

Draft Healthy Homes Strategic Plan



U.S. Department of Housing and Urban Development
Office of Healthy Homes and Lead Hazard Control
September 2008

Table of Contents

Letter from Jon L. Gant, Director.....	2
Executive Summary.....	3
I. Introduction.....	5
II. The Disproportionate Burden of Housing-Related Hazards.....	6
III. Healthy Homes Program Background.....	8
IV. The Current State of Health and Hazards in Housing.....	11
V. Healthy Homes Program Activities and Accomplishments.....	20
VI. Healthy Homes Trends: Strategic Opportunities for the Healthy Homes Program.....	25
VII. Healthy Homes Program Future Directions.....	30
VIII. References.....	40
IX. Appendix: Potential Focus Areas.....	46

Letter from Jon L. Gant, Director, Office of Healthy Homes and Lead Hazard Control

September 9, 2008

Dear Supporter of Healthy Housing:

It has been almost 10 years since HUD assembled a multidisciplinary group of experts to help us develop an initial strategy for implementation of the Healthy Homes Initiative. Since that time, the initiative has matured into a program that, with the help of our partners, has made significant progress in advancing the healthy homes mission. The program has sponsored important research, developed tools and outreach materials, built local capacity, and perhaps most importantly, funded projects to make high risk housing healthier and safer for thousands of families.

It is now time for us to review the performance and accomplishments of the Healthy Homes program to date and update the strategic plan that will serve as a road map for the program as we move forward. The plan will help ensure that program activities are focused and effective in achieving program goals and in supporting HUD's mission of increasing homeownership, supporting community development, and increasing access to affordable housing free from discrimination.

I encourage you to read the draft plan and provide us with your feedback. We will read and consider all comments, and they will help shape the final plan. Please email your comments to us at HUDHHStrategy@hud.gov.

Thank you in advance for your valued contribution to the HUD Healthy Homes strategic planning process, and to the healthy homes mission. We strongly believe that every family deserves a healthy home, and we look forward to working with you to help us achieve this goal.

Sincerely,

Jon L. Gant

Executive Summary

Nearly ten years since the inception of the Healthy Homes (HH) program in the Department of Housing and Urban Development's (HUD) Office of Healthy Homes and Lead Hazard Control (OHHLHC), the Office is in the process of evaluating progress, distilling lessons learned, and forging new strategic directions. With an established lead hazard control program infrastructure and the most comprehensive national healthy homes program, HUD is in a unique position to continue to lead national efforts to reduce housing-related health hazards.

The HH program has been guided by a strategic plan proposed by a multidisciplinary panel of experts in 1999. Initiated in FY 1999 and funded at approximately \$10 million/year, the mission of the HH program is to mitigate key health and safety hazards in housing by providing research, technical and policy guidance, outreach, and capacity building for partners, practitioners, and the public, with a focus on protecting the health of children and other sensitive populations in low income households. These efforts are expected to improve the health, productivity and quality of life of residents and reduce healthcare and related costs from common housing-related illness and injuries.

Key residential hazards include asthma and allergy triggers, mold and moisture, pests and pesticides, injury hazards, and poor indoor air quality. The health and economic burden of housing-related hazards is substantial. For 2007, the National Heart, Blood, and Lung Institute estimated the total cost to the U.S. economy from asthma at \$19.7 billion (includes \$14.7 billion in direct medical costs and \$5 billion in indirect costs such as lost work and school days). About 21% of asthma cases in the U.S. are linked to dampness and mold, at an annual cost of approximately \$3.5 billion. Meanwhile, unintentional injury is the leading cause of death and disability among children younger than 15 years of age.

Past and current HH program activities have yielded strong results. To date, 92 Healthy Homes Demonstration and Healthy Homes Technical Studies grants have been awarded for a total of approximately \$75 million. Healthy Homes Demonstration grants have supported implementation of HH pilot programs throughout the U.S., created capacity through the development of a trained workforce, and identified effective practices for new and existing housing. Healthy Homes Technical Studies grants have supported research to improve hazard assessment and control methods and to better understand the distribution and importance of residential hazards and exposures, resulting in 34 papers published in scientific and professional journals to date. Cooperative work through interagency agreements with OHHLHC's federal partners has resulted in important program achievements, including USDA outreach and training through its Cooperative State Research, Education, and Extension Service (CSREES), and a nationwide training network and reference materials developed through an alliance with the CDC. The HH program has also made important contributions through contract-directed activities. Notable projects include completion of the first national survey on the distribution of residential allergens in housing, and outreach via the Healthy Homes for Healthy Kids Campaign.

As the healthy homes concept gains momentum and visibility, the OHHLHC must address unique challenges and opportunities. OHHLHC's lead hazard control funds are restricted by statute for use in addressing lead hazards only, but many lead grantees are interested in expanding their lead hazard control focus by also addressing other key residential hazards. The green building movement provides a key opportunity to assess the potential health benefits of green practices and promote the inclusion of health-promoting features into green construction and rehab strategies. Housing professionals, including public housing agencies, are beginning to recognize the benefits of a cost-effective integrated pest management approach compared to traditional pest control practices. Smoke-free housing policies are gaining popularity among public housing agencies that increasingly acknowledge the critical public health need to address environmental tobacco smoke. All of these trends represent key components of incorporating the healthy homes approach into ongoing practices and programs.

In FY 2008, HH program staff began updating the strategic plan, a process that involved OHHLHC staff as well as key federal and non-governmental partners. An increase in the FY 2009 HH program budget request of about 50% over FY 2008 funding is anticipated to increase program options. In September 2008, the Office is sponsoring the first National Healthy Homes Conference, which will serve to capture feedback from stakeholders and federal partners to incorporate into the draft plan before its final release in early 2009.

Although the strategic plan is currently in draft form, the OHHLHC has reviewed past and current activities and accomplishments, and identified challenges and opportunities, resulting in proposed future directions that are expected to increase the program's impact and better enable it to achieve its mission. This updated strategic plan will help make the HH program's vision a reality by focusing on the following four key goals identified to date that will guide the program's activities:

- 1) *Building a National Framework*: Foster partnerships for implementing a healthy homes agenda.
- 2) *Creating Healthy Housing through Key Research*: Support strategic, focused research on links between housing and health and cost-effective methods to address hazards.
- 3) *Mainstreaming the Healthy Homes Approach*: Promote the incorporation of healthy homes principles into ongoing practices and programs.
- 4) *Enabling Communities to Create and Sustain Healthy Homes*: Build sustainable local healthy homes programs.

The final strategic plan will be a dynamic roadmap for developing, disseminating, and integrating the healthy homes concept. By coordinating disparate health and housing agendas, supporting key research, incorporating the healthy homes approach into existing practices, and providing tools to build sustainable local healthy homes programs, the HH program can continue to lead in improving the availability of decent, safe, and affordable housing.

I. Introduction

The U.S. Department of Housing and Urban Development's (HUD) mission is to increase homeownership, support community development and increase access to affordable housing free from discrimination. The Office of Healthy Homes and Lead Hazard Control (OHHLHC) supports this mission by *assisting States and local governments to remedy the unsafe housing conditions and the acute shortage of decent and safe dwellings for low-income families (Housing Act 1937)*. No one, of any economic class, should have to worry if their home is putting their loved ones at risk for illness or injury. Today's families are challenged with finding not only affordable housing options, but homes that offer a safe and healthy place to live. The OHHLHC develops and promotes healthy housing tools and enables communities to create and sustain healthy homes

OHHLHC has administered a highly successful Lead Hazard Control (LHC) programs since 1993 and an innovative Healthy Homes (HH) program since 1999. Spurred by the experiences of LHC activities, the HH program works to mitigate health and safety hazards that are attributed to housing. HH programs are based upon the idea that it is more cost-effective to identify and mitigate multiple health hazards rather than addressing individual hazards one at a time.

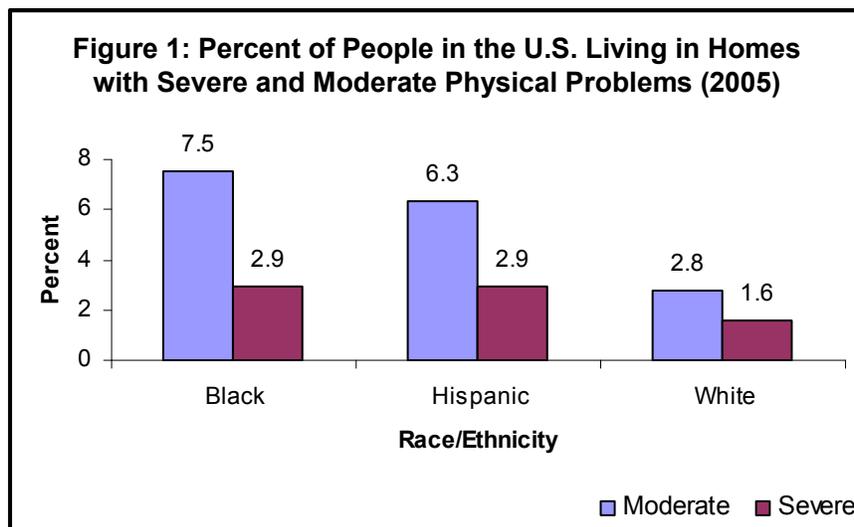
There are numerous health conditions that are caused or exacerbated by exposures or conditions in the home environment. Allergies, asthma, unintentional injuries, poisoning, cancer, and heart disease have been connected to the design and condition of housing as well as the daily habits of residents inside their homes. Because there are interrelated causes for many of these health conditions, efforts to address one hazard can also reduce another, resulting in cost-effective approaches to addressing multiple hazards simultaneously. Addressing moisture, indoor air quality, and dust are key strategies to reducing risk from multiple residential hazards. Widespread adoption of a comprehensive, "healthy homes" approach, including education and physical interventions, can help prevent housing-related injuries and illnesses resulting in reductions in associated costs and improvements in quality of life.

Past and current HH Program activities have yielded strong results. However the OHHLHC recognizes that it operates in a dynamic environment and it is necessary to evaluate activities to ensure that we are able to best meet the needs of the populations we serve. As the Draft Strategic Plan for the HH Program, this document presents a brief overview of some past and current activities and accomplishments to demonstrate the progress that has been made and where gaps still exist. It identifies challenges and opportunities by surveying the current political, scientific, economic, and cultural trends that impact the success and development of the healthy homes concept. This analysis results in the proposed strategies and goals which outline the future direction of the OHHLHC's HH program, which will continue to lead in the development, dissemination, and integration of the healthy homes concepts to improve the availability of decent, safe, and affordable housing.

II. The Disproportionate Burden of Housing-Related Hazards

According to HUD's 2005 American Housing Survey, 6 million households live with moderate or severe housing conditions, including heating, plumbing, and electrical problems, and 24 million households face significant lead-based paint hazards (Jacobs et al., 2002). Anyone can suffer from home related illness and injury; however certain groups such as low income individuals, children, the elderly, or individuals with chronic illness can be more susceptible. Low income persons are more likely to lack resources for preventive measures, and deferred maintenance can lead to the development of residential health hazards. According to the U.S. Census Bureau, in 2007, 37.3 million people lived in poverty (Census Bureau, 2008). During the current acute shortage of affordable housing, people are forced to live in marginal housing, or to choose between affordability and their health and safety (JCHS, 2005).

The burden of a home with physical problems is disproportionately heavy on minorities. A disparity exists among racial and ethnic groups, with disproportionately high percentages of minorities living in poverty. This is clearly indicated by the 2006 Census poverty rates, with nearly three times as many blacks (24.3%) and more than twice as many Hispanics (20.6%) living in poverty as non-Hispanic whites (8.2%). Further, 3% of blacks and 2.8% of Hispanics live with severe physical housing problems, as compared to 1.7% of non-Hispanic whites.



Source: HUD, 2005

Children are typically more susceptible to biological, chemical, and physical exposures. Possible threats include allergens, asbestos, combustion products, pests, lead-based paint, mold, organic gases, pesticide residues, radon, take-home hazards, and unintentional injuries (Krieger and Higgins, 2002). The rapid development of a child's organ systems during embryonic, fetal, and early newborn periods makes him or her more vulnerable when exposed to environmental toxicants. Children breathe more air, drink more water, and eat more food per kilogram of body weight than adults do. An infant's respiratory

rate is more than twice an adult's rate (CDC, 2002). Since children spend up to 80-90 percent of their time indoors, including homes, schools, and other indoor environments, it is paramount to make every effort to minimize possible dangers (EPA, 2002).

Older adults are also more susceptible to certain housing-related hazards. Compared with young adults, older adults have smaller airways and are therefore more likely to experience bronchial hyperresponsiveness (Yeatts, 2006). In terms of injuries, older adults are at a substantially greater risk of falling (Sleet, 2008). The number of people older than 60 years of age is expected to double between 2000 and 2059 (Yeatts, 2006). Older adults tend to prefer to age in place, in their homes (National Council on Aging, 2007). This substantial predicted increase in the older adult population aging at home calls attention to the importance of addressing hazards and identifying unique risk factors for housing-related illnesses and injuries (Selgrade, 2006).

Although these hazards place a particularly significant burden on certain socioeconomic, racial/ethnic, and age groups, it is important to remember that anyone of any class can be harmed by home-related illness or injury. Advances in addressing these health concerns will benefit all categories of individuals and families. The OHHLHC and its HH program and partners have made great strides toward addressing these residential health and safety hazards. However, despite this progress, much work remains to be done. Residential health and safety hazards continue to pose significant threats in our nation's households.

III. Healthy Homes Program Background

In support of HUD's mission to spur community development and promote decent and affordable housing, the OHHLHC was created to address housing related health hazards, particularly those associated with housing conditions for low income households. In order to determine the HH program's future steps, it is important to reflect back on our past efforts to address housing conditions that impact health. Following is a discussion that traces the evolution of OHHLHC's activities. It begins with the successful LHC programs, which set the foundation for the creation of the first federal Healthy Homes Initiative (HHI). Over time, the Healthy Homes Initiative has matured into a program in its own right (the HH program). OHHLHC rose to the challenge to address hazards beyond lead-based paint, and has been charting new territory in the field of healthy homes.

Learning from HUD's Successful Lead Hazard Control Program

OHHLHC has been successfully addressing housing-related health hazards since the inception of the LHC program in 1993. Through a robust grant program, enforcement efforts, research, and outreach, the LHC program has been instrumental in producing approximately 276,000 lead-safe units. By preventing lead poisoning, LHC programs have saved the nation billions of dollars in increased lifetime productivity, decreased medical and special education costs, and reduced criminal activity. The established LHC infrastructure provides a framework for addressing other housing-related health hazards, especially those that disproportionately affect children and low-income populations.

The Healthy Homes Concept

The healthy homes concept truly began to take shape in the 1990's as national attention and local efforts grew. Children's environmental health issues received national attention with President Clinton's Executive Order 13045, "Children's Environmental Health Risks and Safety Risks," which highlighted the special environmental health and safety needs of children. Meanwhile, LHC grantees began to observe that homes with lead-based paint hazards often had other important health hazards that could be addressed at the same time. In the FY 1999 Budget, HUD proposed a HHI, situated in OHHLHC, to build upon the Department's existing activities and expertise in housing-related health and safety issues, including lead hazard control, building structural safety, electrical safety, and fire protection. The healthy homes concept is founded upon the idea that it is more cost-effective and efficient to identify and mitigate multiple hazards in high-risk housing rather than follow the traditional approach of addressing individual hazards through "categorical" programs (e.g., lead, radon, fire safety).

The HUD Healthy Homes Initiative

The HUD HHI began in 1999 when Congress agreed that "the Healthy Homes approach appears superior to addressing problems one by one" and appropriated \$10 million for the Initiative to "develop and implement a program of research and demonstration projects that would address multiple housing-related problems affecting the health of children."

Congress asked HUD to submit a preliminary plan for the HHI that would assess the scientific evidence for links between housing and health hazards, and establish focus areas and objectives for the new HHI. In December 1998, OHHLHC convened an expert panel which endorsed the concept behind the HHI. The panel prepared a HHI Preliminary Plan in April 1999 which identified excess moisture reduction, dust control, improving indoor air quality, and education as four key focus areas for HHI interventions. These four intervention focus areas address a multitude of common household hazards and exposures. The panel recommended five objectives for the HHI, namely:

- 1) Identification of homes where interventions would be appropriate;
- 2) Development of appropriately scaled and efficient intervention strategies;
- 3) Selection of efficient strategies for evaluating intervention effectiveness;
- 4) Development of local capacity to operate sustainable programs to prevent and control toxic mold hazards in residences of low and very-low income families; and
- 5) Determination of biomarkers to address health threshold levels for exposure to mold.

The HHI's first Notices of Funding Availability (NOFAs) were influenced by the panel's recommended objectives. Because of HUD's housing mandate, OHHLHC determined early on that the development of biomarkers, while important, is not consistent with HUD's more housing-focused mission and would also duplicate the efforts other federal agencies. At the inception of the program in FY 1999, funds were made available for grants in three main NOFA categories that reflected the panel's recommended objectives: 1) Mold and Moisture Control; 2) Technical Studies (i.e., research); and 3) Demonstration Projects.

The Evolution of the Healthy Homes Grant Programs

Initially, the Mold and Moisture Control NOFA was created to meet Congress' directive that \$4 million of the initial HHI funding be applied to mold research and intervention. However, while research, education, and intervention related to mold and moisture have remained a focus of the program, since FY 2000 these topics have been incorporated into the other two HH program NOFAs.

In keeping with the first three recommended objectives, the Healthy Homes Technical Studies (HHTS) grant program began with, and continues to, emphasize research activities to develop or improve methods for the identification and control of housing-related health hazards. The panel's focus areas, including moisture reduction, dust control, and improvements in indoor air quality provided the initial framework for the scope of HHTS grant projects and framed the interventions, including education, that are emphasized in the Demonstration grant program. As OHHLHC has identified important research gaps, it has added other focus areas to the HHTS NOFA. Beginning in FY 2002, in recognition of the need to address rodent and cockroach problems in multifamily housing in a more cost-effective way, the HHTS NOFA specifically solicited projects to improve upon and assess integrated pest management (IPM) methods. In recent years,

the OHHLHC has also included evaluation of the effectiveness of education and outreach protocols as a focus area highlighted in the NOFA.

The Healthy Homes Demonstration (HHD) grant program strives to build capacity beyond the federal funding period and implements and promotes low cost hazard assessment and control methods in targeted low-income communities. Since FY 1999, the OHHLHC has more broadly interpreted the panel's recommended building capacity objective to apply to multiple health and safety hazards (in addition to mold), to match the HHI's comprehensive approach. Through its emphasis on promoting the healthy homes approach, the HHD grant program also incorporates the education focus area. In FY 2008, major categories of eligible activities in the HHD program NOFA included direct remediation activities, education and outreach, and training in target communities. In order to meet program goals of reducing health hazards in housing, recent NOFAs have required that at least 65 percent of funds be allocated for direct remediation activities. In recent years the OHHLHC has increased emphasis on grantees' evaluation of the effectiveness of their interventions, including the assessment of health outcomes.

Supplementing Healthy Homes Efforts through Collaboration and Contracts

While the majority of OHHLHC's healthy homes funding advances the field via grants, since the beginning OHHLHC has also employed contracts, interagency agreements, interagency agreements, and collaborations with HUD offices to supplement its efforts in important ways. In the case of interagency agreements and collaborations with other HUD offices, projects complement the OHHLHC's own strengths and unique positioning within the Department, while benefiting from the unique capabilities and networks of OHHLHC's partners. Interagency agreements with the Centers for Disease Control and Prevention (CDC), for example, capitalize on the CDC's public health expertise in ways that complement HUD's housing expertise. Likewise, an agreement with the U.S. Department of Agriculture (USDA) leverages the Department's Cooperative State Research, Education and Extension Service (CSREES) and the expertise of network members in public education and outreach on environmental health issues. Collaborations with HUD offices build on the network and infrastructure available through HUD's housing programs as well as expertise in building science.

From the Healthy Homes "Initiative" to the Healthy Homes Program

As the healthy homes approach has gained acceptance with Congress, the public, and the scientific community, the Initiative has grown into the HH program operating alongside OHHLHC's LHC program. While the LHC program still constitutes the majority of OHHLHC's funding, OHHLHC, in collaboration with key partners, has pioneered the healthy homes concept, funding the most comprehensive Federal healthy homes grant programs.

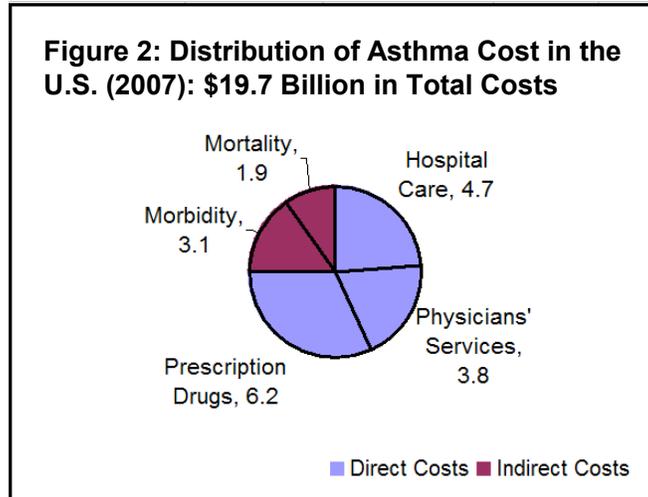
IV. The Current State of Health & Hazards in Housing

The HH program has evolved to efficiently address multiple housing hazards that have the potential to impact residents' lives. Research has shown, and continues to clarify, the relationship of housing conditions and how residents' actions can lead to potential illness or injury. Current research has identified a relationship between the home environment and the following health conditions: allergies, asthma, unintentional injuries, poisoning, cancer, and heart disease. Mold, moisture, contaminated dust, and poor indoor air quality are common housing conditions that pose a hazard to residents' health. There are certain hazards where research is more conclusive. For example, the relationship between lead exposure and poisoning and how these risks can be mitigated are well defined. In other areas, such as the relationship of mold to asthma, further work is needed to devise effective prevention and intervention techniques. Following is a discussion of some of the major residential health hazards and interventions to address these housing-related risks. This list is not comprehensive, but includes health conditions where there is sufficient evidence linking illness and injury to the home environment.

Allergies and Asthma

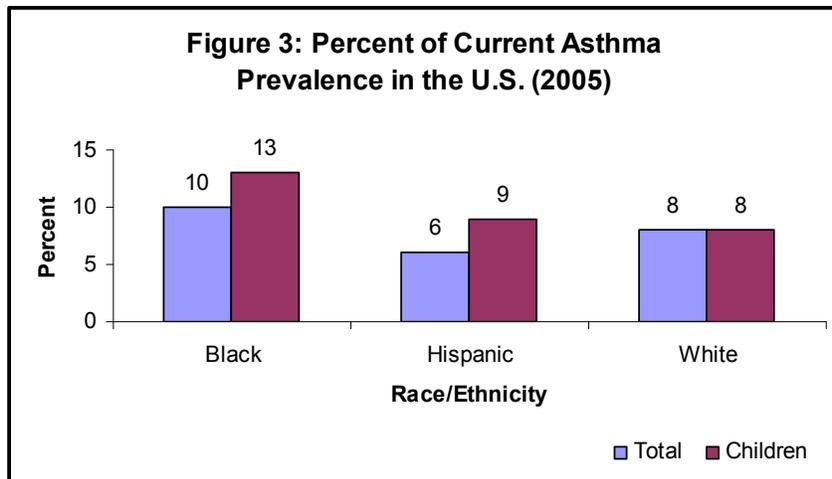
The Health and Cost Burden – Asthma and allergies take a heavy toll on quality of life and contribute significantly to health care costs. Independently these two conditions have great social and economic effects; however allergies are now being connected to increases in asthma symptoms and developments of new asthma cases. Research indicates that allergies affect over 50 million Americans, and a recent nationwide survey found that more than half of the population tests positive to one or more allergens (AAAAI, 2008). Allergies are the fifth leading chronic disease in the U.S. among all ages, and the third most common among children (AAAAI, 2008). Allergic disease costs Americans \$7.9 billion annually, with \$4.5 billion spent on direct medical care (AAAAI, 2008).

Asthma impacts over 20 million Americans, causing dramatic financial costs and decreased quality of life (CDC, 2005). Overall, asthma is now recognized as the leading cause of school and work absences, emergency room visits, and hospitalizations. Direct health care costs for asthma in the United States total more than \$14.7 billion annually; indirect costs (lost productivity) add another \$5 billion for a total of \$19.7 billion (*Figure 2*). Children under the age of 18 make up nine million of those diagnosed with asthma (AAAAI, 2008). This leads to 12.8 million missed school days and more than four million children who have had an asthma attack in the previous year (AAAAI, 2008). The American Lung Association estimates that there are approximately 5,000 asthma deaths a year (AAAAI, 2008).



Source: NIH, 2007

Asthma disproportionately affects children from lower-income families and from specific racial and ethnic groups (EPA, 2008). In 2005, 13 percent of African-American children were reported to have asthma as compared with 9 percent of Hispanic children and 8 percent of non-Hispanic white children (Figure 3). While children are the population most at risk for developing asthma, there is a growing need to address the onset of new cases in older adults, and to examine how their risk factors might differ from those of children (Selgrade et al., 2006).



Source: CDC, 2005

The Home Connection – Both genetic and environmental factors play an important role in the development of allergies and asthma. Allergens not only trigger asthma symptoms, they are considered to be a major cause of the disease as well (NIEHS, 2008). The National Institutes of Health estimates that more than 70% of asthma sufferers also have allergies (AAAAI, 2008). Further, more than half of the 20 million Americans diagnosed with asthma are considered to be allergic asthmatics (AAFA, 2008). In these cases, airborne particles, or allergens, trigger allergic responses that lead to asthma attacks

(EPA, 2005). In addition to acting as triggers, research indicates that exposure to certain allergens and irritants in the home can lead to the development of asthma (Selgrade et al., 2006). Important residential allergens include dust mites, cockroaches, rodents, mold, pollen, and animal dander. There are non allergen asthma triggers as well, such as some combustion products (e.g., nitrogen dioxide) and environmental tobacco smoke (ETS).

Exposure to irritants and certain indoor allergens at a young age contributes to the development of asthma. Residential exposures to allergen and non allergen triggers have been attributed to approximately 39% of new asthma cases in children less than 6 years, and to approximately 44% of new and existing asthma cases in children 6-16 years (Lanphear, 2001a; 2001b). Many of these allergens are prevalent in household **dust** or result from residents' living habits. Interventions aim to remove or limit exposure to allergens and non allergen triggers.

Pests can play a significant role in triggering the symptoms of allergies and asthma. In a recently published study, 70% of inner city children diagnosed with allergic asthma were sensitive to cockroaches and 63% to dust mites (Morgan et al., 2004). Allergens in rodent urine can also contribute to asthma severity (HUD, 2006). Many interventions to reduce these allergens in the home have proven to be effective and are ready for implementation now. These include the installation of impervious pillow and mattress covers, use of HEPA vacuums and air filters, specialized cleaning, and IPM (NCHH, 2007). This approach to the prevention and control of rodent and cockroach infestations minimizes the use of pesticides, instead emphasizing environmental controls, such as utilizing building and screening techniques to keep pests out, eliminating potential shelters both in and around the home, and removing access to sources of food and water. IPM is more effective than traditional practices at similar or reduced (long-term) costs.

Moisture impacts multiple allergy and asthma triggers. Indoor moisture can be due to insufficient ventilation or water intrusion, related to both residents' lifestyle habits and a home's physical condition. High levels of moisture can support roach and rodent populations and lead to mold growth, all of which are known allergy and asthma triggers. The Morgan study of allergic asthmatic children found that approximately half of the children participating were allergic to mold (Morgan et al., 2004). It is estimated that 21 percent of asthma cases in the U.S. are linked to dampness and mold, at an annual cost of \$3.5 billion (Mudarri and Fisk, 2007). Mold and moisture intervention work (e.g., dehumidification, elimination of water intrusion, removal of mold, ventilation improvements) has had promising results in controlling asthma symptoms, but its widespread implementation still requires additional field testing (Kercsmar et al., 2006).

Allergens and other particulate are found in household dust and indoor air. The National Survey of Lead and Allergens in Housing, conducted by HUD and the National Institute of Environmental Health Sciences in 2000, found that more than 46% of homes surveyed had high enough levels of dust mite allergens to trigger an allergic reaction, and almost a quarter had levels high enough to produce asthma symptoms (NIEHS, 2008).

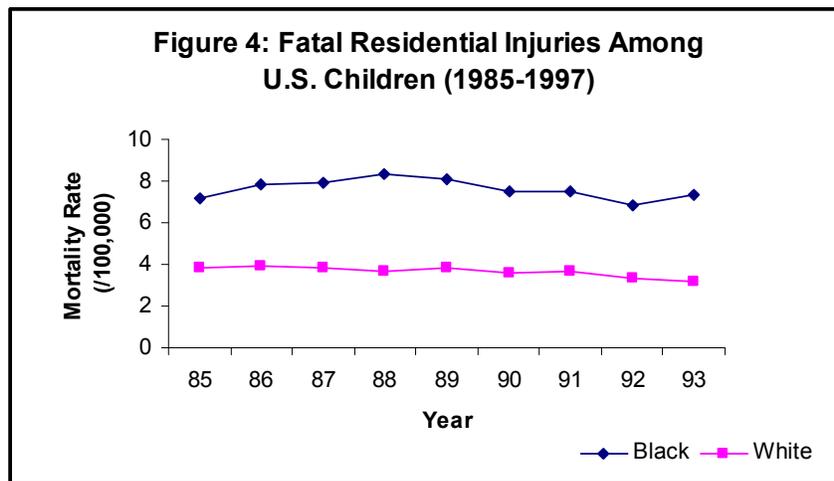
Concentrations of allergens in dust can be influenced by daily living habits, cleaning techniques, and a home's ventilation system. Exposure to secondhand smoke or some

combustion products found in the home, including nitrogen dioxide and particulate matter, also exacerbate asthma symptoms (EPA, 2005). Eliminating secondhand smoke from the home has shown to be effective in reducing asthma symptoms and morbidity. Ensuring proper ventilation and maintenance of heating systems and cooking appliances that produce combustion products can also help to decrease this health hazard, though determining the efficacy of these interventions will necessitate further field research (NCHH, 2007).

Unintentional injuries

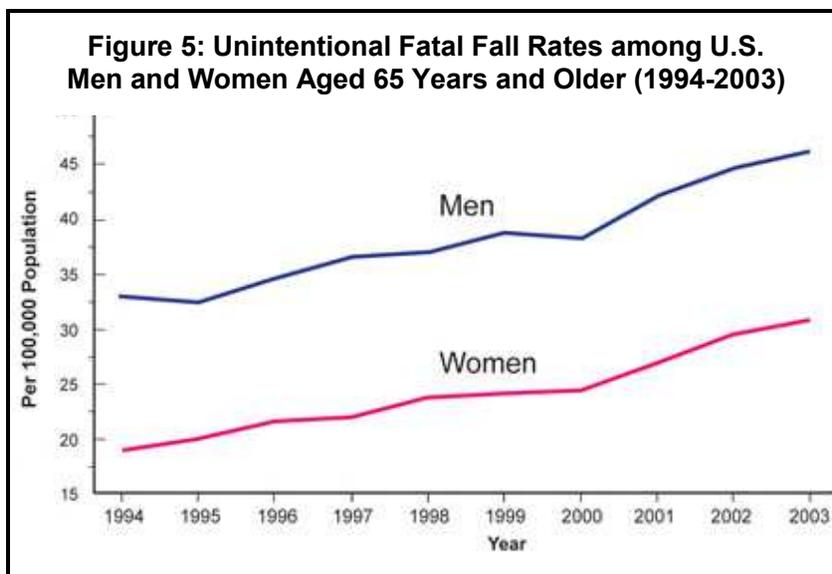
The Health and Cost Burden – Injuries cause emotional, physical, and economic stress. Injuries and deaths from falls, fire, drowning, poisoning, suffocation, and choking all occur in and around the home. A recent HUD-supported study found that an average of almost 3,000 deaths occur annually from residential injuries, and the CDC estimates that approximately half of all injuries occur in and around the home (Nagaraja, 2005; CDC, 2008). Injuries can lead to chronic pain, loss of income, stress, and change in lifestyles, impacting the injured and their family and friends. A CDC report indicates that injury-related medical expenditures may cost Americans as much as \$117 billion annually (CDC, 2006).

Unintentional injury is now the leading cause of death and disability among children younger than 15 years of age. A recent HUD-supported study of deaths among US children and adolescents from 1985 to 1997 found that an average of 2,822 unintentional deaths occurred annually from residential injuries (Nagaraja et al., 2005). The highest death rates were attributable to fires, submersion or suffocation, and poisoning. Black children were two times as likely to die from residential injuries as were white children (Figure 4).



Source: Nagaraja et al., 2005

The elderly are also at an elevated risk for residential injuries (Figure 5). Falls are the leading cause of injury death for Americans 65 years and older. Each year, about 35% to 40% of adults 65 and older fall at least once (CDC, 2007).



Source: CDC, 2006

The Home Connection – Unintentional injuries can be prevented by modifying the home environment and educating residents about risks. Some adjustments to the home, such as installing smoke alarms, fencing around pools, and water heaters with pre-set safe temperatures are effective injury prevention interventions. Other modifications (e.g., handrails, grab bars, lighting improvements, and window guards) have also had promising results but will require more field testing. Implementation of injury prevention-related safety education, building codes, and community based initiatives also need further research (NCHH, 2007).

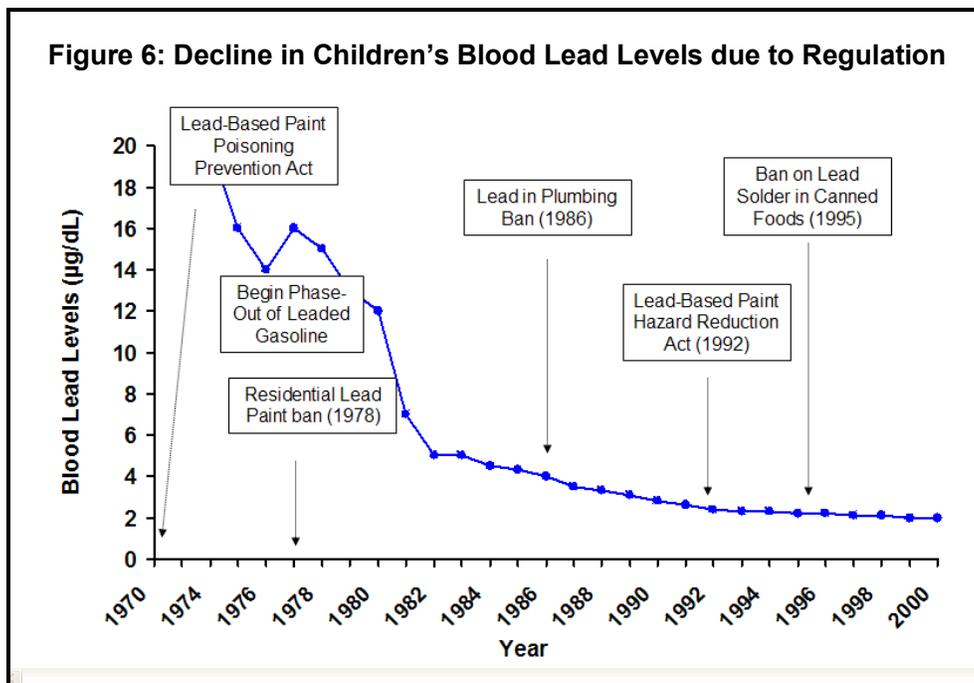
Poisoning

Although poisoning is considered an unintentional injury, the substantial health hazard it alone poses warrants further exploration. Household poisoning results in millions of deaths and injuries and billions of dollars spent in the U.S. each year. The American Association of Poison Control Centers (AAPCC) reported that in 2005 nearly 2.5 million people were involved in poison exposure incidents (AAPCC, 2005). In that same year, 828,899 injuries and 32,691 deaths were attributed to poisoning; 74% of these were unintentional (CDC, 2008). In 2000 alone, it is estimated that poisonings led to \$26 billion in medical expenses (CDC, 2008). More than 90% of all cases of exposure occur in the home, and well over half of these victims are children (AAPCC, 2005). Children are at greater risk for household poisoning, because they are both more likely to be exposed and more susceptible to adverse effects. Common sources of household poisonings include lead, combustion products, pesticides, volatile organic compounds (VOCs), cleaning supplies, automotive products, and pharmaceuticals.

Lead

The Health and Cost Burden – Although national blood lead levels have fallen over the last several decades (*Figure 6*), lead poisoning continues to pose a threat to many children. Reported cases of childhood lead poisoning have declined significantly over the past two decades; however, the most recently published federal estimate was that

310,000 U.S. children still have elevated blood lead levels (i.e., ≥ 10 micrograms per deciliter) (CDC, 2005). Lead poisoning may cause a range of health problems, including: damage to the brain and other vital organs, behavioral problems, learning disabilities, seizures, and in extreme cases, death. Recent research indicates that even relatively low blood lead concentrations in children and adolescents may be associated with deficits in cognitive and academic skills (Lanphear et al., 2000; Canfield et al., 2003). Thus, despite progress in this area, it is clear that lead poisoning continues to be a substantial health risk for young children. The monetary costs associated with lead poisoning are also quite large; a 2002 study estimates that childhood lead poisoning costs Americans approximately \$43.4 billion annually (Landigran, et al. 2002). Further, because elevated blood lead levels impair children from reaching their full potential; the economic benefit resulting from reductions in lead exposure for each year's cohort of 2-year-old children ranges from approximately \$110 billion to \$319 billion (Grosse et al., 2003). Although lead poisoning can affect children from all social and economic levels, those living at or below the poverty line in older (especially pre-1940) housing are at the greatest risk. A disparity also exists among racial groups; the most recent published estimates show 3% of black children have elevated blood lead levels, as compared to only 1.3% of white children (CDC, 2005).



The Home Connection – A large reservoir of lead remains in housing, but corrective measures have proven to be successful. The 2000 NSLAH found that approximately 40% of U.S. housing units contain lead-based paint, and 25% have one or more significant lead-based paint hazards (Jacobs et al., 2002). Further, it was found that approximately 1.2 million of these housing units were home to low-income families with children under the age of six (Jacobs et al., 2002). Fortunately, evaluations indicate that lead hazard control interventions can be effective in significantly reducing lead levels in

the home. Corrective measures include: paint stabilization, moisture control, treatment of friction surfaces, and enclosure and removal of certain building components coated with lead paint, cleanup, and “clearance testing,” have been shown to be effective in reducing dust-lead levels over an extended period (Galke et al, 2001; Wilson et al. 2006).

Carbon Monoxide

The Health and Cost Burden – Exposure to high doses of combustion products can lead to severe and even fatal consequences. The burning of any fuel, such as oil, natural gas, kerosene, and wood, can release a variety of combustion products of health concern, including carbon monoxide (CO). Each year, exposure to CO results in approximately 500 deaths and 15,000 emergency department visits (CDC, 2007). A poisonous gas, CO cannot be seen, smelled, or tasted, and in large doses it can cause long-term neurological disabilities, coma, cardio-respiratory failure, and death. Chronic low level exposure can also pose a health hazard, causing viral-like symptoms, such as fatigue, dizziness, headache, and disorientation. 74% of unintentional CO fatality victims are male, and nearly 60% are middle aged or elderly (CDC, 2007).

The Home Connection – Due to their association with heating systems and cooking appliances, a large portion of CO and hydrocarbon exposures occur in the home. 64% of CO-related emergency room visits are attributable to household exposures (CDC, 2007). Poor indoor air quality due to combustion products can result from improper ventilation, poor maintenance, or misuse of heating systems and cooking appliances. Notably, the greatest numbers of CO deaths occur in winter months and after natural disasters, when residents are more likely to use gas-powered furnaces and alternative heating and power sources indoors, such as portable generators, charcoal briquettes, and propane stoves or grills (CDC, 2007). Preventative measures include proper installation and maintenance of fuel-burning appliances, use of CO detectors and increased public education efforts.

Pesticides

The Health and Cost Burden – Pesticides are one of the most common substances associated with poison exposures in the U.S. In 2005, the AAPCC reported 101,746 pesticide exposure incidents, 23 of which led to fatalities (AAPCC, 2005). Almost half of these incidents (49,232) involved children younger than 6 years (AAPCC, 2005). Exposure to toxic pesticides can result in irritation to the eyes, nose and throat; damage to the central nervous system and kidneys; reproductive disorders; and an increased risk of developing cancer. In particular, organophosphate (OP) pesticides, which account for approximately half of all pesticides used in the U.S., are associated with the occurrence and severity of asthma. Children may be at greater risk for exposure to OP pesticides, as they are often used in the production of “kid foods” (i.e. milk, apple sauce, and orange juice) (EPA, 2002).

The Home Connection – Use of toxic pesticides is widespread in American households. The Environmental Protection Agency (EPA) estimates that Americans use over a billion pounds of pesticides each year, and that 74% of U.S. households use pesticides in the treatment of rodent and insect infestations (EPA, 2002; EPA, 2004). To diminish the risk

of poisoning, a recommended alternative approach to rodent and insect control is IPM, which, as discussed earlier, minimizes the use of pesticides.

Volatile Organic Compounds

The Health and Cost Burden – VOCs pose various negative health effects and are worthy of further research. Exposure to elevated concentrations of VOCs can result in eye, nose, and throat irritation, as well as nausea, headaches, and loss of coordination (EPA, 2007).

The Home Connection – Indoor air quality can suffer as a result of high indoor concentrations of VOCs. VOCs can be found in synthetic paints, glues, polishes, waxes, and building materials commonly used in households. As a result, indoor VOC concentrations tend to be two to five times higher than outdoor concentrations (EPA, 2007). Improper venting and misuse of products containing VOCs can exacerbate this indoor air quality problem (EPA, 2007). Construction of detached garages is an important way to lower indoor VOC emissions, and overall, the use of VOC-emitting products should be limited when possible (NCHH, 2007).

Cancer, Heart Disease, and Death

The Health and Cost Burden – Cancer, heart disease, and even death can be attributed to poor indoor air quality in a home. Exposure to radon gas leads to 15,000 annual lung cancer deaths, according to the National Academy of Science. Radon is a radioactive, odorless, colorless gas that occurs naturally and it is the leading cause of lung cancer among nonsmokers (EPA, 2008). Excessive exposures in the home are typically related to ventilation, structural integrity and geographic location.

According to the US Surgeon General, ETS, or secondhand smoke, causes sudden infant death syndrome (SIDS), acute respiratory infections, ear problems, and more frequent and severe asthma attacks in children (U.S. HHS, 2006). Each year in the United States, secondhand smoke exposure is responsible for 150,000–300,000 new cases of bronchitis and pneumonia in children aged less than 18 months. This results in 7,500–15,000 hospitalizations, annually. Exposure of adults to secondhand smoke has immediate adverse effects on the cardiovascular system and causes coronary heart disease and lung cancer. It has been linked to 38,000 lung cancer and heart disease deaths per year (CDC, 2006).

Home Connection – Disease incidence can be lessened by physical modifications to the home, changes in residents' habits, and education. Indoor air quality can be improved by removing environmental tobacco smoke from the home. The Surgeon General has concluded that eliminating smoking in indoor spaces is the only way to fully protect nonsmokers from secondhand smoke exposure. However, while non-residential smoking bans have proven to be effective in reducing exposure to ETS, the same evidence does not yet exist for efforts to support smoke-free home policies. For radon gas, research indicates that active systems placed in homes in high-risk areas post-construction have effectively lowered radon levels. The most cost-effective approach is to incorporate radon resistance into new construction. Some water interventions have had promising

results as well. However, passive systems, particularly those in new construction, are still in need of formative research (NCHH, 2007).

A Comprehensive Approach to a Healthy Home

Although the health risks associated with homes are many and varied, the household hazards which can contribute to them tend to be interrelated. Excess moisture, poor indoor air quality, and high levels of contaminated dust are common root causes for these hazards. Addressing these deficiencies simultaneously, rather than attempting to tackle each hazard individually, will yield the greatest results in the most efficient manner. For example, dealing with uncontrolled moisture can alleviate conditions associated with allergies and asthma (mold and pests), unintentional injuries (structural safety), and poisoning (reduced lead paint deterioration). Steps to address these overarching deficiencies should include both physical interventions and education.

V. Healthy Homes Program Activities and Accomplishments

As one of the pioneers of the healthy homes concept, the OHHLHC's HH program has contributed to the understanding of housing conditions and their links to residents' health and effective interventions and preventive measures. Great strides have been made to validate the healthy homes concept and set the stage to improve the lives of the most vulnerable populations. Current successes are the result of grant programs, interagency agreements, contracts, and collaborations with other HUD offices. HH program activities have focused on four categories: 1) supporting research; 2) intervention implementation; 3) outreach and education; and 4) creating tools and resources. Since FY 1999, 92 grants have been awarded for a total of approximately \$75 million. Outreach and education promotes the healthy homes concept to the general public and educates housing professionals. 21,687 people trained in healthy home concepts through grant activities. 1,577,518 individuals have been reached by grantee education and outreach. Tools and resources are provided to grantees and local health and housing programs to establish local capacity to address home hazards. Research projects are solicited to provide insight into key knowledge gaps on housing and health, and interventions are performed to directly improve the quality of life of residents. Reflecting on past successes allows us to determine where resources have been effective and what future activities would best compliment current achievements and propel the healthy housing field into the new century.

Research and Evaluation

It is critical to understand how elements in the home environment impact health and to determine the best methods to identify and control residential hazards with the greatest efficacy and efficiency. There is considerable information about lead hazard control strategies; however, the best remediation and hazards control techniques for other residential hazards in the home are not yet as well understood. The OHHLHC supports a variety of research and evaluation activities on a range of healthy homes issues such as the development of improved protocols for mold sampling, developing standardized methods for dust sampling, and evaluating the effectiveness of residential interventions to improve asthma control. Research is conducted through both HH grant programs, contracts, and interagency agreements with key federal partners. Dissemination of this valuable research is conducted primarily through the publication of articles in peer-reviewed scientific and professional journals and the presentation of findings at national conferences. To date, OHHLHC grantees and partners have published 34 papers on healthy homes research issues with more submitted for publication. Some research highlights include:

- A randomized controlled trial in Cleveland, Ohio demonstrated significant improvement in asthma symptoms (including reduced acute care usage) among children following remediation focusing on mold and moisture problems in their homes (Kercsmar et al., 2006).
- HUD teamed with the National Institute of Environmental Health Sciences to implement the National Survey of Lead and Allergens in Housing in 1999/2000.

The survey resulted in estimates of the prevalence and distribution patterns for lead-based based paint hazards in U.S. housing and the first national estimates of the distribution pattern of key residential allergens in the nation's housing (Jacobs et al., 2002; Arbes et al., 2003; Cohn et al., 2005).

- Development of the Environmental Relative Moldiness Index (ERMI), which is based on objective, DNA-based analyses, through cooperative research between a grantee and an EPA scientist led. Continued cooperation between HUD and EPA resulted in the analysis of a nationally representative set of dust samples from the American Housing Survey using the ERMI (Vesper et al., 2007).
- Contract-directed research on inter-laboratory variability in analysis of common allergens in residential dust, which has led to the sponsoring of follow-up efforts to help standardize dust preparation and extraction methods for allergen analyses (Pate et al., 2005). Grant-funded researchers are currently testing dust sampling methods in the laboratory and field with the goal of identifying an optimum protocol.
- Grant-funded research conducted by Air Quality Sciences in the Atlanta, Georgia metropolitan area documented a low prevalence of water indicator molds in air and settled dust of homes without known mold and moisture problems (Horner et al., 2004).
- A study demonstrated that intensive IPM treatments and use of the “dust lead cleaning protocol” led to significant reductions in cockroach populations and cockroach allergen loadings in heavily infested units of publicly assisted housing (see: http://www.ehw.org/Asthma/ASTH_HUDRoach_Sum.htm). Additional research in two cities has demonstrated the effectiveness and feasibility of an IPM approach in public housing.

Sponsoring Interventions to Mitigate Residential Hazards

Interventions to mitigate residential hazards can directly improve the health and quality of life of residents. The HHD grants have facilitated improvements in thousands of units nationwide. As stated in the 2008 HHD NOFA, the goal of the grant program is to “Develop and implement demonstration projects that address multiple housing-related problems affecting the health of children and other sensitive subgroups.” In recent years, the HHD NOFA has placed greater emphasis on the requirement that grantees evaluate the efficacy of interventions, including cost-effectiveness. To assist as many residents as possible, recent HHD NOFAs have required that at least 65 percent of funds be allocated for direct remediation activities. Intervention strategies can range from education-focused approaches to those that consist primarily of physical upgrades to new or existing homes, although most HH program-supported interventions are multifaceted in nature. To date, more than 7,500 interventions have been conducted nationwide using healthy homes principles. Highlights from intervention activities include:

- In New York State, the Erie County Health Department and partners worked together to provide complete inspections for low-income families with children moving into rental housing. Potential renters were identified by the Department of Social Services Housing Assistance program and encouraged to participate in the program. Health inspectors were then sent to participating locations to identify hazards, and landlords were informed of any housing code violations. Landlords were also provided with training and materials, such as carbon monoxide and smoke detectors.
- In Seattle, Washington, a HH grant to non-profit Neighborhood House and partners was used to upgrade 35 new green-built public housing units (built through HUD's HOPE VI program) to "Breathe Easy Homes." These homes have special features to improve indoor air quality and reduce indoor asthma triggers and other air pollutants (Takaro et al., 2008).
- In Cuyahoga County, Ohio, the grantee (Cuyahoga County Board of Health) is partnering with a weatherization program to provide an integrated approach to improve both energy efficiency and indoor environmental quality. A strategy involving weatherization/healthy homes partnering was also implemented in Washington State through a grant to non-profit, Opportunity Council.
- Grant-funded projects to the Boston Public Health Commission and the Harvard School of Public Health included interventions in private and public housing, respectfully, which had strong IPM components. In both instances, evaluations identified improvements in the symptoms of asthmatic children following the interventions.
- In North Carolina, grantee Advanced Energy is studying allergens and health outcomes in homes that have been retrofitted with a national high-performance home specification package that aims to manage moisture while improving indoor air quality and energy savings.
- In Minneapolis and St. Paul, Minnesota, grantee EACH worked with day care providers, local schools, hospitals, and medical home service providers to identify children with asthma and perform home interventions to reduce severity of asthma and improve moisture, safety, and ventilation conditions.

Outreach and Education

OHHLHC activities support public education and outreach that furthers the goal of protecting children and other vulnerable populations from residential hazards. Activities have focused on three main objectives: increasing general awareness of residential hazards, educating residents about preventive measures, and reaching out to housing and health professionals. The OHHLHC has supported grants with education and outreach components, funded the creation and dissemination of targeted educational materials, and entered interagency agreements to develop and provide training programs. Some education and outreach highlights include the following:

- Sponsorship of HUD's *Healthy Homes for Healthy Kids Campaign*, a traveling exhibit that disseminates health and safety messages in a "home environment." The exhibit includes a *Healthy Homes Pavilion* and has been displayed at fairs and community events throughout the country. HUD's Office of Field Policy and Management (FPM) has provided the OHHLHC with critical support on this campaign, contacting local officials, coordinating participation, offering Public Affairs assistance, and attending program planning meeting to provide local insight. A USDA extension agent also conducts "peer-to-peer" training to community residents at locations where the pavilion has been exhibited.
- Development of a National Healthy Homes Training Center and network, through an interagency agreement with the CDC. This training center offers a two-day course, delivered through a nationwide network, on basic healthy homes principles for housing, health and other professionals, and is developing specialized pilot courses geared towards key audiences and emerging trends.
- Reaching an estimated 1.6 million consumers through the USDA's CSREES, which partners with universities and other federal agencies to offer public outreach and education. An interagency agreement with USDA allowed the OHHLHC to tap into their existing national infrastructure to reach the general public and disseminate information to healthy homes training programs within the CSREES network. Support is also provided in coordination with both CSREES and the Alabama Cooperative Extension System through a Healthy Homes Partnership website, which is a listing of healthy homes resources available by state (<http://healthyhomespartnership.net>).
- Coordination with PIH to provide IPM training for public housing authority staff through a USDA interagency agreement. In May 2007, PIH distributed a Notice on IPM to all public housing agencies, encouraging them to explore IPM implementation options. OHHLHC is working with PIH to supplement this Notice with IPM education and training for agency staff.
- Development of educational material including DVDs, fact sheets, websites, an online nurses training site, and publications for diverse audiences, with the help of various federal partners and grantees. Specifically, through an interagency agreement with USDA, the OHHLHC has supported the development of the booklet, *Help Yourself to a Healthy Home* (English, Spanish, Hmong, Vietnamese and Bosnian) and the DVD and User Guide *Healthy Homes: Assessing Your Indoor Environment* (English, Spanish).
- Development and distribution of educational material regarding safe rehabilitation practices to home owners and others involved in the rebuilding of areas hit by natural disasters. *Rebuild Healthy Homes: Safe Rehabilitation of Hurricane-Damaged Homes* was created specifically for students helping in the clean up efforts after Hurricane Katrina. Post-flooding rehab guidance was also developed

in English and Spanish through a joint project with HUD's Office of Policy Development and Research (PD&R).

Tools and Resources

The OHHLHC has developed various tools and resources to help ensure that local healthy homes programs are successful and sustainable. Issue papers, assessment tools, sampling methods, guidance documents, and general publications are available to assist grantees, researchers, residents, and other housing and health agencies. These resources help to establish best practices and disseminate up-to-date information in an effort to increase effective and efficient identification and control of home hazards – and are available to the public at no cost. Materials have thus far been developed primarily through contracts and interagency agreements. Highlights of available tools and resources include:

- A National Healthy Homes Clearinghouse created by the National Center for Healthy Housing with the support of a HUD-CDC partnership. The Clearinghouse is a first cut at a centralized website for information on healthy homes issues and contains over 600 articles, including federal publications and peer reviewed journals.
- *A Healthy Housing Reference Manual* and the accompanying *Healthy Housing Inspection Manual* drafted through an interagency agreement with the CDC. The Inspection Manual covers a variety of housing-related hazards and is intended to be a voluntary assessment tool, for use (specific sections or in its entirety) by property managers, code officials, environmental, public health, housing, energy conservation, and weatherization professionals.
- A guidance on moisture resistant construction, published in coordination with the Program for Advanced Technology in Housing (PATH) within PD&R.
- Development of an initial *Weatherization Plus Health* assessment tool through a contract with ICF International. The tool incorporates health concerns into a weatherization assessment and is being used by current as well as former grantees.
- Developed a tool to assist HH technical studies and demonstration grantees in developing quality assurance (QA) plans and established a dust sampling protocol for HH grantees to use for collecting dust samples for allergen analyses. A system was also established to provide grantees with quality control dust samples for allergen analyses.
- Established a protocol for grantees to collect household dust samples for allergen analyses. This environmental sampling method protocol, which called for vacuum dust collection, was also the result of a contract with Battelle.

VI. Healthy Homes Trends: Strategic Opportunities for the Healthy Homes Program

The OHHLHC has examined not only internal activities, but has also taken into consideration the social, political, and economic climate in which the numerous healthy homes stakeholders exist. The goal of this assessment is to identify opportunities to further the mission of the HH program. The following discussion identifies trends that directly impact the development and implementation of the healthy homes concept.

The Policy and Political Landscape

1) Regulations and Codes – National standards for informing residents about lead-based paint hazards apply to all housing. However, similar far-reaching regulations do not exist for other housing-related health hazards. HUD sets standards for housing receiving HUD assistance. For example, multifamily and public housing must comply with the Real Estate Assessment Center's Uniform Physical Condition Standards (UPCS), while housing receiving Housing Choice Voucher (formerly known as Tenant-Based Section 8 Voucher) assistance must comply with the Housing Quality Standards (HQS). For all other housing, local housing and building codes may be the only health-protective policies in place.

Some localities have been able to efficiently incorporate healthy homes assessments and interventions into their work through the enforcement of local housing or building codes. Most of the localities that adopt and enforce codes use the model codes provided by the International Code Council (ICC). Some of the OHHLHC's non-profit partners are actively working to improve understanding of the role of existing codes in addressing residential hazards and in the development of new codes to address high priority hazards. Use of existing, modified, or new codes is a viable opportunity to address residential hazards in the future.

2) Political Climate – The national political climate for healthy homes is overwhelmingly favorable; attention to healthy homes issues is evident in the anticipated Surgeon General's Call to Action on Healthy Housing, program funding levels, and proposed legislation. For Fiscal Year 2009, HUD has approved a healthy homes program budget request of almost \$15 million, representing a greater than 50% increase over the FY 2008 program budget of \$8.7 million.

In March 2008, Senator Jack Reed, acknowledging the benefits of a comprehensive healthy homes approach, proposed the bipartisan Healthy Housing Council Act and called upon his colleagues to support healthy housing efforts. The Healthy Housing Council Act would establish an independent Council on Healthy Housing to improve coordination amongst Federal, state, and local government representatives, as well as industry and non-profit representatives. Regardless of the bill's outcome, improved collaboration among Federal and non-Federal partners would help to optimize valuable time and resources and achieve more meaningful and widespread results in the healthy homes arena.

3) Federal Partners – Bolstered by the success of the healthy homes approach, other Federal programs have begun to incorporate healthy homes concepts. While the CDC first initiated (and still sustains) a significant portion of its healthy homes efforts via an interagency agreement with the OHHLHC, CDC has demonstrated a commitment to the healthy homes approach in its agency-wide “*Action Plan for Healthy Homes*,” and at a program level, seeks to convert its Lead Poisoning Prevention Branch (LPPB) into a healthy homes branch. CDC plans also include the eventual transition of its Childhood Lead Poisoning Prevention Program (CLPPP) grantees to the healthy homes approach, coordinating a national surveillance system to track housing hazards and related health outcomes, and conducting research on the potential health benefits of healthy homes interventions. The CDC also has existing programs in environmental health, injury prevention, and asthma that can directly inform HH program activities in these areas. As CDC expands its healthy homes efforts, it will be critical for HUD and CDC to coordinate research and program agendas.

The Economic Landscape

The affordable housing crisis in the U.S. adds to the complexity of creating healthy homes. It is estimated that in the U.S. today, 12 million households pay more than 50% of their annual incomes for housing. Further, a family with one full-time worker earning the minimum wage cannot afford local fair-market rent for a two-bedroom apartment anywhere in the U.S (HUD CPD, 2008). For low-income families, the lack of affordable housing may force them into substandard homes, where they are more likely to live under poor conditions with health hazards. The high cost of housing may also prevent them from meeting other basic needs, such as nutrition and healthcare. At the heart of HUD’s mission is the goal to expand the supply of affordable housing to low-income families. HUD’s Office of Community Planning and Development, Office of Housing, and Office of Public and Indian Housing (PIH) all conduct programs targeted toward expanding the stock of low-cost housing. This provides an opportunity for the Office to coordinate with these programs to encourage the adoption of healthy homes principles during housing rehab and new construction.

Current Movements among Housing Programs/Professionals

Housing professionals include those who work in public sector Federal and local housing programs, as well as private sector personnel such as property owners and those who work in housing rehabilitation, construction and maintenance. Other relevant professionals include public health nurses, social service providers, energy auditors, architects, inspectors, pest control specialists, weatherization experts, and others who visit homes to provide services or perform other work. Several current movements among housing and related professionals present the opportunity to incorporate aspects of the healthy homes approach into ongoing practices and programs.

1) Integrated Pest Management – There is increasing recognition that traditional pest control practices, namely, the broadcast application of pesticides, can be hazardous to residents and ineffective in achieving sustained pest control. IPM is more effective than traditional practices at similar or reduced (long-term) costs. Broad adoption of IPM principles by public housing agencies and other property owners and managers has the

potential to improve the health of residents by reducing exposure to pests (and pest-related allergens) and to pesticides.

2) Energy Conservation, Green Building, and Health – The housing sector accounts for approximately one fifth of all energy consumption in the U.S. As the cost of this energy has soared in the last several years, HUD has taken aggressive steps to promote energy efficiency in homes. The Department’s Energy Task Force, consisting of representatives from HUD Program Offices and Regional Energy Coordinators, has developed an Energy Action Plan, which it is now in the process of implementing. OHHLHC regularly participates in Energy Task Force activities. As homes become more airtight in an effort to conserve energy, proper ventilation becomes increasingly important. The Office will work to promote attention to the need of ensuring adequate indoor air quality in conjunction with residential energy conservation.

Department of Energy (DOE) programs support improving the energy efficiency of homes as well as other performance characteristics. The Weatherization and Assistance Program aims at reducing the burden of energy prices on low-income families, by increasing a home’s energy efficiency. As a part of this process, crews conduct an all-around safety check in which they identify hazards, including carbon monoxide leaks and mold. In recent years, DOE has expanded its program to allow weatherization crews to not only identify but mitigate these hazards as well. Building America is another DOE program, which currently sponsors research to find energy-efficient solutions for new and existing housing, and presents another opportunity for OHHLHC collaboration.

As a part of the effort to reduce our nation’s energy consumption, the larger concept of green building has also gained momentum. Traditionally, this concept has focused on construction that is environmentally sustainable and resource efficient, but increasingly proponents have also emphasized the importance of occupant health. The EPA Energy Star program recently released an Indoor Air Package, which promotes both household energy efficiency and indoor air quality. The popular LEED rating system, developed by the U.S. Green Building Council, has incorporated this package into its guidelines. Although the Indoor Air Package is not mandatory for LEED certification, the guidelines do require a certain degree of indoor environmental quality measures and stress the importance of a healthy living environment. The National Center for Healthy Housing has recently completed a preliminary investigation assessing the “healthy homes components” of several green building guidelines. Though they found significant variation among the guidelines’ consideration of occupant health, ultimately they concluded that these programs offer a considerable opportunity for moving toward healthier homes (NCHH, 2006). However, questions still exist as to what tangible indoor environmental quality and health outcomes will come of these new building practices. The green building movement’s momentum represents an important opportunity to promote indoor environmental quality as a key component of “green” rehab and new construction. As the green building movement expands, it will be increasingly critical for OHHLHC to help ensure that green housing and healthy housing are in fact synonymous.

Critical Public Health Needs

It is important to acknowledge emerging public health needs and their relationship to the work of OHHLHC.

1) Smoke-Free Housing – As the dangers of exposure to secondhand smoke and the benefits of smoke-free environments have become better understood, so has the demand for smoke-free housing. As of mid-July, 2008, at least 80 local housing authorities nationwide had adopted smoke-free policies for some or all of their apartment buildings, 66 of which had been adopted since the beginning of January, 2005; an average of more than 1.5 per month (The Center for Social Gerontology). Letters from multiple HUD field offices, including one from the Chief Counsel in HUD’s Detroit field office, have stated that housing authorities and HUD-subsidized owners may adopt smoke-free “house rules” without approval from HUD. HUD and its federal partners have the opportunity to facilitate the adoption of smoke-free housing in the immediate future.

2) Unintentional Injuries – Preventing unintentional injuries has been part of the Healthy Homes program’s mission since the beginning. While OHHLHC has long been an active member of the Public/Private Fire Safety Council, and has sponsored some research, demonstration projects, and outreach efforts focusing on unintentional residential injuries, the majority of the program’s efforts have focused on health outcomes other than injury, particularly asthma. Recognizing the major health toll and economic burden posed by unintentional injuries, there is a continued need to address the cost-effective identification and control of residential injury hazards. The CDC’s Injury Prevention Division is a valuable partner providing research on proven interventions, while non-profits like the Home Safety Council have successful education campaigns. For example, there is increasing interest and need to address the issue of elderly fall injuries. Collaboration with HUD offices represents an opportunity to enhance OHHLHC’s efforts to keep HUD-assisted housing healthy and safe.

3) Natural Disasters – Recent natural disasters, including Hurricane Katrina, wildfires in California, and flooding in Iowa, have demonstrated the connection between homes, health, and extreme weather events. Disasters such as these can contaminate water supplies and cause damage to homes that could result in occupant illness or injury (e.g., water damage resulting in extensive growth of mold and other biological agents). In light of this, OHHLHC has begun to develop educational material for home owners and others involved in the rehabilitation of an area hit by an extreme weather event. Thus far, guidance documents have addressed proper procedures for hurricane and flooding cleanup and rebuilding. In preparation for future events, OHHLHC will continue to work with federal and local partners to develop material which addresses additional natural disaster-related hazards and to expand distribution of these materials to victims. OHHLHC is also well suited to partner on preventive design activities, aiding in the creation of housing that minimizes potential health hazards commonly resulting from natural disasters.

Expanding the Focus of Lead Hazard Control Programs

HUD LHC grantees were among the first to observe that homes with lead-based paint hazards often had other important health hazards that could be addressed in a cost-effective manner. Indeed, some common lead hazard control interventions, such as preventing water intrusion and reducing dust loading would also likely reduce levels of common asthma triggers in dust and air (e.g., mold, dust mites). As the comprehensive healthy homes approach gains popularity and progress is made on the 2010 national goal of eliminating childhood lead poisoning, lead grantees can continue to play an invaluable role in the healthy homes movement. Many LHC grantees are interested in expanding their lead hazard control focus by also addressing other residential health hazards. Some grantees have been able to address other common hazards (e.g., missing/nonfunctional smoke or CO detectors) by securing additional resources, whereas others have addressed health and safety hazards through code enforcement.

OHHLHC will look for opportunities to facilitate the ability of LHC programs to identify and address multiple high priority hazards, such as through the highlighting of effective practices. The Office will also explore options to allow greater flexibility in the use of LHC funds, which are currently restricted by statute for use in addressing lead hazards only.

VI. Healthy Homes Program Future Directions

During the strategic planning process, OHHLHC staff took a broad look at healthy homes trends, reflected on the Office's accomplishments and mission within HUD to date, and considered responses to a set of potential focus areas. Staff used the results of this analysis to draft a revised mission and vision for the HH program. The draft goals that follow align with the revised mission and vision, and, together with the set of proposed draft strategies, are expected to enable the HH program to accomplish its mission and vision of continued leadership in ensuring that homes are healthy.

The Planning Process

The Healthy Homes program drafted a list of revised focus areas, and solicited feedback from selected internal OHHLHC staff and external partners. Respondents were asked to first prioritize the 12 focus areas, and then to note any that they felt had been overlooked. Among the federal partners, non-profit partners, and OHHLHC staff who provided feedback, the seven highest priority focus areas were¹:

- Develop standard, evidence-based HH assessment tools and intervention protocols (Focus Area #7);
- Support the development of objective standards for what is considered a “healthy” residential environment (Focus Area #8);
- Increase collaboration internal to HUD and with other Federal housing programs (Focus Area #10);
- Improve overall dissemination of HH information, including best practices, to partners, grantees, and the public (Focus Area #6);
- Conduct cost-benefit analysis on the effectiveness of a healthy homes approach through the analysis of health and financial outcomes (Focus Area #9);
- Promote the inclusion of health considerations into “Green” and energy efficient construction (Focus Area #1); and
- Increase the emphasis on identifying key research questions and supporting larger, more definitive studies (Focus Area #2).

Of these high priority focus areas, #1, 6, and 10 were never listed as the lowest priority.² See Appendix for a complete list of the focus areas. While most respondents were enthusiastic about the breadth of topics covered under the potential focus areas, a few points were made about additional focus areas to consider. Of particular note were recommendations about training opportunities and building local capacity, enforcement and regulatory options (e.g., codes), collecting health and housing data, and ensuring that lead hazard control is not neglected as healthy homes approaches move forward.

¹ Highest priority focus areas are defined as those that were listed as either first or second priority by at least half of all respondents.

² Lowest priority focus areas are defined as those that were listed as least important by at least half of all respondents.

Healthy Homes Program Vision and Mission Statements

○ **Healthy Homes Program Vision**

To lead the nation to a future where homes are designed, constructed, rehabilitated, and maintained in a manner that supports the health and safety of occupants, with a particular focus on protecting the health of children and other sensitive populations in low-income households.

○ **Healthy Homes Program Mission**

To reduce health and safety hazards in housing by supporting and promoting applied research, assessment and intervention protocols, policy guidelines, outreach, and capacity building for partners, practitioners, and the public. Rather than rely on the traditional approach of addressing hazards one-by-one, the Healthy Homes program develops and promotes integrated approaches to identify and address multiple residential health and safety hazards in a comprehensive, evidence-based, and cost effective manner.

Healthy Homes Program Draft Revised Goals and Strategies

The draft revised goals, discussed in detail below, are as follows:

- 1) **Building a National Framework:** Foster partnerships for implementing a healthy homes agenda.
- 2) **Creating Healthy Housing through Key Research:** Support strategic, focused research on links between housing and health and cost-effective methods to address hazards.
- 3) **Mainstreaming the Healthy Homes Approach:** Promote the incorporation of healthy homes principles into ongoing practices and programs.
- 4) **Enabling Communities to Create and Sustain Healthy Homes:** Build sustainable local healthy homes programs.

Goal 1: Foster partnerships for implementing a healthy homes agenda (Building a National Framework).

OHHLHC's HH program has a strong track record of working with other HUD program offices and Federal partners to accomplish results, and values the unique resources, expertise, and perspective that each partner brings to the table. Because of the multi-faceted nature of the healthy homes concept, HUD must create and sustain both formal and informal collaborations with its federal partners to help ensure that the program's mission is achieved as efficiently as possible. Through interagency agreements HUD can leverage professional expertise in areas such as epidemiology and health education at CDC, and tap into existing networks such as USDA's CSREES.

It is also important to develop and maintain less formal relationships with Federal programs that are active in areas that overlap with the healthy homes concept. For example, an ongoing system of coordination would help facilitate and solidify routes of communication between the OHHLHC and its Federal partners. Such a system would help in necessary efforts to understand program roles and responsibilities, identify knowledge gaps and research priorities, and share effective healthy homes practices. Collaboration with private sector entities involved in housing and health, including non-profit organizations and industry, will also be critical to coordinating and implementing a national healthy homes agenda.

Short Term Strategies

- *Develop New Federal Partnerships*: Identify program goals that can be best accomplished through the formation of formal partnerships with Federal partners and develop new partnerships, as needed. Potential topic areas include, but are not limited to: research on the relationship between ventilation and indoor air quality, incorporating healthy homes concepts into weatherization programs, mental health and housing, and cost-effective injury prevention strategies for children and seniors.
- *Identify and Develop Key Private Sector Partnerships*: Reaching out to relevant private sector entities, including both non-profit organizations and industry, is key to achieving the healthy homes mission. Key partners include builders, insurers, and health and housing advocacy groups.
- *Create a Mechanism for Coordinating Federal Healthy Homes Activities*: This could include, for example, regular (e.g., quarterly) meetings of a coordinating committee with in-person meetings as needed. Representatives from state and local governments as well as private organizations could be invited to participate in meetings to inform the committee on effective strategies, opportunities for collaboration, etc.

Long Term Strategies

- *Continue Future Sponsorship of National Healthy Homes Conferences*: A National Healthy Homes Conference could be organized and held on a regular basis (e.g., once every two years). At each conference, the focus areas would change to reflect the evolution of the healthy homes concept and to address timely issues. As is planned for 2008, the conference would bring together a broad community of experts and involve the close collaboration of HUD and its federal partners in the planning and implementation.

Goal 2: Support strategic, focused research on links between housing and health and cost-effective methods to address hazards (Creating Healthy Housing through Key Research).

The HH program has supported research through the funding of Technical Studies Program grants, contracts, and interagency agreements. While most projects have been funded at modest levels (e.g., \$400,000 - \$900,000), the most significant findings have been produced by larger, more costly studies. Examples include the collection of allergen data from a nationally representative sample of U.S. homes through the National Survey of Lead and Allergens in Housing (NSLAH) (cooperative research with the National Institute of Environmental Health Sciences), and a Cleveland study that assessed the impact of mold/moisture interventions in the homes of asthmatic children. While OHHLHC has been a key contributor to healthy homes research, research gaps remain. Moving forward, the HH program envisions coordinating a research agenda with key partners to produce definitive research in two key areas:

Developing cost effective methods and protocols - Healthy homes experts agree that while consensus is building on effective protocols to assess, prevent, and control housing-related health and safety hazards, knowledge gaps persist. Evidence-based, practical, and widely accessible methods are needed to both identify hazards and conduct follow-up interventions. This is challenging because of the wide range of both hazards and housing types that are encountered. Furthermore, because there will always be funding constraints, it is important that interventions target the highest priority hazards and that they are cost-effective. Ideally an assessment tool will be reliable (i.e., results are reproducible between different users), easily administered, and will incorporate items that have been validated to ensure that they accurately identify hazards. Intervention protocols should have the backing of research that demonstrates effectiveness in eliminating or reducing hazardous conditions with resulting improvements in health outcomes (e.g., reduced incidence of a particular injury, improved asthma control). Cost-benefit analyses should also be conducted in order to identify the most cost-effective interventions.

Linking housing and health – More research is needed in order to fully understand the health effects of housing-related health hazards. The HH program will continue to pursue research on links between housing and health in cooperation with federal partners with health expertise, such as CDC and NIEHS.

Short Term Strategies*Developing Methods and Protocols*

- Promote the use of the “Healthy Housing Inspection Manual” that was developed through HUD’s interagency agreement with CDC and obtain feedback from users of the tool.

- Initiate the development of a combined computerized assessment tool for weatherization (i.e., energy efficiency upgrades) and housing-related health and safety hazards, as per OHHLHC's commitment in the HUD Energy Action Plan.
- Initiate the development of "best practices" guidance for healthy homes programs, which would summarize currently available information on healthy homes assessment tools and intervention protocols.
- Complete research on protocols for processing dust for allergen analysis and develop and facilitate the adoption of a standard protocol.
- Conduct initial planning for a potential multi-site "asthma intervention" study.

Linking Housing and Health

- Analyze data from NSLAH and AHHS to identify risk factors that predict multiple hazards (e.g. elevated allergen burden and lead-based paint hazards). Results would be expected to improve targeting and home assessment tools.
- Conduct research to characterize the potential indoor air quality benefits of "green" construction compared to traditionally built units. Examples include continued collaboration with Office of Affordable Housing Preservation, PD&R, and CDC to document the effects of green rehabilitation efforts on indoor air quality and health.

Long Term Strategies

Developing Methods and Protocols

- Conduct a multi-site study of asthma interventions focusing on multifaceted interventions that include mold/moisture control in different climatic regions of the U.S. (follow up to Cleveland asthma study).
- Support research to improve IPM methods.
- Assess effectiveness of HH professional training and of public outreach/education efforts (e.g., knowledge of HH principles, behavior change).
- Conduct research to refine a comprehensive HH tool that minimizes the burden to the user and maximizes the "predictive power" of the tool.

Linking Housing and Health

- Support research on the potential health benefits of "green" construction and rehabilitation (i.e., use of low emission materials), and on green construction incorporating additional HH factors (e.g., improved ventilation, smooth and

- cleanable floor surfaces) (note: recent HH grant in Seattle showed significant improvements in children's asthma symptoms in newly built units).
- Improve understanding of relationship between residential indoor air quality and ventilation characteristics.
 - Work with federal partners to develop a surveillance system to track HH hazards and housing-related health outcomes.
 - *Conduct Cost-Benefit Analyses:* As methods are validated, the HH program will conduct cost-benefit analyses to assess the effectiveness of standard healthy homes assessment and intervention protocols and possibly more specialized protocols (e.g., mold/moisture intervention focus, and analysis of IPM vs. traditional pest control methods). Such analyses will help to identify the most cost effective protocols and support the need to widely implement these measures.
 - *Define a Healthy Home:* Support the development and adoption of a core set of objective measures for what is considered a "healthy" residential environment. Strategies should include promoting the use of validated residential assessment tools and effective intervention protocols and construction specifications (particularly their incorporation into existing programs).

Goal 3: Promote the incorporation of healthy homes principles into ongoing practices and programs (Mainstreaming the Healthy Homes Approach).

Reducing housing-related health and safety hazards in the maximum number of U.S. homes ultimately depends on the extent to which healthy homes principles can be successfully incorporated into ongoing public and private sector housing practices and programs. Over the short term, collaboration with public sector housing professionals and programs will continue to be the program's focus. Critical housing audiences can be reached through HH program involvement by: 1) promoting cost-effective aspects of healthy homes assessments and interventions; 2) promoting the incorporation of healthy homes principles into popular environmental movements; and 3) promoting the use of healthy homes principles in issue areas where there is a critical public health need. Over the long term, as the healthy homes approach is proven to be cost-effective and methods are validated, it will be necessary to continue work with HUD housing programs, support health-protective codes and enforcement strategies, and secure private sector input.

Short Term Strategies

Promote Cost-Effective Aspects of Healthy Homes Assessments/Interventions

- *Integrated Pest Management:* Continue cooperative work with HUD's Office of Public and Indian Housing and USDA to encourage the adoption of IPM by public housing agencies (and other low income housing providers) through a

training program that reaches management, staff, and residents of public housing developments throughout the country.

Promote the Incorporation of Healthy Homes Principles into Current Housing Movements

- *Energy Conservation:* With energy conservation at the forefront of national attention, and OHHLHC's commitment to the HUD Energy Task Force, the HH program will facilitate the incorporation of healthy homes assessments and interventions into weatherization programs through the piloting of an electronic assessment tool by several weatherization programs.
- *Green Building:* The HH program will work towards ensuring that green housing and healthy housing are synonymous. Through a new Sustainable and Healthy Housing Initiative, the program will actively promote the inclusion of health considerations into green construction and rehabilitation, and sponsor research to assess resulting health and environmental benefits.

Promote the Use of Healthy Homes Principles in Issue Areas where there is a Critical Public Health Need

- *Smoke-Free Housing:* As smoke-free housing policies gain momentum among public housing agencies, the HH program will work with HUD offices to encourage smoke-free housing in public and Section 8 housing and relevant federal partners like CDC and EPA on public health messaging related to eliminating environmental tobacco smoke exposure.
- *Unintentional Injury Prevention:* Initiate collaboration with HUD offices that coordinate supportive housing for the elderly (Section 202 of the Housing Act of 1959) and the disabled (Section 811 of the National Affordable Housing Act of 1990), as well as with key federal partners like CDC.
- *Post-Disaster Environments:* Through its efforts to provide training and guidance in the wake of Hurricanes Katrina and Rita, the OHHLHC has gained experience promoting healthy homes approaches in post-disaster environments. The OHHLHC will continue to seek opportunities to develop and deliver appropriate HH guidance and services in post-disaster settings.

Long Term Strategies

- *Continue to Facilitate the Adoption of Healthy Homes Practices by Existing Housing Programs:* The HH program will continue to work with HUD offices that administer HUD-assisted housing in an effort to incorporate healthy homes practices. Practices to emphasize will include: adoption of IPM practices by low income housing developments; creation of smoke-free developments; and

- adoption of specifications for “moisture resistance” by publicly funded housing rehabilitation programs.
- *Support the Creation and Adoption of Health-Protective Housing Codes and Enforcement Strategies:* Since there are no federal regulations governing healthy homes issues beyond lead-based paint, locally implemented policies are key tools for instituting change. The HH program will identify and facilitate the adoption of effective HH practices into existing codes. HUD’s new membership on the International Code Council will provide a prime medium for program staff to review model property maintenance and energy conservation codes, as well as codes for new construction, existing buildings, and residences, to ensure that they reflect healthy homes principles.
 - *Gather Critical Private Sector Input:* Ultimately, private sector housing professionals will need to feel confident about the healthy homes approach in order for it to become fully incorporated into standard building and rehabilitation practices. The HH program will solicit input from private sector stakeholders in an effort to identify and address their key needs.

Goal 4: Build sustainable local healthy homes programs (Enabling Communities to Create and Sustain Healthy Homes).

The OHHLHC has provided financial and technical support for local programs for over ten years. In order for these programs to succeed beyond the federal funding period, a combination of OHHLHC-provided tools, innovative private sector partnerships, and public awareness will be essential. The OHHLHC plans to provide the resources and education tools necessary to set local communities on the path towards creating and sustaining healthy homes. In the short term, this includes gathering input from local programs, providing continued support for lead and healthy homes grantees, and initiating broader marketing efforts to engage the public in healthy homes awareness. Over the long term, the program recognizes that it will also need to pursue opportunities with the private sector in order to secure adequate commitment to the healthy homes mission in the form of implementation support and funding.

Short Term Strategies

- *Provide Effective Training to a Variety of Audiences:* The National Healthy Homes Training Center, funded through OHHLHC via an interagency agreement with CDC, will continue to cast a wide net through its programs, with the goal of reaching the variety of housing and health personnel who visit homes to provide services or perform other work (such as inspectors, public health nurses, energy auditors, and social service providers).
- *Enhance Lead Hazard Control Programs’ Capability to Address Broader Healthy Homes Issues:* HUD’s new Healthy Homes Pilot Program will provide funds to enable selected communities to facilitate interventions in high risk housing and

promote cooperation between health and housing agencies to conduct assessments and interventions for lead-based paint as well as other housing-related hazards. OHHLHC will provide communication channels for LHC grantees to learn from Healthy Homes grantees' experiences.

- *Facilitate Exchange of Best Practices:* Work with local programs to better understand successes, challenges, and remaining needs. Compile and disseminate guidance that identifies “best practices” in key HH program areas such as participant recruitment, home assessment and intervention to eliminate hazards. Develop a web-based system to facilitate the exchange of information between HH grantees (similar to the former “HH grantee exchange”). Develop and implement a system for summarizing the key findings of HH grantees (e.g., creating and posting final project summaries on the web).
- *Design and Initiate a National Healthy Homes Marketing Plan:* In coordination with partners, the HH program will design and initiate the execution of a national healthy homes marketing plan. Necessary actions will include identifying the target audience(s), formulating and packaging unified messages, identifying ideal mechanisms for dissemination, building on existing outreach and public education efforts, and providing critical healthy homes information in a concise and simple manner. The HH program may review, improve, and initiate a system to periodically assess and upgrade its web sites with HH information, including OHHLHC’s web site and the planned “HH listing” web site which will provide information on identifying and selecting various HH professionals.

Long Term Strategies

- *Evaluate and Improve Training:* Evaluate the effectiveness of OHHLHC-sponsored healthy homes training and use the results to improve the training.
- *Evaluate the National Healthy Homes Marketing Campaign:* Evaluate and improve the effectiveness of specific aspects of the HH marketing campaign.
- *Sponsor Workshops on Specific Healthy-Homes Issues:* Workshops would focus on specific HH topics such as particular scientific or policy issues (e.g., dust sampling and preparation for allergens, modification of housing codes, and adoption of smoke-free housing) or the discussion of the most effective outreach strategies. The goal of the workshops would be to advance the healthy homes concept in specific areas by helping to identify best practices and identify key knowledge gaps.
- *Identify and Pursue Opportunities to Promote Healthy Homes Concepts to Private and Public Sector Entities:* Demonstrating the cost-effectiveness of the healthy homes approach should encourage meaningful private and public sector involvement. For example, housing developers, rehabilitation programs, and

health insurers have critical roles to play in ensuring that homes are healthy and safe.

References

- American Academy of Allergy Asthma & Immunology. 2008. Allergy Statistics. Available: http://www.aaaai.org/media/resources/media_kit/allergy_statistics.stm.
- American Academy of Allergy Asthma & Immunology. 2008. Diseases 101: Asthma Statistics. Available: <http://www.aaaai.org/patients/gallery/childhoodasthma.asp?item=1b>.
- Lai, M.W., W. Klein-Schwartz, G.C. Rodgers, J.Y. Abrams, D.A. Haber, A.C. Bronstein, and K.M. Wruk. 2006. 2005 Annual Report of the American Association of Poison Control Centers' National Poisoning and Exposure Database. *Clinical Toxicology*. 44:803-932.
- Arbes, S.J., R.D. Cohn, M. Yin, M.L. Muilenberg, H.A. Burge, W. Friedman, and D.C. Zeldin. 2003. House Dust Mite Allergen in U.S. Beds: Results from the First National Survey of Lead and Allergens in Housing. *Journal of Allergy and Clinical Immunology*. 111(2):408-14.
- Asthma and Allergy Foundation of America. 2008. Allergic Asthma. Available: <http://www.aafa.org/display.cfm?id=8&sub=16>.
- Canfield, R.L., C.R. Henderson, D.A. Cory-Slechta, C. Cox, T.A. Jusko, and B.P. Lanphear. 2003. Intellectual Impairment in Children with Blood Lead Concentration below 10 Micrograms per Deciliter. *New England Journal of Medicine*. 348:1517-26.
- Centers for Disease Control and Prevention. 2006. Asthma Prevalence, Health Care Use and Mortality: United States, 2003-2005. National Center for Health Statistics. Available: <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/ashtma03-05/asthma03-05.htm>.
- Centers for Disease Control and Prevention. 2005. Blood Lead Levels – United States, 1999-2002. *Morbidity and Mortality Weekly Reports*. Available: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5420a5.htm>.
- Centers for Disease Control and Prevention. 2007. Carbon Monoxide-Related Deaths – United States, 1999-2004. *Morbidity and Mortality Weekly Reports*. Available: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm56590a1.htm?s_cid=mm5650a1_e.
- Centers for Disease Control and Prevention. 2006. CDC Injury Fact Book. National Center for Injury Prevention and Control. Available: http://www.cdc.gov/ncipc/fact_book/InjuryBook2006.pdf.
- Centers for Disease Control and Prevention. 2006. Falls Among Older Adults: Figures and Maps. National Center for Injury Prevention and Control. Available: <http://www.cdc.gov/ncipc/duip/adultfallsfig-maps.htm>.

Centers for Disease Control and Prevention. 2007. Injuries among Older Adults. National Center for Injury Prevention and Control. Available: <http://www.cdc.gov/ncipc/olderadults.htm>.

Centers for Disease Control and Prevention. 2008. Injury in the United States: 2007 Chartbook. National Center for Health Statistics. Available: <http://www.cdc.gov/nchs/data/misc/injury2007.pdf>.

Centers for Disease Control and Prevention. 2002. Pediatric Environmental Health – The Child as Susceptible Host: A Developmental Approach to Pediatric Environmental Medicine. Agency for Toxic Substances & Disease Registry. Available: <http://www.atsdr.cdc.gov/csem/pediatric/susceptible.html>.

Centers for Disease Control and Prevention. 2008. Poisoning in the United States: Fact Sheet. National Center for Injury Prevention and Control. Available: <http://www.cdc.gov/ncipc/factsheets/poisoning.htm>.

Centers for Disease Control and Prevention. 2006. Smoking and Tobacco Use Fact Sheet: Secondhand Smoke. Office on Smoking and Health. Available from: http://www.cdc.gov/tobacco/data_statistics/fact_sheets/secondhand_smoke/secondhands_moke.htm.

Centers for Disease Control and Prevention. 2005. Table 4.1 – Current Asthma Prevalence Percents by Age, United States: National Health Interview Survey, 2005. Available: <http://www.cdc.gov/asthma/nhis/05/table4-1.htm>.

Centers for Disease Control and Prevention. 2008. Web-based Injury Statistics Query and Reporting System. National Center for Injury Prevention and Control. Available: <http://www.cdc.gov/ncipc/wisqars/>.

The Center for Social Gerontology. Environmental Tobacco Smoke in Apartments. Smoke-Free Environmental Law Project. Available: <http://www.tcsg.org/sfelp/apartment.htm>.

Cohn, R.D., S.J. Arbes Jr., R. Jaramillo, L.H. Reid, and D.C. Zeldin. 2005. National Prevalence and Exposure Risk for Cockroach Allergen in US Households. Environmental Health Perspectives.

Galke, W., S. Clark, J. Wilson, et al. 2001. Evaluation of the HUD Lead Hazard Control Grant Program: Early Overall Findings. Environmental Research. 86:149-156.

Grosse, S.D., T.D. Matte, J. Schwartz, and R.J. Jackson. 2002. Economic Gains Resulting from the Reduction in Children's Exposure to Lead in the United States. Environmental Health Perspectives. 110:563-69.

Home Safety Council. 2002. The State of Home Safety in America: The Facts about Unintentional Injuries in the Home, 2002 Edition. Wilkesboro, NC.

Horner, W.E., A.G. Worthan, and P.R. Morey. 2004. Air- and Dust-Borne Mycoflora in Houses Free of Water Damage and Fungal Growth. *Applied and Environmental Microbiology*. 70(11):6394-6400.

Jacobs, D.E., R.P. Clickner, J.Y. Zhou, et al. 2002. Prevalence of Lead-Based Paint in U.S. Housing. *Environmental Health Perspectives*. 110(10):A559-A606.

Joint Center for Housing Studies. 2005. The State of the Nation's Housing – 2005. Harvard University. Cambridge, MA.

Krieger, J. and D.L. Higgins. 2002. Housing and Health: Time Again for Public Health Action. *American Journal of Public Health*. 92(5):758-68.

Landigran, P.J., C.B. Schechter, J.M. Lipton, M.C. Fahs, and J. Schwartz. 2002. Environmental Pollutants and Disease in American Children: Estimates of Morbidity, Mortality, and Costs for Lead Poisoning, Asthma, Cancer, and Developmental Disabilities. *Environmental Health Perspectives*. 110(7):721-28.

Lanphear, B.P., C.A. Aligne, P. Auinger, R.S. Byrd, and M. Weitzman. 2001a. Residential Exposures Associated with Asthma in U.S. Children. *Pediatrics*. 107:505-11.

Lanphear, B.P., K. Dietrich, P. Auinger, and C. Cox. 2000. Cognitive Deficits Associated with Blood Lead Concentration <10 Micrograms per Deciliter in U.S. Children and Adolescents. *Public Health Reports*. 115(6):530-1.

Lanphear, B.P., R.S. Kahn, O. Berger, P. Auinger, S.M. Bortnick, and R.W. Nahhas. 2001b. Contribution of Residential Exposures to Asthma in U.S. Children and Adolescents. *Pediatrics*. 107(6):E98.

Morgan, W. J., E.F. Crain, R.S. Gruchalla, et al. 2004. Results of Home-Based Environmental Intervention among Urban Children with Asthma. *New England Journal of Medicine*. 351:1068-80.

Mudarri, D. and W. J. Fisk. 2006. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General, U.S. Department of Health and Human Services. *Indoor Air*. 17(3):226-235.

Nagaraja, J., J. Menkedick, K.J. Phelan, P. Ashley, X. Zhang, and B.P. Lanphear. 2005. Deaths from Residential Injuries in U.S. Children and Adolescents, 1985-1997. *Pediatrics*. 116(2):454-461.

National Center for Healthy Housing. 2006. Comparing Green Building Guidelines and Healthy Homes Principles: A Preliminary Investigation.

National Center for Healthy Housing and Centers for Disease Control and Prevention. 2007. Healthy Homes Expert Panel Meeting: Peer Review of Intervention Studies – Record of Proceedings and Follow-up Activities. Available: http://www.centerforhealthyhousing.org/Healthy_Homes_Expert_Panel_Meeting_Minutes_and_Final_Power_Points.pdf.

National Council on Aging. 2007. The Creative Practices in Home Safety Assessment and Modification Study. Available: http://www.healthyagingprograms.org/resources/Creative_Practices%20-%20Home_Safety_Report.pdf.

National Institutes of Health. 2007. Morbidity and Mortality: 2007 Chart Book on Cardiovascular, Lung, and Blood Diseases. National Heart, Blood, and Lung Institute. Available: <http://www.nhlbi.nih.gov/resources/docs/07-chtbk.pdf>.

National Institutes of Health. 2008. Respiratory Disease and the Environment. National Institute of Environmental Health Sciences. Available: <http://www.niehs.nih.gov/health/docs/respiratory-enviro.pdf>.

Pate, A.D., R.G. Hamilton, P.J. Ashley, D.C. Zeldin, D.C., and J.F. Halsey. 2005. Proficiency Testing of Allergen Measurements in Residential Dust. *Journal of Allergy and Clinical Immunology*. 116:844-50.

Raub, J.A., M. Mathieu-Nolf, and N.B. Hampson. 2000. Carbon Monoxide Poisoning – A Public Health Perspective. *Toxicology*. 145:1-14.

Selgrade, M.K., R.F. Lemanske, M.I. Gilmour, et al. 2006. Induction of Asthma and the Environment: What We Know and Need to Know. *Environmental Health Perspectives*. 114(4):615-619.

Sleet, D.A., D.B. Moffett, and J. Stevens. 2008. CDC's Research Portfolio in Older Adult Fall Prevention: A Review of Progress, 1985-2005, and Future Research Directions. *Journal of Safety Research*. 39:259-267.

Takaro, T.K., J.W. Krieger, D.T. Sharify, L. Song, and T. Phillips. 2008. Clinical Response in Asthma from Improved Housing Design and Construction. *American Journal of Respiratory and Critical Care Medicine*. 177:A187.

U.S. Census Bureau. Poverty: 2007 Highlights. Available: <http://www.census.gov/hhes/www/poverty/poverty07/pov07hi.html>.

U.S. Department of Health and Human Services. 2006. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Office of

the Surgeon General. Available:

<http://www.surgeongeneral.gov/library/secondhandsmoke/report/>.

U.S. Department of Housing and Urban Development. 2008. Affordable Housing.

Office of Community Planning and Development. Available:

<http://www.hud.gov/offices/cpd/affordablehousing/index.cfm>.

U.S. Department of Housing and Urban Development. 2005. American Housing Survey.

Available: <http://www.huduser.org/datasets/ahs/ahsdata05.html>.

U.S. Department of Housing and Urban Development. 2006. Healthy Homes Issues:

Asthma. Office of Healthy Homes and Lead Hazard Control.

U.S. Environmental Protection Agency. 2005. Asthma Research Results Highlights.

EPA-600-R-04-161. Washington, DC: US EPA Office of Research and Development.

U.S. Environmental Protection Agency. 2002. Child-Specific Exposure Factors

Handbook (Interim Report). EPA-600-P-00-002B. Washington, DC: US EPA Office of Research and Development, National Center for Environmental Assessment.

U.S. Environmental Protection Agency. 2008. Fast Facts on Children's Environmental Health. Children's Health Protection. Available:

<http://yosemite.epa.gov/ochp/ochpweb.nsf/content/fastfacts.htm>.

U.S. Environmental Protection Agency. 2007. Indoor Air Quality: Basic Information –

Organic Gases. Available: <http://www.epa.gov/iaq/voc.html>.

U.S. Environmental Protection Agency. 2004. Pesticides Industry Sales and Usage: 2000 and 2001 Market Estimates. Available:

http://epa.gov/oppbead1/pestsales/market_estimates2001.pdf.

U.S. Environmental Protection Agency. 2002. Pesticides: Topical & Chemical Fact Sheets – Protecting Children from Pesticides. Available:

<http://www.epa.gov/pesticides/factsheets/kidpesticide.htm>.

U.S. Environmental Protection Agency. 2008. Radon. Available:

<http://www.epa.gov/radon/>.

Vesper, S., C. McKinstry, R. Haughland, L. Wymer, et al. 2007. Development of an Environmental Relative Moldiness Index for US Homes. *Journal of Occupational Environmental Medicine*. 49:829-833.

Wilson, J., T. Pivetz, P. Ashley, et al. 2006. Evaluation of HUD-funded lead hazard control treatments at 6 years post-intervention. *Environmental Research*. 102(2):237-48.

Yeatts, K., P. Sly, S. Shore, S. Weiss, et al. 2006. A Brief Targeted Review of Susceptibility Factors, Environmental Exposures, Asthma Incidence, and Recommendations for Future Asthma Incidence Research. *Environmental Health Perspectives*. 114(4):634-640.

Appendix: Potential Focus Areas

Following are the potential concepts and goals, which were considered during the planning process, to be incorporated into HUD's HH Strategic Plan:

- 1) Promote the inclusion of health considerations into "Green" and energy efficient construction.
- 2) Increase the emphasis on identifying key research questions and supporting larger, more definitive studies.
- 3) Increase the emphasis on injury prevention in home assessments and interventions.
- 4) Expand target population (currently children) to include other high risk populations, in particular the elderly.
- 5) Promote HH concepts to strategic private sector entities, such as developers and insurance companies.
- 6) Improve overall dissemination of HH information, including best practices, to partners, grantees, and the public.
- 7) Develop standard, evidence-based HH assessment tools and intervention protocols.
- 8) Support the development of objective standards for what is considered a "healthy" residential environment.
- 9) Conduct cost/benefit analysis on the effectiveness of a healthy homes approach through the analysis of health and financial outcomes.
- 10) Increase collaboration internal to HUD and with other Federal housing programs.
- 11) Promote healthy housing concepts in post-disaster environments, such as the dissemination of information on safe rehab and recovery practices.
- 12) Promote the incorporation of healthy homes principles into ongoing practices/systems. Examples include housing codes, rehab specs used by housing and development agencies, and maintenance plans for multifamily housing (with a particular focus on the incorporation of IPM in low income housing).