

Advancing Healthy Housing A STRATEGY FOR ACTION



2013

A Report from the Federal
Healthy Homes Work Group



Acknowledgements

This document – *Advancing Healthy Housing A Strategy for Action* – was developed by the federal Healthy Homes Work Group under the auspices of the President’s Task Force on Environmental Health Risks and Safety Risks to Children. The *Strategy for Action* paves the way for improving the lives of Americans by reducing health and safety risks in one of the most meaningful places – the home. Many thanks go to all who contributed to and championed this significant accomplishment.

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Healthy Homes Model



Abbreviations

AMI	Area Median Income
APHA	American Public Health Association
CDC	U.S. Centers for Disease Control and Prevention
CO	Carbon Monoxide
DOE	U.S. Department of Energy
DOL	U.S. Department of Labor
EPA	U.S. Environmental Protection Agency
HEPA	High Efficiency Particulate Air
HHS	U.S. Department of Health and Human Services
HUD	U.S. Department of Housing and Urban Development
HHWG	Healthy Homes Work Group
IAA	Interagency Agreement
IPM	Integrated Pest Management
KPI	Key Performance Indicator
NHANES	National Health and Nutrition Examination Survey
NIEHS	National Institute of Environmental Health Sciences
NIFA	National Institute of Food and Agriculture
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety and Health Administration
RHS	Rural Housing Service (U.S. Department of Agriculture)
SIRG	State Indoor Radon Grant
USDA	U.S. Department of Agriculture
USDA CES	USDA Cooperative Extension System
USGBC LEED	U.S. Green Building Council Leadership in Energy & Environmental Design
VOC	Volatile Organic Compound

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A home has a unique place in our everyday lives. Homes are where we start and end our day, where our children live and play, where friends and family gather to celebrate, and where we seek refuge and safety.



Executive Summary

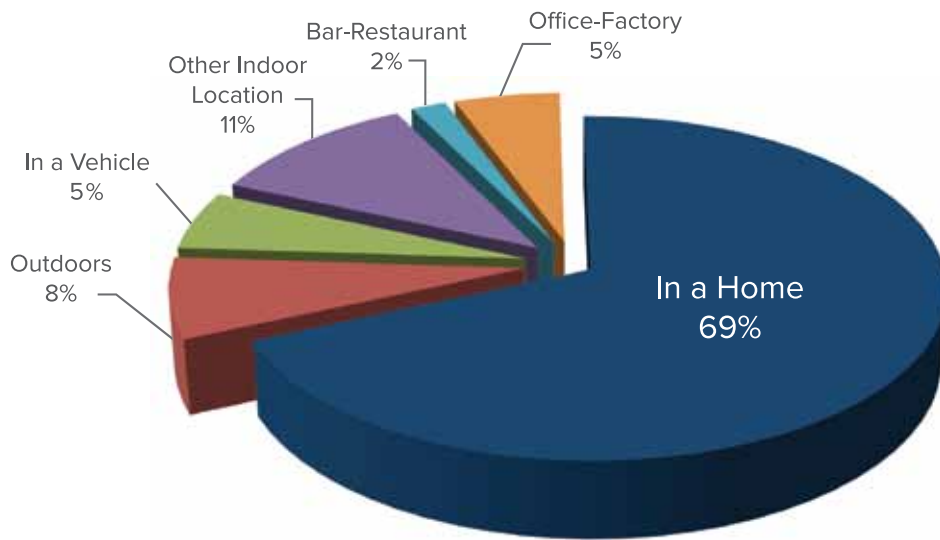
A home has a unique place in our everyday lives. Homes are where we start and end our day, where our children live and play, where friends and family gather to celebrate, and where we seek refuge and safety.

In the *United States Housing Act of 1937*, Congress established as the policy of the United States to “**remedy the unsafe and unsanitary housing conditions and the acute shortage of decent, safe, and sanitary dwellings for families of low income, in rural or urban communities, that are injurious to the health, safety, and morals of the citizens of the Nation.**”¹

This document – *Advancing Healthy Housing A Strategy for Action* (referred to as *Strategy for Action* or *Strategy*) – outlines goals and priorities in healthy housing for the next three to five years based upon the consensus opinion of the federal interagency Healthy Homes Work Group (HHWG). The HHWG includes the Department of Housing and Urban Development (HUD), organizations within the Department of Health and Human Services (HHS) including the Centers for Disease Control and Prevention (CDC) and the National Institute of Environmental Health Sciences (NIEHS), the Department of Agriculture (USDA), the Environmental Protection Agency (EPA), the Department of Energy (DOE), the Department of Labor (DOL), and the National Institute of Standards and Technology (NIST). The final development of the *Strategy* occurred under the auspices of the President’s Task Force on Environmental Health Risks and Safety Risks to Children (the Task Force), which has the objectives to identify priority issues that can be best addressed through interagency efforts and to recommend and implement interagency actions. The initiatives encompassed in this *Strategy for Action* will capitalize on the collective expertise within the HHWG and the Task Force to advance the policy established in the United States Housing Act: “...to assist States and political subdivisions of States to remedy the unsafe

housing conditions and the acute shortage of decent and safe dwellings for low-income families [and] to assist States and political subdivision of States to address the shortage of housing affordable to low-income families.”² Whether in new or existing initiatives, the Task Force recognizes that all actions will be subject to the annual budget processes that require balancing priorities within available resources.

The initiatives encompassed in this *Strategy for Action* will capitalize on the collective expertise within the HHWG and the Task Force to advance the policy established in the United States Housing Act: ‘... to assist States and political subdivisions of States to remedy the unsafe housing conditions and the acute shortage of decent and safe dwellings for low-income families [and] to assist States and political subdivision of States to address the shortage of housing affordable to low-income families.’²



Personal Time in the U.S. by Microenvironment. Klepeis et al., 2001.

THE NEED FOR HEALTHY HOUSING

People in the United States spend about 70% of their time in a residence³, suggesting that the condition of the home is a factor in a person's well-being. Poor housing conditions, such as a dilapidated structure; roofing problems; heating, plumbing, and electrical deficiencies; water leaks and intrusion; pests; damaged paint; and radon gas are associated with a wide range of health conditions, including unintentional injuries, respiratory illness, asthma, lead poisoning, and cancer, respectively.⁴ The HHWG believes that no housing program can be considered successful unless the residents it serves live in homes that are healthy and safe.

While unhealthy and inadequate housing continue to affect the health of millions of people from all income levels, geographic areas, and walks of life in the United States⁵, in some situations, susceptible and vulnerable populations, such as children, the poor, minorities, individuals with behavioral health issues, and people with chronic medical conditions, may be disproportionately impacted by inadequate housing.^{6, 7, 8} Currently in the United States, millions of homes have moderate to severe physical housing problems.^{9, 10}

Although the health risks associated with homes are many and varied, the household hazards that contribute to those risks tend to be interrelated. For example, some research has suggested that excess moisture, poor indoor air quality, and high levels of contaminated dust are common root causes for residential health hazards.¹¹ The HHWG believes that additional research is needed to determine whether addressing these deficiencies concurrently, rather than attempting to tackle each hazard individually, would yield the greatest results in the most efficient, cost-effective manner.^{12, 13}

THE POTENTIAL COST BURDEN OF UNHEALTHY HOUSING

Homes with risks like radon, lead, or other unsafe conditions can have a physical toll on their inhabitants, while also imposing a considerable economic burden in a larger societal context. A number of peer-reviewed studies have been published on the economic burden of specific hazards in at-risk homes, and each study reported costs into the billions of dollars on an annual basis.^{14, 15, 16, 17, 18} For example, one study estimated that the costs for asthma due to one root cause in the home – dampness and mold – were estimated at several billions of dollars in 2004,¹⁹ while an even higher cost burden was attributed to unintentional injuries in the home in another study.²⁰ Until we

can conduct further research, we will not know the total fraction of all health-care costs attributable exclusively to hazards in the home environment and how they may relate to one another; however, current findings suggest hazards associated with the home contribute to both the health and economic burdens of society.

In addition to an evolving understanding on the health outcomes and costs associated with hazards in the home, additional information is beginning to surface on the effectiveness of intervention programs. Current findings suggest that these home-based hazards are preventable, and opportunities exist for intervention programs that would not only reduce health impacts on occupants, but the economic burden as well, resulting in a positive return on investment. Reported findings demonstrate intervention programs on lead poisoning prevention, reducing asthma triggers in the home, and the installation of smoke alarms, for example, are effective at producing a strong return for every dollar invested.^{21, 22, 23} In addition, preliminary research suggests that interventions to prevent childhood residential injuries also have the potential to generate medical cost savings.²⁴

For many of these problems, straightforward fixes may be available. For others, there is a need for increased research to inform policies and practices that minimize adverse health outcomes for those at greatest risk, including young children, immunocompromised individuals and older Americans. With additional research, the HHWG hopes to support healthy housing for all people living in the United States regardless of age, race, ethnicity, income level, or geography. The case study example provided in Appendix A demonstrates the comprehensive scope of healthy homes deficiencies that may be encountered, possible remedial actions that can be adopted to improve conditions, and the impact of those actions on the health and safety of the affected family.

THE INTENTION

This *Strategy* provides an initial framework to coordinate federal action for advancing healthy housing through a comprehensive approach. With additional research, the goal is to craft a “healthy homes model” that aims to implement the United States Housing Act goal: “... that our Nation should promote the goal of providing decent and affordable housing for all citizens through the efforts and encouragement of Federal, State, and local governments, and by the independent and collective actions of private citizens, organizations, and the private sector.”²⁵

The *Strategy* is being published to focus attention on the public health impact of housing and to further the national dialogue on how we can promote healthy homes in the United States.

The *Strategy* urges a dynamic and coordinated effort to improve housing factors that affect health and outlines a series of mutually supportive coordinated actions that may accomplish the vision of achieving substantial reductions in the number of American homes with residential health and safety hazards. It encourages federal agencies to be proactive and to consider taking the first steps in implementing the priority actions. The *Strategy* also invites and encourages participation from many sectors to join in the discussion about healthy homes issues; to make informed, shared, and compassionate decisions; and to develop imaginative and realistic solutions that will help ensure that safe, healthy, affordable, and accessible homes are available to everyone in the United States.

And finally, the *Strategy* advances the healthy homes model by promoting a consensus-based conceptual model of healthy housing focused on supporting the health of its residents. As Kathleen Sebelius, Secretary of Department of Health and Human Services, has stated: “I urge all Americans to embrace the holistic approach to creating healthy homes described in the *Surgeon General’s Call to Action to Promote Healthy Homes*.”²⁶

CONCEPT OF A HEALTHY HOME

“A healthy home is sited, designed, built, maintained, and renovated in ways that support the health of its residents.”²⁷

– U.S. Surgeon General, 2009

The concept of a healthy home has evolved over decades, beginning with the American Public Health Association’s (APHA) seminal 1938 work, “Basic Principles of Healthful Housing,”²⁸ and continuing with the CDC’s Basic Housing Inspection Manual in 1976, which was updated by the publication of the “Healthy Housing Reference Manual” by CDC and HUD in 2006.²⁹ The *Strategy* will continue the precedent set by those efforts and build upon “The Surgeon General’s Call to Action to Promote Healthy Homes” that was published in 2009³⁰ to promote the concept of a healthy home.

Identifying the specific elements of a healthy home is still an evolving process, and the characteristics listed below are not intended to be exhaustive; however, the federal Healthy Homes Work Group believes that in the vast majority of cases, homes that meet the following characteristics can provide a safe and healthy environment for residents:

DRY

CLEAN

PEST FREE

SAFE

CONTAMINANT FREE

WELL VENTILATED

WELL MAINTAINED

THERMALLY CONTROLLED

These characteristics may be impacted by a wide range of factors, including the design, construction, maintenance, age, and overall condition of the building as well as the actions and behaviors of the home's occupants.

FEDERAL AGENCY COLLABORATION

Being able to coordinate federal programs in a comprehensive and strategic fashion is vital to implementing the *Strategy*.

Agencies across the federal government have embraced the healthy housing model to promote safe, decent, and sanitary housing as a means that may prevent diseases and injury (See Appendix B for a listing of agency-specific activities). In addition, agencies have collaborated on a number of inter-agency healthy homes initiatives. Cooperative work through interagency agreements (IAAs) with federal agencies have also resulted in important program achievements, such as outreach and training initiatives through the USDA's National Institute of Food and Agriculture (NIFA) and Rural Housing Service (RHS) and the federal radon action plan.³¹ Interagency collaboration culminated in the planning and delivery of two federal Healthy Homes Conferences, the first held in September 2008 and the second in June 2011, both sponsored by HUD, CDC, EPA, and USDA. These conferences served as an incubator for the exchange of ideas, and helped to focus national attention on the importance of safe, healthy, efficient, and affordable homes for America's families.

EMERGENCE OF THE FEDERAL HEALTHY HOMES WORK GROUP

Although staff from the various agencies have successfully worked together informally to link and collaborate on their individual programs, a formal structure or organization connecting healthy homes activities was lacking. In response, federal partners with a core interest in healthy homes joined forces in 2009 to form the federal Healthy Homes Work Group (HHWG).³² The primary goal of the HHWG is to promote nationwide access to safe and healthy homes. The HHWG works to influence existing programs, and to identify new opportunities and ensure that programs are operating effectively and efficiently. It also links program activities to the broader mission of each individual agency and encourages the integration of the healthy homes model into federal programs.

NEED FOR A FEDERAL STRATEGY FOR ACTION ON HEALTHY HOUSING

With limitations on individual agency resources, it is imperative that the federal partners of the HHWG leverage their resources and expertise to implement a national healthy homes agenda.

The HHWG challenged itself to:

- Establish a comprehensive federal strategy to promote healthy homes;
- Promote comprehensive approaches to controlling and preventing major housing-related exposures and hazards;
- Identify and find ways to eliminate barriers that impede collaboration and that complicate assisting those in need of federal technical assistance and/or funding; and
- Collaborate with key federal and non-federal stakeholders to implement a healthy homes implementation agenda at the community level.

This *Strategy* outlines the goals and priorities in healthy housing for the HHWG during the next three to five years. It is a first step in organizing the work of the federal agencies committed to making healthy homes available to all Americans, thus serving both as a roadmap for coordinated activities and as a visible statement of the agencies' commitments to carry out specific activities. It is encouraging that much progress on the broader healthy homes agenda has been made already by HHWG partners, demonstrating a high level of effective interagency collaboration upon which future activities can build.

The *Strategy* is built upon a framework utilizing an overarching Vision Statement and five related Goals.

The *Strategy* will use this framework to improve the nation's overall health through coordinated action to address health and safety hazards in housing. ▲

VISION: Substantially reduce the number of American homes with residential health and safety hazards.^{126, 127}

The *Strategy for Action* advances five goals to achieve this vision:

-
- GOAL 1: Establish Healthy Homes Recommendations**
 - GOAL 2: Encourage Adoption of Healthy Homes Recommendations**
 - GOAL 3: Create and Support Training and Workforce Development to Address Health Hazards in Housing**
 - GOAL 4: Educate the Public about Healthy Homes**
 - GOAL 5: Support Research that Informs and Advances Healthy Housing in a Cost-Effective Manner**

Over 30 million U.S. housing units have significant physical problems or elevated levels of lead, radon, or other contaminants that place their occupants at potential risk for illnesses and injuries.^{35, 36, 37}



Introduction

Over 30 million U.S. housing units have significant physical problems or elevated levels of lead, radon, or other contaminants that place their occupants at potential risk for illnesses and injuries.^{35, 36, 37}

For example:

- The American Housing Survey (2009) reported that nearly 6 million U.S. housing units have moderate to severe physical infrastructure problems – including water leaks and intrusion; injury hazards; pests; and heating, plumbing, and electrical deficiencies, based on occupant reporting at the time.³⁸ About 23 million housing units have one or more lead-based paint hazards and of these homes, an estimated 3.6 million homes with children under age six (the age group most sensitive to lead poisoning) have one or more lead-based paint hazards; 1.1 million were low income households with one or more children under age six.³⁹
- More than 6.8 million housing units have radon exposures above the current EPA action level.⁴⁰ Radon exposure is estimated to be the leading cause of lung cancer among nonsmokers.^{41, 42}
- Based on the National Survey on Lead and Allergens in Housing (2000), approximately 17 million homes had a high exposure burden to indoor allergens. In one study, high exposure to indoor allergens was associated with asthma symptoms among residents with allergic asthma.⁴³

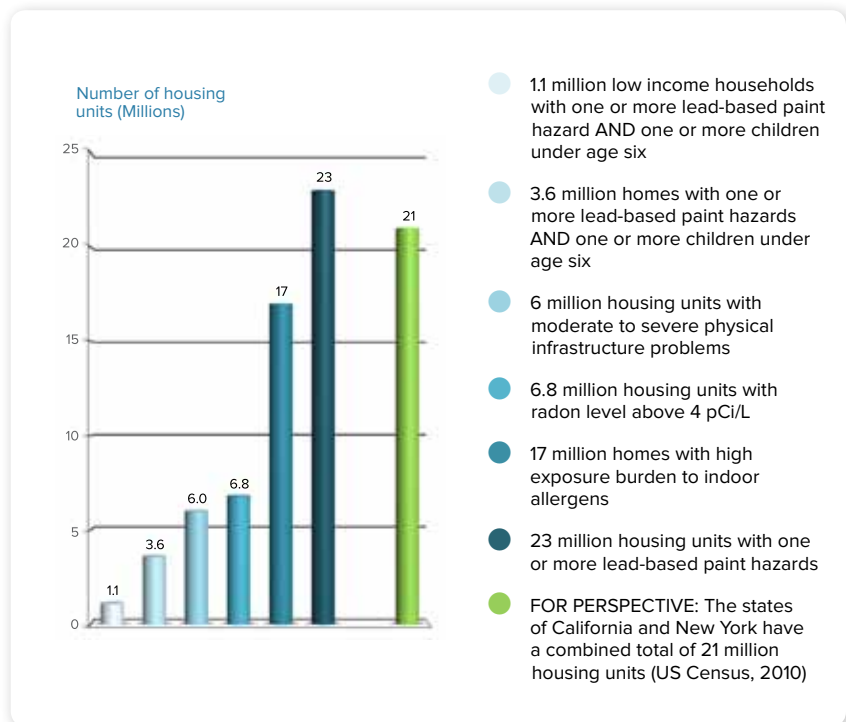
The bottom line is that unhealthy and unsafe housing may have an effect on the health of millions of people in the United States.^{44, 45}

CONSEQUENCES OF UNHEALTHY HOMES

In the United States today, we too often hear tragic stories resulting from incidents

involving common hazards in the home – preventable hazards – that can cause injury and illness in residents. Examples of these types of preventable hazards include: unprotected open upper-story windows; accessible poisonous substances; chemical exposures, including carbon monoxide and lead contaminated dust; poor lighting; lack of handrails on stairs; and electrical hazards. Anyone can suffer from housing-related illness and injury; however, certain groups such as children, the elderly, and individuals with chronic illness are often more vulnerable to the effects of residential health and safety hazards.^{46, 47, 48}

While further research in this area is necessary, some research has suggested that unintentional injuries (UI) may be a major contributor to housing-related health and economic burdens,^{49, 50, 51} **with estimates of billions of dollars in direct and indirect healthcare costs annually; falls within the home may contribute to over 40% of those direct and indirect injury-related healthcare costs.**⁵



While falls in residential settings are relevant to all age groups, children (≤ 14 years) and older adults (≥ 75 years) are often the focus of fall prevention campaigns since they contribute almost half of the nonfatal falls in homes.⁵³ The cause of the injury varies by age group; one study has suggested that falls on stairs or steps rank as the highest contributor to unintentional injury costs among older adults and also when summarizing across all age groups as a whole, while falls from the bed are responsible for the majority of injury costs in young children.⁵⁴ Additional research will help determine how such differences should be taken into consideration when planning interventions and prevention strategies.

Respiratory disease symptoms from conditions such as asthma, chronic obstructive pulmonary disease, and emphysema can be worsened by exposures that may be encountered in the home.^{55, 56} Asthma, in particular, places a considerable burden on affected children and their families, impacting a child's ability to play, learn, and sleep.⁵⁷ Asthma is one of the leading chronic childhood diseases in the United States and a contributor to childhood disability. In addition to biologic allergens and dampness due to moisture intrusion, other indoor air pollutants that may have an important effect on childhood asthma include: secondhand smoke, irritant and sensitizing chemicals and fumes, outdoor air pollution that infiltrates homes, and pollutants (e.g., carbon monoxide, nitrogen dioxide) generated by combustion devices, such as unvented space heaters or fireplaces.^{58, 59} According to the CDC, over 7 million children in the United States currently have asthma,⁶⁰ placing a considerable strain on the families of affected children.⁶¹ It is estimated that 39% of doctor-diagnosed asthma in children under 6 years of age would be prevented with the elimination of residential exposure sources (e.g., pet dander, secondhand smoke, and the use of gas stove or oven for heating the home).

Exposure to lead-based paint hazards in housing remains a critical and important issue. Researchers have estimated that approximately 70 percent of lead poisoning cases are attributed to lead-based paint hazards in the home.⁶² Based on a considerable body of research showing consistent associations between relatively low blood lead level (BLL) and adverse health effects (including reduced IQ and behavioral problems),⁶³ the CDC has recently adopted a blood-lead reference value of 5 micrograms per deciliter ($\mu\text{g}/\text{dL}$) and the current estimate is that approximately 450,000 children have BLLs at or above this value.⁶⁴

Radon gas is an example of a naturally-occurring health risk that silently enters dwellings. Exposure to radon in the home is estimated to cause 21,000 lung cancer deaths annually.⁶⁵ EPA estimates that 1 in 15 homes have a radon level of 4 picoCuries per liter (pCi/L) of air or more in the living area of the home, the level at or above which EPA recommends fixing the home. While progress has been made to test and

fix homes with elevated radon levels, and build homes with radon-resistant features, the problem of exposure to indoor radon grows larger each year due to the growing housing stock.⁶⁶ In addition, it is estimated that less than 10% of new homes incorporate low-cost Radon Resistant New Construction practices, indicating that overall fewer U.S. homes are tested for or mitigated for radon exposure each day.⁶⁷

Although the health risks associated with homes are many and varied, the household hazards that contribute to those risks tend to be interrelated. For example, some research has suggested that excess moisture, poor indoor air quality, and high levels of contaminated dust are common root causes for residential health hazards. The HHWG believes that additional research is needed to determine whether addressing these deficiencies concurrently, rather than attempting to tackle each hazard individually would yield the greatest results in the most efficient, cost-effective manner.^{68, 69} For example, one study has suggested that mitigating uncontrolled moisture can alleviate conditions associated with allergies and asthma (mold and pests).⁷⁰

THE POTENTIAL COST BURDEN OF UNHEALTHY HOUSING



Some research has suggested that an at-risk home can have not only a physical toll on its inhabitants, such as unnecessary emergency room visits due to housing related injuries and illness, but it may also cost the nation billions of dollars annually in healthcare costs. Unintentional injury, lead poisoning, asthma, radon-induced lung cancer, as well as lost productivity in the labor force, are a few examples of effects from housing-based hazards that result in billions of dollars in costs.^{71, 72, 73, 74, 75, 76} One study estimated the total cost for unintentional injuries in the home was billions of dollars annually in direct and indirect costs, with almost half of that due to falls alone.^{77, 78} Another study estimated that the costs for asthma due to one root cause in the home – dampness and mold – were estimated at several billions of dollars in 2004.⁷⁹

The health and economic burdens from preventable hazards associated with the home are considerable, but recent evidence indicates that intervention-based programs intended to reduce in-home hazards may be a cost-effective approach to pursue. One study reported that nearly 30% of residential injuries in their randomized controlled trial with children were preventable with intervention.⁸⁰ Similarly, 70% of lead poisonings were estimated to be the result of dust exposures from lead-based paint in the home, which is also preventable.⁸¹ Other studies have reported similar findings, citing at-risk home characteristics that, if remedied, could lead to potential childhood medical cost savings, including reductions in the amount of pet dander and cockroach allergen, not using a stove or oven for home heating, and prevention of lead exposures.^{82, 83, 84, 85} These findings are further supported by studies on the return on investment for intervention programs. Reported findings demonstrate that intervention programs on lead poisoning prevention, reducing asthma triggers in the home, and the installation of smoke alarms, for example, are effective at producing a strong return for every dollar invested.^{86, 87, 88}

HEALTHY HOMES CONCEPT

For many of these problems, effective interventions and strategies to reduce exposures and risks are available.^{89, 90} For others, there is a need for increased research to inform policies and practices that minimize adverse health outcomes, especially among susceptible and vulnerable populations such as infants and children, immunocompromised individuals, and older Americans. With additional research, the HHWG hopes to support healthy housing for all people living in the United States regardless of age, race, ethnicity, income level, or geography.

The concept of a healthy home has evolved over decades, beginning with the American Public Health Association's (APHA's) seminal 1938 work, "Basic Principles of Healthful Housing,"⁹¹ and continuing with the CDC's Basic Housing Inspection Manual in 1976, which was updated by the publication of the "Healthy Housing Reference Manual" by CDC and HUD in 2006.⁹² The *Strategy* will continue the precedent set by those efforts and build upon "The Surgeon General's Call to Action to Promote Healthy Homes" that was published in 2009⁹³ to promote the concept of a healthy home. This *Strategy* defines a "healthy home" as one that provides the most basic needs for the promotion of physical, mental, and social health, regardless of the income status of the resident or location of the dwelling. **In other words, a healthy home is sited, designed, built, renovated, and maintained in ways that support the health and well-being of its residents.**

There are a number of basic, interrelated characteristics⁹⁴ that have been recently adopted by experts and practitioners for describing a healthy home. Understanding of the healthy homes concept is still evolving and these characteristics are not intended to be exhaustive; however, the

HHWG believes that in the vast majority of cases, homes that meet the following characteristics can provide a healthy environment for residents:

DRY

Damp houses provide a nurturing environment for mites, roaches, rodents, and molds, all of which are associated with asthma. In addition, moisture contributes to the sub-surface decay of building materials that leads to the deterioration of lead-based paints.^{95, 96, 97, 98}

CLEAN

Clean homes reduce pest infestation and exposures to contaminants.⁹⁹

PEST FREE

Exposure to pests such as roaches and rodents can trigger asthma in children.^{100, 101, 102}

SAFE

Injuries such as falls, burns, and poisonings occur most often in the home.¹⁰³

CONTAMINANT FREE

Levels of contaminants such as lead, radon, carbon monoxide, secondhand smoke, and other chemicals are often much higher indoors.^{104, 105}

WELL VENTILATED

An adequate ventilation rate in homes is important to reduce exposure to airborne contaminants.^{106, 107}

WELL MAINTAINED

Poorly maintained homes are at risk for moisture, pest problems, and injury hazards.¹⁰⁸

By looking at the home as a system, the healthy homes approach resolves conflicts among its core principles. For example, the healthy homes practice of integrated pest management reduces exposure to harmful pesticides (contaminant-free) and results in a pest-free home. Although not included in the original list above of seven healthy home characteristics,¹⁰⁹ the HHWG suggests that "thermally controlled" be included as another important characteristic of a healthy home. Populations that are most vulnerable to temperature extremes include young children, the elderly, and those with chronic medical conditions.¹¹⁰ Adequate insulation may have the added benefit of reducing utility costs for residents. Therefore, we recommend adding one additional characteristic to the seven mentioned above:

THERMALLY CONTROLLED

Houses that do not maintain adequate temperatures may place the safety of residents at increased risk from exposure to extreme cold or heat.¹¹¹

HEALTHY HOMES INTERVENTIONS ARE EFFECTIVE

Research has demonstrated improved health outcomes in some situations from policies promoting home-based interventions to mitigate certain health and safety hazards. For example, lead poisoning prevention policies have greatly reduced childhood lead exposure in the United States.¹¹² The increased use of smoke alarms in residences due to smoke alarm policy initiatives and legislation have been shown to reduce residential fatal fires and fire deaths.¹¹³

Housing interventions can be selected and implemented strategically to address multiple health and safety hazards.¹¹⁴ For example, sealing cracks around the foundation of a home may help to prevent moisture intrusion

and the movement of pests into the home, thereby potentially reducing the risks for adverse health outcomes such as asthma stemming from multiple exposure sources.

The Healthy Homes activities of the federal HHWG partners have contributed significantly to the understanding of housing conditions and their connection to residents' health, identified effective interventions and preventive measures, and demonstrated the health benefits of targeting interventions to reduce or eliminate health hazards in homes. Each agency has funded research and demonstration projects on healthy homes issues, consistent with their individual mandates, with positive results:

Cuyahoga County Board of Health and Bellingham, WA Opportunity Council

In Cuyahoga County, OH (Cuyahoga County Board of Health) and Bellingham, WA (Opportunity Council) grantees partnered with a weatherization program to provide an integrated approach to improve both energy efficiency and indoor environmental quality. These projects demonstrated the benefits of this integrated approach and the Department of Energy is now providing training and encouraging Weatherization Programs to adopt this “weatherization plus health” model.^{117, 118}



Boston Public Health Commission and the Harvard School of Public Health

Grant-funded projects to the Boston Public Health Commission and the Harvard School of Public Health included Integrated Pest Management (IPM) interventions and related cleaning and educational efforts in private and public housing, as well as limited case management and community health support from trained advocates. In pre-post analyses, significant reductions in a 2-week recall respiratory symptom score were observed, dropping from 2.6 to 1.5 on an 8-point scale ($p = 0.0002$). Reductions in the frequency of wheeze/cough, slowing down or stopping play, and waking at night were also noted.¹¹⁹



NY State Healthy Neighborhoods Program

A recent program evaluation of the NY State Healthy Neighborhoods Program used data collected between October 2007 and December 2009. During this period, the Program provided healthy homes services to over 36,000 residents in 13,120 dwellings in 12 counties across the state. Among the 22% of homes that were randomly reassessed at a follow-up visit, the analysis indicates significant improvements in tobacco control, fire safety, lead poisoning prevention, indoor air quality, and general environmental health and safety (e.g., pests, mold). For residents with asthma, there were significant improvements in the presence of environmental triggers, self-management, and short-term morbidity outcomes, including up to 3.5 fewer days with worsening asthma in a 3 month period.



Cuyahoga County and Case Western Reserve University

A randomized controlled trial in Cleveland, OH (Cuyahoga County and Case Western Reserve University) funded by HUD demonstrated significant improvement in asthma symptoms (including reduced acute care usage) among children following remediation focusing on mold and moisture problems in their homes. During the 12 months of follow-up, the control (non-intervention) group saw an almost 20% higher rate of emergency department visits or hospital in-patient visits than the intervention group. The difference between the two groups was 30% from 6 months post-randomization to the end of follow-up.¹¹⁵



HUD Healthy Homes and Neighborhood House

In Seattle, WA, a HUD Healthy Homes grant to non-profit “Neighborhood House” and partners was used to upgrade 35 green-built public housing units (built through HUD’s HOPE VI Program) to “Breathe Easy Homes” with special features to improve indoor air quality and reduce indoor asthma triggers.¹¹⁶ Children with asthma, who were moved into these homes, experienced a mean of 12.4 asthma symptom-free days per 2 week period after one year, compared with 8.6 asthma symptom-free days in the control group. Urgent asthma-related clinical visits in the previous 3 months decreased from 62% to 21% and the caretakers’ quality of life increased significantly. Significant reductions in exposures to mold, rodents, and moisture were reported in the Breathe Easy Homes.



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