Protection Agency

Lani Wheeler, Centers for Disease Control and Prevention

Greg Wilson, Indiana State Department of Health

Lloyd Wilson, New York State Department of Health

Karen Wood, Washington Department of Ecology

Jean Woodward, Idaho Department of Health

David Word, Georgia Department of Natural Resources

Dwight Wylie, Mississippi Department of Environmental Quality

Eileen Yamada, California Department of Health Services

Kathy L. Wynne, South Carolina Department of Health and Environmental Control

Robert Zimmerman, Delaware Department of Natural Resources and Environmental Control

Michael Ziolkowski, Oregon Department of Forestry