Asthma Regional Council
of New England

Improving Asthma Management by Addressing Environmental Triggers: Challenges and Opportunities for Delivery and Financing

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Overview

Over the past several years, the base of evidence on the effectiveness of environmental interventions in reducing asthma symptoms has strengthened substantially. In the fall of 2004, for example, the most recent results of the Inner City Asthma Study (ICAS)—funded by the National Institutes of Health (NIH)--were published in the New England Journal of Medicine. ICAS documented that a combination of education and remediation services tailored to the individual and provided in the home improves health and quality of life, and reduces utilization of health services. These results are not surprising, given the central role that environmental factors play in the exacerbation of asthma. But they are important, because health practitioners have not made a priority of implementing the component of NIH-sponsored national asthma management guidelines that addresses environmental exposures. Across the country, lack of attention to environmental factors and controls has led thousands of people to suffer unnecessarily from the burden of chronic asthma and/or from acute asthma events, and accordingly, has resulted in decreases in quality of life for people with asthma and their families, and a substantial increase in avoidable costs from emergency room visits and hospitalizations.

In New England, managed care organizations and public health officials have committed to pursuing best practices in asthma prevention and treatment. In 2000, the pediatric asthma workgroup of the New England Public Health and Managed Care Collaborative developed recommendations that urge the delivery and financing of integrated asthma management, including environmental components such as home-based services and supplies as appropriate. Some health plans in the region are well underway towards ensuring that patients who need in-home environmental interventions get them. But as is true elsewhere, the majority of plans and practitioners have not made these kinds of services available to their patients, for a variety of reasons. The purpose of this paper—and the symposium for which it was prepared—is to provide information and prompt collaboration to encourage investment in an integrated management approach to asthma, one that actively incorporates environmental interventions, consistent with NIH asthma management guidelines.

The Asthma Regional Council of New England (ARC), an organization of federal and state agencies as well as non-governmental organizations from around the region, is now spearheading discussions about the need and opportunity for investing in environmental interventions. When the discussions began in earnest in 2003, leaders in health plans told ARC that concrete examples of successful programs would be particularly helpful as they considered potential next steps. To that end, ARC commissioned researchers from the University of Massachusetts, Lowell (UML) to review many such programs around the country, some run by health plans, some by hospitals, provider organizations, some by community coalitions and government agencies. In phone interviews with staff and via review of written materials, UML examined ten programs in detail, exploring topics of likely interest to plans and policy makers.

The review found the following:

- real-world organizations are developing, delivering, and financing innovative, multi-faceted asthma management programs;

- these programs include home visits and other environmental interventions; and
- program evaluations demonstrate impressive improvements in quality of life and reductions in health care utilization and costs.

On the basis of the scientific literature and the examination of on-the-ground programs, three potential models were developed for the delivery and financing of environmental interventions:

- Low intensity:
  - *Delivery*: Smoking cessation services, allergy testing, education, referrals, and, if needed, selected materials and supplies
  - *Financing:* Benefits coverage, disease management, alternative sources
- Medium intensity:
  - *Delivery:* Home visit with education and environmental assessment, additional materials and supplies
  - *Financing:* NGO and/or health plan reimbursement, in-kind support, or salaried employees
- High intensity:
  - *Delivery:* Above with structural remediation and patient advocacy
  - *Financing:* Public housing and/or local health departments or NGO, health plan support (e.g., grant)

Delivery systems and payers, both public and private, could choose one or more of these models, or hybrids of all three. Ideally, all components in the three models would be available to people with asthma, and the services would be tailored to their individual needs. Internal realities, including the population served, current asthma activities, and financial incentives and disincentives all will influence an organization's choice of a model. External conditions can also either hinder or make more likely the development and maintenance of effective integrated asthma management programs. Favorable conditions and activities, which can be supported by public and private decision-makers outside a given health plan, include incentives for quality care; availability of quality services; support for collaborative studies; and Medicaid policy and research

Payers, providers, purchasers, policy-makers, patients and their advocates all have a role to play in promoting continual improvement of asthma management. In New England, several factors set the stage for a timely and promising conversation among these players about new steps they might take in that context, among them continued increases in rates of asthma in the region; recognition of the importance of environmental controls in asthma management; recent research demonstrating the efficacy of multi-faceted environmental interventions; successful real-world examples of integrated asthma management, and willingness on the part of public and private organizations in the health and other sectors to do their part. With demonstrated commitment to promoting best practices and working collaboratively, New England organizations that bear the direct and indirect costs of the asthma epidemic have the potential to make substantial headway in reducing the burden of the disease. To that end, we encourage these organizations to carefully consider the information in the pages that follow, and to explore opportunities for investing equitably and wisely in integrated asthma management.

I. INTRODUCTION

Purpose

The purpose of this paper is to provide an update about the emerging research on the effectiveness of specific indoor environmental interventions for asthma, and to draw on the experience of asthma management initiatives around the country in suggesting steps that the health sector could take to ensure that people with asthma access these interventions when appropriate. Regulators, payers, providers, purchasers, policy-makers, patients and their advocates all have a role to play in addressing environmental exposures outdoors and indoors. Our primary focus here is on the indoor home environment, on payers and on health sector policy makers whose initiatives affect the broader environment in which decisions about health care delivery and financing are made. This paper was developed for the Asthma Regional Council of New England (ARC), a multidisciplinary coalition of agency leaders across the region who are committed to addressing the environmental factors that impact asthma.

Asthma: A Chronic Disease Out of Control

Asthma is characterized by chronic inflammation of the airways that causes episodes of wheezing, coughing, and difficulty in breathing. It is among the most common diseases in the U.S. today - in 2002 the estimated prevalence rate was 30.8 million nationwide (American Lung Association 2004) and the prevalence of asthma has increased substantially over recent decades (for example, the prevalence of diagnosed asthma and asthma symptoms in children and adolescents is reported to have increased by 25-75% per decade since 1960) (Masoli et al 2004). The disease often begins in childhood and is one of the leading causes of school absenteeism, emergency room visits, and hospitalizations. Even when asthma is relatively well-controlled, it can significantly impair quality of life. Children with asthma are often reluctant to participate in sports; sleep is frequently interrupted.

The total annual cost of asthma in the U.S. in 1996 was estimated to be $14 billion (Farquhar 1998[i]), indicating that at the time the direct medical costs of asthma accounted for between 1% and 3% of all health care expenditures in the United States (President's Task Force on Environmental Health Risks and Safety Risks to Children 2000). Asthma is prevalent in the pediatric population eligible for Medicaid (Strunk et al 2002), and these children have high rates of asthma-related ED utilization and hospitalizations (Nash et al 1999). Children with asthma who have the highest health care expenses – those with inadequately controlled asthma and/or those who regularly experience acute asthma exacerbations that result in unscheduled hospital or emergency room visits - incur costs that are 28 times more than children with asthma who have the lowest health care expenses (Summer and Simpson 2001). Additionally, previously mild asthmatics can experience severe and life-threatening exacerbations.

The Essential Role of Reducing Environmental Exposures in Effective Asthma Management

Asthma is known to have both genetic and environmental components. An array of environmental factors—such as particulate matter in air, certain chemicals, cockroach and cat allergen, and environmental tobacco smoke--can trigger attacks in people who have asthma, and individuals with the disease are more likely than those without it to have allergic responses to common household allergens. Exposure to environmental allergens and irritants also contributes to chronic asthma symptoms – the exposure engenders a state of heightened bronchial reactivity which, in turn, leads to an overall increase in daily symptoms. Moreover, certain environmental exposures are known and others are suspected of contributing to the initial onset of asthma in people previously free of the disease, though much less is known about the etiology of asthma than about causes of asthma exacerbations.[ii] Exposures can occur outside, and indoors--in schools, homes and workplaces.

Because of the strong evidence that environmental factors exacerbate underlying asthma, guidelines for asthma care—among which the most widely accepted and respected are those developed by the Expert Panel sponsored by the National Asthma Education and Prevention Program (NAEPP) --include the control of environmental factors and triggers that make asthma worse.

NAEPP/NHLBI GUIDELINES FOR EFFECTIVE MANAGEMENT OF ASTHMA[iii]

Effective asthma management has four components, all of which are important.

1. Regular assessment and monitoring, including severity classification
2. Control of environmental factors and triggers that contribute to symptoms and disease severity, e.g. tobacco smoke, dust mites, mold, and cockroaches
3. Pharmacological therapy, including long-term inhaled anti-inflammatories
4. Educating the child, the family, and other caregivers to adhere to a written asthma management plan that includes daily management and how to handle acute asthma episodes

Control of environmental factors and triggers can occur through a combination of education and interventions, either by reducing or avoiding the ambient exposure (regulating certain pollutants or remaining indoors on high ozone days, for example) or by modifying the indoor environments where a person with asthma spends time (for example, environmental tobacco smoke risk reduction or pest management to reduce cockroach allergen).

Yet for a variety of reasons, the environmental controls component of asthma management guidelines tends to be less well-understood and less effectively implemented by health practitioners than the other components (Cabana et al 2004).[iv] Clinicians more frequently tend to recognize the value of the pharmaceutical components of the guidelines, perhaps due in part to the focus on pharmacotherapy in the literature and in updates to treatment recommendations. Though appropriate drug therapy is usually a necessary component and first line of defense in asthma management, it is often insufficient. Lack of attention to environmental factors and controls has led thousands of people with asthma to suffer unnecessarily from the burden of chronic asthma and/or

from acute asthma events, and accordingly, has resulted in decreases in quality of life of asthmatics and their families, as well as a substantial increase in avoidable costs from emergency room visits and hospitalizations (Flores et al 2003).

There is growing understanding of and action on the environmental aspects of asthma in some sectors. Health, housing, environment and even education agencies are beginning to tackle indoor and outdoor air exposures, though for the most part, the health sector still focuses on the medical management of the disease.

Some health professionals have been reluctant to pursue environmental interventions because of limited evidence on what works. Yet in recent years, the National Institutes of Health and others have funded robust research on the effectiveness of environmental interventions, demonstrating substantial positive impacts on symptoms, quality of life and utilization of health services. For thousands of people with asthma—including those whose asthma is in relatively good control--this new information holds great promise.

The paper is organized in five sections. After this introduction, we summarize the evidence on the relationship between indoor environmental allergens and asthma as well as on the effectiveness of indoor environmental interventions to address these triggers. Next, we present a summary of options for delivery and financing drawn from analysis of successful integrated asthma management programs being implemented around the country. In section IV, we discuss models that payers in New England could adopt to increase access to environmental interventions as appropriate. We conclude with a discussion of opportunities for public and private decision-makers to help create an actively supportive climate for these kinds of asthma management activities.

II. STATE OF THE SCIENCE ON LINKS BETWEEN ASTHMA AND THE ENVIRONMENT, AND ON THE EFFECTIVENESS OF ENVIRONMENTAL INTERVENTIONS

Links Between Indoor Environments and Asthma

A seminal report by the Institute of Medicine (IOM) in 2000, entitled "Clearing the Air: Asthma and Indoor Exposures" (IOM 2000) conducted a comprehensive review of scientific studies and summarized the evidence on associations between exposure to indoor allergens and the onset or exacerbation of asthma. The IOM classified these associations as either *causal* (evidence in this category is strong enough to conclude that an allergen or irritant causes symptoms to develop in predisposed individuals or to worsen in known asthmatics) or *associated* (evidence in this category is sufficient to conclude there is an association, but does not reach a higher standard of proof needed for causality).[v] The report results are summarized in Table 1.

Table 1. Evidence for "sufficient" and "limited/suggestive" associations between indoor environmental agents and asthma development or exacerbation

Evidence strength	Causal relationship: asthma onset	Causal relationship: exacerbation	Associated relationship: asthma onset	Associated relationship: exacerbation
Sufficient	House dust mite	House dust mite ETS[vi] Cat Cockroach	ETS	Dog Fungi or molds Nitrogen Oxide Rhinovirus
Limited/Suggestive			Cockroach	

Recent Evidence on Effective Environmental Interventions

Though the evidence base on associations between environmental exposures and asthma exacerbation is large and well-established, there has been less research in the past on the effectiveness of individual or multi-faceted interventions in reducing exposures and improving health and utilization outcomes (such as improvements in symptoms and reduction in medical encounters). In the last several years, the literature on environmental interventions has grown substantially, and results of research with major implications for policy and practice are published regularly. Our recommendations that payers and policy makers focus on indoor environments and promote these interventions—summarized in the last sections of this paper—are based on this new science, described below.

In reviewing the literature on the effectiveness of environmental interventions, it is important to keep in mind the inherent differences in the nature of this evidence versus research on effectiveness of medications. It is generally accepted among public health scientists that standards for high quality environmental health research differ from those for more traditional clinical research for a number of reasons, in particular the difficulty of fully controlling exposures to the study population. Decision-makers (e.g., in health policy) tend to rely on "weight of the evidence," in which conclusions are drawn on the basis of a collection of studies.[vii]

Environmental interventions include an array of measures aimed at reducing exposures to allergens and irritants. Some are equipment that can be purchased, such as dust-mite covers for pillows and mattresses, stand-alone air purifiers or HEPA filters on vacuum cleaners. Others are services, such as asthma education that includes information on environmental triggers, indoor environmental assessment to identify problems and solutions, or pest management to control cockroaches. A third category is structural interventions that can be more or less elaborate, usually to control pests or to eliminate or prevent conditions that support mold growth. These interventions, while potentially beneficial for health outcomes, usually have not been defined as health services, and so fall beyond the traditional scope of health insurance benefits.

<u>Review articles: effectiveness conclusions and recommendations</u>

Two recent reviews examined randomized controlled trials of environmental interventions for asthma (Brugge et al 2004, Sandel et al 2004). The reviews conclude the following:

- Intense[viii] interventions are necessary to reduce the source of indoor allergens and control or eliminate allergen exposure (Sandel et al)

- In general, intense, multi-faceted (e.g., use of mattress covers as well as removal of carpet), rather than single interventions are necessary for stronger positive effects on health outcomes or allergen levels (Sandel et al)
- Air filtration (e.g., use of air purifier) and dust mite control, implemented as individual interventions, may result in small improvements in health outcomes (Brugge et al); subsequent meta-analysis by Cochrane et al found that evidence is insufficient to conclude that dust mite control alone is effective (Gotzsche et al 2004)
- Education, case management, and smoking cessation activities result in moderately[ix] improved health outcomes (Brugge et al)
- Structural modification or rehabilitation of housing leads to some improvement in health outcomes (Brugge et al)

Brugge et al did not find a sufficient number of quality studies to determine the effect of pest management strategies on asthma-related health outcomes; however, as cockroaches and other pests such as mice are the source of allergens that can exacerbate asthma, control of these pests is an important consideration for asthmatics affected by these allergens. Traditional methods of pest control include volatile and toxic insecticide sprays for roaches and strong poisons for rodents, and are costly, ineffective over time, and dangerous (for example, some chemicals in pesticides can exacerbate asthma). Integrated Pest Management (IPM), which uses pest monitoring, environmental controls, mechanical capture, and targeted applications of small amounts of low-volatility, least-toxic pesticides is a safer and more effective method of pest control. IPM techniques are increasingly used in environmental intervention programs for asthma.

Randomized controlled trials – evidence for multi-modal interventions

Recent research has attempted to overcome the limitations of intervention strategies that focus solely on decreasing exposure to a single allergen, rather than improving the indoor environment as a whole. For example, a single intervention may reduce levels of house dust mite allergen, but without addressing the other environmental triggers relevant to the patient's asthma, symptoms will persist and health outcomes may not improve. Randomized controlled trials of multiple, or multi-modal interventions include those investigating the effects of education combined with an in-home visit, environmental assessment and/or provision of the environmental supplies as needed for the patient's specific allergies. The intervention can also include a clinical component.

The three clinical trials of interventions focusing on more than one environmental factor reviewed by Brugge et al showed positive health outcomes. The most ambitious and important recent research on these multi-faceted interventions is the Inner City Asthma Study (ICAS), a randomized controlled trial conducted in seven US cities, results of which were recently published in the New England Journal of Medicine (Morgan et al 2004).[x] The ICAS study design built on a previous inner city pediatric environmental intervention research project, the National Cooperative Inner City Asthma Study (Kattan et al 1997, Evans et al 1999).

The ICAS implemented and evaluated a comprehensive in-home environmental intervention for inner-city children with asthma.[xi] The intervention was comprised of an in home environmental assessment followed by an intervention tailored to the specific sensitization and exposure profiles of the study subjects, as determined through allergy

testing and evaluation of environmental characteristics in the home (Crain et al 2002). As appropriate, the child received education and remediation services provided in the home in modules that focused on remediation of exposure to dust mites, passive smoking, cockroaches, pets, rodents, and mold. The results of the study showed that the tailored multi-modal environmental intervention resulted in decreased exposure to indoor allergens and significant decreases in asthma-associated morbidity. The intervention group had significantly fewer symptom days and unscheduled asthma-related ED or clinic visits;[xii] less disruption of caretakers' plans; less loss of sleep among caretakers and children; and fewer school days missed.[xiii]

In addition to the studies of the impact of structural interventions reviewed and summarized by Brugge et al, promising research results on higher intensity environmental interventions have come from Healthy Homes projects across the country. Healthy Homes initiatives, often sponsored by the U.S. Department of Housing and Urban Development (HUD), aim to identify and control health hazards in high risk, low income housing. Several projects have evaluated home-based interventions for asthma, with most focusing on the reduction of environmental allergen levels.[xiv]

The Healthy Homes initiative in Seattle and King County Washington, for example, has studied interventions of varying levels of intensity. Results of a series of home visits and equipment delivered by community health workers (CHW) at two levels of intensity (one group received more visits and more supplies) were compared. Visits included an assessment of exposures; education; development of an individualized action plan; and provision of trigger control resources (bedding covers, low-emission vacuum cleaner with dirt finder sensor, cleaning supplies [green kit, mop, pail, scrub brushes, bleach], etc.) (Krieger et al 2002). The intervention resulted in reduced asthma symptom days and improved quality of life for caretakers in both groups, though quality of life and utilization of health services improved more substantially in the higher intensity intervention group. Urgent care costs (hospital admissions, emergency department visits, and unscheduled clinic visits) were less in the high-intensity group relative to the low-intensity group (Krieger and Takaro 2004).

A new study of the same population is assessing the impact of adding low-cost housing physical remediation strategies (e.g., improved ventilation, removal of carpet, elimination of water intrusion, with repair costs averaging $3,000) to the home visit intervention by community health workers described above.[xv]

This recent research on environmental interventions, as well as forthcoming publications of ongoing studies, provides useful information about both specific environmental interventions and approaches to environmental controls that providers, payers, and policy makers can incorporate with increasing confidence into existing asthma management activities.

Cost and Cost-Effectiveness of Environmental Interventions for Asthma

The published literature on cost-effectiveness of intervention programs—information which payers (justly) often say they must have to support decision-making—remain

somewhat limited, though several reviews and analyses indicate that environmental interventions for asthma can be cost effective.[xvi]

- Brugge et al (2004) reviewed the state of the literature (as of June 2003) on cost-effectiveness analyses for several environmental, educational and case management interventions for asthma. The authors determined that while limited, the available research "suggests that environmental/educational interventions can be cost-effective approaches for improving the health status of patients with asthma, particularly when targeted at those with more severe asthma." (p.266-7[xvii])
- Brugge et al's review included the cost effectiveness analysis of the home visit-based, individually tailored intervention delivered in the National Cooperative Inner City Asthma Study (NCICAS[xviii]), which preceded the Inner City Asthma Study described earlier. The study found that compared to usual care, the intervention significantly improved outcomes for a "relatively modest overall increase in costs" – an average additional cost of $9.20 per symptom-free day gained[xix] (Sullivan et al 2002). Moreover, in the subgroup of the study population with more severe asthma, the intervention was considerably more effective and achieved cost savings.
- A comprehensive cost-effectiveness analysis of the recent Inner City Asthma Study has not yet been completed, but preliminary results suggest that the $1,500 to $2,000 two-year cost (per child) of the multi-modal intervention resulted—as noted above--in a reduction in school absences and in unscheduled office visits. The cost for a given number of symptom-free days was comparable to that of corticosteroid therapy (Sheffer 2004).
- A preliminary cost analysis of the Seattle Healthy Homes CHW intervention found that the high intensity intervention may be cost saving relative to the low intensity intervention – the marginal cost of the high intensity intervention was higher than the low intensity intervention and the high intensity intervention resulted in savings in urgent care costs (Krieger and Takaro 2004).

Later in this paper, in the section on real-world case studies, we summarize additional information about cost and cost-effectiveness in practice, showing substantial cost-savings from multi-modal asthma management programs operating around the country.

Consensus on the Importance of Environmental Interventions for Asthma

As noted in the introduction, environmental interventions for asthma are one of four priority elements of the NAEPP national asthma management guidelines. The Guidelines (and companion documents summarizing key clinical activities for quality asthma care[xx]) provide detail about effective environmental control measures, including a strong recommendation to assess exposure sensitivity to specific allergens in people with persistent asthma (persistent classification is based on history of asthma symptoms and measurements of lung function). The Guidelines state that the only way to determine the effect of sensitivity to specific indoor allergens is to test patients for sensitivity to the allergens to which they are exposed and then assess the clinical relevance of the sensitivity. Experts who developed the national Guidelines suggest that allergy testing--which identifies specific IgE antibodies to the allergens to which a patient is exposed--is essential to justify the expense and effort involved in implementing environmental

controls (NHLBI 1997). The Guidelines also note that no patients with asthma should smoke or be exposed to environmental tobacco smoke (Williams et al 2003).

Several other national initiatives and consensus statements regarding asthma have been developed in the past five years, all of which reference the Guidelines for effective asthma management and/or explicitly address the importance of the environmental aspects of asthma.[xxi] A 2000 federal government strategy developed by the Environmental Protection Agency and the U.S. Department of Health and Human Services (which includes the National Institutes of Health, the Centers for Disease Control and Prevention, the Health Services Resources Administration and other agencies that commit substantial funds to asthma) notes the importance of environmental factors in asthma onset and exacerbation, and the critical role of environmental interventions (President's Task Force on Environmental Health Risks and Safety Risks to Children 2000). It states that neither medical management nor environmental interventions should occur independently, but rather that optimal care is integrated asthma management with clinical and environmental components. "Environmental action," the report states, "along with medical care, will help children with asthma live productive, active lives and may spare future generations of children from the disease altogether." (p. 11)

Three other national efforts are of particular relevance to this paper. The Centers for Disease Control and Prevention (CDC) developed sample language for purchasers to use in negotiating benefits for their employees. CDC suggests that benefits should include both asthma-related health education services (in which information is provided on environmental factors that worsen asthma) and reimbursement for tobacco-use counseling programs.[xxii] America's Health Insurance Plans (AHIP) has recently initiated a program called Taking on Asthma to support health plans and insurers as they design and offer comprehensive care management of asthma. The program, sponsored in part by EPA, has a particular emphasis on defining comprehensive care management to include management of environmental asthma triggers.[xxiii] Last, the Center for Health Care Strategies[xxiv] has developed a toolkit that offers a structured approach for health plans (specifically Medicaid managed care plans) to address quality improvement in the delivery of asthma care. The toolkit includes a description of intervention strategies to achieve better care for asthma based on experiences of the plans who participated in their Best Clinical and Administrative Practices (BCAP) Achieving Better Care for Asthma workgroup; interventions include the training and use of community health workers to conduct home assessments and provide guidance on asthma trigger abatement (Barta and Martin 2002). The results of the recent science described above strengthens the evidence base for these recommendations.

Consensus among prominent asthma researchers, practitioners and other health sector decision-makers is that the results of studies described above, combined with practical medical knowledge about the management of chronic disease, suggest that integration of environmental interventions with education and clinical components comprise best practices for asthma management. They suggest that in-home asthma education and tailored environmental interventions are cost-effective, and should be components of asthma management for asthmatics sensitized and exposed to environmental allergens whose asthma symptoms keep them from living healthy, active lives. Despite this

national consensus, health payer payment policies do not yet reflect these recommendations.

III. CASE STUDIES IN DELIVERING AND FINANCING COMPREHENSIVE ASTHMA MANAGEMENT

In recognition of the steep rise in asthma rates – and consistent with national guidelines on standards for asthma care -- health plans, hospitals, provider organizations, community coalitions and government agencies across the US are exploring how to reduce asthma triggers and improve the quality of asthma management programs. On their own or more often in partnership, these types of organizations are delivering and financing comprehensive asthma management programs that include, to varying degrees, environmental interventions. We reviewed many of these programs, and selected ten that have taken a range of approaches to promoting environmental interventions; some more and some less ambitious. In phone interviews with staff and via review of written materials, we explored topics we think will be of interest to plans and policy makers as they consider how to promote expansion of asthma management programs to include environmental components.

The sponsors of the ten programs we reviewed vary in size and structure, from health systems with multiple hospitals and physician practices, and in one case the local health department and a managed care plan, to individual managed care organizations to a coalition of sixteen organizations implementing an asthma management program at three pilot sites. Numbers of people with asthma in the programs range from less than 100 to 90,000. All the programs are unique and inspiring. Appendix A compares and contrasts their characteristics. Below, we explore themes that emerge when looking at the programs as a group: themes regarding their motivation for establishing their programs; the choices they made about what mix of services and supplies to provide; how they have sought to pay for their activities, and the results they have achieved.

The motivation for many of the organizations was data—often from a patient registry—showing high numbers of emergency room visits or hospitalizations. The initial focus of the asthma management programs in these organizations was on those patients whose asthma was inadequately controlled. For the organizations structured in such a way that they will directly realize cost effectiveness (i.e., the selected intervention would achieve a benefit of decreased utilization), targeting the population of patients who "over-utilized" the hospitals made sense, both from a quality of care and financial point of view. Several organizations do not limit their interventions to patients whose asthma is inadequately controlled, recognizing that large numbers of individuals suffer with the disease—with the quality of their lives substantially impaired--even though they do not use the emergency department and are not hospitalized. These plans provide education on environmental triggers for all asthmatics in their population. The inspiration for several other programs came from concern about multiple risks, among them asthma, for low income families living in poor quality housing. One program had in mind scrutiny by accrediting agencies such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO).

Most organizations designed their own programs, based on research and evaluations of similar programs. The degree of investment in the interventions varies—from low-cost phone communications and basic supplies to multiple in-home visits and structural remediation of home environments.

Figure 1 shows the range of possible environmental interventions described earlier in this paper, and groups them in three categories of "intensity," by which we mean the extent to which an intervention is multi-modal; is tailored to the particular patient and her environment; and targets environmental factors. The scheme is intended to display the various types of activities and services that can be included as part of a tailored, integrated asthma management approach for an asthmatic sensitized and exposed to environmental allergens. It is not intended to correlate with the severity classification – so that a particular model is considered appropriate for patients with a particular severity classification. As many asthmatics who have not been classified as having inadequately controlled asthma still suffer from the burden of environmental triggers, the tailoring of the interventions to the individual patient's condition and environment is paramount, and is the clinician's responsibility. Allergy testing is a fundamental first step in determining which interventions are appropriate, and is recommended for all persons with persistent asthma.

Environmental supplies and remediation activities, such as dust mite impermeable mattress and pillow covers, vacuum cleaners with high-efficiency particulate air (HEPA) filters, and integrated pest management activities, span the intensity spectrum because they can be provided to the patient in conjunction with education provided in the clinic or via phone (Low intensity) or instead implemented and demonstrated in the home environment (Medium to High intensity). Dust mite mattress and pillow covers and HEPA air purifiers are displayed at the low end of the spectrum because they could stand alone without educational programs, and are often delivered without knowledge of the patient's particular allergy profile. (In the case of dust-mite covers, the practice of providing covers without knowledge of sensitivity to dust mites is controversial.) Structural remediation, including closing holes and access points for cockroaches, fixing leaks and improving ventilation systems, for example, could be done without the other activities, but it tends to be an element only of the most comprehensive interventions.

Figure 1: Environmental interventions for asthma: range of intensities

<--- -----**Low** ----- ->			**Medium** ---------->		**High**
Education addressing environmental triggers, in clinic or on phone	Smoking cessation services	Referrals to other programs and resources	Education addressing environmental triggers, in home	In-home environmental assessment	Structural remediation
←HEPA air purifier; dust mite-proof mattress and pillow covers----------			Additional environmental supplies and remediation activities (e.g., IPM)		----------→

By and large, the most intense or ambitious programs among the ten we reviewed involve several organizations, and each organization's responsibilities reflect its mission. Healthy

Homes programs, not health plans, provide structural remediation in homes that require it; home health agencies or visiting nurses associations—often trained specially for the particular asthma management program--conduct the in-home asthma education and basic environmental assessment, for example. Multi-faceted programs usually rely on a case manager or other point-person based in the plan who has an individual relationship with the patient and can track her needs and compliance.

Most of the programs incorporate home visit activities, and others intend to incorporate them as funding permits. The services provided during the home visit range from education about medical and environmental factors relevant to self management, to environmental assessment following a specific protocol, with subsequent education and remediation planning and/or implementation. Providers include respiratory therapists, nurses and community health workers. Most programs contract with an independent organization to provide these services. Some of the most effective of these are community-based organizations, whose strong relationships with families and familiarity with local resources enables them to provide culturally appropriate services, often at very low cost.

Each of the ten programs has found various ways to finance its activities. Some use funds from capitated payments to pay the salaries of asthma educators. Others contract with non-governmental organizations or home health agencies, on a fee for service basis. Some programs benefit from specific policies in their state: in Maine, for example, providers can refer patients to Open Airways educational sessions, paid for by the state Medicaid program. The most stable source of funding appears to be global capitated payments under Medicaid managed care contracts that can be used at the discretion of the plan. Only one of the programs relies exclusively on grant monies, though half of the programs depend partially on grant funding to finance the environmental intervention component of asthma management activities.

Innovative funding mechanisms included:

- Pooling of funds from delivery system, hospital, and health plans to support a community asthma educator
- Use of funds from provider risk sharing or other health plan contracts to finance a provider-based care manager who plays a role in asthma management (and in one case, could provide the home visit service)
- Use of existing benefits codes (e.g., “health and behavior” codes) to reimburse for asthma education (in clinic) and home visit services.

Results from these varied programs--though not often derived from a robust research design with suitable control groups—are impressive. Not all of the ten programs have been evaluated, but those that have demonstrate twofold reductions in emergency room visits; substantial decreases in hospitalizations; and reduction in costs of health care services for an individual child over the course of a year, etc. (i.e., Axelrod et al 2001). The consistent patterns of cost-effectiveness and cost savings shown in the evaluations of these real-world programs debunk the assumption that the costs of multi-faceted programs involving home visits will be prohibitive.

IV. NEXT STEPS FOR PAYERS, PROVIDERS, AND PURCHASERS IN IMPLEMENTING INTEGRATED ASTHMA MANAGEMENT IN NEW ENGLAND

Practices and Perspectives of New England Payers

Motivated in part by the national activities mentioned above, as well as recognition of the potential for collaboration between health departments and managed care to achieve results in reducing the burden of chronic disease, the New England Public Health and Managed Care Collaborative (NEPHMCC)[xxv] convened a work group to address the management of pediatric asthma. The 50-member NEPHMCC Pediatric Asthma Work Group developed recommendations in June 2000, entitled "Children with Asthma Can Lead Fully Active, Normal Lives." These recommendations highlight the commitment of leading health organizations in New England to promote and finance best practices, defined as integrated asthma management, including environmental components such as home-based services and supplies as appropriate. Following the publication of the report, the group focused on one of the recommendations: the dissemination of near-identical forms for individual written asthma management plans for patients across health plans and throughout the six New England states. This initiative has been successful: written asthma management plans for children are far more prevalent than they used to be, and their triplicate format is nudging clinicians and families to include the school nurse as an equal partner in the asthma team. The other recommendations—which include ensuring that components of best practices are covered in benefits packages, as well as action in schools—received less follow-up attention by the Collaborative, though individual plans and health departments have moved forward in these areas.

In the spring of 2003, on behalf of ARC, we conducted interviews with health plans around New England, many of whom had been involved in the development of the NEPHMCC asthma recommendations. Our purpose was to better understand payers' activities and perspectives regarding environmental interventions for asthma. Perhaps the most important finding of this research was the diversity of understanding and perspectives on environmental aspects of asthma and the appropriateness of including environmental interventions in benefits packages. Opinions included:

- Asthma management programs should emphasize appropriate pharmacotherapy; environmental interventions hold less promise for reducing exposures and preventing asthma attacks.
- A high priority should be placed on identifying and supporting the implementation of effective environmental interventions.
- Environmental interventions are important but it is inappropriate for plans to pay for many of them—especially those requiring the use of equipment and supplies that are not medical in nature.

Benefits packages reflected this diversity of opinion on environmental interventions. All but one of the nine plans said they would reimburse for an in-home visit with an asthma educator if asked to do so (e.g., by the patients' physician or case manager). Four of the nine plans do not pay for any equipment or services aimed at reducing environmental exposures.

Many of these New England payers expressed willingness to cover the costs of some in-home activities, but they also acknowledged that even the moderate to severe asthmatics they cared for were not receiving in-home services or equipment on a regular basis. Though some plans were initiating planned care approaches (evidence-based models of effective care delivery[xxvi]) to asthma, most of them--with several notable exceptions—were not intending to include in-home services and supplies as important components of their asthma management programs. Furthermore, most plans reported that providers and purchasers were not requesting that environmental supplies and referrals to in-home services be available to patients.

Building on the "will" reflected in the New England Public Health and Managed Care Collaborative Asthma Recommendations, New England payers, providers, and purchasers have the opportunity to focus on the "way." Determining the appropriate mix of strategies to remediate environmental triggers is not simple, but the recent science on environmental interventions provides strong evidence for a tailored, multi-faceted approach. Financing such interventions can be complicated, but our review of successful programs in the previous section, combined with the growing body of research, suggests that it is feasible—and that both individual plans and other constituencies have a role.

Characteristics of Delivery and Financing Models for Environmental Interventions of Varying Intensity

Using elements of the case study programs as well as results from research, we have developed potential models for the delivery and financing of environmental interventions at Low, Medium and High levels of intensity (see Figure 1 above). Depending on structural incentives and disincentives, the population served, relationships with organizations that could provide in-home services, etc., delivery systems and payers (both public and private) may choose to use one or more of these models, or hybrids of all three. Ideally, all components in the three models would be available to people with asthma, and the intensity of services would be tailored to their individual needs.

Some elements of these models will be appropriate for all asthmatics who are not in control of the environmental factors that worsen their asthma. Those with inadequately controlled asthma as measured by emergency room visits and/or hospitalizations or those classified as severe persistent asthmatics will likely require the more intense intervention to achieve control of the environmental triggers. Regardless of the level of intensity of intervention that a plan is willing to make available, the case studies and results of research suggest that a cornerstone of effective asthma management is care coordination: an individual case manager or coach who develops a relationship with the patient, tracks symptoms, compliance with medications, utilization of services, etc., and helps them access services and providers they need, including allergy testing and environmental interventions.

Environmental Intervention Models

Characteristics of the delivery and financing of environmental interventions at Low, Medium, and High levels of intensity are as follows:

Low Intensity

Delivery:

- Smoking cessation services and pharmacotherapy are offered to asthmatics who smoke and/or their immediate family members and other individuals whose smoke in their presence.
- Allergy tests are performed as necessary, and patients are educated about the results and about evidence-based interventions for avoidance or remediation of the relevant triggers.
- Education addressing environmental triggers is provided, in the clinic or on phone. This activity can be delivered by case managers, asthma educators, clinic staff, or other trained health workers. The environmental components of existing or newly developed asthma education should be reviewed to ensure their value and efficacy. For example, a detailed, intense module on environmental trigger reduction can be included within an overall asthma education program.[xxvii]
- Referrals to other programs and resources are provided (e.g., to community social services).
- Depending on results of allergy testing, access to materials and supplies required for environmental control (e.g., dust mite mattress and pillow covers) is facilitated.

Financing:

- The costs of smoking cessation programs for enrollees with asthma who smoke, and/or for enrolled family members and caregivers who smoke in their presence, are covered by health plans. If the program is not reimbursed (e.g., because the family member is not a health plan enrollee), a referral to the program and education on environmental tobacco smoke avoidance strategies is offered.
- Allergy testing is generally reimbursed. Payers can work with providers to ensure that allergy tests are performed as necessary.
- Many health plans have in-house disease management programs or contract out such services. Programs work to ensure that case management and/or education staff are trained to deliver education addressing environmental triggers (along with other aspects of asthma management) and have the appropriate resources for this education and for referrals to other programs and resources (e.g., to community social services).
- Time spent on education, if not included already in case management services, is reimbursed (e.g., through developing a billing code for reimbursement of educational services) or patients are referred to asthma education programs funded by alternative sources (e.g., public health department programs).
- HEPA air purifiers and dust mite-proof mattress and pillow covers are covered benefits for at-risk asthmatics, or families in need of financial support are referred to programs offering these materials for low or no cost. Depending on the characteristics of the asthmatic population, reimbursement can be contingent on allergy test results.[xxviii]

Medium Intensity

Delivery: In addition to smoking cessation, allergy testing, clinic or telephonic asthma education, referrals to other resources such as community social services, and materials

for at-risk asthmatics, the medium intensity intervention highlights home visits to help patients learn how to effectively manage their asthma by teaching and reinforcing medical and environmental management techniques. These visits can be delivered by one of several types of health care providers ranging from trained lay health workers to respiratory therapists. Home visits should include one or both of the following:

- Education addressing environmental triggers, similar to the education described in the low intensity intervention.
- In-home environmental assessment following an established protocol. Such assessments can also be delivered by industrial hygienists or other environmental health professionals. Results of the environmental assessment should be communicated to all members of the care team and efforts should be made to develop a remediation plan to address the relevant environmental factors (such efforts can be made during in-home education sessions).
- In addition, materials and supplies (beyond mattress and pillow covers and air purifiers) required for environmental control are provided to the asthmatic patient. Some home visit services may include these materials (i.e. the home visit includes provision and demonstration of a high filter vacuum cleaner) while in other cases the materials are recommended during the home visit, accessed independently, and then reviewed during a subsequent visit.

Financing: Home visits can be supported through non-governmental organization or community based organization funding and/or through financing mechanisms which allow for:

- reimbursing provider organizations (visiting nurse agencies, home health service providers, community health workers, non-governmental organizations, public health departments, etc.) directly for the services provided
- providing financial or in-kind support to provider organizations (e.g., reimbursing a program that also receives grant funding or providing grant funds, education materials, or programmatic support to the development and implementation of a home visit program)
- providing in-home services using salaried plan employees

As in the low intensity intervention, time spent on asthma education activities is reimbursed.

<u>High Intensity</u>

Delivery: The highest intensity environmental intervention for asthma adds structural remediation to the other components mentioned above (allergy testing; smoking cessation; home visit with environmental assessment; asthma education activities; and referrals to other resources such as community social services). This intervention is usually provided by a local public housing department or a non-governmental organization that assists low-income homeowners or renters in improving their living conditions. Other relevant activities that promote structural improvements include advocacy efforts to improve housing conditions and health, such as direct legal assistance in the clinical setting to families who have problems relating to housing,

public benefits, domestic violence, immigration, etc., and training of physicians to incorporate advocacy on such issues as part of the treatment plan[xxix]. Delivery of the high intensity intervention generally benefits from increased coordination and communication among the multiple organizations that tend to be involved—especially health plans, providers, families, and other agencies.

Financing: Public housing departments and non-governmental organizations rely on grants and in-kind support to fund their structural improvement efforts. Health plans can also support these efforts through grant funding, collaboration and advocacy (e.g., advocating for increased public housing department funding). The partnerships created in planning and implementing activities at this level of intensity can also promote and benefit from sharing the risks and costs and pooling the savings that accrue.

V. CREATION OF AN ACTIVELY SUPPORTIVE CLIMATE FOR INTEGRATED ASTHMA MANAGEMENT IN NEW ENGLAND

The characteristics of delivery and financing of environmental interventions described in this paper present a challenge to all health sector partners – payers, providers, employers, other purchasers, and enrollees: how can such services and materials best be adapted to an individual delivery or financing setting, which has specific provider relationships, financing structures, and population characteristics, and which may combine multiple roles, such as payer and provider? Given a delivery or financing organization's unique capacity and constraints, steps taken by any one delivery or financing organization to develop or expand integrated asthma management programs will also be unique. However, public and private decision-makers outside a given health plan can help create an actively supportive climate for the kinds of asthma management activities that are the focus of this paper.

In this final section, we describe conditions and activities that would enhance the likelihood that existing payer financing and delivery structures will develop and maintain effective integrated asthma management programs that include environmental controls.

A. Incentives for Quality Care

Quality health activities, defined as primary and preventive care, have several important potential benefits, including return on investment for health plans, and economic and social benefits for the patient, the government, and society at large.[xxx] Quality care is more likely when incentives are aligned -- driving those responsible for delivering and for paying for care in the same direction. It is most likely that payers will cover preventive measures such as environmental controls if they anticipate improved clinical outcomes, net savings and/or market advantage; most likely that purchasers of health insurance will place a high priority on preventive services—and create market advantage for a payer offering benefits for preventive services--if they are convinced that their employees will be healthier (and more productive); and most likely that providers will take the time to provide preventive services, resulting in healthier workers, if they are reimbursed for such services. This simplistic description of alignment of incentives does not factor in the high priority that many payers, purchasers and providers place on

delivering and financing high quality care simply because it improves patients' quality of life. Nonetheless, structuring explicit incentives for all involved to work in the same direction, rather than at cross purposes, is important in making decisions that affect the broader policy arena in which health care delivery and financing decisions are made.

The following organizations could take actions that would begin to align incentives towards delivery and financing of integrated asthma management, including environmental controls.

- State Medicaid agencies: State Medicaid agencies are able to provide effective environmental interventions through an amendment to their state plan or via a waiver, depending on the intervention and/or financing and delivery structure (fee for service [FFS] or managed care) of interest. State Medicaid agencies could work with other state agencies such as housing or public health and with provider organizations to determine the role Medicaid might play in funding environmental interventions.
- State Public Health agencies: Most states have asthma programs that could support research, analysis and dissemination of information about environmental interventions and effective integrated asthma management.
- Federal agencies: The Centers for Medicare and Medicaid Services (CMS), the Federal agency within the U.S. Department of Health and Human Services (HHS) that administers Medicare, Medicaid, and the State Children's Health Insurance Programs, could consider facilitating state Medicaid agencies' abilities to fund environmental interventions. The Health Resources and Services Administration (HRSA), whose Bureau of Primary Health Care (BPHC) has been a leader in supporting innovative asthma management and environmental interventions, could further strengthen its emphasis on environmental aspects of asthma—based on the new research—and expand its work to all community health centers in the region. With appropriate funding, community health centers could serve as resources for plans and other parties needing information and assistance in in-home environmental assessments and education. HRSA and the Agency for Healthcare Research and Quality—which have collaborated on health center practice-based research networks—might consider funding pilots for delivery and financing of integrated asthma management in New England.
- Commercial managed care: Commercial managed care often follows the lead of Medicaid regarding decisions about what services to allow and financing and delivery structures. Purchasers and providers could work with commercial managed care organizations to develop a list of appropriate services to be provided under the capitated (or, more typically, the combined capitated and FFS) rate(s). In managed care organizations (both commercial and Medicaid), contracts between the plan and provider can incorporate performance-based incentives for provision of appropriate care. Initiatives to "pay for quality" are increasingly being incorporated into managed care arrangements with providers, and could be applied to integrated asthma management as well.
- Commercial fee for service: Commercial FFS health plans typically have fewer restrictions than Medicaid does on their FFS products and thus can be more independent and responsive with the types of services and providers they will reimburse.

- Providers: In negotiations with health plans and other payers, providers and provider organizations can commit to delivering effective services based on national guidelines and "best practice" standards of care, advocate for reimbursement of those services (some health plans and payers are strongly influenced by provider requests for coverage of a service or material), and support pay-for-performance incentives that reward providers for high quality care. To the extent that large provider networks are able to benefit from cost savings associated with improved clinical management, those same provider networks could agree to share the risk, with their payer partners, of investing in effective home-based environmental interventions.
- Employer/Purchaser: Purchasers of health insurance are concerned about the cost of health services. They also strive for a healthy and productive work force with minimal lost workdays from illness or caring for a sick family member. Purchasers can work with health plans to ensure that in-home services and materials are covered, taking into account costs and savings of the intervention.
- Enrollee: Enrollees have varying degrees of control over the costs and content of their health care benefits packages, depending on the type of health plan they choose. Enrollees can advocate for certain benefits packages that contain the services, materials and personnel needed for effective asthma management. Those with employer-based coverage can encourage their employers to incorporate such benefits, particularly when increased employee productivity (e.g., via fewer missed work days for caring for an asthmatic child) is possible as a result.

B. Availability of Quality Services

In order to be willing to reimburse a provider, a health plan (public or private) must have confidence that the provider has the appropriate training for the services they will provide. The National Asthma Education Certification,[xxxi] established recently (2002) and certification programs for community health workers are ways to assure the health plan that the provider will deliver appropriate asthma education and/or in-home services. Certification programs are currently being offered in New England;[xxxii] a regional or state entity such as ARC or the state Lung Associations could promote and coordinate such programs to support increasing the availability of trained providers. Community health workers have been shown to be particularly well suited for in-home environmental intervention activities because they often share common cultural backgrounds and have relationships with people in the neighborhood. Community health workers' knowledge and understanding can bridge the historically wide gap between the patient and health agencies/institutions, and generate respect for and trust in the services they provide.

The components of an appropriate in-home environmental assessment can be derived from research results. Translation of this research into an educational or guidance document or module (building on those that have been developed thus far[xxxiii]) would help ensure that staff of home health agencies (including visiting nurse associations), which provide other types of home health services, can be trained to deliver effective environmental assessments and guide patients in environmental intervention activities.

C. Research Projects and Public-Private Collaboration

Research projects often do not address the specific questions, populations, and/or characteristics that are relevant to 'real world' players, which include payers, purchasers and providers, and it is often difficult to translate research into existing asthma management activities. In turn, to answer a range of research questions, researchers are interested in using the rich data on asthma patients held by health plans. Grant funding could support collaboration between researchers and payers to enhance the quality and relevance of research, as well its translation.

To generate a deeper understanding of the links between asthma and the environment, health plans, providers, environmental researchers and public agencies could collaborate to design research and compile relevant data on environmental exposures, the effects of such exposures on asthma, and associated costs. Increased communication and new partnerships could improve the quality and applicability of research even without new sources of funding. An improved research agenda that uses shared data and promotes research relevant to health care decision-making would be of tremendous benefit to researchers and health plans alike.

D. Medicaid Policy and Research

As noted under A. above, state Medicaid agencies can develop arrangements to facilitate coverage of all necessary services for effective asthma management, including environmental interventions. For example, state Medicaid agencies have requested waivers from the federal Center for Medicaid and Medicare Systems to make possible the use of managed care in administration of Medicaid benefits. Research and demonstration waivers are those that allow state Medicaid programs to investigate the use of a service or provider that has not traditionally been approved by Medicaid. These waivers could be used for piloting environmental controls; for example, investigating the use and impacts of integrated pest management or testing the efficacy of community health workers.

VI. CONCLUSION

Reviewing the landscape of asthma issues in New England gives us great hope that payers, providers, purchasers, policy-makers, patients and their advocates can make substantial inroads in decreasing the burden of asthma and reversing the asthma epidemic, creating a new climate for environmental intervention and controls. The following realities are the context for a timely and promising conversation about enhancing delivery and financing of integrated asthma management in New England:

- continuing increases in rates of asthma in New England, which are among the highest in the country;
- recognition that environmental controls are a critical component of asthma management but are not explicitly incorporated or supported in most asthma management initiatives;
- recent research findings demonstrating that environmental interventions are effective;

- multiple examples of real-world programs implemented by health plans and other partners that blend in-home education with environmental assessment and interventions in integrated asthma management, resulting in improved health and, in some cases, cost savings;
- commitment of relevant local, state, and federal agencies to do their part in reversing the asthma epidemic; and
- willingness on the part of a number of health plans in New England to consider incorporating in-home visits and environmental control materials into their strategies and programs, provided that evidence of effectiveness—both in terms of health outcomes and costs—is sound.

With a commitment to improving quality of care for asthma and to developing partnerships and collaborations which will foster that improvement, we invite the New England health care sector partners who are bearing the costs of the epidemic -- directly and indirectly -- to carefully consider the information in this document, and to explore opportunities for investing equitably and wisely in an integrated management approach to asthma, one that actively incorporates environmental interventions.

Appendix A. Case Study Characteristics

Program	Organization type and location	Population addressed* and size of asthmatic population	Medicaid	Asthma management services	Environmental intervention services (additional)	Environmental intervention Provider Type	Financing characteristics
A	Non-profit health plan, Michigan (mix of urban, suburban, rural)	Adults and children, approximately 10,000 total asthmatics	Medicaid managed care; also commercial products	Health plan case management for high risk asthmatics	Home-based case management with environmental assessment for high risk asthmatics with most significant needs (approximately 1,000 members). Up to 18 visits	Non-governmental organization (NGO) staff [RT or RN, Certified asthma educators]	Health plan contract with NGO for home visits; reimbursement per visit; NGO program also funded via grants
B	Health care system (hospitals, primary care practices, public health department, Medicaid managed care health plan), Massachusetts (urban)	Children, 1,400 total asthmatics	Approximately 75% state funded (includes Medicaid)	Planned care program, asthma registry as foundation; all asthmatics	Home visit with medical and environmental information, education, assessment, and intervention	Public health department Healthy Homes program	Grants, hospital funds, public health department funds (include grant and core funding; cover cost of materials)

*in environmental intervention activity

Program	Organization type and location	Population addressed* and size of asthmatic population	Medicaid	Asthma management services	Environmental intervention services (additional)	Environmental intervention Provider Type	Financing characteristics
C	Integrated delivery system (hospitals, primary care practices, physician hospital organization, home care agencies), Maine (suburban and rural)	Adults and children, 90,000 total asthmatics	Primary payers - Medicaid and Anthem	Education and case management for moderate and severe persistent asthmatics; Community-based asthma education and management (more targeted care for asthmatics in poor control/at risk)	Home visits with environmental assessment and education (very infrequently used)	Home visits tend to be delivered by home health agency-based care managers; could be delivered by PHO-based care managers	PHO-based care managers funded by PHO; community educators partially (1/3) funded by health plan (via per visit reimbursement), remainder of funds from hospitals and MaineHealth
D	Collaborative effort; community primary care settings were the three demonstration sites, California (urban)	Low-income children, 900 asthmatics received program services as of May 2004	Medicaid and uninsured	Medical/social planned care model (1 year clinic and home intervention)	2-3 asthma clinic visits interspersed with 1-3 home visits. Home visits include education, environmental assessment, development of remediation plan	Home visits delivered by community health workers (who also worked in clinic)	Grant funding (covers cost of materials)

*in environmental intervention activity

Program	Organization type and location	Population addressed* and size of asthmatic population	Medicaid	Asthma management services	Environmental intervention services (additional)	Environmental intervention Provider Type	Financing characteristics
E	Hospital-owned Medicaid managed care health plan, Missouri (mix of urban, suburban, rural)	Adults and children	All Medicaid; environmental assessment services also available to commercial population	Health plan case management for at-risk asthmatics; health plan physician work with providers to promote improved asthma management	Psychosocial assessment and screening for environmental exposures for all asthma patients receiving care at the hospital. In depth home assessment with visual inspection and sampling	Home visits delivered by hospital environmental health staff	Health plan reimburses for home environmental assessment services; non-health plan members can obtain assessment services via other insurance or out of pocket funds; assessment services also have grant funding
F	Health plan including Medicaid HMO and commercial managed care products, Virginia (mix of urban, suburban, rural)	Adults and children, 8,000-9,000 total asthmatics	Medicaid and commercial	Health plan telephonic case management for moderate asthmatics	Severe asthmatics receive series of home visits which include an initial assessment and subsequent environmental assessment and education as necessary	Home visits delivered by home health agency staff	Health plan contracts with home health agency or DME provider for home visit services, reimbursement a 'case rate' for all visits

*in environmental intervention activity

Program	Organization type and location	Population addressed* and size of asthmatic population	Medicaid	Asthma management services	Environmental intervention services (additional)	Environmental intervention Provider Type	Financing characteristics
G	Managed care plan , Massachusetts (mix of urban, suburban, rural)	Adults and children, approximately 12,000 asthmatics	90% Medicaid managed care	Health plan case management; health plan-created reports for providers	One to two home visits with environmental assessment, remediation plan development, and education	Home visits delivered by DME vendor staff	DME vendors reimbursed on a FFS basis per home visit. Mattress covers are a covered benefit (allergy test proof required)
H	Medicaid managed care plan, Rhode Island (mix of urban, suburban, rural)	Adults and children	All Medicaid	Health plan case management for persistent and other at-risk asthmatics	Three opportunities for home visits: grant program's asthma educator provides 3 visits with environmental assessment and education; community health center patients can access non-governmental organization home visit service; or visiting nurse home visit service arranged by health plan	Grant program and non-governmental organization: trained lay health educator; Visiting nurse association staff	Health plan contracts with VNA for home visit services. Grant funds for the two other home visit programs, one supplemented with health plan funding. Mattress covers are a covered benefit (completion of asthma education required)

*in environmental intervention activity

Program	Organization type	Population addressed*	Medicaid	Asthma management services	Environmental intervention services (additional)	Environmental intervention Provider Type	Financing characteristics
I	Non-profit Medicaid managed care plan, Massachusetts (mix of urban, suburban, rural)	Adults and children, approximately 15,000 asthmatics	All Medicaid	Care management for at-risk asthmatics. Health plan-developed provider communication tool to inform providers of patient problems and use in care management).	Minimum of two home visits for all asthmatics in case management. Visit includes assessment and education on remediation strategies and medical topics	Home visits provided by visiting nurse association staff	VNA staff are reimbursed on a FFS basis per visit. Mattress covers are a covered benefit.
J	Non-profit health plan with Medicaid managed care product, California (urban and suburban)	Children, approximately 4,000 asthmatics	Medicaid managed care	Health plan case manager follow up for members with asthma-related ED visit or hospitalization. Provider data reports.	Health plan refers high risk asthmatics to one of two home visit programs. Home visit includes environmental assessment, remediation activities and materials, and education	One home visit program offered by non-governmental organization; the other by local health department	Health plan reimburses for three home visits per member (with exceptions as necessary). Both programs reimburse using the health plan claims system. Home visit programs are also supported by grant funding.

*in environmental intervention activity

[i] Cited in President's Task Force on Environmental Health Risks and Safety Risks to Children. Asthma and the Environment: A Strategy to Protect Children. 2000.
[ii] This paper does not elaborate on the environmental causes of the initial onset of asthma.
[iii] NHLBI. 1997. Expert Panel Report 2: Guidelines for the Diagnosis and Management of Asthma. http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf
[iv] See also Scarfone RJ, Zorc JJ, Capraro GA. Patient Self-Management of Acute Asthma: Adherence to National
Guidelines a Decade Later. Pediatrics 2001 6 Dec 108(6): 1332-1338 for a broader discussion of lack of compliance with guidelines.
[v] Definitions from News Release,
http://www4.nas.edu/news.nsf/6a3520dc2dbfc2ad85256ca8005c1381/2988a13c2b664ae685256ca70072da9c?OpenDocument
[vi] In preschool aged children
[vii] Under a weight-of-the-evidence approach, an individual study, the design or methods of which may have some unavoidable limitations, may still contribute to the evidence base.
[viii] Sandel et al do not provide a definition for "intense" but compare intense interventions to single interventions (such as placement of a dust mite-proof mattress cover). Later in this paper, beginning on page 9, we describe combinations of environmental interventions as more or less intense.
[ix] A general and qualitative statement based on the authors' interpretation of the study results; lack of consistency in studies precluded use of a more explicitly defined categorization.
[x] This study was co-funded by the National Institute of Allergy and Infectious Diseases (NIAID) and the National Institute of Environmental Health Sciences (NIEHS), two NIH Institutes.
[xi] The study also included a physician-feedback intervention (bimonthly reports of the children's asthma symptoms and use of health care services to their primary care physicians), but the study was designed to have no interaction between the two interventions (environmental and physician-feedback), thus their effects are considered separately. In this paper we report on the effects of the environmental intervention.
[xii] Specifically, maximum number of symptom days was lower by .82 days per two weeks and the reduction in unscheduled visits to ED or clinic was .35 days per year. The intervention did not demonstrate success in one important/relevant outcome: the intervention group did not show a significant change (decrease) in risk of asthma-related hospitalization. However, the study was not powered to reveal a reduction in this outcome.
[xiii] The control group showed improvements as well, suggesting there is a benefit from involvement in an investigation (called the Hawthorne effect).
[xiv] The results of these and other ongoing studies will be used by HUD to develop science-based guidelines on effective housing interventions to be used as part of a holistic strategy to manage asthma in children.
[xv] http://www.metrokc.gov/HEALTH/asthma/healthyhomes/overview.htm
[xvi] Two types of cost analyses are used in evaluating the economic effect of an intervention: cost-effectiveness analyses and cost-benefit analyses. Cost-effectiveness analyses examine the difference between alternative interventions by looking at the incremental cost of the intervention in relation to the incremental health improvement that is associated with the intervention when compared to an alternative, and thus describe the benefit in healthcare terms (e.g., quality-adjusted life-years). Cost-effectiveness analyses require using a specific perspective (e.g., the societal perspective which includes direct and indirect costs, or the health plan perspective which only includes direct costs) and using a reference case (as the alternative to compare with the intervention. Cost-benefit analyses describe the benefit of an intervention in monetary terms, which allows for a direct comparison with the cost of the intervention.
[xvii] One published study (National Cooperative Inner City Asthma Study) examined the cost effectiveness of a multi-factor environmental intervention [See bullet 2]. Brugge et al found that none of the cost effectiveness analyses of educational interventions were particularly robust, yet of the three that were reviewed, the intervention appeared to result in net economic savings.
[xviii] In the NCICAS, a randomized controlled trial, an asthma counselor (social worker trained in asthma management) visited the home to coordinate asthma care, deliver education, and assist with identification and remediation of environmental exposures in the home (Evans et al 1999).
[xix] 95% CI: $12.56 to $55.29.

[xx] For example, Williams SG, Schmidt DK, Redd SC, Storms W; National Asthma Education and Prevention Program. Key clinical activities for quality asthma care. Recommendations of the National Asthma Education and Prevention Program. MMWR Recomm Rep. 2003 Mar 28;52(RR-6):1-8.
[xxi] These initiatives include: Action Against Asthma, a Strategic Plan for the Department of Health and Human Services (DHHS), published in May 2000 (http://aspe.hhs.gov/sp/asthma/overview.htm#es); Asthma and the Environment: A Strategy to Protect Children, a strategy developed by the Asthma Priority Area Workgroup, a workgroup of the President's Task Force on Environmental Health Risks and Safety Risks co-chaired by EPA and DHHS (http://aspe.hhs.gov/sp/asthma/appxd.pdf); and a report entitled "Catching Your Breath: Strategies to Reduce Environmental Factors that Contribute to Asthma in Children," a May 2003 publication of a workgroup sponsored by the Environmental Council of the States and the Association of State and Territorial Health Officials (http://www.sso.org/ecos/projects/Child%20Health/ASTHMA.html)
[xxii] See: http://www.gwhealthpolicy.org/newsps/asthma/asthma_specs_1.htm.
[xxiii] http://www.takingonasthma.org/
[xxiv] The Center for Health Care Strategies is an organization that works with states, health plans, and consumer groups to enhance the quality of health and health care delivery for beneficiaries of publicly financed care.
[xxv] NEPHMCC, a collaborative effort in the New England region, brought together state and public health officials from the six New England states with the medical directors of the major health plans in the region to achieve population-based advances in health.
[xxvi] Planned care for asthma often includes components such as proactive care; use of evidence-based care guidelines (including guidelines for allergy testing); use of a clinical information system; empowering the patient through education, support, and guidance; and involvement of the community that the patient lives in.
[xxvii] Useful resources include:

- EPA's Asthma Home Environment Checklist for Asthma Educators
- American Association of Health Plans Environmental Guide to Manage Asthma http://www.aaaai.org/members/cme_ce/environmental_management/
- Free on-line course for clinicians and educators on managing asthma triggers. See http://www.aaaai.org/members/cme_ce/environmental_management/

[xxviii] In some populations, the provision of these two allergy avoidance supplies (air purifiers and dust mite-proof mattress and pillow covers) will likely benefit a large percentage of the population, due to complex allergy problems in the home (specifically in the sleeping environment), and as a result, could be provided to all at-risk (for environmental triggers) asthmatics as a preventive measure, irregardless of allergy test results.
[xxix] The nation's pioneering medical-legal advocacy program is the Family Advocacy Program, a medical-legal collaborative based at Boston Medical Center (see: http://www.bmc.org/pediatrics/special/fap/).
[xxx] http://www.chcs.org/usr_doc/chcsbiennial0405.pdf
[xxxi] See http://www.naecb.org/history.htm
[xxxii] For example, the Partners Asthma Center's Asthma Educators Institute, in Boston, Massachusetts (http://www.asthma.partners.org/Publications/AEI_brochure.pdf)
[xxxiii] As noted in an earlier note, examples include:

- EPA's Asthma Home Environment Checklist for Asthma Educators
- American Association of Health Plans Environmental Guide to Manage Asthma http://www.aaaai.org/members/cme_ce/environmental_management/
- Free on-line course for clinicians and educators on managing asthma triggers. See http://www.aaaai.org/members/cme_ce/environmental_management

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