Leading Our Nation to Healthier Homes:

The Healthy Homes Strategic Plan

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

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The Strategic Plan is accessible at www.hud.gov/healthyhomes

Executive Summary

Nearly ten years since the inception of the Healthy Homes program in the Department of Housing and Urban Development's (HUD's) Office of Healthy Homes and Lead Hazard Control (OHHLHC), the Office is in the process of evaluating progress, distilling lessons learned, and forging a new strategic direction. This new direction will incorporate these lessons, without abandoning the Office's core mission to ensure that lead poisoning is eliminated as a major childhood disease. 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 promote national efforts to reduce housing-related health hazards.

Program Background

The OHHLHC has administered a successful Lead Hazard Control program since 1993. Through robust grants, enforcement efforts, research, and outreach, this program has been instrumental in achieving a reduction of over 70% in childhood lead poisoning cases from the early 1990s to today. In addition to saving lives and improving the health of children, this reduction has saved the nation billions of dollars by increasing productivity, decreasing medical and special education costs, and potentially reducing criminal activity. The "healthy homes" concept grew out of the observations of Lead Hazard Control grantees that homes with lead-based paint hazards often had other important health hazards that could be addressed at the same time. The core of this concept is that it is more efficient and cost-effective to identify and mitigate multiple health hazards in high risk housing, rather than follow the traditional approach of addressing individual hazards through multiple categorical programs.

The Healthy Homes program has been guided by a strategic plan proposed by a multidisciplinary panel of experts convened by HUD in 1999, and funded at approximately $10 million annually since then. In FY 2009, this was increased to $14.6 million. To date, 101 Healthy Homes Demonstration and Healthy Homes Technical Studies grants have been awarded by HUD for a total of approximately $81 million. Healthy Homes Demonstration grants have supported implementation of healthy homes 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 more than 30 papers published in scientific and professional journals to date.

According to HUD's 2007 American Housing Survey, six million households live with moderate or severe physical housing problems. Anyone can suffer from housing-related illness and injury; however certain groups such as children, the elderly, or individuals with chronic illness are more susceptible.

Key residential health hazards include asthma and allergy triggers, such as mold, dampness and pests (e.g., cockroaches, mice), 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). In addition, research shows that about 21% of asthma cases in the U.S. are linked to dampness and mold, at an annual cost of approximately $3.5 billion. Pests can also play a significant role in triggering the symptoms of allergies and asthma; a recent study of asthma among inner-city children found that 69% were allergic to cockroaches and 33% to rodents. Meanwhile, unintentional injury is the leading cause of death and disability among children younger than 15 years of age, with over 2,800 child and adolescent deaths occurring each year due to injuries in the home. The elderly are also at an elevated risk for residential injuries; each year, 35-40% of adults 65 and older fall at least once. It is estimated that falls account for 33% of injury-related medical expenditures and cost Americans more than $38 billion annually.

> How homes are designed, constructed, and maintained; their physical characteristics; and the presence or absence of safety devices have many effects on injury, illness, and mental health.
>
> *The Surgeon General*

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 residential health hazards. Addressing these deficiencies simultaneously, rather than attempting to tackle each hazard individually, will yield the greatest results in the most efficient, cost-effective manner. For example, dealing with uncontrolled moisture can alleviate conditions associated with allergies and asthma (mold and pests), unintentional injuries (structural safety), and poisoning (lead paint deterioration).

The key over-arching healthy homes principles are to keep homes dry, clean, well-ventilated, pest-free, free from contaminants, safe, and well-maintained.

Healthy Homes Trends and Future Directions for the OHHLHC

As the healthy homes approach gains momentum and visibility, HUD must address unique challenges and opportunities. The OHHLHC's lead hazard control funds are restricted by statute to address lead hazards only, but many lead program grantees are interested in expanding their focus by also addressing other key residential hazards. The green building movement also 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 rehabilitation 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 managers of multifamily housing because of increasing demand from residents, reduced maintenance costs, and acknowledgment of the public health need to reduce

exposure to environmental tobacco smoke. All of these trends represent key components of incorporating the healthy homes approach into ongoing practices and programs.

To develop this Strategic Plan, the OHHLHC reviewed past and current activities and accomplishments, identified challenges and opportunities, and solicited stakeholder review and comments.

A Vision for Healthy Homes

This effort resulted in a roadmap for increasing the Office's impact and better enabling it to achieve its newly defined vision:

> *To lead the nation to a future where homes are both affordable and designed, constructed, rehabilitated, and maintained in a manner that supports the health and safety of occupants.*

The OHHLHC Mission

To accomplish this vision, the Office's mission will be:

> *To reduce health and safety hazards in housing in a comprehensive and cost-effective manner, with a particular focus on protecting the health of children and other sensitive populations in low-income households.*

Healthy Homes Goals

The Strategic Plan focuses on the following four key goals to 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.

Within the plan, the OHHLHC has developed short- and long-term strategies for achieving each of these goals. Short term strategies include: creating a mechanism for coordinating federal healthy homes activities, conducting research to characterize the potential indoor air quality benefits of green construction, collaborating with other HUD offices to promote healthy housing principles in areas where there is a critical public health need (e.g., smoke-free housing, injury

prevention, post-disaster environments), and enhancing lead hazard control programs' capability to address broader housing issues that impact occupant health. In the long term, the OHHLHC will assess the effectiveness of healthy homes training and public outreach/education efforts, support the creation and adoption of health-protective housing codes and enforcement strategies, identify and pursue opportunities to promote healthy homes concepts to private and public sector entities, and continue to act as a convener of national, state and local partners through national healthy homes conferences and workshops. This work will be done in coordination with the Office's ongoing efforts in lead poisoning prevention, as the need to create and maintain lead-safe housing for low income families remains substantial; many areas of the country still lack the infrastructure for an effective lead hazard control program and there is a need for ongoing monitoring and maintenance in homes that have received treatments.

The *Healthy Homes Strategic Plan* will serve as 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 OHHLHC's Healthy Homes program will continue to lead in establishing a framework to help ensure an adequate supply of healthy and affordable housing.

I. Introduction

The mission of the U.S. Department of Housing and Urban Development 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 about whether his or her home is putting 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.

Past and current Healthy Home 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. The *Healthy Homes Strategic Plan* 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, and economic 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 Healthy Homes 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. For a guide to the abbreviations used throughout this plan, please see Appendix D: "Abbreviations Used in this Document."

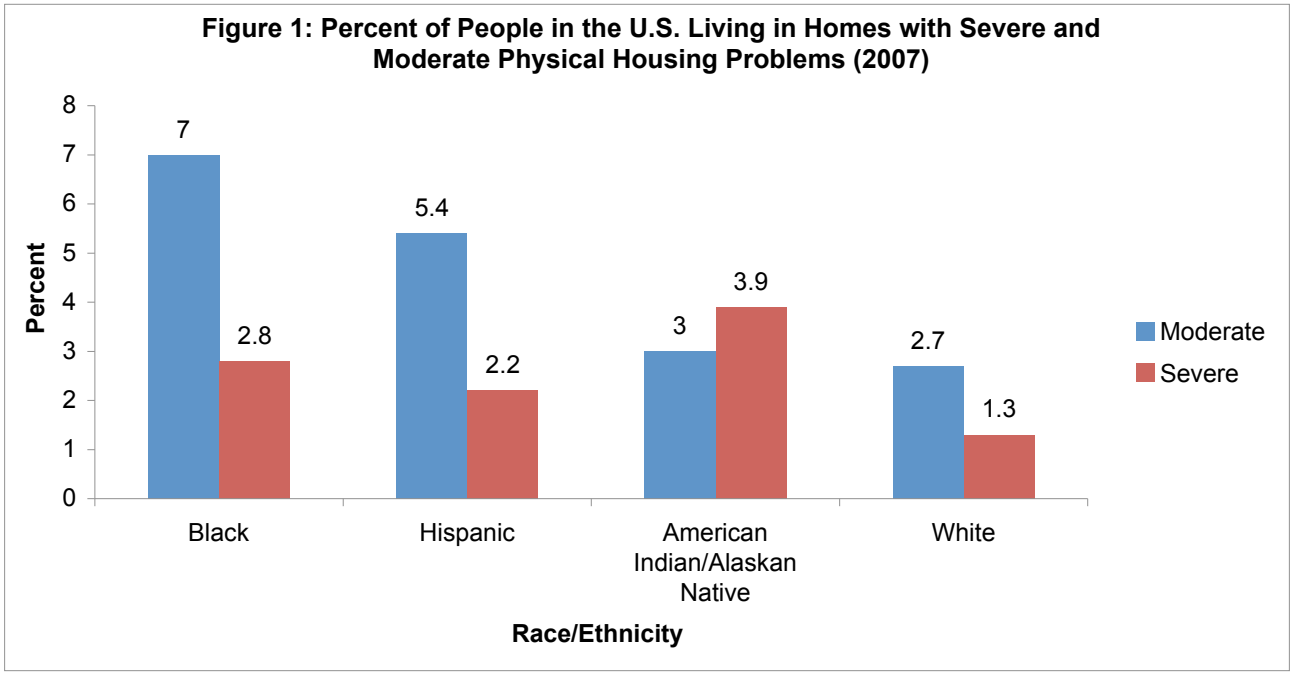
> Focusing on properties that pose the greatest health risks; that is, those properties that are older, low-income, or in substandard condition, will yield the greatest improvement in health outcomes.
>
> *The Surgeon General*

The Disproportional Burden of Housing-Related Hazards

According to HUD's 2007 American Housing Survey, nearly 6 million households live with moderate or severe physical housing problems, including heating, plumbing, and electrical deficiencies (U.S. Dept. of HUD, 2008b). About 24 million households face significant lead-based paint hazards (Jacobs et al., 2002). Anyone can suffer from housing related illness and injury; however certain groups such as low-income individuals, children, the elderly, or individuals with chronic illness are more susceptible.

Low-income persons are more likely to lack resources for preventive measures in the home, 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 also disproportionately heavy on minorities. This is clearly indicated by the 2007 Census poverty rates, with nearly three times as many

blacks (24.5%) and more than twice as many Hispanics (21.5%) living in poverty as non-Hispanic whites (8.2%). For American Indians (AI)/Alaskan Natives (AN), this rate was 29.4% (Census Bureau, 2008). Further, 9.8% of blacks, 7.6% of Hispanics, and 6.9% of AI/AN live with moderate or severe physical housing problems, as compared to just 4% of non-Hispanic whites (*Figure 1*). Housing data indicate that living conditions on tribal lands are generally poorer than the rest of the nation. Almost four percent (3.9%) of Native American housing had severe problems, as opposed to 1.6% for all housing.



Source: U.S. Dept. of HUD, 2008b

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 injury hazards (Krieger and Higgins, 2002). The rapid development of a child's organ systems during embryonic, fetal, and early newborn periods makes children vulnerable when exposed to environmental toxicants. Children breathe more air, drink more water, and eat more food per kilogram of body weight than adults. An infant's respiratory rate is more than twice an adult's rate (Snodgrass, 1992). Children's habits (e.g., hand-to-mouth contact) also make them more susceptible to environmental hazards in the home, especially dust. Since children spend up to 80-90 percent of their time indoors, it is paramount to make every effort to minimize possible dangers (U.S. EPA, 2002b).

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 hyper-responsiveness (Yeatts, 2006), which makes them more vulnerable to indoor air quality hazards. The elderly are also at an elevated risk for residential injuries, especially falls (Sleet, 2008). The number of people older than 60 years of age is expected to double between 2000 and 2059, and older adults tend to prefer to age in place, in their homes (Yeatts,

2006; National Council on Aging, 2007). This substantial predicted increase in the older adult population aging at home underscores the importance of addressing hazards and identifying unique risk factors for housing-related illnesses and injuries in seniors (Selgrade, 2006).

Although housing hazards place a particularly significant burden on certain socioeconomic, racial/ethnic, and age groups, it is important to remember that anyone of any group can be harmed by housing-related illness or injury. Advances in addressing these health concerns will benefit all categories of individuals and families.

II. Healthy Homes Program Background

The healthy homes concept began to take shape in the 1990s 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." In the FY 1999 budget, HUD proposed, and the Congress and President Clinton approved, a new Healthy Homes Initiative (HHI). Congress and President Clinton agreed that "the healthy homes approach appears superior to addressing problems one by one" and appropriated funds 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." This program was delegated to OHHLHC to build upon the Department's existing activities and expertise in housing-related health and safety issues.

Congress directed HUD to submit a preliminary plan for the HHI that would establish focus areas and objectives and assess the scientific evidence for links between housing and health hazards. In April 1999, an expert panel convened by HUD prepared the "Healthy Homes Initiative Preliminary Plan." The plan identified excess moisture reduction, dust control, improving indoor air quality, and education as the key focus areas. The five objectives of the HHI were the:

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 OHHLHC's first Notices of Funding Availability (NOFAs) reflected those objectives with a housing focus. Funds were initially made available for grants in: 1) Mold and Moisture Control; 2) Technical Studies (i.e., research): and 3) Demonstration Projects.

In keeping with the first three recommended objectives, the Healthy Homes Technical Studies (HHTS) grant program emphasizes 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 Healthy Homes Demonstration grant program.
As the OHHLHC identified additional research gaps, it added other focus areas to the HHTS NOFA. For example, 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 solicited projects to improve and assess integrated pest management (IPM) methods.

In conjunction with the HHTS grants, the Healthy Homes Demonstration (HHD) program grant recipients develop, demonstrate, and evaluate cost-effective, preventive measures to correct multiple residential safety and health hazards that produce diseases and injuries in children and other sensitive subgroups such as the elderly, with a particular focus on low income households. Through its emphasis on promoting the healthy homes approach, the HHD grant program also incorporates an education focus. 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 recent years the OHHLHC has increased emphasis on grantees' evaluation of the effectiveness of their interventions, including assessment of health and environmental outcomes, as well as the use of novel approaches.

While the majority of the OHHLHC's healthy homes funding is provided via grants, the Office also employs contracts, interagency agreements, and collaborations with HUD program offices such as the Offices of Policy Development and Research (PD&R), Public and Indian Housing (PIH), and Housing. With PD&R, the Office has developed guidance for the safe rehab of flooded homes and is currently supporting studies of residential moisture sources and of the costs and benefits of green building practices. With PIH, the OHHLHC is working to promote adoption of integrated pest management and the creation of smoke-free housing by public housing agencies. With the Office of Housing, the OHHLHC provided technical assistance in the development of an indoor air quality monitoring protocol for their green rehab program for multifamily housing in their Mark-to-Market program.

Interagency agreements have funded important healthy homes activities by the U.S. Centers for Disease Control, the U.S. Department of Agriculture's (USDA) Cooperative State Research, Education and Extension Service (CSREES), the U.S. Environmental Protection Agency (EPA), the National Institute of Environmental Health Sciences (NIEHS), and the National Institute of Standards and Technology (NIST).

HUD's partnership with the CDC has been among its most significant collaborations. Recognizing the importance of taking a comprehensive approach to addressing healthy homes issues, in 2006, then-Acting Surgeon General Kenneth P. Moritsugu announced that his Office would develop a Call to Action to Promote Healthy Homes, to:

> "help us link the importance of a healthy indoor environment with our priorities of prevention, public health preparedness, and the elimination of health disparities. It will help inform the American people of the science, the evidence, and the data to help improve our health literacy about this issue. And it will call the American people to action based upon this science evidence and data." Moritsugu, 2006.

The Surgeon General's final Call to Action was released at a joint HUD and Department of Health

III. Strategic Opportunities for Mainstreaming Healthy Homes

As part of strategic planning, the OHHLHC examined not only internal activities and successes (see Appendix B: "HUD Healthy Homes Program Activities and Accomplishments"), but also considered the social, political, and economic climate. Some key trends and opportunities that will impact the implementation of the *Healthy Homes Strategic Plan* are examined in this section.

The Policy and Political Landscape

> When enforced, housing and building codes have resulted in better constructed and maintained buildings and in improved health.
>
> *The Surgeon General*

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 physical property standards only for housing receiving HUD assistance. Multifamily and public housing must comply with HUD's Uniform Physical Condition Standards (UPCS; 24 CFR 5, subpart G), while owners housing families with Housing Choice Voucher (formerly known as Tenant-Based Section 8 Voucher) assistance must comply with the Housing Quality Standards (HQS; 24 CFR 982.401). For all other housing, state or local housing and building codes may be the only occupant protections in place.

A few localities have incorporated healthy homes elements into their communities through the enforcement of specialized housing or building codes. However, most jurisdictions that adopt and enforce codes use the model codes provided by the International Code Council (ICC). OHHLHC staff participates in code reviews, and by working with non-profit partners, has achieved some success in shifting attention to including healthy homes in codes. The OHHLHC's non profit partners are actively working to include additional residential hazards in the model code and to amend existing codes to better address health and safety issues. Use of model codes, adaption of existing codes, or the development of new code provisions, especially in rental housing, is a viable opportunity to address residential hazards in the future.

2) Legislative Climate – Attention to healthy homes issues is evident in the OHHLHC's program funding levels, and in proposed legislation affecting multiple agencies. For Fiscal Year 2009, Congress approved an appropriation of not less than $14.6 million for HUD's Healthy Homes program, representing a 67% increase over the FY 2008 program budget of $8.7 million. This resulted in a final FY 2009 program budget of $17.5 million. In March 2008, the Healthy Housing Council Act was introduced in the Senate with bipartisan sponsorship. The Healthy Housing Council Act sought to establish an independent "Council on Healthy Housing" to improve coordination amongst federal, state, and local governments, as well as industry and non-profit representatives. In October 2008, the "Research, Hazard Intervention, and National Outreach for Healthier Homes Act" was also introduced in the Senate. The bill aimed to improve research, enhance the capacity of existing federal programs, and expand national outreach efforts. The legislation would have provided statutory authority for the Healthy Homes program and authorized additional funding for healthy homes research, hazard reduction, enforcement, and outreach. While the housing crisis precluded the bills from being brought to a

vote during the 110th Session, both are planned to be re-introduced during the 111th Session, and represent Congressional support for the healthy homes movement.

3) Federal Partners – Bolstered by the success of the healthy homes approach, other federal programs have begun to incorporate, or expand on healthy homes concepts. Improved coordination with these programs will increase the reach and impact of the Healthy Homes program. While many agencies have contributed to program accomplishments, there are especially timely opportunities to develop new initiatives with respect to HUD, the Centers for Disease Control and Prevention (CDC), and the U.S. Department of Energy (DOE).

CDC has partnered with HUD in its healthy homes efforts via an interagency agreement providing funds from the OHHLHC. CDC continues to demonstrate a commitment to the healthy homes approach through its agency-wide Goal Action Plan for Healthy Homes and recent plans to transition its Lead Poisoning Prevention Branch (LPPB) to a Healthy Homes and Lead Poisoning Prevention Branch. This change will allow CDC to transition Childhood Lead Poisoning Prevention Program (CLPPP) grantees to the healthy homes approach. Additionally, CDC will pursue activities related to healthy homes including surveillance to track housing hazards and related health outcomes, and research on healthy homes interventions. The agency will leverage its existing programs in environmental health, injury prevention, and asthma to directly inform its new healthy homes priorities. As CDC expands its healthy homes efforts, it will be critical for HUD and CDC to coordinate research and program agendas.

DOE programs support improving the energy efficiency of homes as well as other performance characteristics. The Weatherization 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, weatherization work 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. Several Healthy Homes Demonstration program grantees have teamed with weatherization programs in the implementation of their grants; this coordination provides significant benefits to the recipients of the combined interventions.

HUD recognizes that 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. As a first step, in February 2009, HUD hosted a meeting of federal agencies that are involved in healthy homes-related activities, including CDC, DOE, the U.S. Environmental Protection Agency (EPA), the National Institutes of Environmental Health Sciences (NIEHS), the National Institute of Standards and Technology (NIST), and the U.S. Department of Agriculture. In the first meeting, the agencies described their programs related

to healthy homes, identified common interests, and initiated a process to increase federal planning efficiency on healthy homes issues. The group developed several subcommittees for special issues, and will meet regularly to develop a strategic agenda for all agencies, improve programmatic collaboration, and reduce duplication of effort.

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. (U.S. Dept. of HUD, 2008a). For low-income families, the lack of affordable housing may force them into substandard homes, where they are more likely to live in poorly maintained homes 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. This provides an opportunity for the OHHLHC to coordinate with HUD's major program offices to encourage the adoption of healthy homes principles into housing management, construction, and rehabilitation.

> Without an adequate supply of affordable homes, healthy homes cannot be achieved.
>
> The Surgeon General

Current Trends 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 management professionals, 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 (IPM) – There is increasing recognition that traditional pest control practices, especially the broadcast application of pesticides, can be hazardous to residents and ineffective for sustained pest control. There is evidence that IPM is more effective than traditional practices at similar or reduced (long-term) costs. IPM minimizes the use of toxic pesticides and instead emphasizes environmental controls such as elimination of harborages and removal of access to food and water. 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, pest-related allergens, and 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 energy costs have increased, 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, developed and are implementing an Energy Action Plan. The OHHLHC regularly participates in Energy Task Force activities, as this is a key opportunity to incorporate healthy housing principles. 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.

As a part of the effort to reduce our nation's energy consumption, the larger concept of green building has also gained momentum. Although there is no universally accepted definition of "green building," the EPA describes it generally as "the practice of creating and using healthier and more resource-efficient models of construction, renovation, operation, maintenance and demolition" (U.S. EPA, 2008c). Traditionally, the focus of green construction programs has been on maximizing energy and water efficiency, selecting environmentally preferable products and materials, and minimizing the effects of development on the outdoor environment. Many proponents of the concept have also emphasized the potential of green construction to improve indoor environmental quality (IEQ) with the potential for resulting benefits to occupant health. The momentum of the green building effort is a strategic opportunity for the OHHLHC to underscore that IEQ and occupant health is as important as a reduction in environmental impact.

To better understand the potential for green housing to improve occupant health, in FY 2009, the Office is introducing a new Notice of Funding Availability (NOFA) to support research on the potential environmental and health benefits of green building methods. The Office is also coordinating with CDC and HUD's Office of Affordable Housing Preservation on research to assess the potential environmental and health benefits of low income housing units that have undergone green rehabilitation.

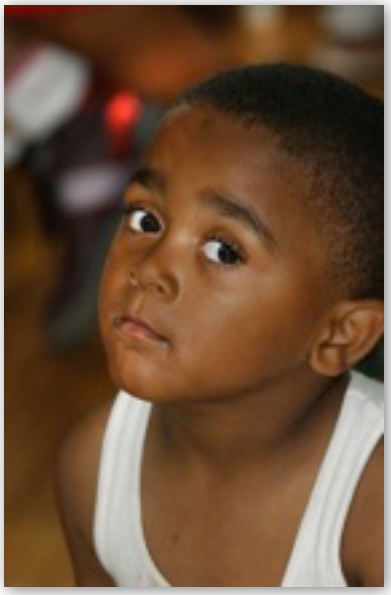
Critical Public Health Needs

It is important to acknowledge emerging public health needs and their relationship to the work of the 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 November 2008, over 100 local Housing Authorities nationwide had adopted smoke-free policies for some or all of their apartment buildings, 27 of which were adopted since January 2008 (TCSG, 2008). 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. The OHHLHC will continue to support these efforts within assisted housing by collaborating with the program offices to encourage further adoption of smoke free policies.

2) Unintentional Injuries – Preventing unintentional injuries has been part of the Healthy Homes program's mission since the beginning. The OHHLHC is a member of the Public/

Private Fire Safety Council (FireSafety.gov), and has sponsored research, demonstration projects, and outreach efforts focusing on reducing unintentional residential injuries, especially for children. 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, especially in the elderly. Noting the statistics regarding the increased population that is aging in place (in their homes), partnerships in this area will be critical.



3) Natural Disasters – Recent natural disasters, including Hurricane Katrina, wildfires in California, and flooding in the Midwest, 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 homes in an area affected 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 state partners and HUD program offices to develop outreach and educational materials which address additional natural disaster-related hazards and to expand distribution of these materials to victims. OHHLHC is also interested in promoting housing design that minimizes potential health hazards commonly resulting from natural disasters.

Expanding the Focus of Lead Hazard Control Programs

HUD Lead Hazard Control 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 certain asthma triggers in dust and air (e.g., mold, dust mites). As the comprehensive healthy homes approach gains momentum and childhood lead poisoning is eliminated as a major childhood disease, lead hazard control grantees will continue to play an invaluable role in the healthy homes movement by expanding their focus to address other residential health hazards. The OHHLHC will work to highlight best practices and encourage adoption by other programs and continue to explore greater flexibility in the use of Lead Hazard Control funds, which are currently restricted by statute for use in addressing lead paint hazards only.

IV. Healthy Homes Program Future Directions

During the strategic planning process, OHHLHC staff broadly examined 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. This resulted in a targeted *Healthy Homes Strategic Plan* that is current, but also incorporates the OHHLHC's continued commitment to ensuring that childhood lead poisoning is eliminated as a major childhood disease by 2010. After 2010, the OHHLHC will continue to provide funding and services for those communities that still have a significant amount of high risk housing.

The Planning Process

To develop this plan, the OHHLHC drafted a list of revised focus areas (see Appendix C: "Focus Areas of Initial Strategic Planning"), and solicited feedback from selected internal OHHLHC staff and external partners. Among the federal partners, non-profit partners, and OHHLHC staff who provided feedback, the seven highest priority focus areas were[1]:

- Develop standard, evidence-based healthy homes assessment tools and intervention protocols;
- Support the development of objective standards for what is considered a "healthy" residential environment;
- Increase collaboration internally at HUD and with other federal housing programs;
- Improve overall dissemination of healthy homes information, including best practices, to partners, grantees, and the public;
- Conduct cost-benefit analyses on the effectiveness of a healthy homes approach through the analysis of health and financial outcomes;
- Promote the inclusion of health considerations into green and energy efficient construction; and
- Increase the emphasis on identifying key research questions and supporting larger, more definitive studies.

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., housing and building codes), collecting health and housing data, and ensuring that lead hazard control is not neglected as the healthy homes approach moves forward. These elements were incorporated into the specific long term and short term goals, and supported the development of the Healthy Homes Office's Vision and Mission:

✦ **Healthy Homes Vision**

To lead the nation to a future where homes are both affordable and designed, constructed, rehabilitated, and maintained in a manner that supports the health and safety of occupants.

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.

✦ **Healthy Homes Mission**

To reduce health and safety hazards in housing in a comprehensive and cost-effective manner, with a particular focus on protecting the health of children and other sensitive populations in low-income households.

Healthy Homes Goals and Strategies

To accomplish this mission, the OHHLHC identified the following key goals:

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 following is a description of the goals as well as short- and long-term strategies to achieve them. Milestones and outcome measures to track progress in achieving each goal are also identified.

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

The OHHLHC's Healthy Homes 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 Cooperative State Research, Education, and Extension Service (CSREES).

It is also important to develop and maintain less formal relationships with federal programs that are active in areas that can influence progress toward the healthy homes goal. 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. The OHHLHC will continue to work with current federal partners, including CDC, EPA, and USDA, but may also pursue new partnerships with the Department of Energy, organizations within the Department of Health and Human Services, and the Federal Emergency Management Agency. Potential topic areas for collaboration include, but are not limited to: research on the relationship between ventilation and indoor air quality, incorporating healthy homes concepts into weatherization and energy assistance programs, cost-effective injury prevention strategies for children and seniors, and strategies for workforce training.

> Actions government can take include…work(ing) together across agencies and sectors to provide guidance and technical assistance to support safe, healthy, and environmentally friendly housing options.
>
> *The Surgeon General*

- *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.

- *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, renovators, insurers, appraisers, financial institutions, multifamily property owners, and health and housing advocacy groups.

Long Term Strategies

- *Serve as a Convener of National, State, and Local Partners*: Support collaboration and the dissemination of information within the healthy homes community by bringing together policy-makers, practitioners, and the public. A National Healthy Homes Conference will be organized and held on a regular basis (e.g., once every 2-3 years). At each conference, the focus areas would change to reflect the evolution of the healthy homes concept and to address timely issues. At the first conference, held in 2008, planners convened a broad community of experts, and included both public and private stakeholders in the planning and implementation.

- *Sponsor Workshops on Specific Healthy-Homes Issues*: Workshops would focus on specific healthy housing 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, identify key knowledge gaps, and foster mainstreaming of healthy homes into housing policy and practice within HUD and throughout the nation's housing construction, rehabilitation, and management programs.

- *Expand Outreach to the Mainstream Housing Industry*: Identify and pursue opportunities to form partnerships with mainstream housing and construction entities in order to expand the base of practitioners.

- *Federal Policy Agenda:* Coordinate the development of a cohesive federal policy that reflects the missions and statutory authorities of the participating agencies and provides the basis for agencies to develop and implement program, policy and regulatory changes, and identify potential legislative improvements for consideration by Congress.

Milestones and Outcome Measures

Milestone 1. Establish an interagency working group to coordinate healthy homes activities.

Outcomes: a) the development of working group goals and objectives; b) participation of partners in regular meetings; c) establishment of new areas of coordination among federal and non-federal partners; and d) demonstrated progress towards meeting established work group goals

Milestone 2. Creation of new federal partnerships.

Outcomes: a) the creation of new formal federal partnerships through the establishment of interagency agreements; and b) the creation of new informal federal partnerships as evidenced by the regular exchange of information on healthy homes issues.

Milestone 3. Create new private sector partnerships.

Outcomes: a) the creation of new formal private sector partnerships through grants and contracts; and b) creation of new informal private sector partnerships as evidenced by the regular exchange of information on healthy homes issues.

Milestone 4. Plan and implement regular national healthy homes conferences and topic-specific workshops.

Outcomes: a) national conferences held at 2-3 year intervals with success determined by the number of public and private sector partners involved in planning and conference implementation, the number of attendees, and feedback from attendees; and b) the organizing and holding of topic specific workshops on key healthy homes issues with success based on feedback from attendees.

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

The OHHLHC's Healthy Homes program has supported research through the funding of Technical Studies and Demonstration 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, such as the collection ofallergen data from a nationally representative sample of homes through the National Survey of Lead and Allergens in Housing (NSLAH) (cooperative research with the NIEHS), and a Cleveland study that assessed the impact of mold/moisture interventions in the homes of asthmatic children. Another important tool for setting the research agenda is the report from the CDC-NCHH Healthy Homes expert panel reviews, released in January (NCHH, 2009). Moving forward, the Healthy Homes program will coordinate a research agenda with key partners to produce definitive and novel research in two key areas:

> Government agencies, other research organizations, and scientists should develop and support a portfolio of rigorous healthy homes research.
>
> *The Surgeon General*

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, it is important to support the development of interventions and preventative practices that target the highest priority hazards and are cost-effective. Assessment tools must be reliable (i.e., results are reproducible among different users), easily administered, and based on validated methods that accurately identify hazards. Intervention protocols should have the backing of research that demonstrates their effectiveness in eliminating or reducing hazardous conditions with resulting improvements in health outcomes (e.g., reduced incidence of a particular injury, improved asthma control) or decreases in the risk of illness or injury. Cost-benefit analyses should be conducted in order to identify the more cost-effective interventions and clarify net costs.

Linking housing and health – While much is already known, more research is needed in order to improve our understanding of residential exposures and conditions. The Healthy Homes 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

- 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.

- Conduct periodic literature reviews for healthy homes issue areas, including available evidence about the effectiveness of residential interventions.

Linking Housing and Health

- Analyze data from National Survey of Lead and Allergens in Housing and the American Healthy Homes Study 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 HUD's Offices of Affordable Housing Preservation (OAHP) and Policy Development and Research (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 knowledge regarding the health outcomes of IPM interventions, particularly in urban multifamily housing. Also support research to improve methods for preventing and combating bed bug infestations.

- Assess effectiveness of healthy housing professional training and public outreach/ education efforts (e.g., knowledge of healthy housing principles, behavior change by health and housing professionals, homeowners, and tenants).

- Conduct research to refine a comprehensive healthy housing assessment tool that minimizes the burden to the user and maximizes the predictive power of the tool.

- Conduct research on the efficacy of residential interventions to prevent unintentional injuries.

- 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.

- Improve understanding of the relationship between residential indoor air quality and ventilation characteristics of homes.

- Support research necessary to clarify and strengthen existing evidence for specific changes to the building or property maintenance codes.

- Support the development and adoption of a core set of objective measures for what is considered a healthy residential environment that can be used to influence housing professionals and policy makers as well as self-protective actions by homebuyers, owners, and tenants.

Linking Housing and Health

- Support research on the potential health benefits of green construction and rehabilitation (e.g., use of low emission materials), and on green construction incorporating additional healthy housing factors (e.g., improved ventilation, smooth and cleanable floor surfaces) (Note: a recent Healthy Homes Demonstration grant in Seattle showed significant improvements in children's asthma symptoms in newly-built units).

- Work with federal partners to develop a national surveillance system to track residential hazards and related health outcomes.

Milestones and Outcome Measures

Milestone 1. Complete the development of tools to facilitate the adoption of standardized healthy homes assessment methods.

Outcomes: a) development of a core set of validated home assessment measures; b) development of a set of evidence-based healthy homes intervention protocols; and c) creation of standardized procedures for dust sampling and dust preparation for allergen analyses.

Milestone 2. Create a regularly updated healthy housing research agenda, informed by public and private partners.

Milestone 3. Initiate and complete research on key healthy homes topics.

Outcomes: a) complete a multi-site study to assess the benefits of mold/moisture-focused interventions on asthmatic children in a variety of climatic zones; b) complete research on the environmental and health benefits of green construction (rehab and new

construction); and c) complete research on the relationship between ventilation and IAQ in energy efficient homes.

Milestone 4. Initiate and complete cost-benefit research on healthy homes interventions.

Outcomes: a) complete cost-benefit research on a standard package of healthy homes interventions; and b) complete cost-benefit research on specific HH interventions and measures (e.g., IPM, smoke-free housing, green construction), including their use with specific populations (e.g., asthmatic children).

Goal 3: Promote the incorporation of healthy homes principles through 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, programs, and delivery systems. Over the short term, collaboration with public sector housing professionals and programs will be critical. Target housing audiences can be reached by the Healthy Homes program's promotion of: 1) cost-effective aspects of healthy homes assessments and interventions; 2) the incorporation of healthy homes principles into related housing and 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 federal and state housing programs, support health-protective codes and enforcement strategies, and secure private sector input.

Short Term Strategies

Promote the Incorporation of Healthy Homes Principles into National and Local Planning Efforts and Current Housing Trends

- *Integrated Pest Management*: Continue cooperative work within HUD's Office of Housing and PIH, USDA, and EPA, to encourage the adoption of IPM by public housing agencies (and other low-income housing providers including owners of subsidized housing) through a training program that reaches management, staff, and residents of multifamily housing throughout the country. Work toward expanding effort to other HUD program offices, such as the Office of Native American Programs, and reach out to local health departments to encourage their involvement in conducting outreach and promoting the use of IPM in their communities.

- *Incorporating Healthy Housing Principles in HUD-Supported Rehabilitation Programs*: Identify key healthy housing components that can be incorporated into the rehab of affordable housing and work with HUD program offices to identify opportunities to promote the inclusion of these components by local programs.

- *Energy Conservation*: With energy conservation at the forefront of national attention, and the OHHLHC's commitment to the HUD Energy Task Force, the Healthy Homes program will encourage an integrated approach to home interventions by facilitating the incorporation of healthy homes assessments and interventions into weatherization programs. The OHHLHC will support the development and field testing of a computerized healthy homes assessment module for use by weatherization programs to expand the identification and control of additional health and safety hazards and improve indoor air quality modeling.

- *Green Building*: Green housing must include elements that improve indoor environmental quality and the health of residents. Through a new Sustainable and Healthy Housing Initiative, the OHHLHC will actively promote the inclusion of health considerations into green housing construction, rehabilitation, and maintenance 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 and in local jurisdictions, the Healthy Homes program will work with HUD program offices to encourage smoke-free housing in public and assisted housing, including tribes and tribally-designated housing entities, and relevant federal partners like CDC and EPA on public health messaging related to eliminating environmental tobacco smoke exposure.

- *Unintentional Injury Prevention*: The OHHLHC will initiate collaboration with HUD program 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 the CDC.

- *Radon Risk Reduction:* The Office will initiate collaboration with HUD program offices that oversee housing assistance and mortgage programs, and with EPA coordination, promote testing for radon and sub-slab depressurization systems in properties with high levels of radon.

Long Term Strategies

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

creation of smoke-free housing developments; adoption of specifications for "moisture resistance" by publicly funded housing rehabilitation programs; and radon risk reduction where radon levels are high.

- *Support the Creation and Adoption of Health-Protective Housing Codes and Enforcement Strategies*: In the absence of federal regulations governing healthy homes issues beyond lead-based paint, state and local policies will continue to be key mechanisms for change. The Healthy Homes program will support research necessary to clarify and strengthen existing evidence for specific changes to the building or property maintenance codes, and facilitate the adoption of effective health protective practices into existing codes. HUD's continued membership on the International Code Council will provide a prime medium for OHHLHC 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 and its cost effectiveness in order for it to become fully incorporated into standard building and rehabilitation practices. The Healthy Homes program will solicit input from private sector stakeholders in an effort to identify and address their key needs and barriers to adoption.

- *Qualified Allocation Plans and Consolidated Plans*: The Healthy Homes program will build on the experience of the Lead-Safe Housing Rule and provide evidence-based guidance regarding how state and local housing agencies can optimally factor healthy homes considerations into plans for publicly supported rehab, construction, and ongoing maintenance.

Milestones and Outcome Measures

Milestone 1. A majority of federally assisted multifamily housing programs have adopted IPM and smoke-free housing policies in at least some developments

Outcomes: the number of public housing agencies adopting IPM practices and establishing smoke-free housing developments.

Milestone 2. The adoption of broader healthy homes assessments and interventions by weatherization programs.

Outcomes: the number of weatherization programs adopting expanded healthy homes assessments and interventions.

Milestone 3. Strengthening of the health protective provisions of existing housing and building codes and development of new codes:

Outcomes: a) the adoption of modified codes; b) the development and adoption of new codes; and c) increase in the number of jurisdictions adopting health-protective codes.

Milestone 4. An increase in the number of jurisdictions adopting healthy homes provisions in qualified action plans and consolidated plans.

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 OHHLHC will also need to pursue private sector commitment to the healthy homes mission in the form of implementation support and favorable financing.

Short Term Strategies

- *Provide Effective Training to a Variety of Audiences*: The National Healthy Homes Training Center, funded through the OHHLHC via an interagency agreement with CDC, will continue to train 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) to promote healthier housing.

- *Enhance Lead Hazard Control Programs' Capability to Address Broader Healthy Homes Issues*: The OHHLHC will work to enable grantees to combine funds to address categorical hazards (such as lead paint) with other housing hazards, and continue to seek flexibility in appropriated funds. The Office promotes cooperation between health and housing agencies to conduct assessments and interventions for lead-based paint (as well as other housing-related hazards) and pursue code enactment/enforcement and educational strategies. The OHHLHC will also provide communication channels for Lead Hazard Control 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 healthy housing program areas such as participant recruitment, home assessment, and interventions to eliminate hazards. Develop a web-based system to facilitate the exchange of information between grantees (similar to the former "Healthy Homes grantee exchange"). Develop and implement a system for summarizing the key findings of Office-funded projects (e.g., creating and posting final project summaries and research results on the web).

- Support the development of an electronic interactive version of the "Healthy Housing Inspection Manual" that was developed through HUD's interagency agreement with CDC, obtain feedback from users of the tool, and revise the instrument if and as necessary.

- *Enhancement of the OHHLHC Communications and Outreach Program:* Activities will continue to address lead poisoning and healthy homes issues, through a variety of channels involving grantees, stakeholders, and low-income families. External information dissemination will also proactively expand into growing audience segments (e.g., seniors) and address emerging trends (e.g., green building). The enhanced communications and outreach efforts will incorporate new media and tools for education and explore, select and implement innovative resources and outreach techniques.

- *National Lead and Healthy Homes Marketing Plan:* The OHHLHC will research, develop, and implement a three-year *National Lead and Healthy Homes Marketing Plan,* which will support a comprehensive strategy to link traditional with new outreach activities. This document will be updated annually and will be developed with input from federal partners and other stakeholders. Components of the *Plan* will include primary and secondary research; tailoring message and media to key target audiences; testing and packaging of messaging; finding opportunities to leverage current resources; selecting appropriate vehicles for dissemination; tactics (specific campaigns); and evaluation and refinement.

Long Term Strategies

- *Evaluate and Improve Training*: Evaluate the effectiveness of OHHLHC-sponsored healthy homes training and use the results to improve and standardize available training.

- *Expand Training to Build Professional Workforce:* Expand training concepts and adapt curriculum for trade schools, community colleges, four-year universities, and graduate programs to increase the professional workforce engaged in designing, creating, and maintaining healthy homes.

- *Evaluate the National Healthy Homes Marketing Campaign*: Evaluate the effectiveness of specific aspects of the healthy housing marketing campaign to advance improvement and viable alternative strategies.

- *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, educators (e.g., the American Council for Construction Education, American Association of Community Colleges), housing developers, rehabilitation programs, builders, financial institutions, component manufacturers, architects, realtors, and health insurers have critical roles to play in ensuring that homes are healthy and safe.

Milestones and Outcome Measures

Milestone 1. Develop a "Healthy Homes Guidance Manual" for health and housing programs looking to incorporate healthy homes provisions in programs or to improve existing programs.

Outcomes: the document is completed and updated as needed.

Milestone 2. Completion and implementation of a healthy housing marketing plan.

Outcomes: a) a national marketing plan is developed with input from HUD's federal partners; and b) an evaluation of education/outreach efforts is completed.

Milestone 3. Develop a web-based communication exchange for healthy homes professionals.

Milestone 4. Healthy housing training centers are established throughout the U.S. and an infrastructure of professionals trained in healthy housing principles has been created.

Outcomes: a) healthy housing training centers offering recognized courses are established throughout the U.S.; b) a workforce of trained and credentialed healthy housing professionals is established throughout the U.S.; c) the effectiveness of the training is formally evaluated and the training is modified based on the findings.

Milestone 5. A majority of health and housing programs in major metropolitan areas have developed healthy homes programs or incorporated key healthy homes components into existing home visitation programs.

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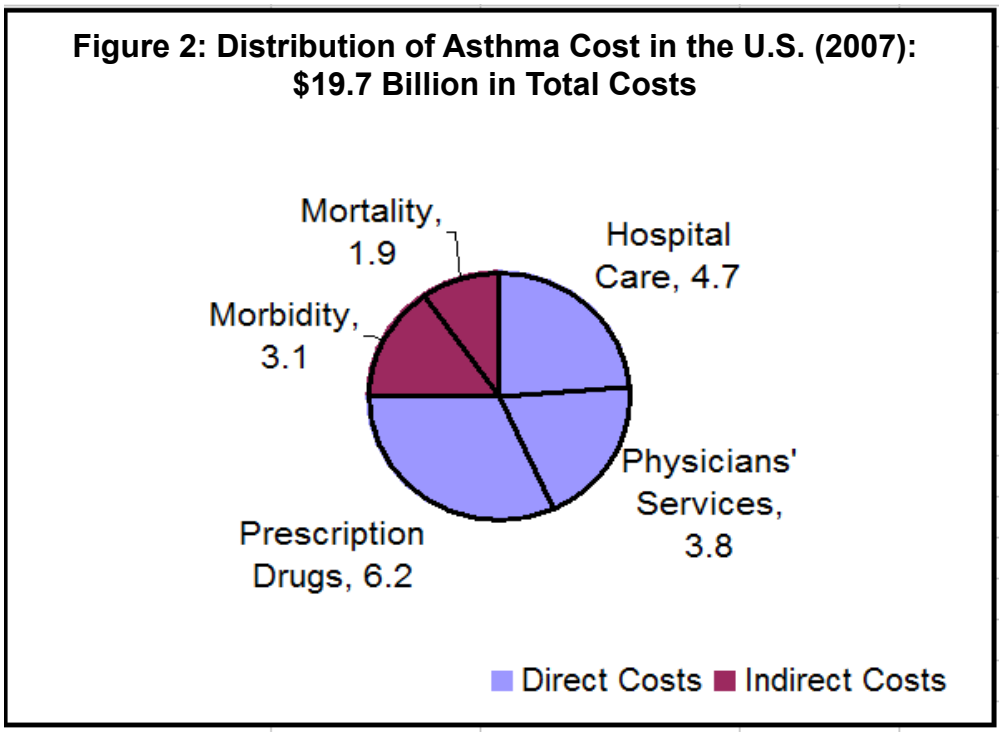
Appendix A: The Current State of Health and Hazards in Housing

The Healthy Homes program has evolved to address multiple housing hazards that have the potential to impact residents' lives in a cost-effective manner. 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 for which research is more conclusive. For example, the relationship between lead exposure, lead poisoning and the benefits of lead hazard control is well understood. In other areas, such as the relationship between mold exposure and the development of asthma, further study is needed to devise effective prevention and intervention techniques. This section is organized by the health condition, and provides a summary of its impact and cost burden ("Health and Cost Burden"), and the evidence that links it to housing, with the recommended intervention ("Home Connection.")

Asthma and Allergies

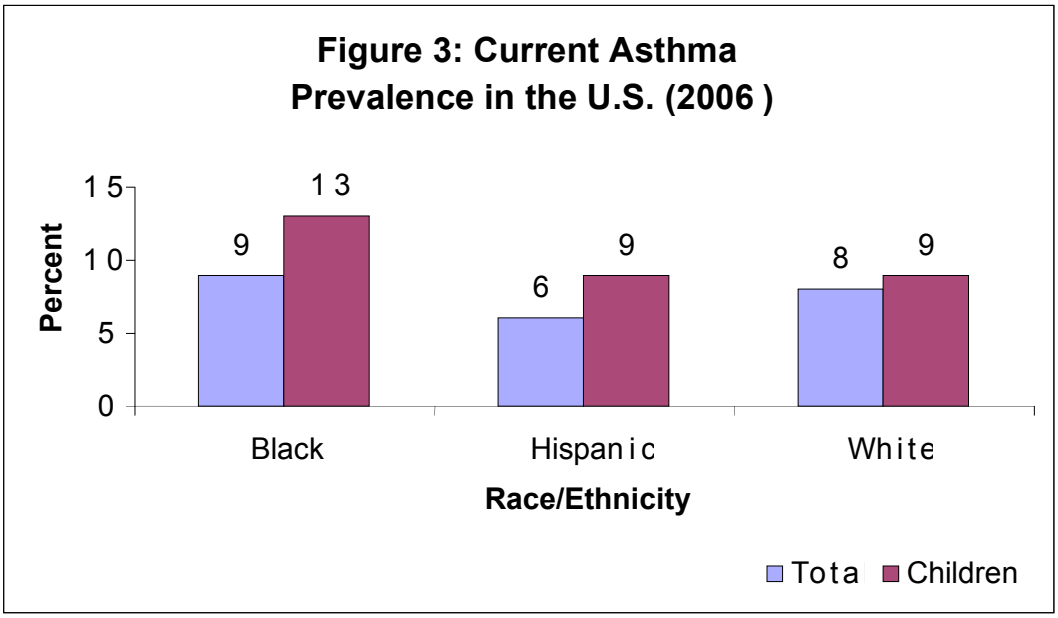
The Health and Cost Burden – Asthma and allergies take a heavy toll on quality of life and contribute significantly to health care costs. Asthma, which is more common in people with known allergies (i.e., atopic), impacts over 20 million Americans, creating a financial burden and decreased quality of life (CDC, 2008d). Asthma is recognized as a 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 about a third, or almost 7 million, of those diagnosed with asthma (CDC, 2008d). This leads to 12.8 million missed school days and nearly four million children who have had an asthma attack in the previous year (CDC, 2006a). The CDC estimates that, in 2005, there were 3,884 asthma deaths (CDC, 2008a).

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 (Gergen et al., 1987; Arbes et al., 2005). Allergic disease costs Americans $7.9 billion annually, with $4.5 billion spent on direct medical care (Stempel, 1997).



Source: NIH, 2007

Asthma disproportionately affects children from lower-income families and from specific racial and ethnic groups. In 2005, 13 percent of black children were reported to have asthma as compared with 9 percent of both Hispanic and white children (*Figure 3*). While epidemiological data is limited, Tribal Health Officials report that asthma is increasing in American Indian (AI)/ Alaskan Native (AN) children. Asthma rates are also higher in AI/AN children than in the general population, estimated at 13% compared to 8.9% in 2008 (Brim, 2008). In the report of the "Great Plains Asthma Education Conference" in 2006, health officials cited exposure to mainstream and sidestream tobacco smoke, the use of wood-burning stoves, a high incidence of attacks of respiratory viruses in infants, and co-morbidity of asthma with obesity as major factors in the prevalence. While indoor smoking and ventilation are housing-related causes, the relationship of asthma to tribal housing conditions is an area where more research is needed. 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, 2008d

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 (NIH, 2008). More than half of the 20 million Americans diagnosed with asthma are considered to be allergic asthmatics (Arbes et al., 2007). In these cases, airborne particles, or allergens, trigger allergic responses that lead to asthma attacks. In addition to acting as triggers, research indicates that residential exposure at a young age to some allergens and irritants can lead to the development of asthma (Selgrade et al., 2006). Important residential allergens are associated with dust mites, cockroaches, rodents, mold, pollen, and animal dander, while important non allergen asthma triggers include chemical residues in dust, combustion products (e.g., nitrogen dioxide), and environmental tobacco smoke.

The presence of significant levels of allergens in house dust is relatively common in U.S. homes. Results from the National Survey of Lead and Allergies in Housing (NSLAH), conducted by HUD and the NIEHS in 2000, indicate that approximately 46% of surveyed homes had elevated levels of at least three allergens (Salo et al., 2008). Cockroach levels high enough to trigger asthma symptoms were found in dust from approximately 10% of kitchens (Cohn at al., 2005).

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). In a study that primarily involved minority children from low income households , 69% of inner city children diagnosed with allergic asthma were sensitive to cockroaches, 62% to dust mites, 50% to mold**,** and 33% to rodents (Morgan et al., 2004; Gruchalla et al., 2005). Allergens in rodent urine can also contribute to asthma severity (Erwin et al., 2003).

Environmental interventions often focus on eliminating allergen sources, such as pests and mold, and controlling dust, which is a reservoir for allergens. Such interventions have proven to

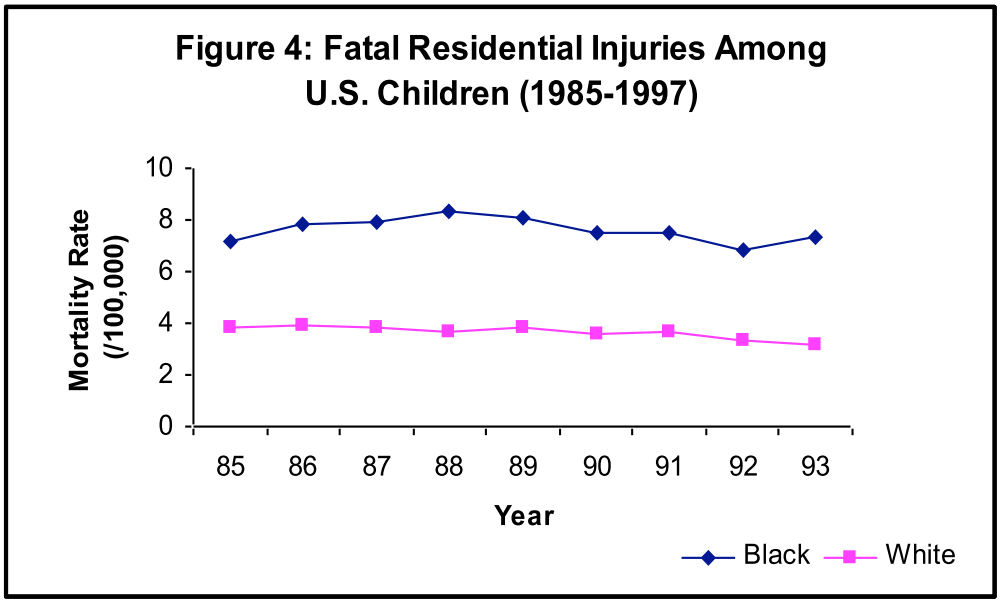
be effective as components of multifaceted interventions that also include health education and optimization of medical care. Common environmental interventions include the installation of impervious pillow and mattress covers, use of HEPA vacuums and air filters, specialized cleaning, and IPM (NCHH, 2009). Interventions to reduce non-allergenic triggers include eliminating secondhand smoke from the home and ensuring proper ventilation and maintenance of heating systems and cooking appliances that produce combustion products.

Excess moisture can amplify levels of allergens such as dust mites and mold, and can support pest populations. Damp indoor environments are themselves associated with increased asthma and other respiratory symptoms (IOM, 2004). Excess indoor moisture can be due to insufficient ventilation or water intrusion, related to both residents' lifestyle habits and a home's physical condition. 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). In HUD's *Mold and Moisture Problems in Native American Housing on Tribal Lands: A Report to Congress,* mold was present in 15% of homes surveyed. Indian housing is likely more susceptible to mold and moisture problems due to increased overcrowding, insufficient thermal insulation, physical deterioration, poor site conditions and depressed socioeconomic conditions.

Unintentional Injuries and Poisoning

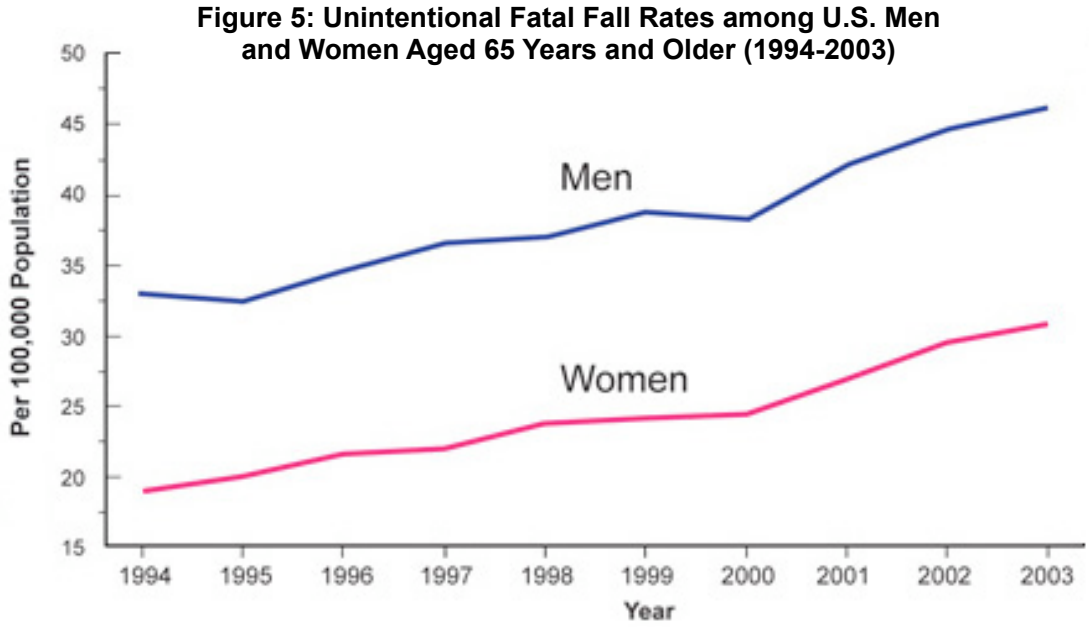
The Health and Cost Burden – Injuries cause emotional, physical, and economic stress. Injuries and deaths from falls, fire, drowning, poisoning, suffocation, and choking all occur in and around the home; the CDC estimates that approximately half of all injuries occur in and around the home (CDC, 2008b). Injuries can lead to chronic pain, loss of income, stress, and change in lifestyles, impacting the injured and their family and friends.

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 U.S. 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*). Injury in AI/AN children is also of special concern. A report from the Great Lakes Inter-Tribal Epidemiology Center (serving tribes in Minnesota, Wisconsin, and Michigan) indicated that the unintentional injury age-adjusted mortality rates were 70 per 100,000 for AI/AN, vs. approximately 40 per 100,000 for all races in the three-state region between 2002 and 2006.



Source: Nagaraja et al., 2005

The elderly are also at an elevated risk for residential injuries (*Figure 5*). Unintentional fall rates among elderly Americans have been increasing in recent years. While the exact cause of the increase is not well understood, one explanation is that Americans are living longer and choosing to age in place in their homes. The fact remains that 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, 2007b). It is estimated that falls account for 33% of injury-related medical expenditures and cost Americans more than $38 billion annually (CDC, 2004).



Source: CDC, 2006c

Although poisoning is considered an unintentional injury, the substantial health hazard it alone poses warrants further exploration. Household poisoning results in millions of injuries (including death) 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 (Lai et al., 2006). In that same year, 828,899 injuries and 32,691 deaths were attributed to poisoning; 74% of these were unintentional (CDC, 2008e). In 2000 alone, it is estimated that poisonings led to $26 billion in medical expenses (Finkelstein et al., 2006). More than 90% of all cases of exposure occur in the home, and well over half of these victims are children (Lai et al., 2006). 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.

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, 2009).

Poisonous substances such as cleaning products, pesticides, cosmetics and medications should be stored high in a locked cabinet, out of the reach of children. Households can also be encouraged to replace toxic substances (e.g., cleaning products, pesticides) with non-toxic or less toxic alternatives.

Important Residential Contaminants

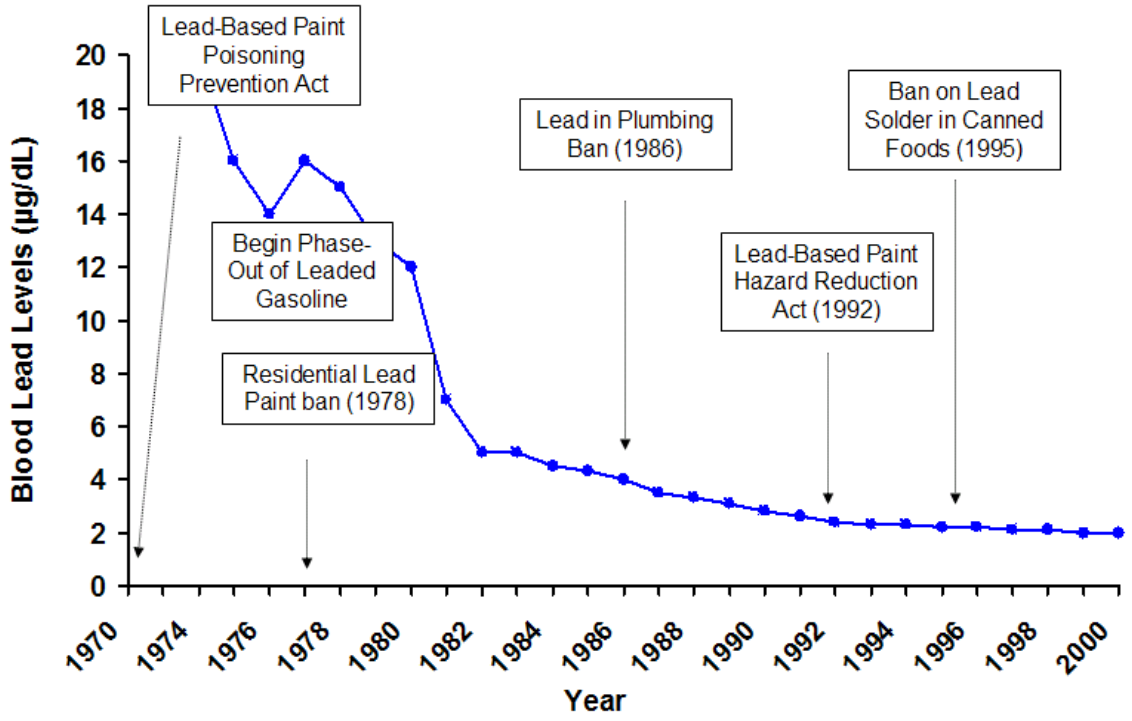
Lead

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, for 1999-2002, 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) primarily in lost wages and lifetime earning power. 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 and 2% of Mexican American children have elevated blood lead levels, as compared to only 1.3% of white children (Schwemberger et al., 2005).

Figure 6: Decline in Children's Blood Lead Levels due to Regulation



Source: CDC, 2005 (from multiple National Health and Nutrition Examination Surveys)

The Home Connection – A large reservoir of lead remains in and around housing, but corrective measures have proven to be successful. HUD's 2000 NSLAH found that, overall, approximately 40% of U.S. housing units contain lead-based paint, and 25% have one or more significant lead-based paint hazards. The prevalence of lead hazards was strongly associated with housing age, with hazards identified in 68% of pre-1940 housing units compared to 8% of homes built during the period from 1960 – 1977 (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). However, lead hazards can redevelop if the home is not properly maintained.

Mold and Moisture

The Health and Cost Burden – Mold (fungi) exposure can cause or is associated with adverse health effects in addition to those associated with allergic sensitization (e.g., asthma, rhinitis). Immune suppressed individuals can be directly infected by exposure to mold. Exposure to mold-produced toxins in food (i.e., mycotoxins) has been long understood to produce illness such as liver cancer from aflatoxin exposure. There is some indication that exposure of infants to the toxin-producing mold *Stachybotrys* may be related to serous lung injury (referred to as acute idiopathic pulmonary hemorrhage); however, the causal relationship has not been confirmed (Mazur and Kim, 2006). Exposure to volatile organic compounds that are produced by different mold species can also cause irritation of the eyes, nose, and throat as well as headache and fatigue. Damp conditions can support the growth of mold, bacteria, and dust mites, and research has revealed associations between damp conditions and respiratory illness without identification of the underlying causal agent(s) (IOM, 2004).

The Home Connection – It is important to mitigate all sources of excess moisture in homes, including both interior and exterior sources. Effective measures include sloping soil so water drains away from foundations, repairing/redirecting down spouts, promptly fixing leaks through the building envelope and plumbing leaks, and ensuring that the home has adequate ventilation. Mold can grow on any organic substrate (paper, wood, and textiles) if moisture levels are sufficiently high. Moldy porous materials that cannot be cleaned should be removed and discarded using proper precautions (U.S. EPA, 2002a).

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 American Association of Poison Control Centers reported 101,746 pesticide exposure incidents, 23 of which led to fatalities (Lai et al., 2006). Almost half of these incidents (49,232) involved children younger than 6 years (Lai et al., 2006). 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., can affect the respiratory and nervous systems (CDC, 2005).

The Home Connection – Use of toxic pesticides is widespread in American households. EPA estimates that Americans use over five billion pounds of pesticides each year, and that 74% of U.S. households use pesticides in the treatment of rodent and insect infestations (U.S. EPA, 2004). Pesticide residues can remain in homes for a considerable time period. A national survey that was recently conducted by HUD and the U.S. EPA found residues of DDT and chlordane, in 41% and 64% of homes, respectively, even though the use of these pesticides have not been used for more than 20 years (Stout et al., 2009). 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.

Airborne Contaminants

Research has demonstrated that contaminant levels in the indoor environment are often considerably higher than in outdoor air (Mitchell et al., 2007). Important contaminants in indoor air with respect to occupant health include carbon monoxide and other combustion products, environmental tobacco smoke, radon, and volatile organic compounds.

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), nitrogen oxides (respiratory irritants), polycyclic aromatic hydrocarbons (e.g., the carcinogen benzo[a]pyrene), and airborne particulate matter (can adversely effect respiratory and cardiovascular systems). Each year, exposure to CO results in approximately 500 deaths and 15,000 emergency department visits (CDC, 2007a). 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. Fatal and non-fatal CO poisonings can result from exposure to motor vehicle exhaust or from exposure to consumer products in the home. The middle-aged or elderly account for nearly 60% of unintentional CO fatalities in the home. Risk factors for older adults include pre-existing medical conditions that affect tolerance to carboxyhemoglobin, alcohol and recreational drug use, and the tendency to own older consumer products (CPSC, 2004). Unborn fetuses are also at increased risk for CO poisoning, as fetal CO accumulation may differ from the mother's (Abelsohn et al., 2002; Liu et al., 2003).

The Home Connection – Improper venting, poor maintenance, and misuse of heating systems and cooking appliances can dramatically increase exposure to CO and other combustion products. It is estimated that 64% of CO-related emergency room visits and 66% of CO fatalities are attributable to household exposures (CDC, 2007a; CPSC, 2004). Notably, the greatest numbers of CO deaths occur in winter months and after natural disasters, when residents are more likely to use fuel-burning furnaces and alternative heating and power sources indoors, such as portable generators, charcoal briquettes, and propane stoves or grills (CDC, 2007a). Other practices that can result increased levels of combustion products include the use of gas ovens or stoves for heating, the use of unvented portable heaters, and idling cars in attached garages. Preventative measures include proper installation, use, and maintenance of fuel-burning appliances, installation of ventilation fans in garages, the use of CO detectors, and increased public education efforts.

Environmental Tobacco Smoke (ETS)

The Health and Cost Burden – Exposure to ETS, or secondhand smoke, can cause respiratory illness, heart disease, cancer, as well as other adverse health effects (HHS, 2006). Each year in the United States, secondhand smoke exposure is responsible for 150,000 to– 300,000 new cases of bronchitis and pneumonia in children aged less than 18 months. Exposure of adults to secondhand smoke has immediate adverse effects on the cardiovascular system and causes

coronary heart disease and lung cancer. Exposure to ETS kills approximately 46,000 adult nonsmokers from coronary heart disease and 3,000 from lung cancer each year (HHS, 2006). The elderly in particular bear a disproportionate burden of the negative effects of smoking and secondhand smoke. Every major cause of death among the elderly – cancer, heart disease, and stroke – is associated with smoking or secondhand smoke. Overall, it is estimated that approximately 50,000 deaths result annually from exposure to secondhand smoke (CA EPA, 2006).

The Home Connection – 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. It has been demonstrated that eliminating exposure to smoke can result in health improvements at any age, including in those 65 and over (TCSG, 2001). Because ETS can migrate between units in multifamily housing, it is especially important that the availability of smoke-free multifamily housing be increased. 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.

Radon

The Health and Cost Burden – Radon is a radioactive, odorless, colorless gas that occurs naturally in the earth's crust and can percolate up to the surface either through porous soils or water. Exposure to radon gas leads to approximately 20,000 annual lung cancer deaths (U.S. EPA, 2008b). It is the leading cause of lung cancer among nonsmokers (U.S. EPA, 2008b), and the risk is even greater for smokers due to the synergistic effects of radon and smoking. Excessive exposures in the home are typically related to ventilation, structural integrity and geographic location.

The Home Connection – Radon can enter homes through openings in floors and walls and through water. Homes can be easily tested for radon gas using short term tests (2 to 6 days) or long term tests (> 90 days). If elevated levels are detected, a radon mitigation system can be installed which vents radon gas from under the foundation of the home through a pipe to the outside. 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 interventions to remove radon from water have had promising results as well. Passive systems (no operating fan), particularly those in new construction, are still in need of formative research (NCHH, 2009).

Volatile Organic Compound s (VOCs)

The Health and Cost Burden – Individual VOCs vary greatly in their potential health impact, ranging from compounds that pose very little health risk to those such as benzene, which is classified as a known human carcinogen (U.S. EPA, 2009). Information on human health effects is generally based on research in occupational settings where exposure levels are generally much higher than in homes. Exposure to VOCs can result in eye, nose, and throat irritation, as well as nausea, headaches, and loss of coordination (U.S. EPA, 2007). There is also limited evidence that exposure to VOCs can exacerbate asthma (Mitchell et al., 2007). Formaldehyde, a

VOC that is commonly found in indoor air because of its use in consumer products and building materials (e.g., plywood and other manufactured wood products), can cause can cause irritation to the eyes, nose and throat, at relatively low levels and is classified as a probable human carcinogen by the International Agency for Research on Cancer (IARC, 2008).

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, carpets, plastics, cabinets, air-fresheners, and building materials commonly used in households. As a result, indoor VOC concentrations tend to be two to five times higher than outdoor concentrations (U.S. EPA, 2007). The interactions between VOCs and other indoor air contaminants, including combustion products, are likely complex and may contribute to the production of any number of secondary pollutants including particulate matter (Mitchell et al., 2007). Improper venting and misuse of products containing VOCs can exacerbate this indoor air quality problem (U.S. EPA, 2007). Construction of detached garages is an important way to lower indoor VOC concentrations, as many VOC-emitting materials are stored there, and overall, the use of VOC-emitting products should be limited when possible (NCHH, 2009). Low- or no-VOC emitting alternatives are now available for many products used in the home, including: paints, primers, sealants, adhesives, carpets, and flooring materials. These products are often included in green construction specifications.

Additional Hazards

In addition to the health conditions discussed in this Appendix, there are many other potential residential health hazards for which the evidence linking illness or injury to the home environment is not as clear. Emerging issues of concern include deficiencies in and around the home, such as a lack of green space, security, or adequate drinking water. Poor outdoor air quality may have effects in the home as well, as polluted air migrates indoors. Bed bug infestations, once thought to be have been largely eradicated in the U.S., have reemerged in recent years, particularly in urban centers. Though the current evidence does not suggest that they, like other pests, carry infectious diseases or have a link to allergies or asthma, their bites can be associated with itching and skin infections. Also, bed bug infestations are often controlled using multiple applications of pesticides, which can be costly and present an exposure hazard to residents.

Appendix B: HUD Healthy Homes Activities and Accomplishments

As a pioneer of the healthy homes concept, the HUD's Healthy Homes 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. Progress has been the result of grant programs, interagency agreements, contracts, and collaborations with other HUD offices. Healthy Homes 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, 123 grants have been awarded for a total of approximately $100 million. Outreach and education promotes the healthy homes concept to the general public and educates housing professionals. Over 20,000 people have been trained in healthy home concepts through grant activities, and more than 1.5 million 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 advance the field of healthy housing.

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 hazard 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 Healthy Homes 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 more than 30 papers on healthy homes research issues with more submitted for publication.

Sponsoring Interventions to Mitigate Residential Hazards

Interventions to mitigate residential hazards can directly improve the health and quality of life of residents. The Healthy Homes Demonstration (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 therequirement that grantees evaluate the efficacy of interventions, including cost-effectiveness. Intervention strategies can range from education-focused approaches to those that consist primarily of physical upgrades to new or existing homes, although most Healthy Homes program-supported interventions are multifaceted in

nature. To date, more than 7,500 interventions have been conducted nationwide using healthy homes principles.

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.

Tools and Resources

The OHHLHC has developed various tools and resources through its grantees 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 (in limited quantities) at no cost. Materials have thus far been developed primarily through contracts and interagency agreements.

Highlights of the Healthy Homes program's accomplishments over the last decade:

Research and Evaluation

- 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 NIEHS 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. 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 lead 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

- 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 Healthy Homes 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 though 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, the City of Minneapolis' project Environmental Action for Children's Health (EACH) involved work 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

- Sponsorship of the *2008 National Healthy Homes Conference: Building a Framework for Healthy Housing*. Working with federal partners CDC, EPA, and USDA, the OHHLHC gathered a broad community of experts to discuss regulatory, policy, research, and outreach needs and their implications in the development of comprehensive, integrated approaches linking health and housing to ensure safe, healthy and efficient homes. The conference examined the lessons learned from the national lead poisoning prevention strategy and the current state of the art in order to begin building the framework needed to develop a national healthy housing agenda. More than 1500 policy-makers, practitioners, and members of the public attended the three-day event held in Baltimore.

- 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://www.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. The 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). The OHHLHC distributed this guidance to state task forces assembled to address flooding in the Midwest.

Tools and Resources

- 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.

- Guidance on moisture resistant construction, published in coordination with the Partnership for Advancing 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 Healthy Homes Technical Studies and Demonstration grantees in developing quality assurance (QA) plans and established a dust sampling protocol for Healthy Homes 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.

Appendix C: Focus Areas of Initial Strategic Planning

Following are the potential concepts and goals, which were considered during the planning process, to be incorporated into HUD's *Healthy Homes 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 healthy housing concepts to strategic private sector entities, such as developers and insurance companies.

6) Improve overall dissemination of healthy housing information, including best practices, to partners, grantees, and the public.

7) Develop standard, evidence-based healthy housing 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).

Appendix D: Abbreviations Used in this Document

AHHS	American Healthy Homes Survey
AI/AN	American Indians/Alaskan Natives
CDC	U.S. Centers for Disease Control and Prevention
CPD	HUD's Office of Community Planning and Development
CO	Carbon Monoxide
CSREES	USDA's Cooperative State Research, Education, and Extension Service
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ETS	Environmental Tobacco Smoke
OHHLHC	HUD's Office of Healthy Homes and Lead Hazard Control
HHD	OHHLHC's Healthy Homes Demonstration grant program
HHI	OHHLHC's Healthy Homes Initiative
HHTS	OHHLHC's Healthy Homes Technical Studies grant program
HUD	U.S. Department of Housing and Urban Development
IARC	International Agency for Research on Cancer
ICC	International Code Council
IEQ	Indoor Environmental Quality
IPM	Integrated Pest Management
NCHH	National Center for Healthy Housing
NIEHS	National Institute of Environmental Health Sciences
NIST	National Institute of Standards and Technology
NOFA	HUD's Notice of Funding Availability
NSLAH	National Survey of Lead and Allergens in Housing

OAHP	HUD's Office of Affordable Housing Preservation, Office of Housing
PD&R	HUD's Office of Policy Development and Research
PIH	HUD's Office of Public and Indian Housing
USDA	U.S. Department of Agriculture

U.S. Department of Housing and Urban Development

HEALTHYHOMES

Healthy Families | Healthy Children

Office of Healthy Homes and Lead Hazard Control