The Healthy Homes Program Guidance Manual

July 2012

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

HEALTHYHOMES
Healthy Families | Healthy Children

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Acknowledgements

Forward

The U.S. Department of Housing and Urban Development (HUD) Office of Healthy Homes and Lead Hazard Control (OHHLHC) has issued this Healthy Homes Program Guidance Manual to advance our nation's efforts to create healthier and safer housing.

The Manual is the result of considerable effort and reflects input from many partners and stakeholders in the healthy homes community. It is based on proven approaches and techniques, and the findings of the most current research. The Manual is written for anyone interested in developing or expanding a healthy homes program.

For well over a decade, HUD, the U.S. Centers for Disease Control and Prevention (CDC), and the U.S. Environmental Protection Agency (EPA) have implemented a campaign to reduce and eliminate childhood lead poisoning. While tackling this challenge, local lead hazard control programs recognized the need to address other housing-related health and safety hazards, and the "healthy homes" concept was eventually embraced by their federal partners. Evidence suggests that problems such as poorly controlled asthma and unintentional injuries are often linked to preventable housing deficiencies. Therefore, HUD, CDC, EPA, the U.S. Department of Energy (DOE), and the U.S. Department of Agriculture (USDA) have sponsored and supported local programs, regulatory and policy initiatives, research and evaluation , and education and outreach to establish comprehensive approaches to healthy housing. This Manual draws upon these efforts and those of subject matter experts, researchers, program managers, state and local officials, representatives of community-based organizations, and advocates for healthy homes.

Substantial savings in health care costs and improved quality of life for occupants can be realized by remediating health and safety hazards in the home. We hope that this Manual will advance the field of healthy housing by providing practical recommendations and guidance to build local program and community capacity.

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Introduction

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The Healthy Homes Program Guidance Manual (manual) offers guidance and tools to help users establish or improve healthy homes programs. It covers a broad range of practical information that will be of interest to organizations, programs, and individuals concerned about the need for healthy housing, including:

- Government health, housing, or community development departments
- Community-based organizations
- Community development corporations
- Weatherization or energy efficiency programs
- Academic institutions
- Hospital or medical clinics
- Health care or housing finance agencies
- Organizations that serve special populations, such as seniors, immigrants or the disabled
- Advocacy organizations

Suggested tools, techniques, and systems in this manual represent practices identified as effective, efficient, and realistic. The seven chapters mirror specific features of successful healthy homes programs.

Healthy homes programs are more efficient than single focus programs because they promote cost-efficient housing interventions that address multiple health hazards that are often interrelated. This comprehensive approach can increase the availability of affordable housing,

Key Messages

The manual offer guidance and tools to help establish or improve healthy homes programs.

- Healthy homes programs are defined by their comprehensive approach toward multiple residential health hazards.
- Each principle in the "Seven Principles of Healthy Homes" impacts multiple sources of exposure.
- There is no "one size fits all" in designing healthy homes programs.
- Healthy homes programs encompass multiple strategies and models.

raise housing values, and improve health outcomes by reducing costs associated with uncoordinated housing improvements.[1, 2]

Focus of the Manual

Many factors at the neighborhood and community level affect the health and safety of the home

environment. This manual focuses on the home environment and does not specifically address the neighborhood or community-at-large, or issues such as natural disasters, the built environment, and outdoor air quality. Appendix 1 contains a list of resources related to these broader concerns.

Substandard housing is more likely to contain environmental hazards, and owners and renters of these properties are less likely to have the resources to prevent or remediate these problems. Given these realities, the manual concentrates largely on assuring health and safety in economically distressed housing and promoting cost-effective interventions for affordable housing. It is important to note, however, that no income group is immune to health hazards found in housing. Healthy homes programs should assure that their efforts are viewed as community-wide priorities when they reach to the larger community.

Two companion documents can be used with this manual: the Healthy Homes Reference Manual and the Healthy Homes Inspection Manual. Both provide data and recommendations on specific hazardous conditions that may be found in substandard housing. The Healthy Housing Reference Manual details how specific housing conditions relate to disease and injury.[3] The Healthy Homes Inspection Manual addresses the broad range of housing deficiencies and hazards and describes elements of a home inspection.[4]

Manual Development

The U.S. Department of Housing and Urban Development (HUD) Office of Healthy Homes and Lead Hazard Control (OHHLHC) established its Healthy Homes program in 1999. Since that time over 100 Demonstration and Technical Studies grants have been funded. This manual is intended as a "best practices" document that assembles the cumulative knowledge that OHHLHC and other members of the healthy homes (HH) "community" have acquired about effective healthy homes program practices. OHHLHC used several methods to develop this manual:

- An expert panel representing subject matter experts from around the country provided advice and peer review.

- Relevant literature, documents and healthy homes grantee reports were examined to identify best practices.

- Stakeholder interviews were conducted with healthy homes professionals in the field to further document best practices, programmatic challenges and barriers, and address information gaps.

- Case studies were developed to describe model healthy homes programs and their strategies.

The case studies located in Appendix 1, provide examples of various healthy homes program models.

Impact of Housing on Health

The connection between housing and health is well established. Structural defects, indoor air quality, exposure to toxic chemicals and biologic contaminants, and injury hazards are known to affect the health and safety of residents. These conditions can impact or cause lead exposure, asthma and allergies, and unintentional injuries; they may also contribute to the development of cancers, cardiovascular disease, and other illnesses.

Paradoxically, the health and housing agencies charged with addressing these issues are frequently separate organizations, resulting in decreased effectiveness in combating overlapping problems. For example, health departments are responsible for addressing the health effects of exposure to environmental contaminants while building or housing code enforcement agencies have the authority to correct structural deficiencies that may cause illness.

According to HUD's 2007 American Housing Survey,[5] almost six million households live with moderate or severe physical housing-related problems. Although anyone can suffer from a housing-related illness and injury, certain groups such as children, the elderly, or individuals with chronic illnesses and disabilities are more susceptible. These problems disproportionately affect lower-income families and specific racial and ethnic groups.[6]

Deteriorated lead-based paint on housing exterior

Health Issues Commonly Addressed by Healthy Homes Programs

The high morbidity and costs of housing-related childhood lead poisoning, asthma, and unintentional injuries have garnered the attention of government agencies and a range of experts. Both the HUD Healthy Homes Strategic Plan, and the Surgeon General's Call to Action on Healthy Homes identify health-related housing conditions as high priorities. Their concern is prompted by the following evidence:

Lead Exposure: Lead-based paint and lead contaminated dust are the main sources of exposure for lead in U.S. children. Childhood lead poisoning results in lower IQ, learning, behavioral and attention problems and, in severe cases, death. According to the Centers for Disease Control and Prevention (CDC), approximately 250,000 U.S. children ages one to five years old (2005–2006) had blood-lead levels greater than the level at which CDC recommended at that time. CDC has recently adopted a reference value of five micrograms of lead per deciliter for children's

blood lead levels.[8a] Although lead affects children from all social and economic levels, those living at or below the poverty line in older housing (especially homes built before 1940) are at the highest risk for exposure. There are an estimated 11.8 million housing units built before 1940 and 22.9 million built before 1978 with significant lead based paint hazards.[8] Preventing lead poisoning in children results in cost savings in lost production, medical care, and special education.

Asthma: Asthma affects approximately 23 million Americans. Children under the age of 18 make up over a third, or almost seven million of the affected population.[9, 10] Asthma particularly affects economically distressed families and minority populations living in substandard housing. Asthma is the leading cause of school and work absences, emergency room visits and hospitalization and incurs an estimated annual economic cost of $20.7 billion to our nation[11]. Common allergens and other asthma triggers found in the home, such as dust mites, cockroaches, rodents, mold, and pet dander, can trigger asthma symptoms. Other common triggers include environmental tobacco smoke

and nitrogen oxides from gas stoves.

Unintentional Injuries: Injuries and deaths from falls, fire, drowning, poisoning, suffocation, and choking occur often at home. These injuries are now the leading cause of death and disability among children younger than 15 years old, and also disproportionately affect the elderly.[12] Unintentional home injuries cost society at least $222 billion per year in medical costs.

Housing Conditions that Pose a Risk to Health Status

In response to the prevalence of these diseases and conditions, both the Surgeon General's Call to Action to Promote Healthy Homes and HUD's Healthy Homes Strategic Plan identified the need to address the following housing

deficiencies:

- Interior Chemical Contamination: Air quality is compromised by CO and other combustion byproducts, environmental tobacco smoke, radon, volatile organic compounds (VOC), and allergens. Improper use of pesticides, and unsafe storage of cleaning and pool chemicals are additional common home health hazards. The proper use, maintenance, and venting of heating systems and cooking appliances can decrease exposure to CO and other products of combustion. Lead hazard reduction is effective in reducing lead exposure in children. Safe chemical storage, radon testing and mitigation, use of low VOC alternatives, selection of the least toxic pesticides, and enforcement of indoor smoking prohibitions can successfully protect individuals from harmful exposures.

- Interior Biological Contamination: Because

Question: How many unhealthy housing conditions can you identify in this picture?

Answer: Mold, sharp objects, possible lead-based paint hazards, and possible pests.
(This photograph was taken in New Orleans—post hurricane Katrina—in November of 2005.)

damp conditions in the home facilitate the growth of mold, bacteria, dust mites and other pests, it is important to address interior and exterior sources of excess moisture. Effective solutions include sloping soil so water drains away from foundations, repairing and redirecting downspouts, fixing leaks, exhausting kitchen and bathroom vents to the outside, and adequately ventilating homes.

- **Structural and Safety Defects:** Deferred maintenance of old homes, inadequate design of new construction, and lack of safety devices can result in injury, illness, and poor health. Window guards, stair railings, smoke and carbon monoxide (CO) alarms, and reducing the temperature of hot water heaters have all been demonstrated to reduce morbidity and mortality.

Vulnerable Populations

HUD's Healthy Homes Strategic Plan clarifies the extent to which certain populations are affected more significantly by health and housing problems. The burden of housing hazards disproportionately affects certain age groups, races, ethnicities, and varies geographically.

- **Pregnancy:** The many stages of fetal development present the opportunity for developmental harm. Environmental exposures during pregnancy can be detrimental to both the pregnant woman and her unborn baby. Such exposures include cleaning products, pesticides, chemicals in plastics, tobacco smoke, mold, and lead.

- **Age:** In general, children are more susceptible to environmental toxins due to their developing organs and nervous systems. They inhale more air, drink more water, and eat more on a body weight basis than adults. The normal hand-to-mouth and exploratory behavior of young children and babies makes them more vulnerable to environmental hazards, especially to contaminants in dust. Since they may spend up to 80 to 90 percent of their time indoors, the importance of minimizing possible dangers is clear.[13]

  Even older persons in good health may experience increased health risks from exposures to environmental pollutants. As we

age, our bodies can become more susceptible to environmental hazards (e.g., CO, tobacco smoke, temperature extremes) that can worsen chronic or life-threatening conditions. Older adults are also more prone to housing-related injuries such as falls. Proper housing design can help prevent some of these episodes such as injuries and falls, and help seniors remain in their homes and function independently rather than moving to assisted living facilities or nursing homes. The U.S. Environmental Protection Agency's (EPA) Aging Initiative contains more information on these alternatives (www.epa.gov/aging/index.htm).

- **Race, Ethnicity, and Income:** Low-income, minority populations are more likely than the general population to live in homes with structural defects and environmental hazards and lack the resources to assure a safe and healthy living environment. When housing costs consume a disproportionate share of income, families have little left over for other basic needs, including food, heat, and health care.[14, 15] It is hard to be healthy in a home without heat, and hard to be healthy when you have to choose between heating and eating. Healthy homes programs need to promote energy security, food security and housing security and stability by ensuring access to fuel assistance, food stamps, health insurance, energy efficiency benefits and other resources.

- **Geography:** Some hazards are more common in certain geographic locations. For example, the potential for extreme weather conditions and disasters varies across the country. While radon gas levels are found in every state, some areas present higher risks for exposure than others.

What is Healthy Housing?

A healthy home is a home designed, constructed, maintained, or rehabilitated in a manner that supports the health of residents.[16] This broad definition incorporates three interrelated strategies to control or eliminate environmental hazards and assure the health and safety of the home environment. The strategies involve:

• Changes in structural conditions and building practices;

Community Testimonial: Emergency Department Visits No Longer Routine

Imagine you are a mother living in a single room with your husband and five small children, four boys and one girl. The space you occupy with your family is infested with roaches and rats, and there is no central air to cool the hot summers, nor is there heat to warm the cold winters. The kids are constantly getting sick. Some are coughing, some have tummy aches, and others have colds that never end. You repeatedly find yourself in the emergency department in a desperate attempt to cure your child's ills.

When you go home and get a moment to yourself, you feel ashamed because the living environment is causing your family pain. You are ashamed to invite family and friends for dinner because there is nowhere to sit. This was the story of Alejandra C. before she became a tenant of Esperanza Community Housing Corporation (Esperanza).

For 20 years, Alejandra had been a resident in South Central Los Angeles, moving from single room to single room with her husband and five children, which included her son Roberto. When he was in fifth grade Roberto remembers moving into a building on Estrella Avenue. Before Esperanza purchased and renovated the building, Roberto remembers the space being a little bigger than what they had been used to before but still not big enough for a family of seven, "There was no space," he says. "Our parents, my brothers and sister all shared one room. It was hard to go to school and get ready in the morning."

Now think back to when you were 11 years old and you wanted to bring your friends over. If you were Roberto this was unthinkable because of the lack of space. You show up to school with bug bites all over your arms, because the building you live in is infested with bed bugs. One day your mom says "We're moving, they're going to remodel the building." You don't even know who "they" are and you don't know what exactly the move entails but you pack up and leave.

Roberto had no idea that the next time he would move back into the building on Estrella Avenue, he would be walking into a completely renovated three-bedroom apartment. Alejandra says that the emergency department visits were officially over. Gone were the tummy aches and incessant coughs. The bed bugs had also vanished. The family is breathing easier and finding time to consistently go to school and stop missing work.

This is what it means to have healthy housing; this is what it means to transform a life through housing restoration. As Alejandra puts it," The newly remodeled building gave us our health back." Now Alejandra and her children, including Roberto who is now 21, can enjoy the company of family and friends in their spacious apartment. Alejandra loves seeing Roberto and her other children fraternize in the living room. "Everybody works and goes to school….We're all doing good," she says as her face lights up.

Provided by Esperanza Community Housing Corporation

- Modification of resident and property owners' behaviors; and

- Development or revision of policies, legislation and service systems to enable healthy housing practices.

This definition also exemplifies a comprehensive/holistic approach rather than focusing on a single health issue, such as lead poisoning prevention, radon exposure or prevention of unintentional injuries.

Seven Principles of Healthy Homes

The comprehensive approach promoted by this manual incorporates multiple interventions, program activities, and resident actions to assure healthy homes. These actions are organized around the "Seven Principles of Healthy Homes" and necessary programmatic capacities related to planning, interventions, evaluation, and sustainability. The Seven Principles were developed by the National Center for Healthy Housing's National Healthy Homes Training Center (www.healthyhomestraining.org), funded by HUD and CDC.

The Seven Principles are:

Keep it:

1. Dry

2. Clean

3. Safe

4. Ventilated

5. Pest-Free

6. Contaminant-Free

7. Maintained

Because each principle has an impact on multiple sources of exposures, implementation of multiple principles can significantly reduce exposure to hazards. (See Table 1.1) Among the benefits of this comprehensive approach is the shared ownership of problems. Household residents, property owners, government agencies, industries, and communities all have a role to play in addressing these exposures. In addition, following the "Seven Principles of Healthy Homes" can lift individuals and

programs from feeling overwhelmed by a daunting list of problems to feeling confident and energized. The principles offer clear direction for taking concrete action toward specific achievable ends.

Pathways to Healthy Housing

Healthy homes programs use multi-tiered approaches to improve the health and safety of the home environment.

Pathways

- Housing Interventions

- Individual Behavior Change

- Community Capacity Building

- Program Design Improvements

- Policy Development

- **Housing Interventions.** Changes to the structure and safety of the home environment include lead hazard reduction, mold remediation, leak prevention, improved ventilation, integrated pest management, installation of smoke detectors and CO alarms, improved lighting, radon mitigation, and slip and fall prevention through modifications to stairs, entryways, and bathrooms.

- **Individual Behavior Change.** Residents or tenants and property owners need to become knowledgeable about the hazards and risks that may exist in their home, how to reduce them, and the importance of preventive maintenance.

- **Community Capacity Building.** Community, advocacy, and grass roots organizations are important partners in increasing community awareness and healthy homes intervention capacity, and in sustaining program activities. Target communities and the public at large need to be involved in designing, carrying out, and evaluating healthy homes activities.

Program Design Improvements. Healthy homes programs need to assess their capacity, monitor, and evaluate their performance, and make needed

Table 1.1 Relationships among the "Seven Principles," recommended actions, reduced hazards, and outcomes

Principle	Actions	Hazard and Contaminant Reduction	Associated Health and Other Impacts
Keep It Dry	Water Intrusion: Prevent water from entering the home through leaks in roofing systems, windows, and exterior shell. Drainage Problems: Control ground drainage to prevent intrusion in crawlspaces and basements. Address inadequate gutter and downspout systems. Interior Leaks: Prevent plumbing or sewage leaks or overflows. Humidity: Control humidity from occupant behavior such as use of room humidifiers, and unvented clothes dryers. Exterior Leaks: Respond to water intrusion and leaks, and correct condensation problems on walls, windows, and fixtures.	• Cockroaches • Mold • Rodents • Lead-based paint • Dust mites • Termites • Injuries associated with slips, trips and falls • Volatile organic compounds	• Reduction in asthma triggers and respiratory irritants. • Reduction in risk for childhood lead poisoning. • Reduced risk of injuries. • Increased physical comfort and energy efficiency. • Decrease in structural deterioration related to decay and pest damage.
Keep It Clean	Control dust and contaminants. Create smooth and cleanable surfaces. Reduce clutter. Store food in pest-resistant containers. Use wet-cleaning methods and HEPA-equipped vacuum. Address hoarding behavior.	• Cockroaches • Rodents • Contaminant residues in dust • Injuries	• Reduction in asthma triggers and respiratory irritants. • Reduction in risk for childhood lead poisoning. • Reduced exposure to contaminants in dust.
Keep It Safe	Store chemicals and medicines out of the reach of children. Add child-safety devices such as cabinet locks, electrical outlet covers and safety gates. Secure loose rugs and keep children's play areas free from hard or sharp surfaces. Add grab bars in bath, two handrails on stairs, and other measures to prevent falls, especially for seniors. Install smoke and carbon monoxide alarms. Keep fire extinguishers charged and accessible. Assure adequate lighting. Reduce clutter. Avoid circuit overloads and extension cords. Keep water temperature below 120F.	• Injuries associated with slips, trips and falls. • Fires • Household chemicals, pesticides, and medicines. • Carbon monoxide poisoning	• Reduced exposure to chemicals and poisonings. • Reduced risk of burns. • Reduced risk of injury, especially to children and the elderly.

Principle	Actions	Hazard and Contaminant Reduction	Associated Health and Other Impacts
Keep It Ventilated	Ventilate bathrooms and kitchens. Use whole house ventilation to provide fresh air. Use active ventilation systems to manage indoor moisture, provide occupant comfort.	• Carbon Monoxide • Formaldehyde • Mold and Moisture • Nitrogen Oxides • Radon • Volatile organic compounds	• Reduced respiratory irritation. • Reduction in asthma triggers. • Reduced chemical exposure. • Reduced risk of lung cancer.
Keep It Pest-Free	Make the home less habitable for pests by identifying sources of water, food, and shelter. Remove harborage sites. Seal cracks and openings throughout the home. Address overgrown vegetation. Store food in pest-resistant containers. Monitor for pests and respond with integrated pest management approaches that prevent pests and use lower risk pesticides.	• Cockroaches • Mice • Rats • Ants • Bed bugs • Pesticides	• Reduction in asthma triggers and respiratory irritants. • Decrease in bite-related injuries. • Increased physical comfort. • Protection of central nervous system.
Keep It Contaminant-Free	Reduce contaminants coming into the home through purchasing decisions. Limit spread of contaminants. Stop smoking or move smoking outside. Test for radon and, if needed, install a radon removal system.	• Environmental Tobacco Smoke • Asbestos • Formaldehyde • Lead-based Paint • Pesticides • Radon • Volatile and semi-volatile organic compounds • Flame retardants • Treated lumber	• Reduced risk of lung cancer. • Reduced respiratory irritation. • Reduced risk for childhood lead poisoning. • Protection of central nervous system. • Reduced developmental hazards.
Keep It Maintained	Inspect, clean and repair the home and its equipment at regular intervals. Change air filters and similar equipment. Respond to problems quickly before minor problems become more serious. Use lead-safe work practices for deteriorated paint in homes built before 1978.	• All of the above	• Reduced risk of lung cancer. • Protection of central nervous system. • Reduced asthma triggers. • Reduced risk for child-hood lead poisoning. • Increased physical comfort and energy efficiency.

The contents of this table related to hazards and contaminants are not exhaustive. For more detailed information go to
http://www.healthyhomestraining.org/Credential/Contaminant_Guide_4-20-09.pdf

changes to assure effectiveness and cost-efficiency. It should be noted that expanding existing infrastructure or enhancing service systems may be more affordable and sustainable than creating new programs and services.

Policy Development. Passage, implementation, and refinements to specific laws, such as lead-based paint ordinances and housing codes, can advance and sustain healthy housing. Codes and ordinances require enforcement to be effective. Program policies such as cross-department and organizational referrals and partnerships can strengthen and expand healthy housing programs.

A Variety of Program Approaches

There is no "one size fits all." Individual healthy homes program goals, partnerships, health priorities and community assets will determine the design of each initiative. Urban and rural healthy homes programs often look very different based on unique hazards in their respective environments. Effective healthy housing programs are defined by the integration of health and housing services and usually include interagency partnerships that are reflective of federal priorities and practice.

The variety of efforts detailed below are useful to consider in designing or expanding a healthy homes program. In-depth case studies of selected program strategies can be found in Appendices 1.2–1.10.

Transitioning from a lead hazard control program to a healthy homes program

Because of the success and significant funding invested in lead poisoning prevention and lead hazard control programs, many localities have expanded into more comprehensive healthy housing programs that identify and reduce asthma triggers and injury risks and hazards. Transitioning from lead to healthy homes programs requires new partners, staff training, assessments/inspection protocols, and capacity to provide additional interventions such as moisture control, increased ventilation, integrated pest management (IPM) and injury prevention.

Baltimore City Health Department expanded its urban childhood lead poisoning prevention program into a comprehensive healthy homes initiative by adding interventions to reduce asthma risks, injury hazards, carbon monoxide poisoning,

and fire hazards. In 2006, the department established a Healthy Homes Division and appointed an Assistant Commissioner for Healthy Homes to focus on the impact of housing on health. The healthy homes program was developed through pilot testing of new tools and protocols, focus groups with community members, intensive staff training, and expansion of partners to leverage resources, receive and provide referrals for their clientele, and provide healthy homes training to an expanded group of community stakeholders.

Medical-Clinic partnerships

Similar to childhood lead poisoning prevention programs which services are based on specific health criteria (e.g., elevated blood-lead levels), many healthy homes programs identify families for interventions based on asthma diagnosis. In these instances, programs partner with hospitals, health plans, asthma clinics and/or community-based health centers to develop a referral system. The medical facility screens their patients and makes referrals to the healthy homes program for follow-up in the home. It is essential to assure a feedback loop so that the health and medical services provider is aware of healthy homes program services and coordination and medical support are assured.

The City of Boston's Breathe Easy At Home program, while more than a medical-clinic partnership, is a web-based referral system that allows doctors, nurses, or other health professionals to refer patients with asthma for a home inspection. Inspections are conducted by the Boston Inspectional Services Department, which enforces the sanitary code for housing. Their trained Breathe Easy at Home inspectors identify asthma triggers such as mold and chronic dampness, leaks, pest infestations, drafty doors and windows, lack of heat, poor ventilation, and damaged carpeting. The inspectors also work with property owners to eliminate these poor housing conditions. The web-based system offers ongoing communication between medical, public health and housing partners on the status of the referral and case disposition. The Boston Public Health Commission manages the Breathe Easy Program and provides families with educational home visits and help in managing their asthma if needed. These complementary services are provided by community health workers.

Medical-Legal partnerships

The medical-legal partnership is defined by combining preventive medicine and preventive law to address non-medical issues that influence health and housing. Legal issues affecting health and housing include problems related to public benefits, housing, and utilities, legal (immigrant) status, and personal and family stability. Because doctors and other health care providers are a trusted and credible resource for families, screening for legal issues in the clinical setting can help to detect and resolve legal problems. Pairing a medical partner with a legal partner—usually from legal aid or pro bono support from the local bar association or law school—can ensure that basic family needs are met and result in systems change.

Boston Medical Center is the home of the National Center for Medical-Legal Partnerships (MLP) (www.medical-legalpartnership.org). This program was founded in 1993 to address housing conditions and the nutritional status of asthma patients. The MLP in Boston currently services 1,000 patient-families per year at six community health centers and provides training to health care providers. Other services include legal advice and assistance for patients/families and advocates for improvements in the health care and legal service delivery systems.

The Medical Legal Community Partnership (MLCP) in Los Angeles is composed of St. John's Well Child and Family Center and Esperanza Community Housing Corporation. The combined effort educates medical providers on the social determinants of health, provides legal advocacy to patients on non-medical issues affecting health status, and works strategically to bring about systematic change to improve the health of the community. Over a two-year period, the program opened 684 cases; one-third were related to health program eligibility and services, and two-thirds primarily related to such housing issues as habitability, evictions, affordability and foreclosures.

Education

Repeated home visits by health educators, even without structural interventions, can let residents know about specific health and safety hazards in their home environments and help them plan actions to reduce risks. Use of community health workers or community Promotoras de Salud with similar backgrounds as the residents increases trust, facilitates entry to housing units, and builds long-term relationships. Small scale incentives, such as distribution of smoke and carbon monoxide alarms, pest control products, and mattress and pillow covers, should be considered to reinforce and motivate behavior change. There are a myriad of existing home visitation programs that can be explored for incorporation of healthy homes education and assessment.

Seattle and King County Healthy Homes Project compared a single home visit by a trained community health worker with a higher intensity intervention consisting of four to eight visits to homes of asthmatic children. The study demonstrated that both groups of residents benefited from the home visit experience, but that substantially greater improvements in caregiver quality of life and reductions in use of urgent medical care services were associated with the high-intensity services.

Esperanza Community Housing Corporation (Esperanza) in south Los Angeles uses Promotoras de Salud who are residents of the target area to conduct community outreach, visual assessment, environmental sampling, education, tenant rights advocacy, clinic coordination, and referral to city and county code enforcement services. A promotora is a community health advocate who has been trained in a six month-long comprehensive community health curriculum followed by extensive training in healthy homes issues. Esperanza is truly a grassroots effort whose establishment resulted from an organizing campaign by community residents. With its clinical partner St. John's Well Child and Family Center, Esperanza has developed a system in which clinicians can refer cases to a promotora for an environmental home visit and case management.

Housing agency-based

Housing agencies can provide meaningful leadership for healthy housing initiatives. Location in a housing department can provide access to federal and state housing programs and funding such as Community Development Block Grants (CDBG) and the Weatherization Assistance Program. Key to the success of these programs is partnerships with public and private sector health

programs and service providers.

The City of Phoenix Neighborhood Services Department provides leadership for a healthy homes program that leverages financial support through set-asides within their existing housing programs. The program established relationships to receive referrals of families with elevated blood lead levels, asthma, or injuries stemming from known or suspected housing hazards. Securing commitment from department leadership was central to achieving the program's priorities. Significant problem solving occurred to integrate the need for timely health services with longer term and more comprehensive housing rehabilitation.

Elderly programs

Older adults have particular needs for safe and affordable home environments. Preventing unintentional injuries—especially falls and poisonings—through education, medication management support, and retrofitting homes for safety is especially critical for this population. Older adults often subsist on fixed incomes and may not have the financial resources for home repairs and rising utility costs. In addition to interventions such as installation of hand railings on stairs, grab bars in bathrooms and adequate lighting, community education programs can be highly effective in addressing home health and safety issues affecting seniors. Education should be provided at locations that are accessible and comfortable for older adults, allow time for adequate discussion, and provide options for additional services. The U.S. Department of Health and Human Services (HHS), HUD, and EPA are committed to promoting better ways for older adults to remain in safe and healthy homes and "age in-place."

Rural programs

Rural healthy homes programs focus on unique issues such as well water protection, household wastewater management including septic systems design, fertilizer and pesticide use and storage, and agriculture-related injuries. These programs also address typical issues like lead-based paint, radon, natural disasters, and mold and moisture.

The University of Rhode Island Cooperative Extension Water Quality Program works in cooperation with the Rhode Island Department of Health (RIDOH), private licensed water testing laboratories, and the Ground Water Association comprised of licensed well drillers to assure the safety of well water. The program includes education of private well owners about the importance of regularly testing their well water, professional training and networking, and phone consultation. The RIDOH recently established regulations that require testing private wells at the sale of property or when a new well is installed.

State programs

In addition to city or county healthy homes programs that usually target specific high risk neighborhoods, state governments have begun to provide leadership for advancing healthy housing initiatives. Rhode Island has developed a five-year work plan to facilitate integration of state health and housing services and programs. Maryland builds healthy homes goals into its state and local sustainability plans. New York State has a Healthy Neighborhoods Program that provides home education on safety, pests, asthma triggers, and lead and visual assessment visits to selected neighborhoods.

New York State Healthy Neighborhoods Program (HNP) provides in-home assessments and interventions to improve the environmental health and safety of residents residing in high-risk target communities in ten counties. The HNP is delivered by local health departments and relies on a variety of strategies to recruit participants including door-to-door canvassing and referrals from other health and housing programs. Homes are assessed for hazards related to fire safety, lead poisoning, carbon monoxide poisoning, indoor air quality, pests/vermin, mold and moisture, tobacco use, and other common environmental health issues. During the home visit, residents are provided with education, products, and referrals to help them correct or minimize each potential hazard. This approach relies heavily on strong local partnerships to ensure that resources are in place to help residents deal with the wide variety of environmental health and related social issues identified during a typical visit. Twenty-five percent of the homes are visited again after 90 days to reassess conditions and to provide additional interventions as needed. A comprehensive program evaluation is underway.

Despite the fact that injuries are a leading cause of illness and death in the United States, home interventions to prevent injuries are often overlooked. Efforts aimed at addressing injuries include attention to fire safety through smoke alarms and escape plans, retrofitting homes to prevent falls, poisoning prevention through proper storage, and safety education.

Cincinnati Children's Hospital Medical Center developed an injury prevention program as part of a larger research project targeted to homes of young children from birth through four years of age. This initiative is validating the benefits of its Home Observations and Measures of the Environment (HOME) Injury Survey, a 55-item tool that quantifies unintentional injury hazards in the indoor environment of homes with young children. After the injury assessment is completed, recommended interventions are reviewed with parents who participate in prioritizing interventions. Consumer product safety devices are then installed by project staff.

Child care programs

Based on the disproportionate burden of environmental hazards on children, home-based child care programs offer a strategic opportunity for healthy housing partnerships. Home-based child care programs located in high-risk target areas can be targeted for education and housing interventions to protect large numbers of children. Priority interventions may include lead hazard reduction, child safety installations such as railings and gates, assurance of product (toys) safety, crib safety, and safer cleaning products, and focus on asthma, allergies, and indoor air quality.

The Philadelphia Department of Health's Healthy Homes Child Care Program provided education and remediated lead and safety hazards in licensed home-based child care programs located in an area of the city with old and deteriorating housing stock serving low-income children. The Pennsylvania Department of Public Welfare's Office of Child Development provided a list of certified child care providers located in the target area, and interagency agreements facilitated partnerships with the Philadelphia Early Childhood Collaborative and Pennsylvania's Keystone Stars, which promotes quality improvement in early learning of school-aged children. The project also integrated established procedures from Philadelphia's Lead Hazard Control, Healthy Homes and Lead-Safe Babies Programs. Activities were aimed at safety, indoor air quality, energy efficiency, integrated

pest management, and lead hazard control. Over a three-year period, more than 150 child care providers received intensive continuing education on safety, lead, pest management, and asthma, and 50 child care homes were remediated.

Energy efficiency and weatherization partnerships

The U.S. Department of Energy funds Weatherization Assistance Programs that are managed by states through Community Action Agencies (CAA) to improve energy efficiency. By leveraging work with weatherization programs, health and housing departments can take advantage of weatherization staff expertise on how to address whole-house ventilation and other issues. In turn, weatherization staff and their recipients (e.g., low-income families) can benefit from comprehensive healthy housing assessments and interventions.

The Opportunity Council of Bellingham, Washington, is a CAA which houses a weatherization and Head Start program. The organization targeted low-income families with children suffering from asthma and ten home-based child care providers who served those children for intensive education, weatherization, and rehabilitation. All staff, including weatherization professionals, Head Start, and social service home visitors, were trained on program elements. Families received specialized education on how the home functions as a system and were given supplies to use in the home to reduce asthma triggers (e.g., cleaning kits, HEPA vacuums, and other items). The homes benefited from enhanced ventilation and pollution mitigation services. Visual assessments and family interviews were conducted before and six months after renovation. The program reported improvements in the children's asthma symptoms, and an unexpected benefit of reduced turnover in the units. The average cost of improvements was $5,600 per unit.

The Green and Healthy Homes Initiative (GHHI) is a project of the National Coalition to End Childhood Lead Poisoning with support from HUD and the CDC. It is a social innovation that breaks down funding restriction barriers between federal, state, local and philanthropic resources. A number of project sites are being funded by establishing new public-private foundation partnerships. The goal of GHHI is to align funding sources, coordinate

resources and train workers to advance a "whole house" strategy. Integrated green and healthy housing assessment and interventions focus on environmental health, safety and energy efficiency.

Code enforcement partnerships

Housing codes originally dealt with health problems and were the responsibility of health departments to enforce. However, the reality is there will never be enough government funding to make all homes healthy. Updating and enforcing housing codes are effective ways of leveraging property owner and public resources and building sustainability of healthy homes programs. Any type of agency partnership will require cross-training of staff and will benefit from regular problem-solving meetings. Some municipalities focus their joint sessions on case reviews to build consensus on effective strategies. Other partnerships use different approaches. The aim is to avoid duplicating activities, coordinate mutual resources, and maximize the effectiveness of interventions. Partnership strategies include:

- Deputizing health department staff to enforce the housing code.

- Referring housing code violations observed during health department home visits to housing code enforcement officials. The two departments can then collaborate on carrying out needed work.

- Conducting joint health department and code inspection home visits to assess conditions and develop a collaborative response.

The Columbus, Ohio Health Department has the authority to enforce housing codes. Because of limited staff capacity, they coordinate with the Columbus Department of Development to conduct joint inspections and enforce orders if the property owner isn't initially responsive.

The Multnomah County, Oregon, Health Department used its Healthy Homes Demonstration grant to facilitate policy and systems changes that integrate healthy homes concepts into the daily work of government housing programs. The City of Gresham established a program requiring annual inspections of rental housing units. The City of Portland Quality Rental Housing Workgroup changed the city's housing code and enforcement procedures. Multnomah County itself passed a resolution related to improving rental housing conditions in unincorporated areas of the county.

Characteristics of Successful Healthy Homes Programs

In addition to insights garnered from high-functioning healthy homes programs, other documents identified key characteristics of effective programs.[17, 18] These qualities include:

- **Planning:** Allow adequate time for community and program planning.

- **Community Involvement:** Involve the community in program planning, implementation, and evaluation.

- **Clinic/Medical Connections:** Engage hospitals and clinics as resources for identifying at-risk families in need of healthy homes interventions, monitoring, and education. Determine if a Pediatric Environmental Healthy Specialty Unit is located in your community. www.aoec.org/PEHSU/index.html

- **Leadership:** Recognize that community and program leadership is crucial to effective healthy homes programs. Identifying program champions inside collaborating organizations is especially important. One inspired leader can make a difference.

- **Partnerships and Coalitions:** Build and maintain collaborations across a wide variety of multidisciplinary programs. Partnerships among healthy homes programs are mandatory to assure a comprehensive and sustainable approach.

- **Policy Development:** Focus on the policies, legislative infrastructure, and building code changes and enforcement that can support healthy homes programs, enable structural changes to housing, and strengthen sustainability.

- **Evaluation:** Plan for program evaluation during the program design phase. Regular data collection and analysis are central to assuring cost-effective health and housing outcomes and fidelity to program policies and procedures.

In addition to the above key characteristics, successful healthy homes programs must also focus on the following:

- **Improvements in the Delivery of Services to Residents:** Look for opportunities to make programmatic changes that can streamline intake processes and restructure service delivery systems to integrate interventions and better leverage the use of available resources for residents, such as by identifying and braiding federal, state, philanthropic, and other private sector resources.

- **Sustainability:** Make sustainability a fundamental component of the initial and ongoing program plans. Ultimately, sustainability involves learning from experience (ongoing evaluation), making decisions about which elements of the program to sustain, selecting the right strategies, and using the right tools to build support for your program.

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Notes

Community Involvement in Program Planning

Community Involvement in Program Planning

2

Developing partnerships is essential to the holistic approach that defines healthy homes programs. In addition to the importance of collaborating with multiple organizational partners, engaging the community most affected by health and housing problems is particularly crucial to long-term success and sustainability.

Involving community members and organizations not only enhances understanding of and by the target population, it is fundamental to identifying the best way to meet the community's needs.

Healthy homes programs may be located in housing departments, health departments, community-based agencies or non-governmental organizations. Regardless of where they are based, program designers can benefit from the insights provided by public health planning models on how to develop partnerships, create a community vision, and establish priorities for action.[1, 2, 3, 4, 5]

Model programs have several features in common including:

- Identification and engagement of stakeholders;

- Investment in coalition building and maintenance;

- Analysis of and sharing relevant data; and

- Building consensus on program priorities.

Key Messages

- Efforts to develop partnerships are important since healthy homes programs encompass activities that cross traditional organizational boundaries that separate health and housing service systems, resources, and policies.

- Involvement of multiple agencies and disciplines is important to the success and sustainability of healthy homes programs.

- Partnership development should be viewed as an ongoing activity beginning at the program design stage and continuing throughout implementation and evaluation.

- Engagement of the community most affected by health and housing problems is particularly important to program effectiveness and long-term success.

Identify and Engage Stakeholders

Healthy homes programs require the collaboration of housing agencies and policies. Successful programs require knowledge of behavioral change, structural conditions of housing, and social and economic conditions. To ensure this capacity, healthy homes programs require multiple partners. Many communities accomplish needed collaboration through coalitions in which trusting relationships are developed and decisions are made by consensus.

An Evaluation of HUD's Healthy Homes Initiative: Current Findings and Outcomes (FFY 1999–2004) reported the involvement of multiple partners in healthy homes program activities based on community assets and program goals and objectives.[6] Health departments, housing departments, academic institutions, and community-based organizations were most likely to form partnerships, while advocacy, faith-based organizations, schools, and hospitals/health centers were also involved, but to a lesser extent.

If strong community partnerships already exist or healthy homes program and policy assets are readily identifiable, partnership development and asset mapping do not have to become exhaustive processes. Sometimes an opportunity presents itself—stakeholder interest, political will, funding—that can be capitalized upon while at the same time assuring community participation.

Community Asset Mapping

When establishing or modifying a program to incorporate healthy homes issues, a comprehensive inventory of community interests and resources can provide important insights, especially if members of the vulnerable and underserved populations are engaged. Community-asset mapping defines an "asset" as anything that improves the community's quality of life.[7] All sectors of community life—both individuals and organizations—have resources that can be leveraged:

- Human resources: an organization's staff, board of directors, programs, membership, and target population including individual expertise, talent, and training skills;

- Physical resources: a geographic location that is accessible to the target population and provides public space and meeting rooms;

- Informational resources: formal and informal networks of communication and participation in formal and informal associations;

- Political resources: constituencies of elected officials and public/private institutions that advocate for resources and policy changes; and,

- Existing intervention resources: lead hazard control programs, home visiting services, building and/or housing code service systems can be leveraged or integrated into a healthy homes program.

Encouraging groups to identify their common self-interest and examine their members' strengths enables programs to broaden community participation outside their normal comfort zones, and identify where resources do or do not exist to advance health and housing within a target area. Appendix 2.1 identifies potential healthy homes stakeholders and their assets.

To start the process, program planners can conduct focus groups or stakeholder interviews to assess the knowledge, hear the concerns, and learn from key individuals who are either active in the neighborhood, affected by the problems associated with hazardous housing, or will have a role in addressing problems. These can be conducted as a part of the needs assessment before convening formal partnership meetings. When discussions focus on assets, program planning can emphasize

Figure 2.1 Sample Inventories of Community Assets

My Community

Individuals

Parents of asthmatics

Parents of lead poisoned children

Community leaders

Elected officials

Non-elected officials

Doctors

Activists

Students/Interns

Older adults

Researchers

Evaluators

Lawyers

Institutions

Government health departments

Government housing programs

Government code enforcement programs

Public housing

Hospitals & health systems

Medical clinics

Child care programs

Community based organizations

Social service agencies

Academic institutions

Fire departments

School systems

Weatherization and energy efficiency programs

Philanthropic foundations

Media

Local Economy

Housing developers

Health insurance payers

Insurance companies

Banks/mortgage brokers

Hardware stores

Community development corporations

Job centers

Pest management companies

Lead abatement contractors

General contractors

Handymen

Environmental health and safety trainers

Cleaning companies

Radon mitigation companies

Physical Space

Community agency offices

Public meeting spaces

Libraries

Community gardens

Associations

Rental property associations

Realtors associations

Lead Task Forces

Asthma Coalitions

Neighborhood groups

Block clubs

Parent groups

Environmental groups

Advocacy organizations

Tenant groups

Bar association (Legal)

Teachers union

Faith-based organizations

Source: Kretzmann, McKnight, Dobrowolski, and Puntenney, 2005, p. 15.[8]

strengths rather than limitations.

Advocates of community-asset mapping recognize the benefits of a map of a geographic area with resources clearly identified as a tool to build consensus. A map provides all planning participants with a visual depiction of assets and can facilitate communication with the media, residents of the target area, and public officials.

Asset mapping starts with an inventory of categories of assets—associations, institutions, the local economy, public spaces and individuals—in the community. Once inventoried, the type of activities in which organizations are engaged can be identified and the links that can be built or increased explored. Seek assistance from community leaders to serve as conduits to resources inside and outside the target community. Engage the community in visioning and planning how assets can be mobilized to address community needs.

Coalition-Building and Maintenance

While identifying program partners and stakeholders is an important step in building a successful health-related community coalition, effective coalition building and maintenance require several other activities (Figure 2.2). Based on the experience of the seven coalitions in the Allies Against Asthma initiative funded by the Robert Wood Johnson Foundation, Clark et al defined a successful coalition as one that:

> …(a) serves a defined community (usually having a common location or experience) recognized by those within it as a community, (b) is purposeful and its duration is time specific, (c) exists to serve the broader community, (d) is viewed by community residents as representing and serving them, (e) reflects the diversity evident in the community, (f) addresses

Figure 2.2 Critical Factors in Coalition Building

- A general climate of public support for the coalition or the issue it seeks to address.

- A respected community leader—either a person or agency—to convene the meetings.

- An existing coalition that can be expanded to address new issues/members.

- Positive past collaborative experiences among members.

- Initial consensus on a mission/vision. Refining a coalition's mission is a normal part of coalition growth but failure to achieve a common view indicates a fundamental problem with coalition dynamics.

- Decision styles and operating procedures that can be developed quickly enough to initiate program activities and achieve some initial successes. Public and private institutions may have different decision-making styles and methods of achieving success, but their procedures—regardless of differences—should be understood by all participants.

- In-house leadership capacity that is developed over time.

- Shared responsibility for such daily activities as staff, communications, and service delivery.

- Flexibility in the level of member involvement needed to achieve goals. However, there must be some continuity of participants over time and a core group who can activate engagement by others when needed.

- A mechanism that records coalition decisions (such as meeting minutes or a policy and procedure manual) to avoid revisiting and reanalyzing past decisions.

- Members' perceived return on their investment in time, monetary commitment, and compatibility with their organization's goals.

- A transparent and representative decision-making process that avoids the appearance of bias.

Sources: Butterfoss, 2009; Center for Managing Chronic Disease, 2007; Durch et al., 1997; EPA, 2008; Sofaer, 2004

Community Involvement in Program Planning

the problem(s) systematically and comprehensively and (g) builds community independence and capacity.[9]

Awareness of the self-interest of your program partners is central to establishing and maintaining collaborations. Maintaining partnerships depends on fulfilling individual or agency needs, and demonstrating that the partnership and program are beneficial to them. Simply put, there needs to be a return on member investments of time and resources expended in healthy homes program activities.

Analyze and Share Relevant Data

Identifying the target population and priority geographic area are important components of program planning. This process also promotes community understanding, engagement, and ownership fundamental to program design. Begin with a review of the easily accessible national,

state, or local data, and broaden information gathering as needed to learn specific health and housing indicators including residents' priorities. This comprehensive approach takes advantage of each participant's unique expertise. The data can be qualitative and quantitative (Figure 2.3).

Appendix 2.2 provides examples of where to obtain these data at the federal, state, local, and neighborhood levels, as well as resources for best practices and model programs.

Data to review during the planning process include:

- Socioeconomic and demographic characteristics of potential target populations. These data are generally available from the U.S. Census by zip code or census tract and include ethnicity, age, income, educational attainment, and unemployment rates. The number and proportion of individuals, children and seniors living in poverty, single parent and female head of household families, and those without health

Figure 2.3 Philadelphia's Healthy Homes for Child Care

Family or home-based child care providers are responsible for a large portion of the child care in low-income neighborhoods. However, the providers themselves often have the same problems with deferred home maintenance as the rest of their neighbors. Since they serve a large number of young children, the risk of children's exposure to poor indoor air quality or deteriorated lead-based paint is high, and many of these exposures are not assessed through the licensing process.

Coalition-building and data collection for the Philadelphia Healthy Homes for Child Care Demonstration grant began more than one year before the grant application was submitted. Discussions began in March 2004, building on the National Center for Healthy Housing's 2003–2005 Lead Elimination Action Program (LEAP) model Home-Based Child Care Lead and Safety Program and the City of Philadelphia's prior Healthy Homes grant collaborations with the National Nursing Consortium. Representatives from these programs, child care licensing and referral agencies, private funders such as the Nonprofit Finance Fund, advocacy organizations such as

the Philadelphia Citizens for Children and Youth, and others began to meet quarterly to convene working groups on education, outreach and fund development. Throughout 2004 and into 2005, staff from the Philadelphia Department of Health served as the resource managers, assembling community profiles that included maps of lead poisoning cases, asthma and injury rates for high-risk neighborhoods, and the numbers of licensed home-based child care providers in these communities. As planning began to solidify, organizations working directly with the child care community collaborated with child care providers to identify additional educational service needs. The funding working group also prioritized needs for additional funding, such as what might be needed in a relocation unit if it was to serve as a child care site during the period of intervention. Prior to applying for the Healthy Homes Grant, the program began to secure commitments from private funders and the YMCA for Philadelphia and Vicinity. By the time the Healthy Homes NOFA was announced, the advisory group had many of the design and funding commitments already in place.

insurance are commonly used to describe a target population. The Census also provides general data on the number and proportion of groups that may have difficulty gaining access to community services (e.g., migrants, homeless, and non-English speakers). Program planners are encouraged to consult with local organizations serving the target population to identify specific needs. These data can be compared by neighborhood to the city at large, similar size cities, the state, and the nation.

- Health status. For healthy homes programs, data include the prevalence and severity of childhood asthma, childhood lead poisoning, and age-adjusted injury rates. Local fire departments can provide information on fire incidence and location, and hospitals can provide information on injuries such as falls, carbon monoxide poisoning and other poisonings. Common sources of data include CDC's National Environmental Health Public Tracking Network and the Behavioral Risk Factor Surveillance Survey, state-level Healthy People 2010 reports, reportable conditions registries, the National Association of Counties Healthy Counties database, and EPA's Toxic Release Inventory. Other health data include asthma hospitalization and death rates, infant mortality rates, data on chronic health conditions such as obesity, immunization status, tobacco use rates, and identification of geographic areas that do not meet state or federal air and water quality standards.

  The Health Insurance Portability and Accountability Act (HIPAA) should not impede the ability to obtain important health data. The Privacy Rule (45 CFR §164.512 (b)) permits disclosure without patient authorization "to prevent or lessen a serious and imminent threat to the health or safety of a person or the public." This authority should only be used as a last resort. The Alliance for Healthy Homes has produced a guidance document, titled "Overcoming Barriers to Data Sharing Related to the HIPAA Privacy Rule"(www.cehrc.org/aboutus/pubs/HIPAA_CLPPP_June_2004.pdf).

- Health care consumption. Expenditure data include per capita Medicare and Medicaid spending for asthma and injury and the number and/or rate per 100,000 for emergency department visits, hospitalizations,

and urgent care visits for asthma, injuries, and poisonings. This data is available at the state level from the Agency for Health Care Research and Quality, as well as from state regulatory and insurance agencies. Some local hospitals, health systems and insurance companies can also provide this information.

- Self-Reports of Functional Status and Quality of Life.[10] This includes such issues as special health care needs, mental health status, and caregiver stress. America's Children: Key National Indicators of Wellbeing, available through www.childstats.gov, provides this information at a national level, while the Annie E. Casey's Kids Count report provides this information on state, county, and local levels.

- Characteristics of Housing Stock. A description of housing stock includes information on age, vacancies, and ownership status (rental versus owner-occupied) and is available through the Census on a zip code and census tract basis. The American Housing Survey documents housing defects in owner-occupied and rental units for over 40 communities and may serve as a basis for a more local assessment. Foreclosure rate data are available on the HUD website and through local tax assessor databases where information on assessed housing value is also available.

  The EPA Map of Radon Zones can be used to assess the radon potential for jurisdictions (www.epa.gov/radon/zonemap.html). Regional and local Consolidated Plans for the use of federal rehabilitation funds provide data on at-risk neighborhoods and efforts to serve them.

Figure 2.4 Multnomah County Health Department, Oregon

Multnomah County used the PACE-EH program to assure a comprehensive and community-driven planning and needs assessment process rooted in a vision of environmental justice and targeting health and housing disparities. One of the results of the planning process was the establishment of OPAL (Organizing People—Activating Leader) a new nonprofit 501(c)3 organization dedicated to working for environmental justice in Portland.

Program planners can also conduct windshield surveys or access governmental building inspection/code enforcement data to identify common housing defects.

State, county, or city lead elimination plans may contain valuable information on health status and housing characteristics.

- Neighborhood characteristics. These data include information on transportation, access to employment, parks, schools, emergency, other public services, and public safety. This information may be available from local planning departments as part of a community comprehensive plan.

Protocols for Assessing Community Excellence in Environmental Health (PACE-EH)

If data are not readily available, a number of resources are available to help plan a program. CDC and the National Association of County and City Health Officers (NACCHO) have developed Protocols for Assessing Community Excellence in Environmental Health (PACE-EH) that include model surveys, visual assessments, and other tools easily adapted to local conditions. PACE-EH's approach emphasizes that all community assessments pair data collection with efforts to engage the community.[11]

Build Consensus on Program Priorities

Community involvement in program planning requires additional time and activities. In the long run, failure to address community priorities may jeopardize the success of the project since programs need to be valued by the affected community to ensure they are meaningful and sustainable. Program planners should have experience in partnership and coalition development. Skill in dispute mediation, especially when groups have competing self-interests or a history of feeling ignored, may be needed if consensus cannot be reached in a reasonable amount of time. Methods for setting priorities range from visioning exercises, focus groups, stakeholder interviews, brainstorming followed by ranking, and iterative formal ratings systems such as Delphi techniques (an approach

to group problem solving). Strategic planning takes time; it is important that program planners and participants value the process.

Environmental Justice

EPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, culture, education, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies."

Many vulnerable populations such as low-income, minority, elderly and disabled communities live in areas with an increased prevalence of environmental hazards as a result of cultural, social, and economic conditions. Environmental justice asserts that no group bear a disproportionate burden of harmful environmental hazards. Environmental injustice occurs when environmental hazards disproportionately affect a segment of the population and/or when those communities are not a part of the decision-making process. Commitment to environmental justice identifies and addresses environmental inequalities to reduce the effects of harmful exposure.

The EPA definition of environmental justice includes the concept of meaningful involvement of all communities to participate in partnership with government in the environmental decision-making process. Collaborative partnerships and engaging community members in all phases of the research, planning, design, implementation, enforcement, and evaluation process includes:

- Identifying the environmental justice community;

- Creating meaningful involvement and empowering the community by involving residents early in the process;

- Collaborating with the community to create awareness;

- Educating, training, and prioritizing actions and policy needs;

- Measuring health impacts in order to develop and implement necessary actions;

- Creating official partnership agreements; and

- Establishing organizational responsibility in the pursuit of environmental justice goals.

Resources and support for proactive involvement are essential for disproportionately affected communities to fulfill an active role in healthy homes initiatives and environmental justice.

Community-Based Participatory Research: One way to involve the community most affected is by adopting the principles of community-based participatory research (CBPR), which seeks to create a project design that is "of the community," rather than imposed from the outside. CBPR tenets can be applied to program planning, management, and evaluation without conducting formal research. The key is to engage community members in all phases of an initiative—from identification of problems through program design, implementation, and evaluation. CDC's Preventative Research Center (PRC) describes CBPR's key steps as:

1. Engaging community members;

2. Employing local knowledge in the understanding of health problems and the design of interventions;

3. Investing community members in the processes and products of research or programming; and

4. Investing resources in the dissemination and use of research findings to improve community health and reduce health disparities.[12]

The Community's Long-Term Role

A program's vision statement serves as a basis for evaluating the merit of future activities and speaks to the conditions that will be changed if the project achieves its objectives. Community participation in program planning in general and development of the vision statement specifically sets the stage for sustainability, and is often part of a strategic planning process. Healthy homes program planners and leaders are encouraged to establish a strategic planning process with broad and meaningful community involvement. Whatever process is used, partners should reevaluate vision and mission statements periodically to be certain that project activities continue to be consistent with long-term goals.

The University of Kansas' Community Tool Box recommends that vision statements be understood, shared, broad enough to include diverse perspectives, inspiring and uplifting, and easy to communicate. Mission statements, on the other hand, generally speak to a project's specific purpose, how it is accomplished, key populations served, and the values underlying the services provided. Mission statements should be concise and outcome-oriented.[13]

HUD's Healthy Homes Strategic Plan illustrates the difference between a vision and a mission statement:

> 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.

> 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.[14]

After the program is designed and throughout the implementation and evaluation process, community stakeholders and community members most affected by the problem should be included in decision making and reviewing program outcomes. This can be achieved by holding regularly scheduled meetings, documenting and reviewing meeting activities through minutes, assessing program progress in the context of the work plan and timeline, identifying problems and successes, and involving program partners in

Figure 2.5 The Power of a Coalition, Baltimore, Maryland

The Coalition to End Childhood Lead Poisoning has altered the landscape of lead poisoning in Maryland by providing technical assistance to community-based organizations and government agencies. Their success has been accomplished through:

- Identifying and working with community assets.

- Listening to clients, and recognizing that their feedback is the best form of quality control.

- Hiring people from the community and providing competitive wages, benefits, and training.

- Tracking specific outcomes and sharing them with staff as tangible proof that their efforts are meaningful.

- Working with families as partners.

- Encouraging government agencies to open themselves up to the community and listen to feedback.

- Conducting follow up with families within the context of a relationship. Nothing can replace in-person services and a genuinely caring connection.

- Teaching advocacy skills.

- Understanding that government agencies are not usually set up to do community work effectively. Build community capacity through contracts and financial assistance to community based organizations.

developing solutions and celebrating successes. The partnership infrastructure is important to program sustainability and can be self-generating in addressing more comprehensive health and housing concerns. One example of the impact coalitions can have in improving community health and housing appears in Figure 2.5.

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Notes

Community Involvement in Program Planning

3

Program Design

<div style="text-align: right">3</div>

The design of your healthy homes program should reflect priorities identified during the community planning process, which explored community concerns and reviewed health and housing data.

The program plan starts with defining your target population and specifying health and housing outcomes you hope to achieve. Ideally, the design process and program plan development are collaborative activities, involving community partners and stakeholders. Chapter 6 discusses logic models for linking your desired outcomes to activities and resources. These can be useful frameworks in the program planning stage.

Program design calls for decisions on such factors as:

- Goals and objectives
- Target population
- Geographic target area
- Eligibility requirements
- Participant recruitment and retention
- Staffing
- Organizational structure
- Home assessment methods
- Intervention protocols
- Resource availability
- Partner roles and responsibilities

Key Messages

- Conduct program planning in collaboration with partners, agencies and community stakeholders.

- Mainstreaming your healthy homes activities and leveraging partnerships can allow healthy homes initiatives to expand and move forward without dedicated funding.

- Multiple strategies are required to recruit and retain program participants—residents, property owners, and contractors.

- Staffing and organizational structure of healthy homes programs vary based on individual program goals, resources, and partnerships.

- Program evaluation must be considered early in the program planning process.

- Leveraged resources (including service systems)
- Development of service delivery protocols

- Compliance with and utilization of existing laws and regulations

- Data collection

- Evaluation plan

Program Design Questions

The program design process answers the following questions:

- **Why:** Why is a healthy homes program needed? What priority health and housing problems exist in the community? What does a healthy home mean to the community? What is the vision and mission of the program?

- **Who:** Who is most affected by housing based health hazards? Who is most likely to benefit from healthy housing activities? Who is the target population? Who will refer participants to the program? Who will provide leadership for administering the program? Who is responsible for coordinating the work of program partners and stakeholders? What agencies have resources, service systems or regulations that can be leveraged? Who will provide program services? What staff are needed? Who among elected officials and local decision makers will champion the program?

- **What:** What are the program's goals and objectives? How will the program assess home hazards? What services and interventions are needed to make a home healthier and safer? What education and support do residents, homeowners and the community need?

- **When:** What is the program timeline for achievement of short-, intermediate- and long-term goals? What is the schedule for target housing and residents from intake to case closure? When will data be available that demonstrate program outcomes?

- **Where:** Where is the high-risk housing located in the community? What is the program's geographic target area? What assets exist in the target area and community at large?

- **How:** What resources and partnerships are needed to implement the program? What level of funding is needed? What sources of funding will be targeted? What infrastructure or service systems can be leveraged? What systems or public policies need to be developed or revised? What immediate actions can be taken to initiate healthy housing activities? If effective, how will the program be sustained?

Mainstreaming Healthy Homes Activities

As you begin planning your healthy homes program and working with community partners, it can be helpful to brainstorm actions that can be taken immediately to advance the healthy

homes movement in your community. Gather your partners and stakeholders together to explore the question: What can our community do without dedicated healthy homes funding to accelerate healthy homes activities?

Examples of such activities include:

- Recruiting the fire department to assist with fire safety education and provision of smoke alarms and carbon monoxide detectors.

- Partnering with code enforcement agencies to take advantage of existing enforcement systems and resources to make homes healthier and safer.

- Cooperating with local childhood lead poisoning or lead hazard reduction programs to remediate lead-based paint hazards in target properties.

- Working with existing housing rehabilitation programs to prioritize healthy housing assessment and interventions as a part of their funding requirements.

- Advocating for funding "set asides" for healthy homes within CDBG-funded housing rehabilitation programs.

- Working with public housing agencies as they implement building upgrades and address pest management issues.

- Promoting smoke-free multifamily housing to property owners and managers, and residents.

- Cooperating with sustainable and green housing initiatives to prioritize housing rehabilitation treatments or new construction practices that result in health improvements.

- Collaborating with weatherization and energy efficiency programs.

- Contacting local law schools or bar associations to recruit volunteers to work with target populations on legal issues that impact public benefits and/or housing habitability.

- Redirecting existing funding where possible.

- Identifying a researcher or evaluation specialist interested in healthy homes issues.

- Sponsoring an intern to focus on a healthy homes mini-project.

- Exploring health plans and HMO reimbursement options for home visits and environmental services in homes of children with poorly controlled asthma.

- Exploring the donation of cleaning supplies, mattress and pillow covers, and vacuum cleaners.

"Mainstreaming" your healthy homes activities within existing service systems and programs promotes sustainability of these efforts. When partners and stakeholders work strategically to establish a healthy homes program prior to dedicated funding, they are laying the groundwork for securing resources as well as piloting and cost estimating interventions. These activities can be used to leverage funding when applying for healthy homes grants.

Healthy Homes Program Components

A healthy homes program includes some or all of the following functions:

- Identification of program participants
- Establishment of referral systems
- Establishment of intake and eligibility criteria
- Resident education, behavior change, and interviewing
- Visual assessments
- Environmental measurement/sampling
- Asthma action or case management plans
- Scope of work development
- Housing interventions
- Community education
- Environmental follow-up

Each healthy homes program will look different depending on your program's resources, strategies and partners. The flow chart in Figure 3.1 depicts each programmatic stage from referrals and intake through family education and case management and housing intervention.

Figure 3.1 Flow Chart of Program Stages

Recruitment and Referrals

Health care providers, government funded health, housing or social service programs, community organizations, canvassing, self-referral

↓

Intake and Eligibility

Application and enrollment based on target area, income, and other program criteria (e.g., age, health condition)

↓

Resident/Family Services	**Environmental Assessment**
Resident interview Quality of Life Survey Resident education Provision of cleaning kits and mattress and pillow covers	Visual Assessment Lead Risk Assessment/Inspection Home Safety Assessment Environmental/Measurements/Sampling Energy Audit
↓	↓
Case Management or Asthma Action Plan	**Scope of Work**
Education on cleaning Coordination of health services Health care access/health insurance Compliance with asthma action plan	Specification of treatments Information on grants and loan Permit requirements Clarification of roles and responsibilities of property owner and contractors
↓	↓
Care Coordination and Referrals	**Housing Interventions**
Medical services Social services Legal advocacy Employment assistance Smoking cessation Weatherization or rehab programs	Moisture control Mold remediation Integrated pest management Housing repair and rehabilitation Lead hazard control Air quality—venting, dehumidifier use, dust reduction Installation of safety devices
↓	↓
Follow-up Education and Case Management	**Environmental Follow-up**
Reinforcement of education Reinforcement of behavior change Monitoring and revision of case management or asthma action plan	Post-intervention visual assessment Post-intervention environmental/allergen sampling Pest Monitoring

Program Design

Program Parameters

Determining program parameters includes:

- Defining eligibility criteria for program services;

- Identifying recruitment partners, referral systems, and retention strategies; and

- Determining assessment methods and intervention priorities.

While some of this planning activity can occur as part of the process to secure funding, the program "start up" phase requires an additional level of detail to prepare policies, protocols, and program materials. Most programs can expect an additional three to six months to get underway.

Eligibility Requirements

Eligibility—who is qualified to receive program services—involves determination of the following:

- Geographic location of target housing;

- Target populations for services: children with asthma, older adults, and/or families residing in substandard housing;

- Inclusion/exclusion criteria such as income levels, property tenure (owner-occupied versus rental property), private versus public housing, level of housing deterioration; and

- Availability of documentation needed to demonstrate eligibility.

- Review of applicable requirements related to federal grant funds (i.e., criteria under the HUD Lead Hazard Control Grant Program).

Eligibility decisions involve tradeoffs and include criteria for families, property owners, and properties themselves. A broader definition makes it easier for the program to meet its target numbers for recruitment in a timely manner, but may make it more difficult to demonstrate specific health benefits and target services to those most in need. For example, criterian such as "rental units housing families of children with asthma who agree to remain in their residence for 12 months after renovation," may be too

Figure 3.2 Most Common Recruitment Challenges Reported by HUD Healthy Homes Grantees

- Difficulty in reaching the target population (related to client transience or fear of authorities)

- Overly strict enrollment criteria

- Over-reliance on partners for referrals and lack of back-up recruitment strategies

Source: HUD, 2007, pp 36–37.

restrictive resulting in the program not reaching its benchmarks for enrollment. On the other hand, eligibility defined as "families living in substandard housing within a specific geographic area" may not yield the health outcomes central to the goal of healthy homes programs.

An Evaluation of HUD's Healthy Homes Initiative: Current Findings and Outcomes reported that the majority of grantees surveyed defined unit eligibility by using a combination of specific population groups and housing conditions.[1] Many of these programs explicitly required enrolled families to have a child with physician-diagnosed asthma.

Based on these experiences, several eligibility issues deserve special attention:

Table 3.1 Recruitment and Eligibility Strategies Used in Model Programs

Project Name	Recruitment Strategy	Eligibility Criteria				
		Geography	Income	Age	Housing	~~Illness, Health~~ Condition or Other Criteria
Baltimore City's Transition from Lead to Healthy Housing	Recruited families of EBLL children receiving case management services from the Health Depart-ment and women with high-risk pregnancies referred by non-profit programs.	City of Baltimore only	Low-income	Children 0–6 years and pregnant women	Owner-occupied and rental housing units with a focus on rental property	EBLL or pregnancy
Boston Breathe Easy Home Program	Web-based referrals provided by doctors, nurses, BPHC, other health professionals, and asthma home visit-ing programs.	Boston area neighborhoods with highest rates of asthma and multi-family rental housing	Low-income	Adults and children	Public housing and private rental housing	Have physician-diagnosed asthma.
Case Western Healthy Homes and Babies	Families recruited through Case Western pediatric, family medicine, and geriatric clin-ics by attending medical residents.	City of Cleveland and first ring sub-urbs served by Case Western clinic	Low-income	Children, pregnant women, and "frail" seniors	Owner-occupied and rental housing units with a focus on rental property	Diagnosis of asthma for children and seniors at risk for falls
Esperanza Community Housing Corporation, South Central Healthy Homes Demonstra-tion Project	Referral by St. John's Well Child and Family Center and door-to-door recruitment of families in the buildings that housed referred families (some resulting from tenant-organizing activities of Stra-tegic Actions for a Just Economy.)	13 Census tracks in City of Los Angeles	Low income	Families with children under six and at high risk for lead poisoning	Substandard housing	At risk for lead poisoning; diagnosis of asthma

Program Design

Project Name	Recruitment Strategy	Eligibility Criteria				
		Geography	Income	Age	Housing	Illness, Health Condition or Other Criteria
Philadelphia Healthy Homes for Child Care	Recruited through word of mouth, child care resource, and referral agencies, and advocacy groups that work with children and youths.	19 zip codes in Philadelphia with large numbers of EBLL children, high rates of asthma, and large numbers of home-based child care providers	Child care providers must meet HUD income guidelines for Lead Hazard Control Grants	Licensed child care providers, enrolled in Keystone Stars quality improvement program	Licensed home-based child care providers (primarily owner-occupied)	One or more children in the providers' care had to have an EBLL or diagnosis of asthma
Opportunity Council Weatherization Program	Recruited primarily from client families served by Opportunity Council's weatherization or Head Start programs.	Four-county area in northwest Washington state	125% of federal poverty level	At least one child with clinically diagnosed asthma	Owner-occupied units and family child care homes that served children from these units	Asthma diagnosis\n\nUnits with pets or cigarette smokers were excluded

- Use of community health workers or Promotores de Salud can increase the effectiveness of recruitment and retention. Because they live in the neighborhood being served, they are familiar with the community and credible to families enrolled in the program. (See Seattle/King County and Esperanza Community Housing Corporation case studies located in Appendix 1.)

- Strict limits on geographic location can make it harder to recruit, especially if multiple family and health factors are required. Thirteen (20 percent) of the grantees surveyed in HUD's evaluation had to broaden their geographic target areas over time.[2] The use of multiple eligibility criteria related to health and family factors may require a broader geographic target area to assure recruitment success.

- Rental units can be challenging to serve, especially if major structural interventions are needed.

  ▸ Most healthy homes programs include rental properties because the high-risk geographic locations targeted usually have a high percentage of rental units with maintenance

Figure 3.3 Criteria for Targeting Most Likely to be Used by HUD Healthy Homes Demonstration Grantees

- Families with children in a specific age range

- Families with children with medically-diagnosed asthma or at risk for respiratory illness

- Housing units located in specific geographic and census tracks

Source: HUD, 2007 p.15

issues that result in health and safety hazards. The degree of cooperation between the owner and the owner's relationship with the tenant may impact the time to recruit, obtain documentation to verify eligibility, assess conditions, and complete and finance structural interventions.

  ▸ Scheduling low-level interventions (e.g., cleaning, education, provision of safety and cleaning supplies, small-scale repairs)

can incentivize the property owner's involvement to more intensive housing interventions. Both the Case Western Healthy Homes and Babies and the Children's Mercy Hospital Environmental Health Program (CMH-EHP) staged lower level education and environmental interventions before more intensive structural interventions (Appendices 1.5 and 1.9). Many healthy homes programs combine their funding with lead hazard control grants and/or loans as both an incentive and means to conduct comprehensive housing interventions.

‣ Any recruitment strategy that targets families from rental units must account for resident mobility and more frequent unit turnover. This may result in more units and/or families lost to long-term follow-up.

‣ Some healthy homes programs require rental property owners to share the cost of structural remediation. Strategically, this makes sense if the program is helping the property owner comply with lead hazard control or building code requirements. In these cases, the benefits of the program and the amount of funding to be leveraged from the owner needs to be communicated clearly at the point of recruitment.

• Multiple sources of funding pose a challenge based on disparate eligibility requirements. A program that seeks to use both Department of Energy (DOE) weatherization program and HUD funding must recognize that DOE typically uses household income of 125 percent of the area poverty level as a cutoff, whereas HUD Healthy Homes Grants use the

designation of low income, and HUD Lead Hazard Control Grants use a household's percentage of the Area Median Income (AMI).[3]

‣ Use an application process that collects and evaluates all relevant income data at one time. This may include verification of the occupants' age and the income of all adults living in the housing unit.

‣ Establish Memoranda of Understanding (MOUs) with partnering programs to ensure your income verification process meets all requirements and to clarify roles and responsibilities.

• Exclusion criteria need to be specific.

‣ Identify the minimum conditions for units enrolled in the program. For example, the housing unit is structurally sound; there are no outstanding building code violation orders; property owners have the required insurance and are current on their property taxes; and the loan-to-value ratio is acceptable if owners are asked to agree to forgivable loans.

‣ Provide a list of resources of other housing programs and services for applicants deemed ineligible for your healthy homes program.

• Give owners and tenants a fixed period for completing all program phases. If the program establishes a "first come, first served" approach, be clear about how long an application will remain on the waitlist, and what will be needed to reactivate the application. Once program interventions are initiated, tenants and owners need to be compliant with project timeframes to continue to receive services. This will serve as extra incentive for sustained behavior change, property owner contributions, and ultimately assure program cooperation.

• Provide application support to tenants and property owners to streamline the application process.

‣ If needed, identify a staff person who can assist with the application process and serve as a contact for follow-up. This individual must possess good problem-solving skills, be diligent in providing follow-

up, and have the ability to work with all parties to facilitate enrollment.

▶ Develop mechanisms to reduce the time needed to verify income. This can include training outreach workers or program staff to function as notary publics and developing affidavits of income sources for tenants.

▶ Prepare all applications and supporting materials to serve low-literacy populations.

▶ Ensure that a bilingual staff person or translator accompanies program staff on home visits to families who do not speak English, and all written materials are translated into the predominant languages of populations in healthy home program target areas.

Recruitment

1. Setting Benchmarks

Program benchmarks, resources, and evaluation strategies all affect recruitment methods:

• Expect attrition when setting benchmarks for recruitment. The longer the time between recruitment, service provision, completion of interventions, and post-intervention follow-up/evaluation, the more likely applicants will drop out. To compensate, programs should use a common practice in survey research—recruit at least 30 percent more units or families than they ultimately expect to serve. Regularly monitor progress to determine if program changes are needed.

• Understand how available resources limit enrollment. The more costly the set of interventions planned, the fewer the number of housing units and families that can be served.

• Determine what factors the program will evaluate, and if conducting research, what statistical power and precision are needed to assess outcomes. Higher-level statistical analyses and the number of comparisons planned across groups will require more participants or units to be enrolled. If a program wants to draw confident conclusions, there must be a large enough sample size of participants for the statistical significance needed to determine whether outcomes are due to chance or the program.

• Understand the role and self-interest of rental property owners. If structural remediation will be taking place, the property owner's permission and involvement is required even if resident families (tenants) have already agreed to participate. If the owner is unable or unwilling to participate, education, case management, installation of safety items, and supplies can still be offered to families in need. Some programs provide relocation assistance to assure a healthier living environment for the family.

Lessons learned from healthy homes programs are highlighted in Figure 3.4

2. Strategies

There is no single "right way" to recruit. Almost half the grantees surveyed for HUD's Evaluation reported delays in meeting program benchmarks related to recruitment. Three-quarters of the grantees used one-to-three

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Figure 3.4 Recruitment—Lessons Learned

• Find the right organizations, especially community health workers (e.g., Promotores de Salud), who live in the target neighborhood to conduct recruitment.

▶ Identify a trusted individual within the target community to assist with recruitment.

▶ Ensure that all partners understand and value the priorities of the project.

• Be realistic in expectations, especially about the time needed to recruit.

• Be prepared to re-evaluate and change recruitment strategies.

• Time distribution of incentives to retain participants (e.g., offer "big ticket" items such as vacuums later in the project cycle).

• Piggyback onto recruitment activities of existing programs.

• Demonstrate how this program addresses needs of potential clientele by reducing home-based health hazards threatening the health of family members.

methods of recruitment (see Figure 3.5). The evaluation also highlighted successful recruitment methods and factors influencing achievement of outcomes:

- A majority, 58 percent, reported referrals from health care providers and other agencies as a successful or very successful recruitment method.

- Almost half, 48 percent, reported distribution of informational materials to schools, community organizations, and health care providers as successful or very successful.

- A total of 29 percent reported recruitment through public meetings or other public events as successful or very successful.

- Door-to-door recruitment was used much less frequently, but the majority of those who used it found it successful.[4]

Over 80 percent of the Evaluation grantees offered incentives for property owner and tenant recruitment and retention; 88 percent reported the use of incentives as effective. Grantees differed in what they considered incentives, with some identifying the grant funding or other financial assistance for the costs of the intervention. Costs of incentives ranged from five dollar gift certificates to up to $8,000 in grant funding to property owners for structural interventions.

3. Key Partners

HUD Demonstration grantees reported using partners most frequently as a recruitment strategy (80 percent of all respondents). Key recruitment partners included health care providers, health departments, clinics, hospitals, and asthma coalition partner organizations, followed by community-based organizations and housing programs.

A. Health Care Providers

The majority of model healthy homes programs focusing on asthma trigger management reported more success when they partnered with health care providers to conduct recruitment. This is consistent with findings of the EPA's Asthma Health Outcomes Project (AHOP 2007)[5, 6] conducted by the Allies Against Asthma initiative and EPA's Communities in Action for Asthma-Friendly Environments Change Package.[7] See Figure 3.6 for highlights of AHOP findings.

When anticipating an ongoing relationship with a health care partner, a liaison should be assigned to the project and kept up to date on program progress and involved in problem solving. It is important to ensure that medical staff is educated about health impacts of housing hazards and program services. As partner health care organizations gain more understanding

Figure 3.5 Percentage of HUD Demonstration Grantees Using Various Recruitment Methods (n=38)
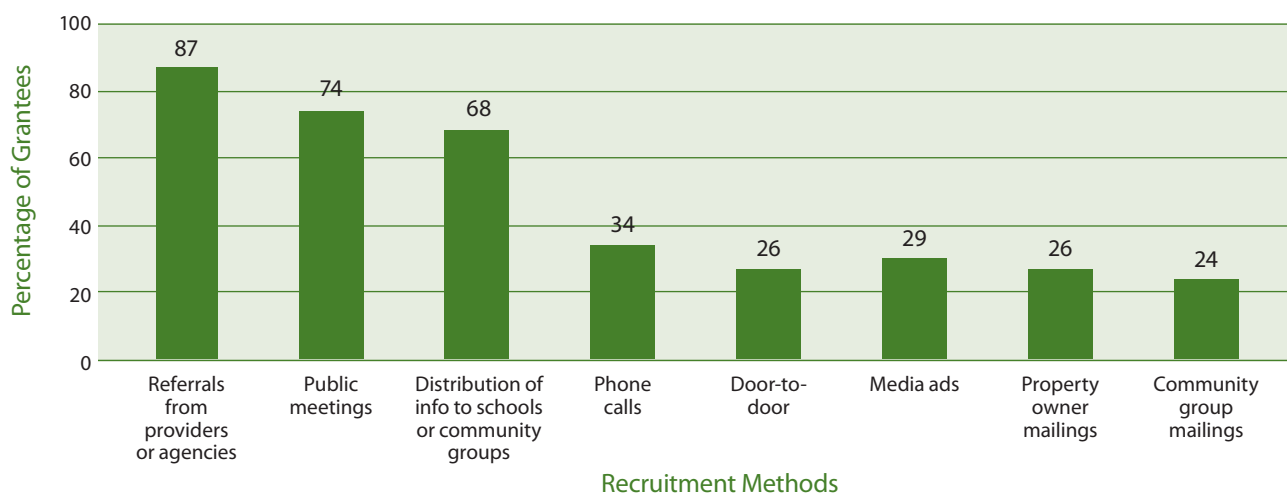
Source: HUD, 2007, p.A.5–6.

Program Design

of and commitment to healthy homes issues, there may be opportunities to provide technical assistance in developing or revising protocols.

Health care providers should be given information on healthy homes program services that their patients are receiving such as case management and housing interventions. This will strengthen the relationship and help the provider feel like part of the team.

Esperanza Community Housing Corporation, South Central Healthy Homes Demonstration Project's partnership with St. John's Well Child and Family Centers, reports a strategy that involves recruiting families through door-to-door canvassing and then referring and sometimes transporting them to the clinic. The clinic then prescribes a Promotora home visit and obtains the patient's permission to share medical information.

Conversely, health care funders and health clinics can consider providing leadership for

comprehensive asthma management programs by providing home visits as an extra level of support. EPA's guide, Implementing An Asthma Home Visit Program: 10 Steps To Help Health Plans Get Started, offers step-by-step instructions on how to start an asthma home visit program with particular emphasis on environmental risk factor management.[8]

B. Community-Based Organizations and Community Health Workers

Community-based organizations located in the target area can serve as meaningful partners for recruitment. Community Action Agencies (CAAs) usually house a variety of programs in at-risk communities, including weatherization (Figure 3.7), Head Start, anti-poverty, and a variety of other social service programs. Because residents are familiar with these offices and program staff, they are likely to be trusted sources for information and referral.

HUD Healthy Home's grantees and evidence-based research agree on the effectiveness of Community Health Workers (CHWs) for recruitment and education related to management of asthma triggers and implementation of Integrated Pest Management.[9, 10, 11, 12] Krieger et al. note that the value of CHW visits is attributed to multiple factors. The CHW:

- Shares the clients' community experience, culture, and lifestyle—especially important factors for Spanish-speaking and other minority communities;

Figure 3.6 AHOP Findings on Health Care Provider

Partnerships with health care providers have the most tangible effects on asthma health outcomes when they have the following:

- Offices in the affected community;

- Time or staff dedicated to asthma education; and

- Compensation to local healthy homes program for providing extra asthma-related services since most health care insurance policies do not reimburse for the additional time devoted to this effort.

EPA's Asthma Forum suggests that high-performing asthma programs are characterized by five key factors:

- Committed leaders and champions;

- Integrated health care services;

- Strong community ties;

- High-performing collaborations; and

- Tailored environmental interventions.

Source: EPA, 2008, p. 1.

Figure 3.7 CBO Partnership Example

The Opportunity Council in Bellingham, Washington developed a successful Healthy Homes Demonstration program based on their ability to supplement services offered with their existing weatherization program. This organizational structure allowed them to recruit through their existing network of clients (Head Start and weatherization services). The program is now a model known as Weatherization Plus Health.

- Serves as role models for clients related to both project aims and the larger goal of economic self-sufficiency;

- Has time to communicate information that is often not addressed in health care visits, such as individualized asthma trigger management;

- Demonstrates and observes the client's implementation activities, and reinforces proper techniques; and

- Addresses the individual's most pressing concerns in the context of the home visit.[13]

CHW and Promotores de Salud are often less costly to hire than nurses or asthma educators. However, programs that employed them with the greatest success engaged in rigorous and continual training (Figure 3.8), hands-on and accessible supervision, visit quality control, and competitive compensation. Seattle/King County's Community Health Worker Guidelines can be found at http://www.kingcounty.gov/healthservices/health/chronic/asthma/resources/hcp.aspx#chw. The Healthy Homes Training Center's Community Health Worker training curriculum (English and Spanish) can be found at http://www.healthyhomestraining.org/chw/

4. Recruitment and Educational Messages

Strategies: Successful recruitment and retention start with understanding what motivates target families and property owners (Figure 3.9). Conduct focus groups, key informant or stakeholder interviews, and/or community meetings to collect these insights. Attend to the immediate concerns of residents at the same time that program concerns and issues are addressed.[14] To respond to these concerns, establish referrals to appropriate resources for issues that are outside the program's scope. Families and property owners may be motivated by any or all of the following issues:

- Health concerns. Residents may value program services to improve existing conditions or to prevent illness or injury from occurring.

- Improved housing. Owners may be motivated by such factors as cost, compliance with regulations, satisfying outstanding code violations, liability, unit turnover, and ease of maintenance issues involved with improving and maintaining properties.

- Strengthening of the owner-tenant relationship. Programs can provide incentives such as cleaning supplies, equipment, and training that support tenant responsibilities. Here, it is important to distinguish between tenant and property owner roles and responsibilities. Many programs include a Statement of Tenant Responsibilities in recruitment materials. (See Figure 3.10 for guidance in preparing materials.) Identify local agencies that mediate conflicts between property owners and tenants, especially those that focus on preventing eviction.

Figure 3.8 Knowing the Target Audience

Baltimore's transition from a Childhood Lead Poisoning Prevention Program into a Healthy Homes Program began with community meetings and focus groups to garner community feedback on current services and discuss expectations of the new approach. This input resulted in extensive revisions to protocols, assessment tools, and client education. The outcome is a client-driven approach whereby families identify their top health and housing concerns and CHW provides a combination of referrals to other agencies, education, and low-level interventions tailored to the clients' stated needs.

Figure 3.9 Motivating Tenant Involvement

Environmental Health Watch (Cleveland, Ohio) reports that when tenants observed the immediate outcome of integrated pest management, they were more motivated to maintain a clean living environment. Most families have had long experience with intractable problems and felt hopeless about controlling their environment. An integrated approach calls for tenants, property owners and contractors to work together to improve the health of the home environment.

• **Program Materials:** Low literacy and culturally appropriate recruitment materials and educational messages should be used (Figure 3.10).

• **Existing Materials.** Whenever possible, use existing program materials. For example, the Healthy Homes Partnership, an initiative between the United States Department of Agriculture (USDA) National Institute on Food and Agriculture's Extension Services and HUD, includes a growing network of state coordinators who provide information about home health hazards. This partnership has produced a self-help guide, Help Yourself to a Healthy Home, that is available in English, Spanish, Hmong, Vietnamese, Arabic and Bosnian, and is appropriate for low literacy audiences. There is also a Native American version of the guide. http://www.csrees.usda.gov/nea/family/in_focus/housing_if_healthyhomes.html. Another resource is The National Center for Healthy Housing's National Healthy Homes Training Center & Network, which brings together public health and housing practitioners to promote practical and cost-effective methods for making homes healthier through the use of the Seven Principles of Healthy Housing. It also serves

as a forum for exchanging information on new research and best practices. http://www.healthyhomestraining.org

• **Literacy.** Materials should be evaluated according to standards for health care communications, reading level, and "plain language." The HHS's Office of Disease Prevention and Health Promotion, Health Communications Activities, Health Literacy Improvement website offers links to fact sheets and other materials: http://www.health.gov/communication/literacy/default.htm.

• **Cultural Appropriateness.** Materials should be screened for cultural appropriateness. In addition, it is necessary to educate recruitment partners, CHWs, inspectors, and contractors about behavior that could be considered offensive to target groups. These can include attitudes toward roles for men and women, dress, body language, and physical/eye/hand contact. Other cultural factors can include differing values concerning traditional versus Western medicine, and practices related to food and housekeeping.

• **Communication methods.** Multi-media communication methods should be employed whenever possible. Appendix 3.1 has examples of multi-media campaigns that can be adapted for your needs. Healthy homes programs are encouraged to develop a formal "Distribution Plan" to raise awareness of their services.

5. Confidentiality and Ethical Concerns

Since healthy homes programs include interactions with individuals and collection of private information, it is important that programs be knowledgeable about the rights of participants and how to protect them from harm. For example, all confidential health information needs to be protected so that it is not disclosed inappropriately. Appendix 6.1 provides detailed information on informed consent, Institutional Review Boards (IRB), and HIPAA. It is important to note that a healthy homes program is voluntary. Program services and interventions need to pose minimal risk to participants so that they are not harmed as a result of voluntary cooperation. Take time to explain to residents/families what their roles, responsibilities and rights are if they choose to

participate. Research studies on the outcomes of interventions should undergo an IRB review before recruitment begins.

Priorities for Assessment and Intervention

As noted in Chapter 1, healthy homes projects often have multiple desired outcomes: health improvement, resident behavioral change, repairs and rehabilitation to housing, community capacity building, system change, and policy development. Chapters 4 and 5 will address assessment and intervention methods in detail. However, there are several program design issues that apply to decisions about home assessments and interventions that must be considered in the program design phase.

1. Assessment Considerations

Home assessment for health and safety hazards can be achieved in three ways:

• Resident interviews;

• Visual assessment/comprehensive health and safety assessment (e.g., HUD's Healthy Homes Rating System); and

• Environmental measurement and sampling, and building performance testing.

Most grantees who participated in the HUD Healthy Homes Initiative Evaluation reported that well-designed resident interviews and visual assessments were sufficient to collect the data needed for their programs. This was echoed by grantees interviewed for this manual. Environmental sampling was more likely to be used as part of research and to show the housing impact of interventions. Long-term environmental sampling and any post-intervention follow-up can pose challenges because residents may move or not permit reentry to collect post-intervention samples. Also, clinical measurements in non-clinical settings, such as pulmonary function measures, can be difficult to standardize. Repeat environmental assessments or clinical measures are subject to residents' schedules and commitment to the project; the more precise the time intervals required to collect repeat samples, the greater the challenge.

During the first few years of HUD Healthy Homes Grant funding, more emphasis was placed on collecting allergen samples to measure their levels in dust and document intervention effectiveness. At this point in the evolution of healthy homes programs, there is reduced focus on environmental sampling.

The Evaluation suggested the following practices to improve assessments:

• Gather only the information that you plan to use;

• Use established validated tools whenever possible; and

• Set clear parameters for pre- and post-remediation assessment.[15]

Healthy homes programs also noted the importance of:

• Training (Figure 3.12), rigorous supervision, and tight quality control for data collection;

• Following equipment calibration and maintenance standards faithfully;

• Treating CHW, Promotores de Salud, and other field staff as respected community experts who are a valued part of the team and free to suggest revisions to protocols and procedures;

- Piloting all procedures and making revisions as needed. Once protocols are established, all changes should be carefully documented;

- Establishing a tracking system to ensure assessments proceed on schedule. Delays in this process impact all other phases of the project; and

- Assuring that program participants fully understand the importance of the assessment in developing specific scopes of work (interventions) that meet their health needs and needs of the property. This can be reinforced by sharing the assessment results with both the families served and property owner.

2. Intervention Considerations

If this is your first experience with healthy homes work, there is an advantage to starting small. Figure 3.13 includes a list of common healthy homes interventions. Intervention options should be tied directly to hazards found as part of the home assessment. Most of HUD's Healthy Homes Demonstration grantees surveyed in the Evaluation did not undertake major improvements initially. As programs developed and additional funding became available, the work evolved into higher-level structural interventions, such as replacement of ventilation systems.

Programs are encouraged to capitalize on existing health and housing programs to leverage their resources and provide more comprehensive housing interventions. These programs and services include case management/home visiting programs, weatherization, lead hazard control, and CDBG-funded housing rehabilitation programs. There is a lack of research showing that individual "low-level interventions" (e.g., education, cleaning, mattress enclosure, resident pest management), when conducted in isolation are effective. Such efforts should be incorporated into a multi-faceted strategy that includes multiple interventions.

The Community Guide Branch of the CDC recommends home-based, multi-trigger, and multi-component environmental interventions to control asthma for children and adolescents (see http://www.thecommunityguide.org/asthma/multicomponent.html). The Task Force reviewed 23 studies for effectiveness and found that education combined with minor or moderate

Figure 3.12 Training of Research Assistants

Tulane University hired neighborhood residents as research assistants who participated in participant recruitment and retention and took responsibility for survey administration, collection of blood samples, and environmental sampling. To assure collection of valid and reliable data, they participated in a two-month training program, were required to pass an oral and written test, were evaluated in the field, and participated in refresher training.

Figure 3.13 Common Interventions

- Education

- Provision of Cleaning and Safety Kits and Mattress and Pillow Covers

- Promoting Smoke Free Homes

- Integrated Pest Management

- Lead Hazard Control

- Moisture Control

- Mold Remediation

- Home Repair and Rehabilitation

- Dust Reduction

- Ventilation Interventions

- Installation of Safety Devices

- Weatherization

environmental remediation resulted in more symptom-free days, savings in asthma care, and improved productivity.

Intervention Challenges. Some of the intervention challenges programs face include:

- Lack of property owner compliance. Property owners' cooperation is needed to obtain consent to work in rental properties and to perform maintenance and repair activities. Therefore, the following should be built into your program design:

- Presentations to realtors and property owner groups to raise awareness of the project and funding availability. Provide clear cost data and information on benefits expected from the interventions. Discuss the benefit of a reduction of liability as a result of fewer risks of poisonings and injuries.

- Inclusion of property owners in the planning process to identify issues that will encourage participation. Having a voice in selecting intervention needs can reassure owners that they are valued participants.

- Perform joint field visits with code inspectors or other agencies. Identify how your program can link services to remediating code violations. Programs can offer compliance assistance to help owners proactively satisfy an "order" or use enforcement procedures to correct structural defects.

- Offer funding from your local lead hazard control program for window replacement in exchange for the property owner conducting maintenance and repair activities that are health-oriented.

- Offer incentives to residents and property owners such as safety items (smoke detectors, carbon dioxide detectors, or batteries), cleaning supplies, injury prevention devices (cabinet locks, non-slip rug pads, stair gates), and paint, paintbrushes, plastic and primer.

- Offer free training in lead-safe work practices.

- Perform interventions that do not require owner consent, such as installing smoke or carbon monoxide detectors and providing supplies (Figure 3.14).[16]

- Resident mobility and lack of compliance. Until the program builds a trusting relationship with the community, residents may perceive healthy housing issues as a low priority relative to other concerns. Some tenants may fear repercussions from owners. Others tenants or owners may expect more services than a program can provide. Options to consider in developing a productive relationship include:

- Partnering with community-based organizations to assist and support referral, recruitment and retention, and conflict resolution or mediation.

- Branding the program through development of an image or theme that distinguishes the program from other governmental initiatives and raises awareness of its availability. This may reduce residents' concerns that program personnel are really police, protective services, or immigration officials.

- Provide a calendar with all scheduled visits documented for residents/families. Provide incentives for completing appointments as scheduled. Get as many contact numbers as possible for target families and use multiple methods to communicate with them.

- Use centralized scheduling to coordinate visits between outreach workers and other staff, such as risk assessors to minimize the number of home visits and disruption to the family.

- Provide information to tenants about their rights and responsibilities under the program (Figure 3.15).

- Engage CHW and Promotores de Salud for recruitment, retention and education.

- Building a strong base of contractors. Unless guaranteed a steady and profitable source of work, many contractors will avoid the required

Figure 3.14 Incentives

The Columbus, Ohio Health Department customized the provision of Healthy Homes supplies based on a family's need. In all, the supplies cost less than $500 and included items such as baby gates, storage bin for clothing, cleaning supplies, mattress and pillow encasings and window locks. Combined with education, this type of intervention can be conducted without property owner consent and can be used as an incentive for physical interventions and Integrated Pest Management to be conducted at a later time.

training, insurance, or perceived costs of "working healthy." The quality and timeliness of the work must be closely monitored by program staff. This is especially true when combining HUD Healthy Homes funds with Lead Hazard Control Grants and federal rehabilitation funding (e.g., CDBG). Moreover, small contractors may have difficulty keeping a tight production schedule and funding up-front costs. Consider the following remedies:

▸ The HUD Section 3 program requires that recipients of certain HUD financial assistance grants, to the greatest extent possible, provide job training, employment and contract opportunities for low- or very low-income residents in connection with projects and activities in their neighborhoods. http://www.hud.gov/offices/fheo/section3/section3.cfm

▸ It may be possible to partner with community-based and non-profit organizations to develop contracting crews comprised of residents from the target community. This approach advances economic development within high-risk communities and increase community support.

▸ For small interventions, hiring a "handyman" that your program will train and fund may be preferable.

▸ Make expansion of the contractor base a project benchmark, supported by free training and problem-solving discussions as needed. Provide training delivered at convenient times, such as evenings and weekends.

▸ Pre-qualify a select group of contractors and develop an equitable method to rotate work.

▸ Provide ongoing technical assistance. Make frequent visits to project sites at different phases of work in progress.

▸ Consider issuing a Request for Proposal asking for a fixed unit price contract for specific interventions. This helps manage program costs and can also guarantee steady work for the contractors selected.

Figure 3.15 Sensitivity to Tenants' Rights

In order to protect the tenancy of renters, Esperanza Community Housing Corporation and project partners in the South Central Healthy Homes Demonstration Project coupled home-based environmental risk management education, including cleaning and pest control products, with education on tenants' rights. Units were also referred to code enforcement after home visits, but only if there was an established relationship between the tenants and a tenants-rights organization to assure protection from landlord retaliation should enforcement action result from the referral.

▸ Consult other housing rehabilitation and weatherization programs to determine whether their contractors could be trained to perform interventions during "down time," thus keeping contractors fully employed.

▸ Encourage contractors to diversify services through training and certification to conduct multiple interventions.

▸ Work with workforce development programs to train and apprentice staff to perform interventions. Many high school and college vocational education programs offer a construction track. Partner with Youthbuild, or other youth development programs.

▸ Assure timely payment at job completion. Smaller contractors may require partial or progress payments.

▸ Set a standard of performance for contractors. If a contractor fails to meet the timelines or quality of work expected, take steps toward performance improvement or initiate action to drop the firm from the approved contractor list.

▸ Ensure that contractors have necessary training and qualifications. For example, lead hazard control activities must be conducted by persons qualified according

to 24 CFR Part 35, subparts B-R (possessing certification as abatement contractors, risk assessors, inspectors, abatement workers, or sampling technicians; or others having been trained in a HUD-approved course in lead-safe work practices), and firms and persons certified in accordance with the EPA's Renovation, Repair, and Painting (RRP) Rule (see 40 CFR 745 and http://www.epa.gov/lead/pubs/renovation.htm). Programs often assist small contractors by covering the cost of required training.

- Cost Overruns and Funding Limitations. New services and interventions require practice to achieve optimal efficiency and effectiveness. Field staff, contractors, and community partners will likely need to pilot and refine services and interventions at the beginning stages of the project or intervention. Recognize early experiences as a training ground for the entire project and expect the process to move more efficiently after the first 10–15 units.[17]

▶ Accompany field staff on initial home visits and assessments and visit contractors at the job site early and often to provide technical assistance. Keep records on the cost of supplies, job specifications, intervention protocols, and lessons learned to identify savings or cost overruns and support future planning. Managers, supervisors, and coordinators should countinue to make field visits after the pilot or beginning stage of programs to assure quality.

▶ Recognize that some grant sources may set maximum amounts for intervention costs and others require documentation of a minimum percentage of grant funds devoted to administrative costs.

▶ Leverage other sources of funding by partnering with other health, housing and social service programs to increase the comprehensiveness of your interventions and support program sustainability.

Organizational Structure

Organizational structure—how a program operates, how managers and staff relate to each other and how program decisions are made—reflects the culture and size of the primary agency, clarifies roles and responsibilities, and can affect a program's effectiveness and efficiency. Simply put, organizational structure defines the "chain of command" and specifies the span of control of participating staff and agencies. Government health and housing departments are often influenced by bureaucratic structures that can be hierarchical in nature. This can be a challenge to healthy homes programs that need to be multi-disciplinary and implemented by a team of professionals in cooperation with community partners. Decisions related to organizational structure flow from answering the following questions:

- Will healthy homes program staff be located in the same organization, department and division or separated by function (health, housing, or environmental)?

- How will decisions be made—top down or in a team environment?

- How much authority will be granted to managers, coordinators, and field staff?

- What formal role will partner agencies and community agencies fulfill?

- What commitments have been secured for intra- and interagency coordination?

Staffing

Healthy homes programs have different organizational structures and staffing. However, they usually involve some or all of the following functions that can be reflected in job titles.

- Program Direction. The Program Director is often responsible for multiple health/housing initiatives. This individual provides high-level oversight to assure that the program is funded, implemented within its timeframes and budget, adheres to all requirements, and advocates for the program internally and with program partners.

- Program Coordination and Supervision. This individual, often referred to as the Program Manager, is usually dedicated to the program full-time and responsible for day-to-day activities, partnership coordination related to service systems, and staff supervision.

- Intake Coordination. This individual is responsible for receiving applications from residents/families or property owners. She or he can be an administrative assistant or a program coordinator. Responsibilities include screening applications for eligibility and ensuring all required documentation is obtained and in the case file.

- Community and Family Education. Educating the community at large and residents that live in target housing is essential to the success of healthy housing programs. Community education can be conducted by health educators, nurses, social workers, outreach workers and/or CHWs. Similarly, these disciplines can provide one-on-one education and support behavior change as a part of home visits. Health behavior change for occupants in housing units served by healthy homes programs is important. For more information see Chapter 5, page 115, for interventions aimed at resident knowledge and education.

- Case Management. Case manager(s) can be nurses, social workers, public health educators or sanitarians. Some programs use CHW or Promotoras de Salud that are supervised by nurses or social workers as they represent and are trusted by the target population. Case management includes the assessment of health and social service needs, development of an action plan, and ongoing referral and support. Case managers provide a coordination role to assure that a family's multiple needs are met.

- Environmental Assessment. Visual assessment, administering a standard questionnaire to residents, and environmental sampling are conducted by properly trained persons qualified to do the work. Sometimes these positions are referred to as sanitarians, environmental health technicians, or environmental hygienists.

- **Laboratory analysis.** If a program is collecting samples for laboratory analysis, it needs the services of an analytical laboratory with all the appropriate certifications.

- **Data Management.** Data management staff can be administrative assistants, information system specialists or epidemiologists, depending on their role and responsibilities. Administrative assistants can enter program data into health or housing data bases. Information systems specialists can provide oversight for the entire data collection system from service delivery to the production of process and outcome evaluation reports. Epidemiologists or biostatisticians usually take responsibility for data analysis.

- **Evaluation.** Evaluation can be conducted by a third party—often an academic partner—or in-house by a team that commonly includes individuals with training in epidemiology or biostatistics.

All staff should understand how their productivity and responsibilities affect the overall project. Regular staff meetings are important to assure that small delays or implementation issues do not become large. Case reviews are an especially effective tool to identify program strengths and weaknesses and refine program protocols. Healthy homes programs require innovative staff with good problem-solving skills. All staff need opportunities for skills training and continuing education. Since the program staff are often the most effective ambassadors for the initiative, it is important to build in opportunities for attendance and presentations at professional conferences.

Clarifying Roles and Responsibilities

Healthy homes programs are characterized by many moving parts. Whether your program remains small or expands to include other organizations and activities, failure to clarify roles among staff and partner organizations leads to inefficiencies, confusion, and frustration. The optimum way to do this is through regular team and partner meetings and project-wide use of a Policies and Procedures Manual (Figure 3.16). Memoranda of Understanding and/or subcontracts should be executed with partner organizations as a means of ensuring

accountability and timely performance. Secure data-sharing agreements early in the process and be sure that your IT systems are compatible for data transfer. The policy and procedures manual should cover:

- The project work plan including goals and objectives;

- Recruitment and enrollment procedures and materials, including guidelines for documentation to determine when eligibility criteria are met;

- Assessment forms with annotations about how to record observations;

- Chain-of-custody forms when environmental or biological sampling are part of the project;

- Relocation policies, if needed;

- Sample contracts, scopes of work, and occupant protection plans for contractor use;

- A master schedule of activities for each housing unit and the project as a whole;

- Job descriptions and work flow charts that clearly define which staff are responsible for project activities;

- Procedures for collecting and submitting environmental or clinical samples for analysis;

- Procedures for submitting and approving vouchers;

- Data collection and analysis plans;

Figure 3.16 Tulane Policy and Procedures Manual

Tulane University developed a Manual of Operation that detailed its Healthy Homes Technical Study Grant project's internal policies and procedures. All study personnel received the Manual and brought it to the weekly staff meeting. If any changes were made in policies and procedures as a result of problem solving and project discussion, changes were immediately and carefully documented in the Manual.

- Quality control procedures; and

- Field safety.

Budget Priorities

Programs planners often underestimate the administrative time and costs necessary to implement their programs. Programs also need to scrutinize their own payment mechanisms for vendors, subcontractors, and housing contractors. Because contractors usually cannot afford to wait long periods for reimbursement, programs should consider partial or progress payments. The HUD Evaluation suggests new programs should consider the following budget strategies:

- Identify a cap for total housing unit and specific intervention costs at the start of the project. Track these costs carefully for future planning purposes.

- Weigh the costs and the quality of work when selecting contractors. If possible, establish a bidding procedure that allows the program to factor in contractors' past performance both in terms of timeliness and quality.

- Consider low-cost interventions in the context of resident behavior. One grantee found that cheaper fans installed in the bathroom or kitchen area were not effective because they were so noisy that many families chose not to use them. Families receiving quieter fans were much more likely to use them.

- Explore funding (leveraging) from partner resources such as nursing case management through health insurance/HMO reimbursement. Other sources include weatherization funds, lead hazard control grants and loans, CDBG-housing rehabilitation programs and Prevention and Maternal and Child Health Block Grants.

- Dedicate staff and/or a portion of the project budget to develop and maintain partnerships and coalitions.

Program managers should be aware that under many of HUD's grant programs, grantees must expend a certain portion of grant funds on direct remediation activities and have an administrative cost cap of 10 percent of the grant.

Evaluation and Program Performance Measures

Plans for evaluation must be built into the earliest phases of project design and used as a management and process improvement tool (Figure 3.17). While Chapter 6 addresses program evaluation in detail, it is important that decisions about health and housing outcomes and what to assess and monitor be an ongoing part of your

Figure 3.17 Benefits of Working with an Academic Institution

One grantee identified the benefits of working with an academic institution as responding, in part, to their self-interest in publishing study results. This kind of partnership lends itself to healthy homes programs' producing peer-reviewed scientifically valid outcomes. The grantee reported that this level of evaluation rigor sharpened their critical thinking skills as they institutionalized project results and piloted and expanded their healthy homes interventions.

program plan. Two kinds of evaluation—process and outcome—should be included:

- Process evaluation focuses on the programmatic actions and services needed to achieve a particular outcome.

- Outcome evaluation focuses on whether the program achieved the desired health and housing outcomes.

Decisions about project evaluation should take place early in the planning process. Programs must decide:

- Whether to perform the evaluation in-house or to use an outside (third-party) evaluator. Costs may be lower in-house but outside evaluators may bring credibility to controversial decisions and a higher level of skills.

- How much weight to place on qualitative versus quantitative data. Qualitative data gives richness to the understanding of the process; quantitative data helps put performance into perspective and is necessary for cost/benefit calculations.

- What outputs (activities) and health and housing outcomes will be used for program evaluation?

- How long a time frame should be established for program evaluation? For instance, should results be examined over a six- or twelve-month period post intervention, or over a longer period?

- Who will the program target for dissemination of progress and findings and how will this information be provided? It is important for programs to demonstrate accountability and value to funders, policymakers, health care providers, and beneficiaries of services.

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Program Design

Notes

4

Housing-Related Health and Safety Hazard Assessment

Housing-Related Health and Safety Hazard Assessment

4

Housing conditions should support the health and well-being of its residents; they should not cause injuries or illness.

This simple principle lies at the heart of healthy housing initiatives and recognizes interactions between housing and disease, injury, and overall well being. Identifying unhealthy housing conditions is a prerequisite to correcting them before they negatively impact health.

This chapter provides an overview of inspection and assessment methods, highlights specific tools, and lays the foundation for effective and efficient interventions addressed in Chapter 5. Home-based health hazards can be assessed by: (1) collecting information on occupants' health and housing concerns during resident interviews; (2) performing a visual assessment; and (3) for some hazards, collecting environmental measurements and samples (Figure 4.1). The visual assessment is the cornerstone of the assessment process and can be conducted alone or in combination with the resident interview and/or environmental

Figure 4.1 Assessment Methods

There are three approaches to identifying health and safety hazards in the home environment:

- Resident Interviews.
- Visual Assessment.
- Environmental Sampling and Building Performance Testing.

Key Messages

- There are three primary ways of identifying housing health and safety problems: resident interviews, visual assessments, and environmental sampling. Visual assessments are the foundation of the assessment process, while environmental sampling is usually limited because of cost constraints.

- Interviews with residents should be conducted by skilled individuals. The interview can help to inform the visual assessment and environmental sampling, as well as provide an education opportunity.

- Program staff performing these functions must be trained to carry them out properly, understand how to work as an integrated team, and know when to refer a problem to a more highly trained professional.

- Numerous interview and visual assessment tools have been developed. In general, new programs should not change validated, evidence-based tools. Use of common tools ensures consistency.

- The visual assessment covers moisture, ventilation, safety (injury) hazards, combustion safety, pest problems, and cleanliness. It usually begins with the exterior site (including garages), building exterior, common areas (if any), building equipment rooms, building penetrations and proceeds finally to living areas.

measurements. Environmental sampling should be used judiciously as it can be costly. The Department recognizes the need for local jurisdictions to tailor programs based on priorities and end users. While programs are encouraged to use the best tools to meet their needs, the Department is requiring grantees of the Healthy Homes Production Grant program to use HUD's Healthy Home Rating System in an effort to standardize assessment criteria. In order to be considered healthy, a home must support the health and well-being of its residents, and protect against harm caused by health and safety deficiencies. Unless common assessment criteria are used, these definitions are subject to interpretation and wide variability in practice.

Assessing and remediating health and safety risks in housing includes recognizing hazards, assessing their importance, and controlling or eliminating them. Proper assessment of hazards can help your program move to an evidence-based selection of intervention priorities and maximize the impact of limited resources for housing interventions. It can also enable you to determine when a housing unit is in such a deteriorated state that it cannot be restored to a healthy living environment. Done properly, hazard assessment provides the foundation for detailing which interventions need to be prioritized based on consultations with construction and housing rehab specialists. (Figure 4.2).

Resident Interviews

Purpose

Although some assessments are performed in vacant housing, most take place in occupied housing units. Gaining the residents' perception of the home environment and their health concerns are important sources of information and engages them in creating and maintaining a healthier living environment. A useful checklist for residents is available at: http://www.surgeongeneral.gov/topics/healthyhomes/checklist.pdf.[a] Residents'

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[a]An additional item not included on the checklist is ascertaining the thermal comfort of the occupants where there may be excess heat or cold due to the lack of proper insulation or inadequate heating/air conditioning.

Figure 4.2 Assessing Building Deficiencies and Outcome
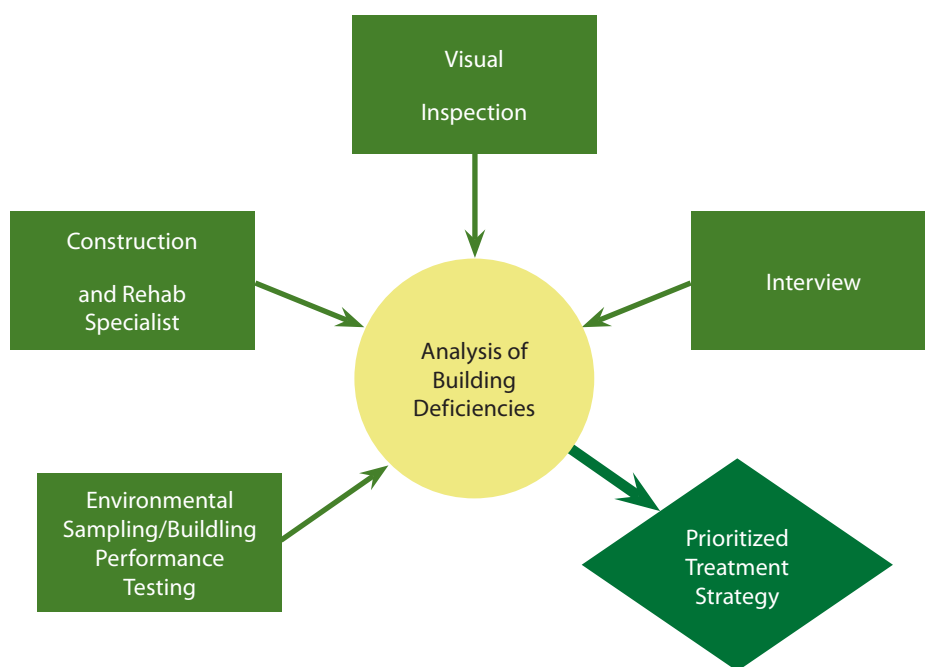
Note: The Prioritized Treatment Strategy reflects the focus of your program (e.g., asthma, energy efficiency, injury prevention) as well as other factors such as identifying imminent health hazards and risks to occupants, resources, intervention costs, and their relation to housing value and level of deterioration.

Housing-Related Health and Safety Hazard Assessment

input can help focus the subsequent visual assessment and environmental measurements that, in turn, will determine intervention priorities.

Resident interviews that gather information on health and environmental problems are useful aids but should not replace a thorough visual assessment. Resident interviews can provide an important opportunity to educate residents on what they can do to improve and maintain a healthy home. Skilled interviewers not only collect data but provide information to residents that can motivate and reinforce good health behavior and discourage unhealthy practices.

Past Experience

The report, An Evaluation of HUD's Healthy Homes Initiative: Current Findings and Outcomes,[1] examined over 50 Healthy Homes grantees from the first four rounds of grant funding (1999–2006). It found 83 percent of these programs routinely conducted multiple assessments and interviews of clients. Resident assessments and interviews usually focused on behavioral information (such as smoking or cleaning habits), health data (such as asthma symptoms), household/resident/family characteristics, and the client's knowledge of specific subject matter. The top three types of data routinely collected as part of the baseline interview were:

- Behavioral information (88 percent);

- Health data (83 percent); and

- Household/resident/family characteristics (81 percent).

Data were collected most commonly on asthma, emergency department visits, doctor visits, and health-related absences from school or work (see Figure 4.3). These health data sets are often used to assess child and caregiver quality of life. Self-reported data, collected using a validated instrument during an interview, contain valuable information on health status and have proven to be an acceptable way to assess health outcomes associated with housing improvements.

Interviewer Staffing

Consider carefully who will conduct the interview, keeping in mind the program design and local resources. Interview staff can be health educators, community health workers, community organizers, nurses, social workers, environmental health specialists, health inspectors, housing code inspectors, physicians, or other medical care providers.

Community health workers and organizers are outstanding resources for education and many aspects of research studies. All data collectors should be trained in how to protect confidential

Figure 4.3 HUD Healthy Homes Programs and Type of Data Collected (n=52)
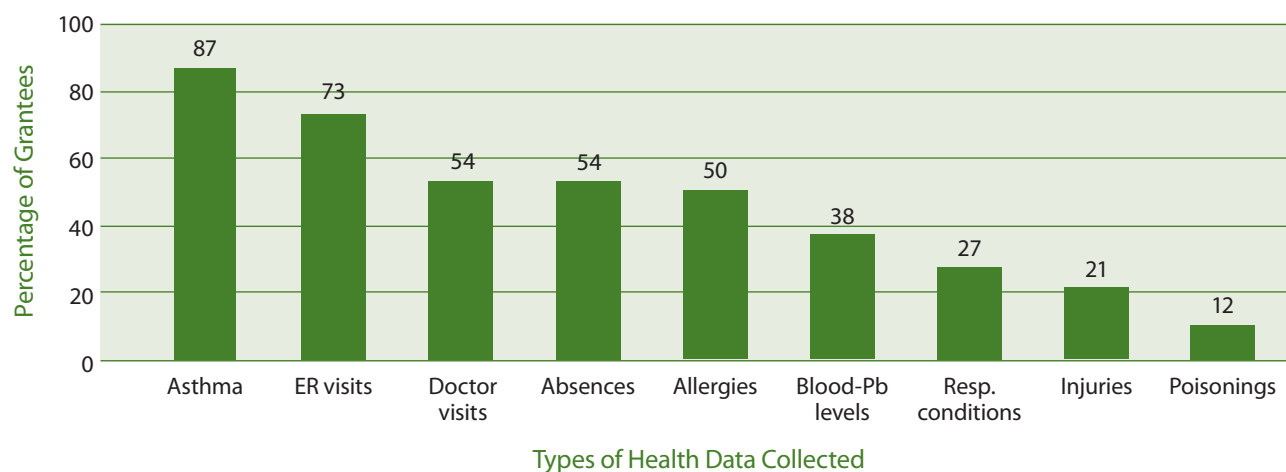
Source: An Evaluation of HUD's Healthy Homes Initiative pp. 17–18 and A11–15.

information. It may be difficult for residents to share sensitive information with anyone other than an objective professional.

Many healthy homes programs use a team approach to conduct the assessment—with a health services staff person conducting the interview and a housing services staff person conducting the visual assessment. Some programs have integrated these functions within one person's job responsibilities with appropriate training and support (see Figure 4.4). In some communities, language translation services are required.

Interviewer Training

It is essential that the person conducting the interview be trained to follow the protocol and prepared to handle various interview situations. Training should include content education,

Figure 4.4 Examples of Healthy Homes Assessment Methods

Kansas City Children's Mercy Hospital Environmental Health Program's intensive assessment takes two hours to complete and is conducted by two staff members. While the environmental hygienist conducts environmental measurements and collects samples, another staff member (respiratory therapist, health educator or social worker) provides education and case management.

Healthy Homes and Babies Program in Cleveland uses computerized tools such as PDAs (personal data assistant) and tablet personal computers to collect environmental assessment data. The computerized assessment tool guides the inspection in each area of the home, documents building and behavioral conditions through drop-down alternatives to document observations, lists options for corrective actions, and can specify the responsible party for each.

Environmental Health Watch (EHW) in Cleveland uses visual assessments as an opportunity for occupant education. As EHW inspectors conduct the assessment, they are accompanied by the resident and provide education on identified hazards, intervention options, and resident responsibility.

role playing, an explanation and practice of standardized methods of documentation, and cultural competence. The training should also teach interviewers and other healthy homes professionals to understand the limits of their expertise, such as when to refer a suspected problem to a structural engineer or medical professional (see Figure 4.5).

Interview Documentation

Documentation calls for recording information in a manner that is accurate, legible, and understandable so that others can interpret the results. The following guidelines are helpful:

- Entries onto interview data collection forms (and all other data collection forms) should be made in ink.

- Any corrections should be made with a single line through the mistaken entry and initialed by the interviewer.

- Interviewers should also sign and print their names on the forms in case clarifications are needed. This practice promotes a sense of the importance of the data collected.

- Provide a "notes" section on the form where any pertinent information, including deviations from the standard interview method, can be recorded. No interview form can fully capture all potentially important information.

Much of this data collection is now automated through the use of computer tablets and other

Figure 4.5 *Promotoras*: Healthy Homes Training Model

Esperanza Community Housing Corporation in South Central Los Angeles employs community health promoters—promotoras—to conduct outreach, education, case management, and environmental assessments. Promotoras have been found to be effective in reaching underserved populations through peer education since they are members of the communities they serve and speak the same language. The promotoras participate in a six-month intensive Community Health Promoters Training program and receive ongoing specialized healthy homes education.

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electronic data collection devices. This reduces the time needed for data entry and can also reduce data entry errors. Using a centralized database to upload data can also save time and prevent errors.

Quality Control/Quality Assurance

A supervisor or project coordinator should review documentation periodically for completeness and conduct quality control site visits to observe interviews and provide training and support if needed. When interview information is entered into a database, quality control checks should be included in the data management protocol. This might include randomly reviewing data to ensure that the data entered match the data on the forms, double-keyed data entry (data entered twice), or using a statistical program that can be programmed to check data accuracy, such as ACCESS.

Quality assurance procedures should also be included in the interview process. For example, some interviews can be observed by a supervisor to determine whether the interview results are properly recorded, all questions are being asked, and if the interviewer has established a relaxed but thorough interaction with the person being interviewed.

More broadly, programs should have a Quality Assurance Plan (QAP) in place to ensure that all program activities are consistent with established program plans and carried out in the most effective and cost efficient manner possible. A QAP template that should be used by HUD Healthy Homes programs is available at http://www.hud.gov/offices/lead/hhi/hhts.cfm. The QAP, which is most appropriate for programs that are conducting rigorous outcome evaluations, has four components:

• Project Management Plan

• Measurement/Data Acquisition Procedures

• Assessment/Oversight Activities

• Data Verification and Usability Confirmation

Managing Confidential Data and Resident Concerns for Privacy

The interview provides an opportunity to help residents understand the scope of the program and what it will and will not do. It also points to housing conditions that will be considered for interventions. The interviewer should inform the resident about how the data will be used and delineate how private and confidential information will be protected. Although a research project involving an Institutional Review Board (IRB) will likely require more formalized protection of this information at a later date, the resident's expectation of confidentiality should be explicitly confirmed by the interviewer at the beginning. Regardless of whether a given project is under the purview of an IRB, which ensures the privacy and ethical nature of research studies, the interviewer should make it clear that residents are not required to answer any question they feel uncomfortable with, and that they can stop the interview at any time. Individuals attending the interview, including translators, should also understand the confidential nature of the process. The interview must be conducted in a professional, courteous manner that respects the resident's dignity and culture. Data should be securely stored and managed; access to the data should be limited and electronic data should be stored in secure, password protected files.

Interview Tools

There are several healthy homes interview instruments that have been field-tested and found useful in characterizing health status and housing conditions (see Figure 4.6). One is the HUD/CDC Healthy Homes Inspection Manual.[2] A longer, more detailed instrument designed for research projects is drawn from the CDC National Health Interview Survey and other national surveys and was developed jointly by the National Center for Healthy Housing and CDC staff. Variations of this instrument have been used in two studies that document health improvements associated with green, healthy housing rehabilitation of low-income housing and elsewhere.

Each has strengths and weaknesses. Healthy homes programs should evaluate existing tools and methods to determine which elements of each can be adapted to their programs and local conditions. For example, the Seattle-King County interview is focused on asthma while Cleveland's interview focuses on mold and moisture. If existing tools are not used,

interview instruments need to be developed
with your program's housing intervention and
desired outcome in mind. Be mindful that if
you change a tool that has been widely used,
your changes may compromise its reliability. In
general, creating your own assessment tool is
not recommended.

Interview Data Security

Completed interview forms may contain
personal information. To prevent inadvertent
disclosures of this information, secure the
data by keeping forms in a locked file cabinet
or a locked room, limiting access to the data
to specified staff, and establishing a data
retention schedule to destroy the information
at a designated time after the project ends.
Unique identifiers can be used to protect an
interviewee's identity. Finally, anyone who
collects or has access to personal health
information should sign a confidentiality
agreement that such information should not
be disclosed to unauthorized parties. Training

on protection of human subjects is available at:
http://phrp.nihtraining.com/users/login.php.

Visual Assessment

Purpose—Identify Housing Defects and Causes

Visual assessments by trained individuals have
emerged as the primary assessment tool for
most housing conditions related to health (see
Figure 4.7). This system works best for visible
hazards such as missing or deteriorated building
components and systems. It can also identify
causes of hazards and how they are likely to be
remediated. The visual assessment should be
integrated with the interventions (discussed
in Chapter 5). Missing hand railings, leaking
pipes under a kitchen sink, and openings that
permit pest entry are obvious examples of
problems amenable to visual examination.
There is an emerging consensus that most
mold problems can be identified by a visual
assessment. Of course, the eyes are not the
only senses that should be used. For example,
mold is often associated with a musty odor
and has been linked with adverse respiratory
health outcomes in large studies.[3, 4] The rotten-
egg odor of hydrogen sulfide from sewer gas
is also well known. The odor of natural gas
can indicate a dangerous gas leak. Although
some protocols have a simple "yes" or "no"
response, most conditions require some
assessment of the severity of each observed
hazard. Digital photography of units can be
helpful in documenting specific conditions.
Programs should obtain permission from the
resident to take photographs, which should
then be included in the project file with other
documentation.

Limitations of Visual Assessment and Training Needed

Visual assessments should be performed only
by trained personnel and criteria should be
developed for enlisting specialized assistance
(Figure 4.8 describes one source of available
training). Some housing hazards are not
amenable to sight and smell assessment. For
example, the pipe leak under the kitchen sink
may not be obvious if the leak begins three

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levels up or the water is pooling behind a wall and the leak is sporadic, which might be the case for an infrequently used drain. Radon and carbon monoxide are examples of contaminants that cannot be assessed visually. To assess hidden structural defects, programs may need to employ engineers or electricians when problems include inadequate or missing grounding or other faulty wiring.

Scope

Visual assessments can evaluate many structural, environmental, and behavioral risk factors. For example, many ventilation problems can be identified visually, such as inoperable bath or kitchen exhaust fans or disjointed flues on water heaters (a structural problem). However, if the bath fans are operational and there is still a large mold problem, it may be that the resident is not turning the exhaust fan on when needed or it may not be ducted to the exterior. Similarly, no amount of ventilation will prevent the health hazards associated with tobacco smoking (behavioral problem). In short, visual assessments can provide clues to occupant behavior that can cause or exacerbate hazards.

Visual assessments should document the tenure of the unit (rental versus owner-occupied),

if the unit is occupied or vacant, the type of structure (such as manufactured housing, or duplex, single- or multi-family housing), type of ventilation and air conditioning system, type of foundation, and whether the basement is treated as a living space.

How your program performs a visual assessment depends to some extent on your target housing. For example, assessing the structural condition of row homes may differ from stand-alone single family housing due to the presence of shared walls. If the dwelling is a multi-family home, the common areas (if present) should be included in the visual assessment. Similarly, if the dwelling is a mobile home, it might be prudent to check the tie-down systems. Tie-downs are an example of why the assessment should be driven by the type and location of housing. In earthquake zones, for example, seismic retrofits may be needed.

The type of water supply and sewage system should be determined. In rural areas, well water should be tested periodically to ensure it is potable and tile fields/septic systems may need assessment for adequate treatment of waste water. Crawl spaces and attics should also be included in the visual assessment.

Sequencing Areas

Experience and studies have found a standardized sequence increases the accuracy of an assessment and reduces omissions when pinpointing building deficiencies. Checklists and/or documentation should mirror the sequence. Figure 4.9 and the

Figure 4.7 Most Frequent Hazards Identified by Visual Assessments

An Evaluation of HUD's Healthy Homes Initiative: Current Findings and Outcomes reported 81 percent of 51 Demonstration and Technical Studies programs conducted visual assessments. The five most frequently reported hazards assessed included:

- Presence of visible mold and moisture problems (96 percent);
- Pest infestation (82 percent);
- Lead hazards/chipping peeling paint (72 percent);
- Fire hazards (69 percent); and
- Carbon monoxide hazards (67 percent).

An Evaluation of HUD's Healthy Homes Initiative, 2007, pp A9–11.

Figure 4.8 Training for Healthy Homes Practitioners

The National Healthy Homes Training Center's Essentials for Healthy Homes Practitioners course provides an introduction to the concept of the house as a system. The course prepares participants for a comprehensive exam to receive National Environmental Health Association accreditation as a Healthy Homes Specialist. The training is not required to sit for the exam. See http://www.nchh.org/Training/National-Healthy-Homes-Training-Center.aspx

following discussion detail a recommended sequence enabling inspectors to examine areas methodically and assess common features efficiently.

First, examine the general site on which the building is located for common hazards such as pooling of water, damaged fencing (or lack of fencing, especially around swimming pools), erosion, extensive plant overgrowth, sidewalk cracks, and safety of play area equipment. Inspect garages and other structures during this phase of the inspection.

Second, examine the building envelope (walls, roofs, doors, windows, etc.) and exterior for items such as: leaks from deteriorated caulk; gaps in doors that might enable pest entry or water incursion; broken or inoperable windows; bulging walls; sagging rooflines; damaged or missing trim (fascia and soffits) or flashing; and problems with gutters.

Third, examine the "guts" of the home, which consists of the equipment room where the HVAC (heating, ventilation, and air conditioning), laundry, electrical, and other systems are located. Items such as fuel leaks, misaligned flue vents, the absence of makeup air (e.g., air that is supplied to a space to replace the air that is exhausted), damaged or frayed electrical wiring

Figure 4.9 Recommended Sequence for Visual Assessments

1. Site (including entrance and egress).

2. Garages (attached and non-attached) and other site structures (e.g., sheds and fences) and facilities (e.g., swimming pools, play areas).

3. Building exterior.

4. Common areas (multifamily housing only).

5. Equipment rooms (HVAC, laundry, basements, crawl spaces, attics).

6. Kitchens.

7. Baths.

8. Living areas.

9. Bedrooms.

or burn marks on fuse or electrical breaker boxes, and faulty fire protection systems (e.g., painted-over sprinkler heads) are examples of items to be examined.

Fourth, proceed into the living area of the house itself, which can be divided into "wet" rooms (kitchens and baths), bedrooms, and living areas. Some of the items to be assessed in these areas include leaks and drains; cracks in walls, floors and ceilings; water temperature (120° Fahrenheit or lower); trip hazards; paint condition; mold; overuse of extension cords (overloaded circuits); broken electrical sockets; presence of unvented fuel-fired space heaters; and inadequate food preparation, storage, and disposal facilities. Evidence of pests, such as mice and cockroach feces (frass), is typically assessed in these locations. Smoke and carbon monoxide alarm operation should always be tested. Visual assessment should include the stairways that service the living space.

Fifth, examine all penetrations into the house from the inside to the exterior. Healthy homes inspectors should be trained to recognize the limits of their expertise. For example, they should not touch electrical systems unless adequately trained. Inspectors should also avoid tracking contaminants, soil or dirt from one area to another (e.g., from crawl spaces into bedrooms). Some ventilation problems require specialized building science or engineering expertise. Training in lead risk assessment is recommended and required by most jurisdictions for assessment of lead-based paint hazards.

Healthy Home Rating System

While programs are encouraged to use the best tools to meet their needs, HUD is requiring grantees of the Healthy Homes Production Grant program to use HUD's Healthy Home Rating System (HHRS) in an effort to standardize assessment criteria. The HHRS is categorized in accordance with the American Public Health Association's 1938 publication entitled, "Basic Principles of a Healthful Housing." Using the HHRS, the assessor examines 29 hazards, or categories of hazards, and determines the risk to the occupant (i.e., the likelihood of hazard causing harm and the severity of the harm should it occur) for each hazard that is identified

(see Figure 4.10 and Operating Guidance at: http://www.hud.gov/offices/lead/hhrs.cfm). Each of the 29 hazards are assessed separately and weighted according to likelihood of occurrence and the severity of possible outcomes should the hazard result in harm (i.e., a risk-based approach in which a numerical value is generated for each hazard). The HHRS is available for use by those not receiving HUD grant funds, as well.

A priority ranking of hazards is generated based on the estimated risks of potential harm to the most vulnerable occupants. Inspections are essentially carried out in the traditional fashion (i.e., a physical assessment of the whole property for deficiencies) using a portable computer with specialized software. The HHRS follows the same approach to identifying health and safety hazards in the home as successfully implemented in the British "Housing Health and Safety Rating System" (http://www.communities.gov.uk/publications/housing/housinghealth). The basic principle is that the property should be safe and healthy for all occupants.

The assessment using the HHRS is made based on the condition of the whole dwelling. This means that, before such an assessment can be made, a thorough inspection of the dwelling must be carried out to collect the evidence of the condition. While this does not involve a new approach to the inspection of dwellings, it does require an understanding and appreciation of the potential effects that could result from conditions and deficiencies that should have been identified during the inspection.

The HHRS concentrates on threats to health and safety. It is generally not concerned with matters of quality, comfort and convenience. However, in some cases, such matters could also have an impact on a person's physical or mental health or safety and so can be considered. Also, as the Rating System is about the assessment of hazards (the potential effect of conditions), the form of construction and the type and age of the dwelling do not directly affect the approach taken in the assessment. The age of the dwelling would be a consideration when assessing for lead hazards, for example, but would not alter the overall approach taken in terms of evaluating the hazards present. Matters related to age and type of construction will be relevant to determining the cause(s) of any problem and so indicate the nature of any remedial action.

The HHRS has been devised and designed so that it can be applied to any form of dwelling. To achieve this, it is only necessary to inspect and assess the dwelling and those parts and areas (whether shared or not) that are associated with that unit.

Once the inspection has been completed, the

Figure 4.10 Healthy Home Rating System (HHRS)—Categorization of 29 Hazards

Physiological	Psychological	Infection	Safety
1. Dampness & Mold Growth 2. Excess Cold 3. Excess Heat 4. Asbestos and man-made fibers 5. Biocides 6. Carbon Monoxide 7. Lead-based paint 8. Radiation 9. Un-combusted fuel 10. Volatile organic compounds	11. Crowding and Space 12. Entry by Intruders 13. Lighting 14. Noise	15. Domestic Hygiene, Pests, and Refuse 16. Food Safety 17. Personal Hygiene 18. Water Supply	19. Falls in baths etc. 20. Falls on the level 21. Falls on stairs etc. 22. Falls from windows etc. 23. Electrical hazards 24. Fire hazards 25. Hot surfaces etc. 26. Collision/ Entrapment 27. Ergonomics 28. Explosions 29. Structural collapse

inspector makes the assessment. This involves:

(a) determining whether there are any deficiencies present by assessing whether each dwelling element and the dwelling as a whole meets the relevant Ideal;

(b) determining whether any deficiencies contribute to one or more hazards, and if so, which hazards; and

(c) for each hazard which is obviously worse than average for that type and age of property, the inspector assesses:

   i) the likelihood of an occurrence over the next twelve months; and

   ii) the probable spread of harms which could result from such an occurrence.

It is important to note that the HHRS only assesses the physical aspects of the home; it does not collect information on occupant behavior that can contribute to some hazards (e.g., misuse of pesticides), nor does it incorporate environmental sampling results. If desired, programs can supplement the HHRS with a resident questionnaire and a plan for collecting environmental samples and measurements.

For more information on the Healthy Homes Rating System, refer to the Operating Guidance available at www.hud.gov/healthyhomes.

Major Housing Conditions to Assess Visually

Conditions to be assessed visually include:

- Moisture
- Ventilation Systems and Combustion Sources
- Safety Hazards
- Structural Defects
- Insulation and Temperature Regulation
- Pest Infestation*
- Cleanliness and Clutter

(*Investigation of pest problems is also covered in the building performance section of this chapter, because it involves the use of certain traps and other tools. A more complete

discussion appears in the HUD/CDC Healthy Homes Inspection Manual[5] and the HUD/CDC Healthy Housing Reference Manual.[6] Additional technical information is available in EPA's Indoor airPLUS Construction Specifications: www.epa. gov/indoorairplus/construction_specifications. html).

Moisture

Excessive moisture in housing has been related to a number of adverse health outcomes. Structural rot, rust, and other degradation can result in physical injury hazards as well as slips and falls from slippery surfaces. Moisture in housing can amplify indoor levels of biological agents such as mold, dust mites, and pest populations, many of which can trigger asthma and allergy symptoms.[7] Excessive moisture is also one of the leading causes of deteriorating lead paint.

Many moisture problems can be identified visually:

- Look for discolored or wet walls ceiling and walls;
- Identify missing or damaged downspouts and gutters;
- Check for ponding near foundations;
- Examine exteriors for holes and cracks;
- Look underneath sinks for drain and plumbing leaks;
- Determine if air conditioner condensate drains are operating and sloped;
- If humidifiers are present, determine if they are clean;
- Look for condensation on windows in cold weather; and
- Look in basements for water damage and entry.

In addition, while there may not be obvious visible signs of moisture, the presence of a strong musty smell may indicate the presence of mold from excess moisture/water leaks. The National Academy of Sciences examined the association between exposures to biologic agents in the home and the development and exacerbation of asthma. The review found sufficient evidence to establish a causal association between asthma and dust mite exposure as well as between asthma exacerbation and the presence of

Figure 4.11 Ways in Which Water Can Enter a Building (Envelope leaks can occur from anywhere in the building roof, windows, walls, doors and penetrations)
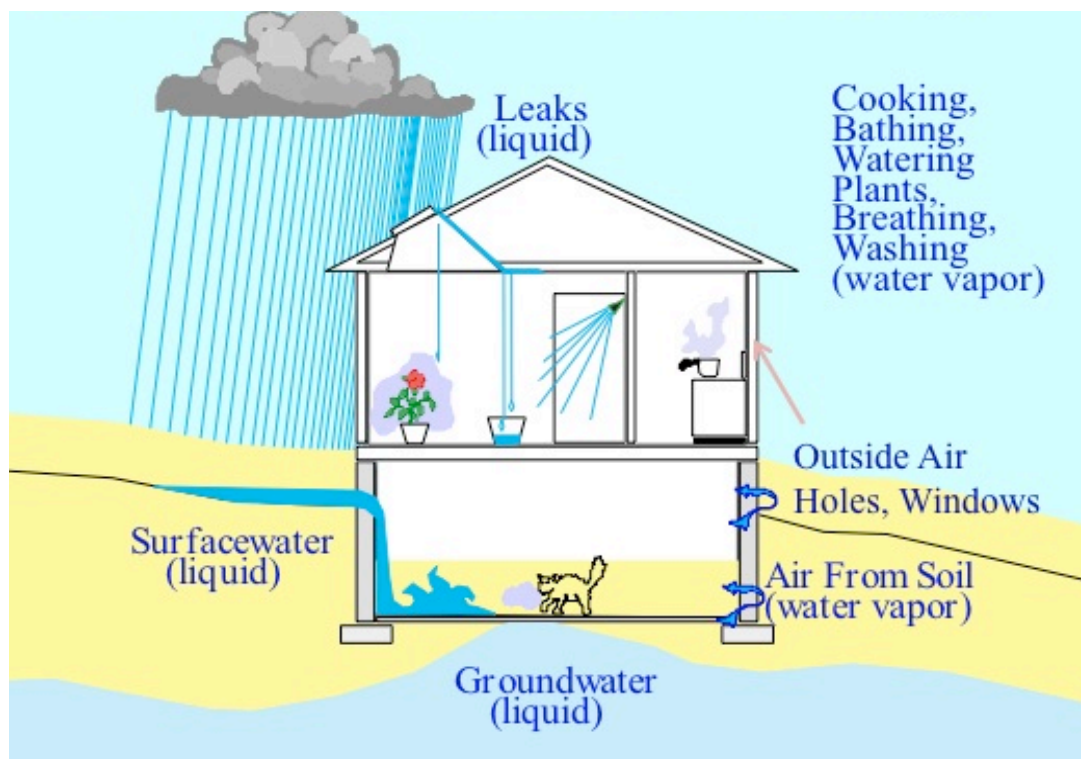
dust mites, cockroaches, fungi (mold), and pet dander.[8, 9] There is also evidence of associations between excessive moisture and other adverse respiratory outcomes.[10] Mice and cockroaches spread allergens that can trigger asthma suffered by both inner-city and suburban children.[11, 12, 13]

Moisture problems can be typically assessed by trained individuals through direct visual observation. The CDC/HUD Healthy Housing Inspection Manual identifies moisture-related building deficiencies such as discolored ceiling tiles, presence of visible condensation (may only occur in the winter), missing or damaged downspouts and gutters, pooling of water near foundations, presence of holes or cracks in building walls, plumbing systems that have inadequately insulated cold water pipes (leading to condensation), and sewage and water drain and supply leaks. Clearly, there are many ways in which water can enter a building (Figure 4.11). Some programs find that using a simple moisture meter helps identify moisture problems along with visual assessment (Figure 4.12).

Homes equipped with air conditioning systems or dehumidifying systems require attention to ensure that condensate drains do not become blocked or contain mold. Additionally, condensate pans need to be properly sloped so that the water runs to the drain and does not pool in other areas. Keeping coils clean can reduce contaminants in the air and also promote energy efficiency.

Figure 4.12 Moisture Meters as an Adjunct to Visual Assessment of Moisture Problems

Unvented combustion appliances, such as unvented space heaters and unvented fireplaces, can introduce substantial amounts of moisture and other combustion products (depending on whether the appliances are properly functioning) into the home whenever the devices are in use.

Some HVAC systems are equipped with humidifiers, especially in northern climates where indoor winter air can be very dry; sometimes individual rooms may be equipped with room humidifiers. In southern climates, the systems may be fitted with a dehumidifier to remove moisture before the conditioned air enters the home. In both cases, the water supply, water tank, water pads, water wheels, or other distribution systems need to be maintained. If the systems are not used regularly, they can breed biological agents such as mold and bacteria. Drafty homes are often too dry in the winter and too humid in the summer, depending on the climate region. The resident interview can help to determine if there is excessive dryness in the winter and whether boiling pots of water or other measures are used as "home-grown" humidifiers, which may lead to mold problems.

Aside from floods, sources of water and moisture in homes include structural leaks (e.g., roof leaks), plumbing leaks, condensation, damp foundations and crawl spaces, inadequate ventilation, and activities such as bathing and cooking. Condensation is often linked to inadequate insulation, inadequate vapor barriers (in cold climates) and/or poor ventilation. Unless moisture-laden air is exhausted from the home, building envelopes that are "tightened" for energy conservation purposes may lead to excessive indoor moisture levels.

Other sources of moisture can foster problems, such as capillary action that "wicks" moisture from basement floors up into certain types of walls (such as drywall, paneling, or other cellulose-based materials touching concrete basement floors). Excessive crowding may also produce high moisture levels.

Interior moisture levels are strongly influenced by exterior conditions, making a uniform definition of acceptable interior moisture levels dependent on climate zones. In general, maintaining an indoor relative humidity between 30–50 percent (lower in the winter and higher in the summer) optimizes comfort and improves indoor air quality by reducing dust mite and mold growth. Water content (sometimes called "water activity") of building components can be measured with a moisture meter (Figure 4.12) but be mindful of the fact that building materials have differing amounts of water activity. For example, plaster or concrete hold much more water than drywall, so interpreting moisture meter readings is typically dependent on the type of material.

Local exhaust ventilation for bathrooms and kitchens should be present and properly installed and maintained, and, of course, actually used. Many building codes do not require such systems if windows are present. However, if windows are kept shut during peak water use (such as bathing when the outdoor temperature is too cold or hot), moisture has nowhere to go other than the rest of the living area. Kitchens also benefit from local exhaust by removing excess moisture from cooking and by removing combustion gases from fuel-fired stoves and ovens.

If installing new fans, use quiet "low sone" Energy Star-rated products, because residents are less likely to use noisy fans. Moist air should be exhausted to the outside, never into a building cavity, attic, basement, or crawl space. New and rehabilitated houses increasingly equip local exhaust fans with timed humidistats that automatically operate the exhaust fans when moisture increases to a certain level. This conserves energy and reduces the need to rely on resident behavior. Fans should be properly sized (Figure 4.13).

Figure 4.13 Fans Should Fit the Building Configuration

The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) recommends that kitchen fans exhaust 100 cubic feet per minute (cfm) and bathroom fans exhaust 50 cfm (see http://www.ashrae.org/technology/page/548). Actual fan performance depends on the duct configuration and other factors that contribute to the pressure drop (resistance) in the system. For example, a fan rated at 50 cfm located in a basement bathroom that has to push air through several stories before being exhausted may not move sufficient air.

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When installing exhaust ventilation for kitchens and baths, the issue of supply (makeup) air matters. If sufficient makeup air is not available, it can create negative pressure in the home. If there are combustion appliances, this negative pressure can cause "backdrafting"—the reversal of airflow in chimneys, water heaters, and other devices. Backdrafting results in carbon monoxide and other combustion products being released into the living space. An example of makeup air is the passive or powered delivery of outside air into a basement that has a furnace, boiler, or gas water heater. Another is a heat recovery ventilator that permits tempering of the outside air supply using the energy of air being exhausted. Both examples involve a planned fresh air supply to replace the exhausted air (Figure 4.14).

Exterior Grading and Pooling

Water penetration into a building often occurs at the foundation and ground level. Evidence of standing water, pooling, or erosion usually means failure to slope and grade the soil and ground properly around the foundation (Figure 4.15). Maintaining proper grading around a foundation can prevent moisture intrusion into basements and the need for expensive foundation waterproofing and excavation. Proper grading also supports the durability of the structure by reducing the prospect of settling that leads to cracks.

Ground Treatment

Bare earth floors in a basement or crawl space should be covered with a durable vapor retarder—such as 6 mil or thicker polyethylene plastic—covering the

Figure 4.14 Backdraft Deficiencies
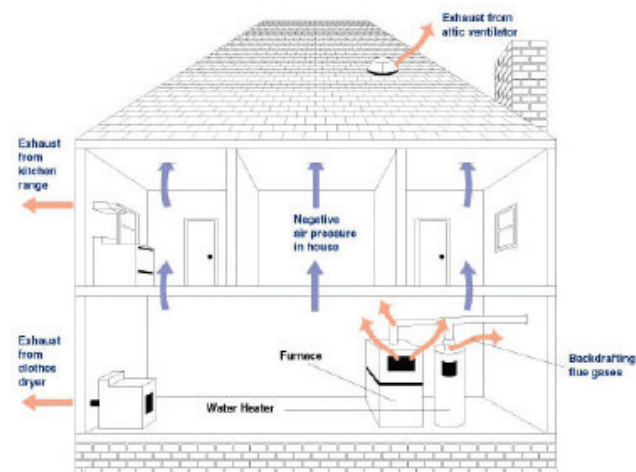
Figure 4.15 Moisture Problems Caused by Improper Ground Slopes

entire soil area and sealed to the foundation walls and piers. In some parts of the country, a thin concrete slab is poured over the poly to protect it. Called a "rat slab," the concrete prevents rodents from burrowing through the poly and entering the space. The visual assessmentshould determine if the bare earth is covered.

Water Pipes

Water pipes located in unconditioned areas should be insulated to prevent condensation. One way of detecting this problem is to look for areas of discoloration where condensation from pipes has dripped onto a lower surface. The same principle applies to ductwork that carries warm or cold air through air zones with a high temperature gradient.

Ductwork

All ductwork should be sealed and well insulated. To prevent condensation, the insulation should be protected by a vapor retarder depending on the climate zone. Insulation should be applied to the exterior of the ductwork to keep insulation fibers out of the air stream and reduce the opportunities for dirt and debris to build up inside the ductwork, which creates a habitat for mold and other organisms. While insulation of ductwork is a simpler matter in new construction, poor insulation of ductwork in older housing can result in condensation and become a significant breeding ground for mold and other biological agents.

Flashing

The absence or deterioration of flashing is a common building deficiency associated with

water leakage through the building envelope. Flashing refers to thin continuous pieces of sheet metal or other impervious material installed to prevent water from leaking into a structure through an angle or joint. Flashing is appropriate in numerous building situations:

- Roof penetrations such as chimneys;

- Places where walls meet a roof line;

- Valleys between opposing roof surfaces;

- Wall penetrations such as windows or ventilation hoods; and

- Other structural discontinuities such as additions.

When new building components such as windows are installed, they should be installed with flashing to prevent moisture intrusion. The key design requirement of flashing is its assembly in a manner that allows flashing layers to use gravity to shed water rather than rely on caulks or sealants. The principle of flashing should be extended to all penetrations in structures—i.e., they should be sealed to prevent moisture and pest incursion into the living space. Moisture meters and visual assessment can sometimes be used to assess the adequacy of flashing, although it is not always possible to see if flashing is present without removing building coverings, which is not recommended. If moisture meters or visual assessment results identify building components with excessive moisture, defective or absent flashing may be a cause.

Condensation

Evidence of window condensation also deserves special consideration (Figure 4.15). Depending on the indoor and outdoor temperature and humidity levels, condensation may not be present at the time of an inspection. Condensation can occur when air that is sufficiently warm and moist comes in contact with a cold surface. The water created through condensation can lead to mold and other problems that create both health hazards and building decay.

Condensation often occurs on windows because the window is not adequately insulated and it is the coldest surface. Modern double- and triple-pane windows, some filled with inert gases between the panes, effectively eliminate condensation problems on windows when properly configured for the specific building application, orientation, and climate. Such window replacement also has the benefit of removing a major source of lead-based paint exposure, as old single pane windows are known to have the highest levels of lead-contaminated dust and paint of any other building component. If old windows coated with lead-based paint are replaced, lead-safe work practices must be used.[14]

Sometimes condensation occurs within the walls, ceilings, and floors that separate the outside unconditioned air from the conditioned air inside the structure as warm moist air travels through the cavity. Crawl spaces, attics, and exterior walls can be subject to such condensation.

In some cases a vapor retarder—often called a vapor barrier—is recommended to inhibit condensation or other sources of moisture intrusion by reducing the movement of moisture-laden air into walls, ceilings and floors. However, vapor retarders require some careful thought and are dependent on climate zone and other factors. If an insulated wall has materials on both the interior and exterior surfaces that retard vapor movement, moisture can become trapped within the wall cavity and cause a serious problem. Walls should be designed to have the ability to dry in at least one direction. If a mold problem is identified, vapor retarder problems may be the cause.

Drains

As important as entry of excess moisture into a building is, how water exits the housing structure is equally as important. Drains are often overlooked as important sources of moisture because the leak may be a slow one. Drain traps, like all plumbing, deteriorate over time. If drain traps are not kept full of water, harmful soil or sewer gases can enter the living area. If an odor is detected, dry drain traps may be the cause. Basement floor drain traps should be kept full by periodically adding water into them (Figure 4.16).

Other Moisture Sources

Metal windows and door casings directly touching sheetrock can lead to moisture problems. Inadequate insulation or leaks from old caulking can be related to condensation and moisture problems. Furniture that is pushed up directly against exterior walls, especially in rooms

Figure 4.16 Floor Drain Traps

that are below grade, can foster mold growth by reducing air movement. Inadequate ventilation and moisture problems are often closely related. The following sections on ventilation and environmental sampling and building testing contain additional information on identifying moisture and ventilation problems.

Ventilation System and Combustion Sources

Many ventilation system problems can be identified visually.

- Look for discoloration on carpets under doors. This suggests air pressure differences between the two rooms may be too high (i.e., the carpet is acting as a filter for the air as it moves from the higher to lower pressure space).

- Check for pooling or ponding of water near air intakes that may cause moisture to infiltrate the building.

- Check whether an attached garage has doors that lack seals or other holes between the garage and living space. This allows for carbon monoxide (CO) and other combustion by-products and Volatile Organic Chemicals (VOCs) to enter the living space.

- Identify whether an exhaust vent is located too close to a supply vent. If so, the air can be "short-circuited," meaning that instead of mixing with the supply air and diluting contaminants, it enters the room and is immediately exhausted.

- Identify ducting problems (too many twists and turns), disconnected ducts, and leaky ductwork.

- Identify misaligned, cracked, corroded or disconnected chimney and water heater flues.

- Check that bathroom, dryer, kitchen, and bathrooms have exhaust systems.

- Make sure all the exhaust ducts go all the way through the building envelope to the exterior, especially clothes dryers and kitchen and bathroom exhaust.

- Identify any unvented combustion appliances and determine if all existing combustion appliances are vented properly.

- Make annual inspections of gas and wood and other fuel burning appliances and their venting systems to prevent poisoning by combustion gases.

- Assess homes for the presence of properly working carbon monoxide and smoke alarms located near all sleeping areas.

- Additional information on testing ventilation systems is covered in the Building Performance section of this chapter.

Safety/Injury Hazards

Injury hazards can be identified through home safety questionnaires and/or home inspections such as those detailed in the HUD/CDC Healthy Housing Inspection Manual. Questionnaires focusing on the presence or absence of certain safety devices (e.g., CO alarms, smoke alarms, ground fault circuit interrupters (GFCI) and arc fault circuit interrupters)are generally more reliable than responses to questions about safety practices (e.g., safe medicine storage).[15] Users have found the HOME Injury Survey, a 55-item tool that quantifies unintentional injury hazards in the indoor environment of homes with young children, to be reliable, valid, and re-producible[16]. Figure 4.17 illustrates categories of home injury hazards.

Falls

Bathrooms, stairs, windows, and outdoor play equipment should be evaluated to ensure that safety devices such as grab bars and non-slip surfaces are installed, especially for the elderly; that safety gates are used to block

Figure 4.17 Main Injury Hazards in the Home
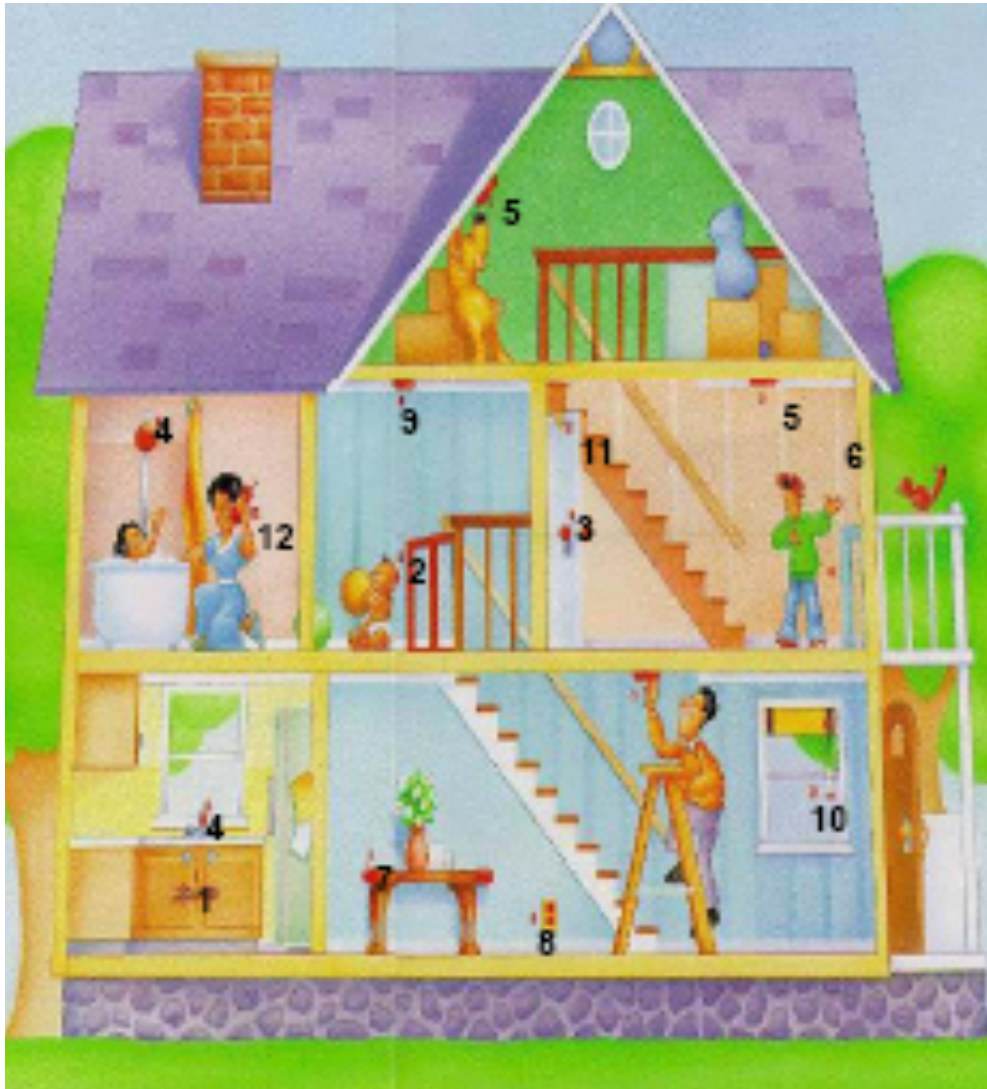
Assess for the Presence of These Items

1. Safety latches and locks for cabinets.
2. Safety gates.
3. Door knob covers and door locks.
4. Anti-scald devices for faucets and showers.
5. Smoke detectors on every level of the home.
6. Window guards and safety netting.
7. Corner and edge bumpers.
8. Outlet covers and outlet plates.
9. Carbon monoxide (CO) alarms outside bedrooms.
10. Window blind cords secured.
11. Door stops and door holders.
12. Cordless phones make it easier to continuously watch young children.

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stairs for children; that windows presenting fall hazards have permanent window guards affixed; and that outdoor play equipment is placed on an impact-absorbing surface. Stairs should be evaluated for structural defects and the presence of adequate railings on both sides. Cords that present trip hazards should be moved and secured. Throw rugs should be attached to the floor or used with non-slip pads to secure them. Also, check for trip hazards related to changes in elevation, such as with steps, ramps, or where there is a change in surface level. The visual examination should also check for adequate lighting over steps and other uneven surfaces.

Poisoning/ Storage of Household Chemicals

The visual examination should examine how household chemicals are stored and whether or not they are within the reach of children. In homes with, or visited by, young children bathrooms and kitchens should be assessed for the presence of safety locks on cabinets that contain medicine and dangerous substances, such as cleaning supplies or biocides to control pests. These types of products should not be stored with food supplies. Flammable and volatile substances such as gasoline and paint thinner are best stored in a detached building such as a shed or garage. All pre-1978 homes should be inspected for deteriorated lead-based paint, lead dust, and soil-lead hazards. Home visitors can be easily trained to visually identify deteriorated paint and refer these potential hazards to trained inspectors or risk assessors.

Fire and Burns

Homes should be inspected for the existence of at least one smoke alarm on each floor, including the basement and outside each sleeping area. Smoke alarms should be mounted high on walls or ceilings and away from windows and doors. It is not recommended that smoke alarms be installed in kitchens since they are more likely to be disabled from this location. Hot water temperature should be measured using a thermometer to ensure that it does not exceed 120°F and water heaters should be set to 120°F. Safety covers for electrical outlets should be used if young children reside in or frequently visit the home.

Choking

Home environments should be assessed for objects accessible to children that may result in a choking incident. This includes toys with small parts, coins and other small items that could be ingested by young children. Education should be provided related to choke hazards for children and the infirm elderly.

Drowning

Pools and hot tubs should be inspected for fencing on all sides to prevent drowning. Non-rigid pool covers can also be used to reduce the occurrence of drowning when pools are not in use. Uncovered rain barrels and five-gallon buckets used for cleaning are also a potential danger and should be used with caution when toddlers are around.

Suffocation and Strangulation

Sleep and play environments should be assessed for safety. The Consumer Product Safety Commission has published mandatory standards for cribs, including requirements for side height, slat spacing, and mattress fit. Co-sleeping (infants sleeping with adults) should be avoided. Toy boxes should be inspected to ensure that they have proper lid supports and window covering cords should be secured and out of reach of children. Plastic bags should be kept out of children's reach.

Tip-Over Hazards

Furniture and appliances such as televisions that are not well secured represent tip-over hazards to young children in particular. Children can be subject to injuries from tip-overs, in particular crush and head injuries. Home inspectors should ensure that furniture and appliances are stable and not prone to tipping. Large appliances and furniture (e.g., bookcases) should be anchored to the wall and televisions should be on sturdy, low bases and should be pushed as far back on stands as possible. Remote controls, toys, and other items that might attract children should be kept off of TV stands or furniture that represent tip-over hazards.

Firearms

While questioning families about the presence of firearms may not be comfortable, a discussion about the presence of guns should be initiated

when possible. Guns should be removed from a child's environment. When stored, firearms should be unloaded and ammunition locked up separately from guns. Trigger locks should also be used.

Structural Defects

The visual examination should include all elements of the structure of dwellings to ensure they are properly maintained to ensure they remain safe and stable. The dwelling should be assessed for signs of structural movement, such as cracks and/or bulges to external walls, open joints in brick, stone or block work, in external walls or chimney stacks. Also look for siding defects, such as loose, missing, or other insecure external finish to external walls, disrepair to lintels/sills, and poor roof conditions, such as sagging, distorted, or missing shingles, and loose missing or improperly fastened gutters/downspouts. The goal is not to make healthy homes assessors experts on building structural issues, rather they should be able to identify possible problems that could be referred to those with more expertise on the topic.

Insulation and Temperature Regulation

In many climates, poor temperature regulation can result in hazardous conditions, especially for vulnerable populations. Although an assessor may not encounter extreme conditions at the time of the assessment, information on the occupant's thermal comfort can be obtained during the resident interview or by a combination of visual assessment and interview. The visual examination should check for adequate insulation (where possible), the adequacy of caulking and weather-stripping, the age and condition of the heating and/or cooling system, and holes or other voids in the building envelope that should be repaired. In many instances, ventilation from open windows may be limited or non-existent due to concerns with crime or noise (i.e., windows locked or barred shut).

Cleanliness and Clutter

Because house dust is the primary medium through which residents are exposed to toxins (e.g., lead, pesticides) and allergens (e.g., cockroach, dust mite) it is important that residents engage in regular and effective cleaning. Regular cleaning is also an important aspect of integrated pest management and is essential in food preparation areas for preventing bacterial contamination of food. Excess clutter can prevent effective cleaning, interfere with IPM implementation, and pose a fall hazard for occupants, especially seniors. Visual assessment instruments should include one or more items for the assessment of cleanliness and clutter and questionnaires often include a question on cleaning habits. A key consideration with this assessment is whether the residents are capable of maintaining cleanliness in the dwelling, or whether other characteristics (e.g., arrangement of furniture, condition of surfaces) interferes with cleaning. For example, the lack of smooth, cleanable surfaces in the kitchen can make cleaning difficult. Clutter may also pose trip or fall hazards and may block access to exits and entrances.

Hoarding

Compulsive hoarding is a psychological condition characterized by the acquisition of, and failure to discard, a large number of possessions that appear to be useless or of limited value. Hoarding is defined as having the following three components: 1) the acquisition of and failure to discard a large number of possessions that may appear to be useless or of little values; 2) living spaces sufficiently cluttered so that the clutter precludes activities for which those spaces were intended; and 3) significant impairment in functioning or distress caused by the clutter.[17]

Hoarding represents an extreme type of clutter that may result in filth, infestations and serious maintenance problems. Hoarding is only a focus on the number of possessions, and can range from mild to life threatening. Squalor is filth and/or degradation from neglect. Commonly associated with hoarding are health and safety hazards (including building code violations). It is possible to have hoarding and squalor together but both conditions can also exist independently. Many hoarders have one or more other mental health conditions (e.g., depression, generalized anxiety, obsessive-compulsive disorder, social phobia, failure to process or organize information).

Hoarding situations must be handled in a multidisciplinary manner. Healthy homes programs should address hoarding as part of a team that may include the sufferer, family members, the housing provider, local health departments, representatives of the judicial

system, and providers of therapeutic, social and clean-up services. Long-term case management and monitoring is needed.

Prioritizing Visual Assessment Results

The results of the visual assessment should be presented as a prioritized list of items requiring repair or remediation. Priorities depend to some extent on the program's focus but the level of health risk posed by the condition must be considered regardless of the focus. Hazards that might result in immediate harm or death must be corrected first. Although there is no universally accepted system of weighing each item for its likely health impact, two rating systems have been used.

As mentioned previously, HUD's Healthy Home Rating System uses an approach that prioritizes health hazards based on the likelihood of the hazard resulting in harm, and the extent of the harm should it occur.

Healthy Homes programs have used a variety of methods for prioritizing the results of the visual

Table 4.1 Priority List of Better Homes for Asthma (adapted from Seattle/King County Health Department)[18]
High priority items are indicated with an [A] and lower-priority items with [B] or [C].

Description
Vent clothes dryer to exterior using rigid metal ducting, not flexible plastic. [A]
Repair plumbing leaks [A]
Correct mold problems [A]
Clean evaporator pan under refrigerator [A]
Install range hoods that vent to exterior [A for gas; B for electric]
Repair dry floor drain traps if sewer gases detected [A]
Assure that at least one window in each room can open [A]
Remove basement, bath and kitchen wall to wall carpet [A]
Install smoke and carbon monoxide alarms [A]
Repair deteriorated bath and tub caulk [B or C]
Install pleated filter in forced-air heating system. [A]
In the crawl space, seal /cover soil with poly. [A]
Seal crawl space from house air. [A]
Assure adequate runoff from downspout away from house. [A: wet walls; B: other]
Caulk windows. [A]
Caulk wood siding vertical seams. [A]
Caulk door seams. [A]
Repair roof and chimney flashing if damaged or evidence of interior leaking is observed. [A]
Check furnace chimney draft and, if inadequate, check cleanout opening. [A]
Redirect flow from gutters to functioning downspout. [B]
Check return and supply ducts (only if in garage, crawl space, or attic) for leaks. [B]
Remove debris from the crawlspace, make rodent-proof. [B]
Wood-earth contact—assure 6 inch minimum gap. [C]
Repair or replace leaky chimney flue. [A]
Seal basement concrete if moisture probe indicates high moisture content. [C]

assessments. Usually this involves preparing an action plan in consultation with the residents and property owner. Table 4.1 provides an example of priority rankings from the Neighborhood House in Seattle's "Better Homes for Asthma" Demonstration project and Figure 4.18 show other examples from the field. HUD's Public Housing Assessment System (PHAS) uses pre-established weighting of items on the physical assessment checklist and allows the assessor to assign severity scores based on specific criteria for some of the items. (see: www.hud.gov/offices/reac/products/prodpass.cfm).

Environmental Sampling and Measurement Methods—General Considerations

Depending on the goals of your program, visual assessment can be used in conjunction with environmental testing, sometimes called "sampling and analysis," and building performance testing (e.g., as conducted by Weatherization Assistance Programs). The purpose of environmental sampling is to determine levels of harmful substances and agents in air, soil, dust, water, or on surfaces or other media. Some contaminants may be odorless (such as radon or carbon monoxide) or not amenable to examination by the naked eye (such as lead or pesticide residues). The results are typically compared to either existing exposure limits or to levels in the outdoor air. Interpretation of sampling results may prove difficult since, with few exceptions such as lead and radon, environmental exposure standards for residential environments have not been established. Levels of allergens in settled dust such as dust mite and cockroach can be measured to characterize hazards in a program's target housing, or collected pre- and post-intervention to determine if program efforts have produced desired changes.

Information on levels of contaminants in a home can be obtained by collecting samples for subsequent analysis by a laboratory (e.g., lead wipes) or by using portable instruments (sometimes called "grab sampling" or "real-time analysis") to provide instantaneous measurements during the home assessment (e.g, a CO meter). A sample can be collected during the initial visit or a sampler can be left in the home to be collected at a follow-up visit (e.g., a longer term air sample). In general, samples or measurements collected over a longer period of time (typically termed a "time-weighted average") are more likely to provide an accurate indication of typical values than short-term, grab samples. The simplest real-time measurements include temperature and humidity; instruments are often also used to measure carbon monoxide concentrations or to determine if there are atypical levels of volatile organic compounds or particulates in the air.

Before deciding whether to collect environmental samples or measurements it is important to consider the following factors: (1) how the data will be used (e.g., will it inform mitigation decisions or is it suitable for assessing the effectiveness of interventions?); (2) whether there is a standard or guideline for the analyte that is suitable for the home environment; (3) the ease of sample collection; and (4) the cost. For example, if pets or pests are present in a home, it can be inferred that elevated levels of the associated allergens would be found in dust samples. Also, guidance from authoritative sources on mold/moisture issues generally discourages environmental sampling for mold because of difficulty interpreting the results and the fact that mold/moisture problems that are observed should be mitigated regardless of the

findings from environmental sampling.[19,20]

Once a program has made the decision to collect environmental samples or to take measurements the choice of sampling methods will depend on: (1) the type of media sampled; (2) how rapidly results are needed; (3) available expertise; and (4) cost. The HUD/CDC Healthy Housing Inspection Manual and the HUD/CDC Healthy Homes Reference Manual each contain a list of sampling methods that can be used in a healthy homes inspection. Lead-based paint testing must be done by licensed lead-based paint risk assessors or inspectors. In most states, lead dust testing may be performed by a lead sampling technician or risk assessor. Healthy homes programs that will be doing environmental sampling should determine what training, licensing, and other legal requirements apply for their jurisdictions. Environmental sampling and analytical methods for lead in the residential environment have been established by law and are detailed in the HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing.[21] A brief review of sampling methods follows.

Passive versus active systems. In general, there are two types of environmental sampling: passive and active. Passive systems rely on the contaminant being adsorbed onto special collection media via diffusion. One example is formaldehyde, for which the sorbent is opened to the air for a measured period and then analyzed in a laboratory. Active systems typically require

Figure 4.19 Passive Diffusion Dosimeter

an air sampling pump, which pulls air at a known flow rate through a filter or other collection media, which is then sent to a laboratory for analysis.

Each of these approaches has its strengths and weaknesses. For example, passive systems, if available, tend to be simple; they do not require a great deal of training and cost less (see Figure 4.19). Active systems may have greater accuracy and precision and may achieve the lower detection limits that are especially important for the home environment. In all cases, approved sampling and analysis systems should be used.

Costs. Costs associated with environmental testing include the purchase or rental of equipment and, for some devices, regular periodic calibration or servicing by the manufacturer; staff time to collect the sample; sampling media; and laboratory shipping and analysis. In order to contain costs, the question to be answered by the sampling should be articulated and various approved methods considered by asking the lab.

Prior consultation. If laboratory analysis is contemplated, it is essential that field personnel communicate with the laboratory before samples are sent. This will help determine laboratory capabilities, shipment procedures, and turnaround times. In addition, industrial hygienists may be helpful in designing field-based sampling efforts. A listing of board-certified industrial hygienists is available from the American Board of Industrial Hygiene, http://abih.org/members/roster/rostersearch.cfm. Healthy Homes programs should assure that laboratory and field personnel are properly trained, licensed, and accredited.

Adapting air pollution and workplace sampling to the home environment. For many contaminants found in the home environment, scientifically based health exposure limits do not yet exist. Several options are available to overcome this deficiency. One approach is to compare indoor to outdoor levels. Another is to compare the indoor level to exposure limits established for the occupational setting, although these limits are typically set for healthy adults who are exposed over a typical eight-hour workday. Clearly, these may not be a valid comparison for housing occupants who may have longer-term exposures or be in poor health and may include children, the elderly, and other sensitive populations. A list of indoor exposure levels has been published by the Air Infiltration and Ventilation Centre (AIVC) in
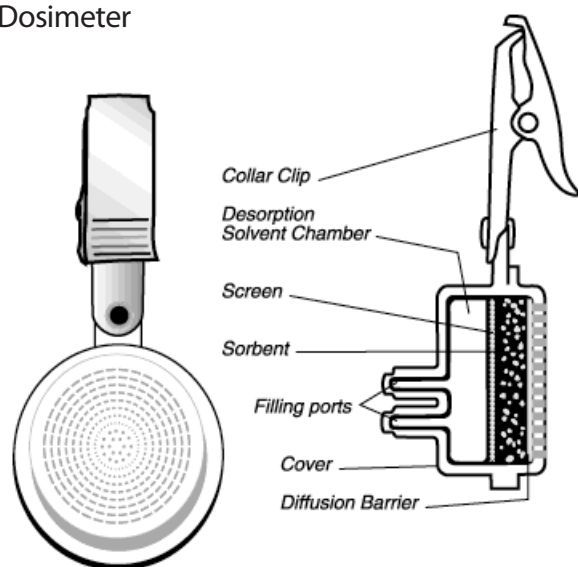
Figure 4.20 Most Frequently Reported Samples Collected by Healthy Homes Programs

- Dust mite allergens (64 percent)
- Relative humidity (64 percent)
- Temperature (56 percent)
- Mold (52 percent)
- Lead (50 percent)

Table 4.2 Environmental Testing and Sampling Methods

Environmental Hazard	Sampling Method
Lead dust	Dust wipe
Cockroach allergens	Dust vacuum/filter-type material
Carbon monoxide	Direct-reading instrument or detector tube
Carbon dioxide	Direct-reading Instrument or detector tube
Volatile Organic Compounds	Passive dosimeter or canister/GC-MS
Cat allergens	Dust vacuum/filter-type material
Dog allergens	Dust vacuum/filter-type material
Dust mite allergens	Dust vacuum/filter-type material
Mouse allergens	Dust vacuum/filter-type material
Pesticide residues	Wipe or vacuum
Mold sampling	Air pump/filter
Nitrogen Dioxide	Passive badge
Particulate matter	Air
Formaldehyde	Passive badge
Temperature:	Digital sensor
Relative humidity:	Digital sensor
Radon: Short-term	2-7 day canister or data logger
Long term	3-month canister or data logger

Europe[22] and by the World Health Organization in 2010 (see: http://www.euro.who.int/__data/assets/pdf_file/0009/128169/e94535.pdf).

Seventy-nine percent of healthy homes programs (more than 50 surveyed) collected environmental samples as part of their healthy homes projects (Figure 4.20). Twenty-one percent of the healthy homes programs collected only one set of environmental samples in each home, while 65 percent collected two sets of samples or more. A "set" means a group of samples collected at the same time. Examples of environmental testing and sampling methods are shown in Table 4.2.

Specific Testing Methods

Testing Ventilation Systems

Testing ventilation systems can be a useful addition to the visual assessment described earlier in this chapter. Good ventilation can help to keep exposures to contaminants, odors, moisture, and other substances low. However, controlling the source of the contaminant is always the primary approach because ventilation cannot always be expected to do the job. If a contaminant exists in a home, its source should be investigated. A source reduction strategy should be implemented before a ventilation system is installed or otherwise improved. Ventilation systems generally fall into two categories: Local exhaust ventilation is designed to move a relatively small amount of air containing the contaminant at the point it is generated before it can enter the indoor air at large. Examples in the home include kitchen and bathroom exhausts, chimneys, clothes dryers, vented combustion appliances (furnaces, water heaters) and range hoods over gas ovens and ranges.

General dilution ventilation moves larger volumes of air, and, as the name implies, operates by diluting contaminants with uncontaminated air. While some multi-family buildings in the U.S. have a planned fresh air supply, relatively few single-family dwellings do. Instead, outside air enters the home in an uncontrolled manner through movement of air through the building envelope or through open windows and doors (referred to as passive ventilation). In some homes, outside air is brought directly into the home through mechanical ventilation, with more sophisticated systems recovering the heat from indoor air before it is exhausted. As building envelopes

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Figure 4.21 Air Flow Exhaust and Entries

Air Flow Needs Designed Holes

Chimneys

Bath and kitchen exhaust vents

Combustion vents

Fresh air inlet/outlet

Dryers

Ventilation intake and exhaust

Central vacuum outlet
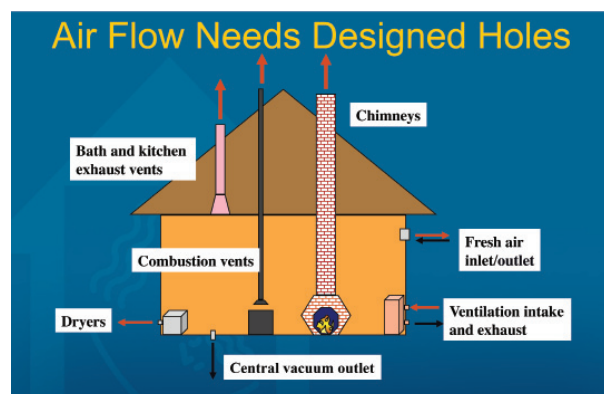
are tightened for energy conservation purposes and building leakage declines, it is important that a system for an adequate supply of fresh air be planned and installed. As a result of research demonstrating that passive ventilation was not sufficient to provide adequate air exchange rates, in 2009 the State of California revised its building code to require that newly constructed homes incorporate mechanical ventilation[23].

Airflow patterns can be quite complex and flow in unexpected directions if properly designed entry and exhausts ("holes") are not included (Figure 4.21). Air moves from higher to lower pressure areas, and warm air rises while cold air settles. The buoyancy of warm air rising creates a "stack effect" in the building, just like hot air flowing up through a chimney. In tall buildings, this can sometimes cause apartments on the lower floors to be cold while those on the upper floors are hot. These air flows also move contaminants such as environmental tobacco smoke between units of multi-unit buildings.

Regulating pressure differentials so that air moves as intended is essential for good building design. Failure to regulate these pressure differentials can have serious consequences. For example, if a new air exhaust system is added without balancing air pressure, air that would normally rise through a chimney or fireplace can actually reverse direction and enter the living area, introducing carbon monoxide and other contaminants to the home.

Many tools are available to evaluate ventilation and airflow, including smoke tubes or bottles, flow hoods, pressure gauges duct air-tightness

testers, and blower door tests. Smoke tubes can be used to identify "back-drafting" of exhaust from combustion appliances (e.g., water heaters) that do not have closed exhaust systems. In most healthy homes inspections, ventilation problems are identified visually. However, for healthy homes programs that partner with weatherization programs, the blower door test and pressure diagnostics are options. During a blower door test, the house is placed under negative pressure using an exhaust fan sealed in a doorway or other large opening. This method determines breaches or leaks in the building envelope. It can help pinpoint the pathways that allow contaminants into the living space. By identifying where the holes or leaks are, they can be repaired more cost-effectively.

Moisture Measurement

In addition to the visual assessment methods described earlier in this chapter, moisture measurements can help identify places needing attention. Moisture meters measure water content in building materials through gauging changes in electrical resistance/capacitance (Figure 4.12). Two major types of moisture meters include one that gauges surface moisture by measuring the current between two electrodes. The second type has two pins that can be inserted into building materials to measure moisture content or water activity. Most moisture meters are calibrated to a specific type of wood at a particular temperature and are accompanied by charts that have adjustment factors for different types of wood and different temperatures. If the adjustments are not

Figure 4.22 Infrared Thermograph of a Ceiling with a Hidden Water Leak

Degrees
71.2
70.2
69.3
68.3
67.3
66.3
65.4
64.4
63.4
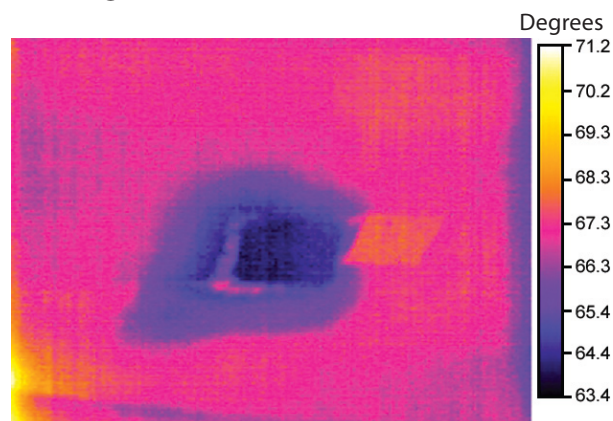
Note: The blue section reveals the location of the water leak.

done properly, inspectors are likely to get false conclusions from the meter reading.

Another method of identifying moisture problems behind walls and other building cavities is thermography. Here, a special camera photographs infrared spectra. Because building components with higher water content are "cooler" than those without water, components with higher water content appear bluer than those with lower water content (Figure 4.22).

Relative humidity is the measure of the amount of water vapor in the air at a specific temperature compared with the maximum amount of water vapor that air could hold at that temperature. It is expressed as a percentage. Total humidity depends on the temperature since warm air holds more moisture than cold air. Dew point is the temperature at which air becomes saturated and condensation forms on cooler surfaces, which can in turn lead to mold problems.

Mold Sampling

Mold sampling is generally not recommended because a visual examination and odor detection are usually adequate to identify a mold problem. Testing procedures do exist to determine the species of mold present in a house, but most healthy homes programs and others involved in mold remediation have come to the conclusion that such speciation does not yield the kind of information needed to inform remediation.[24,25] Similarly, measuring the mold spore concentrations in air is generally not recommended because results can vary widely and are difficult to interpret.

Testing for Gases

Carbon monoxide (CO) and oxides of nitrogen (NOx) are odorless, colorless gases that can cause health problems. CO can be fatal if present in high concentrations. As byproducts of combustion, they can enter the living space if there is inadequate venting and/or improper indoor use of combustion appliances (e.g., gas ovens to heat homes). Inspectors should test both the fuel-burning device to determine whether it is producing high levels of CO and NOx, as well as the ambient room air. Two systems available for testing for CO and NOx are:

- Direct-reading, real-time carbon monoxide and

oxides of nitrogen analyzers, which require periodic calibration from the manufacturer; and

- Detector tubes, which involve pulling a small volume of air through a glass tube filled with a resin that changes color in proportion to the concentration of CO or NOx in the air. The length of stain is read on a scale on the tube. (Figure 4.23).

Additional details on measurement of combustion by-products in the home environment are available from the Building Performance Institute.

Radon is an odorless, colorless radioactive gas that, next to smoking, is the leading cause of lung cancer in the United States. The two principal means of laboratory-based measurement for radon used by healthy homes practitioners are:

- Systems that employ activated charcoal canisters; or

- Alpha-tracking devices, such as those that contain film.

Ideally, measurements should be taken over a long period and under conditions in which outdoor air incursion is at its lowest (e.g., winter) although short term measurements (e.g., two-to-seven days) are also useful. If a short-term test registers a radon level of 4 pCi/L (picocuries per liter of air) or more, a long-term test or a second short-term test should be conducted to verify an actual problem before deciding that mitigation is needed. If the long-term result or the average

Figure 4.23 Detector Tubes

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of two short-term tests is 4 pCi/L or more, mitigation is recommended. Residents should be instructed not to move the radon test kits or devices. For valid test results, it is important that test devices be returned to the laboratory immediately after completing the test.

Formaldehyde and Other Volatile Organic Compounds (VOCs) can be measured by healthy homes practitioners using passive dosimeters, which are analyzed in a laboratory. Detector tubes are also available for formaldehyde and individual VOCs. Interpretation of VOC results is difficult because residential standards have not been developed; there are many individual compounds with different toxicities and concentration can be very low. Standard and approved methods should be used whenever possible.

Testing for Allergens in Settled Dust

Allergens in settled dust and the resulting resuspension into the air from normal foot-traffic and from soft furniture and bedding are associated with asthma and other respiratory health problems. Estimates of sensitization and asthma exacerbation thresholds, based on concentrations of allergens in dust, have been developed from epidemiological studies. (Table 4.3). Sampling for allergens in settled dust before and after a healthy home intervention has been used to estimate the effectiveness of the intervention. The National Survey of Lead and Allergens in Housing showed that housing conditions are linked with allergen levels. Of the surveyed homes, 51.5 percent had at least six detectable allergens and 45.8 percent had at least three allergens exceeding thresholds. Race, income, housing type, absence of children, and presence of smokers, pets, cockroaches, rodents, and mold/moisture-related problems were independent predictors of high allergen burden.[26]

Most healthy homes programs use a single sampling method whereby a vacuum is fitted with a dust collection device. The dust is sent to a laboratory where it is sieved and analyzed using several differing analysis methods. One recent development is the MARIA™ (Multiplex Array for Indoor Allergens) method which enables the rapid determination of multiple allergens from a smaller quantity of dust. This method may not provide results that are directly comparable to the common allergen-specific ELISA (enzyme-linked immunosorbent assay) analysis for some allergens, so healthy homes programs should work with their analytical laboratories to be sure that the same analytical method is used for dust samples collected before and after remediation. Research is underway to improve standardization of both field and laboratory methods. Personnel collecting these samples

Table 4.3 Current Threshold Levels for Assessing Common Residential Hazards

Allergen	Asthma Symptom Threshold
Dust mite allergen (Der f 1 and Der p 1) in the bedroom	10 µg/g (Platt-Mills et al., 1995)
Cockroach allergen (Bla g 1 and Bla g 2) in the kitchen	8 Units/g (Eggleston and Arruda, 2001)
Cat allergen (Fel d 1) in the bedroom	8 µg/g (Ingram et al,1995; Custovic et al., 1998)
Dog allergen (Can f 1) in the bedroom	10 µg/g (Ingram et al.,1995; Custovic et al., 1998)
Mouse allergen (Mus m 1) in the kitchen	1.6 µg/g23 (Phipatanakul et al., 2000)

(Note: Thresholds are subject to change and may not reflect actual risk. References: Custovic A, Chapman M. Risk levels for mite allergens. Are they meaningful? Allergy. 1998; 53(suppl 48): 71–76. Eggleston PA, Arruda LK. Ecology and elimination of cockroaches and allergens in the home. J Allergy Clin Immunol. 2001; 107(suppl 3): S422–S429. Ingram, J.M., Sporik, R., Rose, G., Honsinger, R., Chapman, M.D., Platts-Mills, T.A.E., 1995. Quantitative assessment of exposure to dog (Can f 1) and cat (Fel d 1) allergens: relationship to sensitization and asthma among children living in Los Alamos, New Mexico. J Allergy Clin Immunol. 96, 449–456. Phipatanakul W, Eggleston PA, Wright EC, Wood RA. Mouse allergen, part I: the prevalence of mouse allergen in inner-city homes. The National Cooperative Inner-City Asthma Study. J Allergy Clin Immunol. 2000; 106(6): 1070–1074. Platts-Mills, T.A., Sporik, R.B., Wheatley, L.M., Haymann, P.W., 1995. Is there a dose response relationship between exposure to indoor allergens and symptoms of asthma? Journal of Allergy and Clinical Immunology 96, 435–440.)

need to be trained to collect dust samples using a standard protocol. Asthma symptom thresholds have been published and are useful in interpreting allergen sampling results, although the use of new standards and sampling and laboratory analytical methods may not permit easy comparison (Table 4.3). HUD has developed sampling guidelines for allergens in settled house dust: www.hud.gov/utilities/ intercept.cfm?/offices/lead/library/hhts/ DustSampleCollectionProtocol_v2_05.08.pdf).

Monitoring for Pests

Like other healthy housing issues, pests in housing and the methods of detecting and controlling them are often intertwined with other housing deficiencies, especially inadequate moisture control; deferred maintenance associated with structural defects that create entryways and harborage for pests; leaks; clogged drains and gutters; improperly graded soil around the house; and clutter. Holes and penetrations in the building envelope permit pests to enter the dwelling. Poor moisture control provides the necessary water for pests to flourish. Access to nutrients can often be prevented by ensuring proper storage of food, trash, and garbage, and cleaning of all food preparation surfaces, utensils, and other equipment. (See Figure 4.24 for links to additional information.)

Resident complaints about pests are often the first indication of an infestation, and they should be encouraged to report evidence immediately so infestations do not spread. A trained pest management professional (PMP) will use this information to conduct a visual inspection that can identify the type of pest and its location(s)

Figure 4.24 Methods of Pest Detection

Methods of detecting pests are varied and described in detail in the CDC manual on integrated pest management: http://www. cdc.gov/nceh/ehs/docs/IPM_Manual.pdf. The Healthy Housing Reference Manual also provides detailed guidance on how to identify the most common types of pests in different regions of the country. IPM training material can also be found at http://www. stoppests.org

in the dwelling. Fecal matter released by insects and rodents along common pathways around the perimeters of rooms provides relevant information. Insect fecal matter is typically spherical while fecal matter from rats or mice is usually elongated with one pointed end due to the presence of a sphincter. Other body parts, such as cast off exoskeletons or fur, may be visible. Of course, the most obvious visual evidence of the pest is the actual live or dead animal.

Rub marks and burrows are also signs of pest activity. Exterior evidence may include ant mounds, burrows, and nests. A trained observer looks in food storage areas and trash and garbage disposal systems, such as trash chutes. Penetrations in walls, under kitchen sinks, in basements, and in other areas suggest that pest infestations may be present. Some practitioners have found that the use of a heat gun can drive cockroaches into the open where they can be observed easily.

Monitoring with glue traps is also effective for cockroaches. Since cockroaches often do not emerge in daylight hours, monitoring with overnight traps may be more reliable than looking for the pests themselves (Figure 4.25). Cockroach glue traps are glue-covered strips of cardboard available in many shapes and styles. The two most basic types come in a triangle or flattened tube. If cockroaches are seen, they are likely to be found in cracks and crevices.

All visual survey systems attempt to identify potential harborage sites. Harborage simply means those areas where pests are able to take shelter (e.g., unused boxes in basements, clutter, brush and bushes near structures, and standing water containers).

Figure 4.25 Cockroach Monitoring

Roach monitoring stations

Housing-Related Health and Safety Hazard Assessment

Cockroach baits and traps can be placed in corners, under refrigerators, and under sinks. If glue traps reveal an increase in pest prevalence, then quick action can help to avert a large infestation. Useful instructions on proper placement of sticky traps can be found at: healthyhomestraining.org/ipm/HUD_M2M.htm.

The most common signs of rodent infestations are those that can be seen, such as feces, urine stains that can be detected with a UV flashlight, stored food that has been opened or shows gnaw marks, nests, burrows, and rub marks along walls and other linear surfaces.

Bed bug infestations are becoming increasingly common, especially in multifamily housing. Bed bugs cannot be controlled by common IPM techniques such as denying pests access to food and water since they do not need food or water for extensive periods. Their survival depends simply on a human host who can offer a blood meal every few months. Signs to look for when inspecting for bed bugs include dark spots (about this size: •), which are bed bug excrement that may bleed onto the fabric; tiny white eggs and eggshells (about 1mm); skins that nymphs shed as they grow larger; live bed bugs; and rusty or reddish stains on bed sheets or mattresses caused by bed bugs being crushed. See: epa.gov/pesticides/controlling/bedbugs.html.

Finally, a healthy housing inspection should explore information on previous use of pesticides, if known. Routine monthly spraying of pesticides may be an early indication of both pest infestation and exposure to pesticides. Routine spraying indicates an ineffective pest control strategy that does not follow IPM principles. Protective gear and tools for healthy homes inspectors investigating pest infestations are listed in Figure 4.26.

Sampling for Lead

Procedures for identifying lead-based paint and lead-based paint hazards are contained in the HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing and regulated by EPA and many state governments. Dust-wipe sampling is performed by trained sampling technicians or lead-based paint inspectors or risk assessors. Measurements taken via x-ray fluorescence (XRF) or paint chip, soil, and water samples all require specialized training and licensing/certification. The extent of training and certification needed to perform these sampling techniques varies from state to state. Make sure your program adheres to state or EPA requirements. Laboratories that analyze paint, soil, and dust for lead must be EPA-recognized through the National Lead Laboratory Accreditation Program (NLLAP).

Figure 4.26 Healthy Homes Pest Inspection Gear

Inspectors should wear protective gear when investigating sites with potentially heavy pest infestations. EPA and CDC recommend the following tools and equipment:

- Building or floor plan to mark areas that need follow-up or regular ongoing inspections.

- UV flashlight for detecting urine stains that fluoresce under ultraviolet light.

- Standard flashlight.

- Knife or flat spatula for scraping narrow crevices where pests like to hide. If a spatula fits in a crack in concrete, baseboards, or wallboards; behind a kitchen or bathroom backsplash; or any other space 1/16" or greater, insects can use that space to enter a building.

- Hand lens or jeweler's loupe magnifying glass for insect identification.

- Vial for collecting specimens.

- Pest identification guide book.

- Telescoping mirror (one that extends from 6" to 36" is perfect for seeing behind or under hard-to-reach places.

- Dust mask.

- Small portable HEPA vacuum.

- Hard hat.

- Protective eyewear.

- Small ladder.

Energy Audits

An effective programmatic strategy that provides additional benefit to program clients is to integrate a home energy audit with the healthy homes assessment. A home energy audit, as conducted by a Department of Energy (DOE)-funded Weatherization Assistance Program, includes a comprehensive assessment of the current condition of a home followed by a detailed evaluation of the energy conservation measures that can improve the building's performance (see: http://waptac.org/Technical-Tools/Energy-Audits.aspx). The first step is a comprehensive assessment that includes visual and diagnostic assessments of the whole home as a system, including the building shell, heating and cooling systems, and appliances. Combustion appliances are tested for safety and efficiency, existing insulation levels are determined, air leakage is measured, electrical appliances are metered, moisture and other health hazards are evaluated, and the residents are interviewed about energy usage, trouble areas in the home, and health issues that may be connected to the indoor environment (Figure 4.27 shows a blower door test to estimate air leakage).

The data collected during the comprehensive assessment, or site audit, is then entered into an approved energy audit software tool, such as the DOEs Weatherization Assistant. Based on the local climate, energy rates, the costs of materials and labor, and the current condition of the home, the software evaluates the cost-effectiveness

Figure 4.27 Blower Door

of home energy retrofit measures. Typical cost-effective measures include air sealing and insulating the building shell, heating and cooling system tune-ups, repairs, or replacements, and duct sealing and insulation. In addition to the energy conservation measures, the auditor will recommend measures to improve the health and safety of the residents. Typical health and safety related measures include adding mechanical ventilation to kitchens and bathrooms to manage moisture and other indoor pollutants, installing vapor barriers on dirt-floored basements or crawl spaces, and installing smoke and CO detectors. The successful energy audit results in a work order of measures that, when installed, will reduce energy consumption and potentially improve the health of occupants.

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Notes

Housing-Related Health and Safety Hazard Assessment

5

Intervention Strategies

5

nterventions include physical modifications to a home to make it healthier and safer. They also include educational efforts to change the knowledge and behavior of occupants so they can protect themselves from health and safety hazards.

A housing assessment (described in Chapter 4) helps inform the intervention strategy and prioritize selection of interventions. This chapter describes intervention strategies according to the Seven Principles of Healthy Homes, and reviews evidence supporting their effectiveness. Resident education is an intrinsic component of all seven principles and is discussed at the end of this chapter.

Health benefits from combined structural and behavioral interventions are greater than resident education alone. The HUD/CDC Healthy Homes Reference Manual provides detailed descriptions of construction and maintenance practices. Appendix 5.1 describes specific healthy housing interventions and details their relationship to "green" building design systems, such as the Enterprise Community Partners' Green Community Standards and the LEED (Leadership in Energy and Environmental Design) rating system. The Appendix also contains technical information on EPA's Indoor airPLUS Construction Specifications for new construction.

Intervention Principles

Prioritizing Interventions

Depending on the local program and available resources, priorities can be established in

Key Messages

- Healthy housing interventions make a home dry, ventilated, safe, contaminant-free, pest-free, clean, and maintained.
- Specific healthy homes interventions often have many benefits and should be implemented by both owners and occupants.
- Substantial evidence shows that healthy housing interventions are effective.
- Interventions require resident education to be effective.
- Interventions can prevent harm; they are more effective and less expensive than acting after harm has occurred.

This chapter is organized around the *Seven Principles of a Healthy Home.* Keep it:

- Dry
- Ventilated
- Pest-free
- Safe
- Contaminant-free
- Clean
- Maintained

several different ways (see Table 4.1 in the previous chapter). One general approach involves first correcting imminent hazards such as carbon monoxide or a sagging roof; second, correcting hazards associated with chronic health conditions such as asthma triggers; and third, taking steps to prevent other housing deterioration. While many jurisdictions have housing repair programs that address imminent hazards, chronic problems and preventative strategies also require attention. Further, there are likely to be some housing units that simply cannot be brought to a healthy status and need to be condemned, demolished, or vacated.

Similarly, some localities are slated for widespread demolition and development, making healthy homes investments in existing housing in the near term inappropriate. Healthy homes programs should always coordinate their efforts with local planning officials in order to maximize the impact and durability of the work. The case studies in Appendix 1.2 demonstrate how different programs have established intervention priorities.

Shared Responsibilities for Implementing Interventions

Owners, property managers, maintenance staff, and tenants share responsibility for a healthy and safe home environment in rental housing. Because home environments experience normal wear and tear and all systems (e.g., electrical, plumbing) degrade over time, maintenance is also an ongoing responsibility. Owners are responsible for providing a living environment that complies with housing and building codes, responding to tenant reports of needed repairs, and conducting periodic inspections (e.g., at unit turnover or annually). Tenants are responsible for maintaining the cleanliness of the property and for immediately reporting maintenance needs to the property owner.

Multiple Benefits of Interventions

Many healthy homes interventions result in multiple health benefits. For example, eliminating a moisture problem helps prevent mold, dust mites, deteriorated paint, structural rot and degradation, and pest infestation. Radon mitigation not only reduces exposure to radon but is effective in reducing other soil gases and can reduce moisture levels.[1] Keeping food preparation areas clean and maintaining smooth and cleanable surfaces helps to eliminate pest infestation, prevents dust accumulation, and reduces infections and food-borne diseases. As part of a program's education efforts with owners and occupants, these varied intervention benefits should be presented and emphasized so that the outcomes are well understood.

Proper Use of Products

Some home-related injuries and health problems can be traced to improper use and storage of certain products. For example, combining incompatible cleaning agents such as ammonia-based cleaners and bleach can produce toxic gases. Misuse of pesticides can be associated with poisonings. Improper installation or location of warning devices such as smoke or carbon monoxide alarms can promote a false sense of security.

Saving Treatment Costs through Prevention

The health and societal costs of housing-related disease or injury far outweigh the costs of prevention. Savings associated with preventing childhood lead poisoning from residential lead exposures run well over $67 billion.[2] The cost of controlling housing-related asthma triggers pales in comparison to health care costs such as emergency department visits, hospitalization, and missed school and work days. A Systematic Review of Home-Based Multi-Trigger Multi-Component Environmental Interventions to Reduce Asthma Morbidity, summarizes cost-benefit studies showing a return of $5.30 to $14.00 for each dollar invested, and a cost effectiveness of $12 to $57 per additional symptom-free day.[3] See http://www.thecommunityguide.org/asthma/multicomponent.html for more information.

An improvement in health outcomes and associated savings should be incorporated in your local evaluation plan to document how your healthy homes program contributes to containing health care costs by preventing housing-related disease and injury.

Choose Evidence-Based Interventions

For many interventions, the evidence on clinical and environmental health benefits is well established. For others, further research and field testing is needed. The World Health Organization conducted an extensive review of the health impacts of inadequate housing.[4] The CDC and the National Center for Healthy Housing convened a group of experts to review scientific findings on the effect of housing interventions on improved clinical and environmental health outcomes (Figure 5.1).[5] The resulting report focused on five broad areas:

• Indoor Biological Agents Interventions. Studies related to allergens, dust mites, asthma, cockroaches, domestic animals, mice, and rats.

• Interior Chemical Agents (Toxins) Interventions. Studies related to water and air pollution, integrated pest management (IPM), pesticides, safe chemical storage, particulate matter, filtration, ventilation, volatile organic compounds (VOCs), formaldehyde, organic chemicals, radon, and lead.

• External Exposures (drinking water and sewage treatment). Studies related to exposures from the water supply, drinking water, in-home filtration, wastewater treatment, sewage, waste management, water pollutants, purification, and water filters. (Not covered in this Manual.)

• Structural Deficiencies (injuries and safety). Studies related to burns and burn prevention, accident prevention, home injuries, protective devices, accidental falls, and fall prevention.

• Intersection between Housing and Community. Studies related to environmental justice, universal design, ordinances, law and law enforcement, and public policy.

Intervention Costs

An Evaluation of HUD's Healthy Homes Initiative: Current Findings and Outcomes[6] identified the most common interventions and their costs. Of seven categories, the costliest was lead hazard control, with an average per unit cost of $5,312 (including labor and materials). The least costly was education, with an average total cost of $211 per unit (Table 5.1). Because costs and activities vary widely, it is important for programs to develop local cost databases, including relevant units of measurement, such as dollars per linear or square foot. It is also important for programs to evaluate benefits as well as costs. For example, one program

Table 5.1 Average Cost[a] of Interventions per Housing Unit[b,c]

Intervention Category	Cost per Housing Unit (Average)
Allergen reduction (n=17)	$1292
Education (n=16)	$211
Injury prevention (n=14)	$233
IPM (n=14)	$290
Lead hazard control (n=8)	$5312
Moisture control (n=13)	$1272
Weatherization (n=8)	$2266
Average total cost per unit for all interventions (n=10)	$3705

[a]Benefits not included in cost estimates. Average cost includes both cost of materials and labor. Some costs are capped by the relevant program and may not be related to correction of all hazards or deficiencies.

[b]Numbers presented in the table include both estimated and actual quantities provided by healthy homes programs. Of 44 healthy homes programs, 33 reported their numbers were estimates.

[c]n=number of programs surveyed.

Source: HUD, 2007, p. ES-5.

Figure 5.1 Rating of Housing Intervention Effectiveness

Housing Interventions and Health panelists rated interventions according to:

• Sufficient evidence to consider the intervention effective;

• Promising intervention that needs more field evaluation;

• Intervention that needs more formative research; and

• Intervention with no evidence of effectiveness.

installed weather stripping and sealed ductwork as part of its weatherization activities while another replaced windows.

Principle #1: Keep It Dry

Review of the Evidence

Ventilation and moisture control are typically related. Both ventilation and dehumidification help to reduce humidity levels and exposure to dust mites. A national survey found the use of a dehumidifier predicted lower levels of some asthma triggers and mold.[7] Additionally, installation of a whole-house mechanical ventilation system can reduce humidity, thus decreasing dust mites and improving clinical outcomes.[8, 9] Effective dehumidification in temperate climates can be achieved with air conditioners and/or dehumidifiers.[10] In climates with high humidity, whole-house ventilation has been less effective.[11, 12, 13] Climate zone must therefore be considered when making decisions about dehumidification.

Ventilation can improve indoor air quality when the outdoor air has lower levels of humidity and contaminants than the indoor air. Conversely, families in housing near pollution point sources such as industrial sites, high-pollen forested sites, and high-traffic roadways may need to filter or otherwise clean the outdoor air that enters the home environment.

Structural Interventions

Structural deficiencies related to moisture include water intrusion through the building envelope, plumbing leaks, drainage problems, and condensation. Key structural control methods are shown in Figure 5.2. Chapter 4 identifies a number of structural factors central to moisture control and how to assess when these controls have failed. The HUD/CDC Healthy Housing Reference Manual describes maintenance practices, proper insulation, and how to prevent moisture intrusion from a home's foundation, walls, and roof. The Reference Manual also provides information on the operations and maintenance of plumbing systems, venting requirements for plumbing systems, and methods to conserve water.

Figure 5.2 Key Structural Controls for Moisture

1. Limit water entry (e.g., maintain gutter systems).

2. Dehumidify damp spaces such as basements.

3. Repair leaks and assure that drains work properly.

4. Clean or properly remove wet or moldy building components.

5. Manage ventilation systems so that moisture is removed at the source.

Finished basements require special consideration regarding moisture control. In general, such spaces should not use sheetrock or paneling to cover exterior walls or wall-to-wall carpeting, both of which can lead to moisture and mold problems. Capillary breaks are discussed below as one way of controlling moisture in basements.

Controlling Building Envelope Leaks

Ensuring that roofs, walls, and foundations shed water effectively helps to control leaks. Absence or deterioration of flashing is a common building deficiency associated with water leakage through the building envelope. Flashing refers to thin continuous pieces of sheet metal or other impervious material installed to prevent water from passing into a structure through an angle or joint (Figure 5.3).

When new building components such as windows are installed, they should be accompanied by pan flashing to shed water away from the wall penetrations and prevent water from entering the structure. Flashing at the base of structures should allow water that has been repelled by the flashing to escape the plane of the building surface. The principle of flashing should be extended to all penetrations in structures. In other words, all of them should be sealed to prevent moisture as well as pest incursion into the living space.

Maintaining proper grading around a foundation and preventing erosion that can lead to pooling of water helps prevent moisture intrusion into

Figure 5.3 Window Flashing

❺ Overlap successive weather-resistive barriers in shingle fashion

❹ Install head flashing and overlap with upper window barrier strip

❷ Install side window barrier strips

❸ Install window

❶ Install lower barrier strip over weather-resistive barrier installed to underside of opening
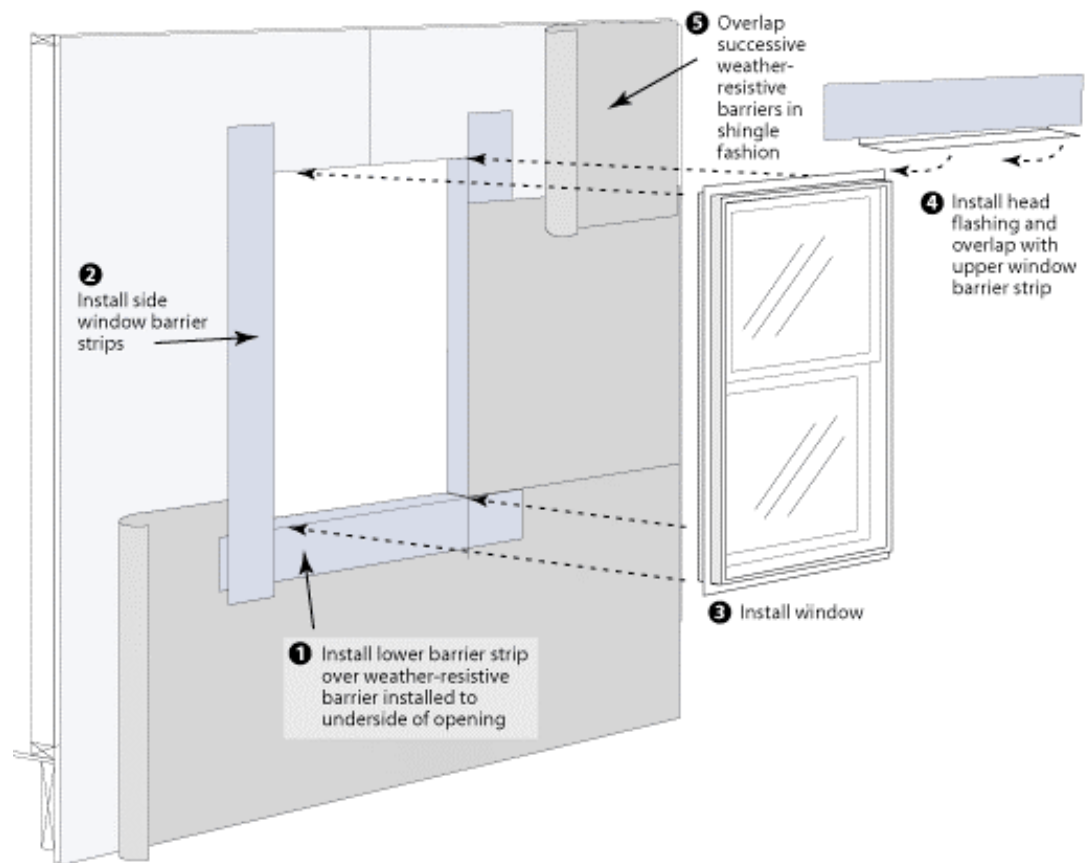
Source: http://www.energysavers.gov/your_home/windows_doors_skylights/index.cfm/mytopic=13470

basements and reduces the need for expensive foundation waterproofing and excavation. This practice also promotes the durability of the structure by reducing the prospect of settling, which can sometimes lead to cracks. Specific interventions are discussed below.

- In new construction, install capillary breaks around interior foundation walls to prevent water from "wicking" up from the ground and into the building through capillary action. Capillary breaks can also be installed in existing construction. Capillary breaks are needed to prevent vertical moisture movement, such as from the foundation wall up into the wall or floor framing (only practical in new construction) and horizontal moisture movement, such as soil moisture moving through the foundation wall into the basement or crawl space. This is accomplished by water-proofing or damp-proofing the exterior side of the foundation wall during construction. While usually very expensive to carry out as a retrofit, it is sometimes the most cost-effective

way to control moisture in existing homes when combined with perimeter drainage and proper grading away from the structure. Construction information on capillary breaks is available in EPA's Indoor airPLUS construction specifications (epa.gov/indoorairplus/construction_specifications.html).

- In existing structures, a retrofit with French drains or other means of diverting water away from foundations may be needed.

- Gutters and downspouts should drain water from the roof to the ground with no breaks in the system. Drainpipes or splash blocks should redirect water from the downspouts away from the foundation, but care should be taken not to direct the water near the foundation of the neighboring building.

- Planter boxes, decks, or other outdoor structures should be placed so that they do not obstruct rainwater flow or snowmelt from the foundation (Appendix 5.1).

Condensation can occur when warm, moist air comes in contact with a cold surface. This can lead to mold and other problems, creating health hazards and building decay. Sometimes condensation occurs within walls, ceilings and floors that separate the outside unconditioned air from the conditioned air inside the structure as warm moist air travels through the cavity. Crawl spaces, attics, and exterior walls can be affected. In some cases a vapor retarder (often called a vapor barrier) is recommended to inhibit condensation from the movement of moisture-laden air into walls, ceilings, and floors. Placing a heavy plastic sheet on the bare ground in a crawl space, carefully sealing any seams, and sealing the plastic to the foundation can minimize moisture movement from the crawl space into the structure.

Note that vapor retarders require careful thought. If an insulated wall has materials on both the interior and exterior surfaces that retard vapor movement, moisture can become trapped within the wall cavity and cause a serious problem. Walls should be designed so they dry in at least one direction.

Similarly, cold water pipes located in areas where the air is warm should be insulated to prevent condensation. One way of detecting this problem is to look for areas of discoloration where condensation from pipes has dripped onto a lower surface. The same principle applies to ductwork that carries warm or cold air through air zones with a high temperature gradient. Ductwork should be sealed and well insulated in unconditioned spaces to prevent

condensation. Insulation should be applied to the exterior of the ductwork, not the interior. While insulation of ductwork is a simpler matter in new construction, poor insulation of ductwork in existing housing can result in condensation inside ductwork and become a significant breeding ground for mold and other biological agents.

Ensure that windows are adequately installed, caulked, and insulated to prevent condensation—a cause of both mold and lead-based paint failure. Replacing old single-pane windows with modern double- and triple-pane windows can effectively eliminate window condensation problems. This intervention may be cost-prohibitive for healthy homes programs unless funds can be leveraged through partnerships, from lead hazard control and/or weatherization programs, or the private sector.

Reduce moisture sources with high quality exhaust fans in bathrooms and kitchen, and proper venting of dryers, to substantially reduce the likelihood of condensation on windows or walls. Finally, eliminate insulation voids in walls and ceilings since cold interior wall surfaces in the winter can lead to condensation and mold.

Prompt Repair of Plumbing Leaks

How water and moisture leave a home are as important as how they enter. Plumbing is often overlooked as a significant source of moisture because leaks can be slow or undetected. Drain traps can degrade or dry over time if the drain trap is not kept full of water. Basement floor drain traps should be kept full by adding water periodically to prevent harmful soil and/or sewer gases from being emitted.

Safe Cleaning or Removal of Wet or Moldy Items

Failure to correct the source of moisture that produced mold contamination guarantees the eventual failure of mold remediation efforts. There are established procedures for safely removing wet and moldy building materials and furnishings, typically involving minimizing the disturbance of such materials to prevent mold spores from becoming airborne.[14, 15, 16] Projects requiring large areas of mold decontamination (e.g., more than ten square feet) may warrant the use of a mold mitigation professional. Improper

solutions, such as blowing air over mold contaminated items, can increase exposures and may do more harm than good. Individuals attempting to mitigate mold problems should be trained to prevent exposure to mold during the elimination process through the use of respiratory, eye and skin protection equipment.

Appropriate Design, Installation, and Management of Heating, Ventilation, and Air Conditioning (HVAC) Systems

Many kitchen fans in older homes simply recycle air coming from stoves and ranges rather than vent it to the exterior of the building. Some current building codes for new construction require that kitchen range hoods be exhausted to the outside. Check by looking above the fan or range hood to see whether there is ductwork and examining the exterior wall for a flap that would exhaust the air. Installers often forget to remove the manufacturer's tape on the flap, so it is important to ensure that the flap is not only present but functioning properly. Bathroom exhaust fans and clothes dryers must be vented to the outside.

In general, a home's relative humidity should be kept in the 30–50 percent range. Filters in clothes dryers, kitchen ranges, furnaces and bath exhausts should be cleaned and/or replaced to ensure air flow is adequate and moisture does not accumulate on the dust in the filters. Instructions on when and how to clean and replace filters properly should be part of a program's education intervention strategy.

Air conditioning or dehumidifying systems need to be checked regularly and cleaned to ensure that condensate drains do not become blocked. Blockage results in leaks from the drainage pans onto surfaces that may not be visible. Condensate pans should be properly sloped so that water runs to the drain and does not pool in other areas. Cooling coils need to be kept clear and clean to prevent blockage as well as prevent high fuel consumption due to lower heat transfer. Homeowners/residents or maintenance personnel can take care of this for window air conditioners, but for central air conditioning systems, a licensed contractor is generally needed.

Some heating, ventilation, and air conditioning systems (HVAC) are equipped with humidifiers,

especially in northern climates where indoor winter air becomes dry. In other cases, individual rooms may be equipped with portable humidifiers. In both cases, the water supply, water tank, and water wheels or other distribution systems should be kept clean. If the systems are not used for some time, they can become breeding grounds for biological agents, including mold, bacteria, and viruses. Very dry conditions in the house may be due to dry cold air entering the home during the winter. Proper air sealing may remove the need for a humidifier.

If an area has become wet, drying is typically the first step in remediation after eliminating the moisture source (Figure 5.4). However, some forms of drying can exacerbate the problem. Blowing high-velocity air streams over surfaces contaminated with extensive mold can cause mold spores and fragments to become airborne, where they can be inhaled readily or contaminate other surfaces. Use of dehumidifiers, personal protection and other measures can help to avoid these problems. In some cases, it may be necessary to discard contaminated items that cannot be properly cleaned. If the extent of damage is extensive, trained professionals should address the problem. It is equally as important to identify the moisture source and to make needed repairs to prevent reoccurrence. During catastrophic water events (e.g., pipe breaks, water heater failure, flooding), time is of the essence. Typically, water needs to be removed within 24–48 hours, after which mold begins to develop. Many restoration companies are now available to extract water following a flood using dehumidifiers, fans, and other tools.

Figure 5.4 Remediation Guidance

Mold and moisture remediation guidelines are available from the following organizations:

- EPA: http://www.epa.gov/mold/moldcleanup.html.

- New York City Health Department: http://www.nyc.gov/html/doh/html/epi/moldrpt1.shtml.

- AIHA: http://www.conferencemedia.net/store/stores/aihce/american-industrial-hygiene-conference-and-expo-2009/perspectives-on-the-aiha-green-book.html.

Figure 5.5 Unhealthy Heating System Using Basement Air
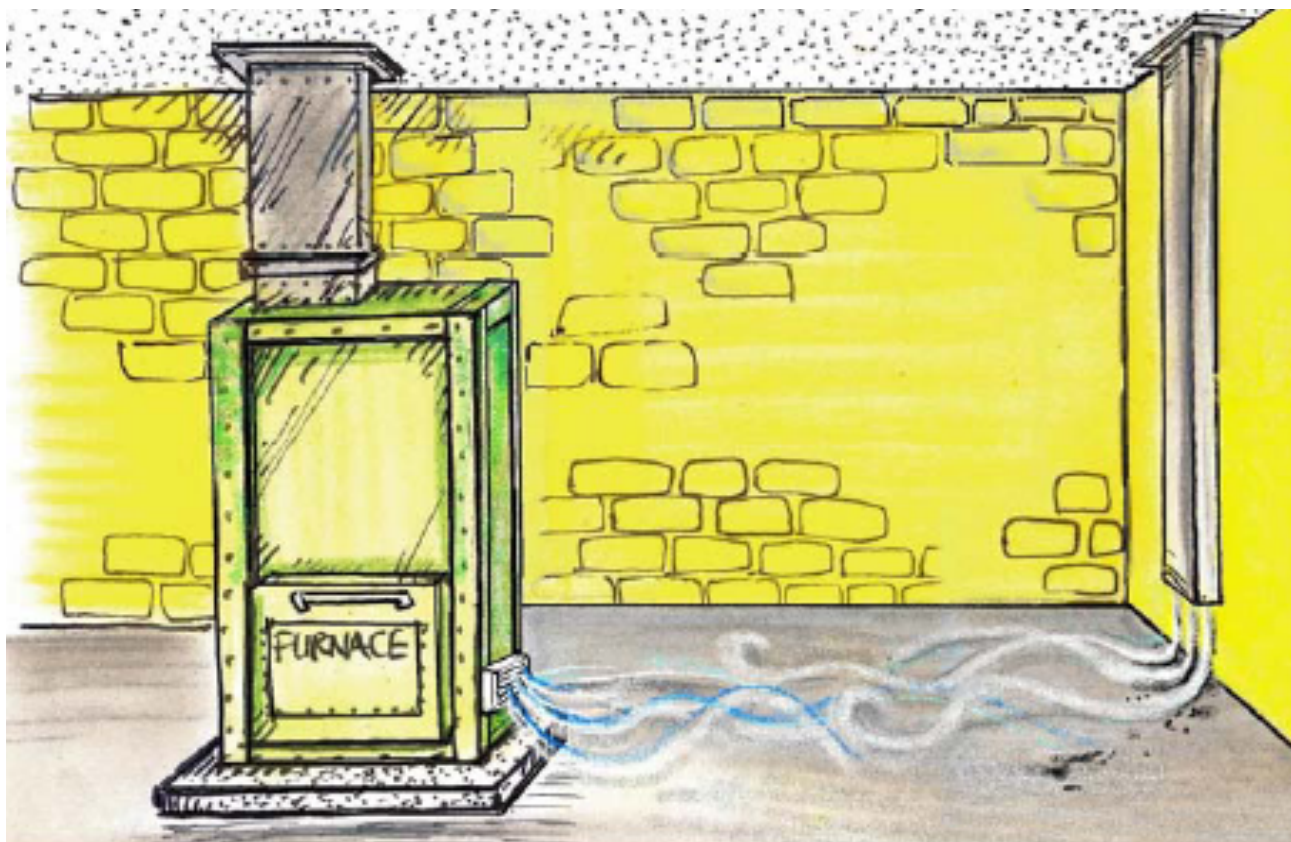
The illustration shows returning air entering the basement air, then supplying the furnace with air distributed throughout the house. Figure 5.6 shows a simple fix that avoids contamination of supply air.

For some moisture problems, changes to the HVAC system may be needed. For example, a ventilation system that draws air from a moist basement instead of a living area may result in dispersing moisture and mold throughout the house (Figures 5.5 and 5.6). This type of system is sometimes called "the Cleveland Drop" because it was first identified in a number of Cleveland-area houses that were investigated for mold and moisture problems. A solution is to ensure that the air supplying the furnace is supplied from the exterior or from a living area, rather than the basement. Leaky ductwork can also lead to problems because it may draw in air from unconditioned spaces. Ductwork should be sealed to prevent such leaks. For new construction, information is available in EPA's Indoor airPLUS construction specifications: www.epa.gov/indoorairplus/construction_ specifications.html.

Reporting Moisture and Leak Problems

Owner occupants and renters should be encouraged to conduct regular visual assessments to identify leaks and condensation. Tenants need to have confidence that requests for minor repairs and reporting maintenance needs are taken seriously or they will fail to report problems when they are relatively easy to correct. Tenant failure to promptly report problems and property owner failure to respond represent major problems in economically distressed rental housing. Clarifying roles and expectations and providing incentives for responsible behavior are important tools for healthy homes programs.

Principle #2: Keep It Ventilated

A number of housing defects and conditions leading to health problems can be corrected by

Intervention Strategies

Figure 5.6 Healthy Heating System Using Outdoor Air or Air From Living Spaces
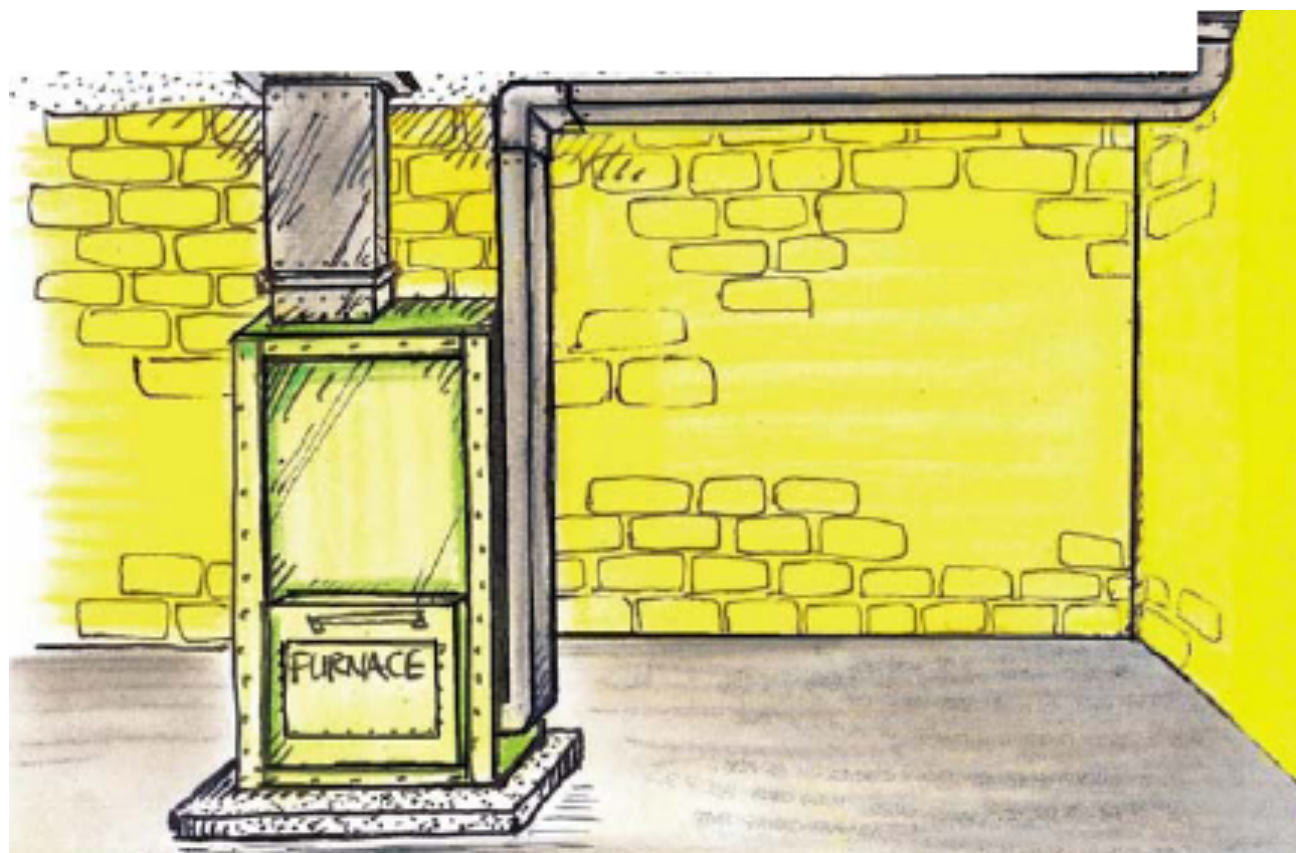
Figures 5.5 and 5.6 courtesy of Environmental Health Watch/Cuyahoga County Board of Health, Cleveland, Ohio

proper ventilation. However, source control—eliminating certain products or selecting materials that have low emissions, thereby limiting the chemicals released into the air we breathe—should precede any changes to ventilation. Using building materials, carpeting, and furnishings that have no or low levels of formaldehyde or other VOCs is recommended. The California Air Resources Board has rules limiting the amount of formaldehyde that off-gases from building products such as pressed wood and particle board.[17] Some sources of hazards, such as radon, however, can only be controlled by specialized systems.

Review of the Evidence

As noted under Keep It Dry, ventilation is usually critical to moisture control. Failure to provide adequate fresh air supply and proper distribution can also lead to a variety of adverse health conditions. Two recent studies, one related to new construction and the other to housing rehabilitation, demonstrate that statistically significant health improvements can be associated with improved ventilation when conducted in association with other building improvements.[18, 19] Standards for applying ventilation to the home can be found in American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standards 62.1 and 62.2.

Figure 5.7 Ventilation Interventions

- Remove airborne contaminants through proper exhaust ventilation.

- Supply fresh air through dilution ventilation.

- Test for and conduct radon remediation as needed.

Structural Interventions

There are two types of structural interventions: (1) local exhaust ventilation to remove pollutants created at a source, such as moisture vapor from a bathroom or cooking fumes from a kitchen range; and (2) general ventilation for the whole house that helps lower pollutant levels. Local exhaust ventilation systems capture a contaminant and remove it before it enters the entire housing unit. General ventilation provides fresh air to reduce the chance that concentrations of contaminants raise to hazardous levels. Houses should have both types of ventilation.

Local Exhaust Interventions

All kitchens and bathrooms should be equipped with exhaust systems to remove moisture and odors. Although some building codes permit windows to be used for ventilation, windows are unlikely to be open during the cold winter or hot summer months. Exhaust systems are therefore best practice. Local systems should be exhausted to the exterior, not into a building chase, attic, basement, crawl space or wall cavity. All clothes dryers should be exhausted to the exterior. Energy conservation devices that permit warm moist air from clothes dryer exhaust to be re-circulated back into the house should not be used.

All combustion burning appliances, such as fuel-fired space heaters, water heaters, furnaces, boilers, fireplaces, and gas ranges/ovens should exhaust to the exterior. If new equipment is installed, it should be direct-vent or power-vented equipment. A direct vent uses a double pipe to carry both exhaust and supply air (Figure 5.8). When additional exhaust systems are installed, the supply air (makeup air) should be installed or planned. If no makeup air is provided, serious problems can occur from the creation of negative pressure within the home.

General Dilution Ventilation and Heating System Interventions

Ventilation systems should first ensure that the supply air is contaminant-free and does not pass over standing water or use air from garages or high traffic areas. When dilution ventilation systems for fresh air are designed or retrofitted,

Figure 5.8 Direct Power Vent Increases Energy Efficiency and Helps Avoid Back Drafting Problems

Figure 5.9 Air Handler Filter Ratings

they should comply with standards established by ASHRAE. Standard 62.1 is the standard for multifamily buildings and 62.2 is for low-rise and single-family dwellings. ASHRAE recommends the amount of fresh air needed based on the size of the building and number of occupants. Heat recovery systems can decrease the energy needed to temper fresh air. A high efficiency heat recovery system transfers the heat in exhausted air to the incoming untempered fresh air supply to reduce added energy costs.

Air filters in ventilation systems need to be changed frequently because a dirty filter reduces air flow. Furnace filters that remove small particles more efficiently are now available and rated by ASHRAE according to their Minimum Energy Rating Value (MERV) (Figure 5.9). MERV ratings of 5–8 mean that the filters control the majority of particles of 3 microns or greater in size. However, particulates smaller than 2.5 microns are now subject to EPA regulation in ambient air and include asthma triggers such as environmental tobacco smoke.

Programs should select the MERV-rated filter geared to indoor air contaminants that trigger asthmatic reactions and meeting manufacturers' recommendations. Ideally, your program should consider recommending a filter with a MERV rating above eight, depending on the capabilities of the air handling system. Check with the equipment manufacturer or HVAC contractor to make sure the new filter will not put excess strain on the system or create negative pressure problems.

Principle #3: Keep It Pest-Free

Pests are an important health issue for many residences, but can be particularly troublesome in multifamily housing where infestations can quickly spread from one unit to the next. Pesticides, while sometimes helpful, also pose risks. Pests can be managed more effectively with fewer pesticides through Integrated Pest Management (IPM) (Figure 5.10). IPM is an integrated preventive approach that targets conditions conducive to pests rather than simply treating the symptoms (i.e., pests) with pesticides. In short, IPM:

- Is more effective at eliminating pests.

- Prevents pest infestations in the future.

- Is expected to reduce pesticide exposures to residents and staff, which is important to children, older adults and chemically sensitive individuals.

- Can save time, money and energy.

- Can improve quality of life for residents.

Figure 5.10 Principles for Keeping It Pest-Free

- Educate residents/tenants

- Reduce moisture

- Remove harborages

- Eliminate food sources

- Use low toxicity pesticides as needed

- Monitor

Principles of Integrated Pest Management (IPM)

IPM is a common-sense approach to managing pests while reducing use of harmful pesticides. It focuses on getting rid of the food, water and shelter that pests need to survive. IPM works because integrated approaches for pest management are more effective in the end than a single one like spraying pesticides. IPM is always a team effort among the building manager, landlord, maintenance staff, residents, and pest management professional. Everyone has a role to play and must communicate and cooperate.

As a decision-making process to manage the control of pests and disease vectors,[20] IPM is a departure from the traditional practice of trapping, spraying, and poisoning. In addition to other factors, it uses the least toxic pesticides in a way that controls human exposures to possible harm. For example, use of gel baits to kill cockroaches along with sealing cracks and crevices are often key components of IPM. It considers the behavior and ecology of the specific pest, where it is active, and how environmental changes may influence the pest. In so doing, IPM has a strong educational component because the environment includes the behavior of occupants. Education is indeed a critical component, and the evidence to date documents that IPM is effective in controlling pests, reducing exposure to pesticides, controlling pest access, reducing moisture, and is equivalent to or costs less than traditional pest control methods over the long term. Figure 5.11 lists key elements of IPM.

Review of the Evidence

Several rigorous studies have demonstrated the effectiveness of IPM in reducing exposure to cockroaches.[21, 22, 23] Arbes found that roach allergen levels were significantly reduced in beds and kitchens with IPM, and the levels in the beds dropped below thresholds for both asthma sensitization and exacerbation. Wang and Bennett showed a significantly greater decrease in roach counts with IPM compared to gel bait alone. Miller and Meek found that while IPM was initially more costly, it was much more effective in reducing cockroaches compared to

Figure 5.11 Key Elements of Integrated Pest Management

HUD's Office of Public and Indian Housing Notice PIH-2007-12 (HA) defines the key components of an IPM program as:

- Communicating the Housing Authority's IPM policies and procedures to all building occupants, administrative staff, maintenance personnel, and contractors.

- Identifying (1) pests and (2) environmental conditions that limit the spread of pests, including the presence of pests' natural enemies.

- Establishing an ongoing monitoring and record keeping system for regular sampling and assessment of pests, surveillance techniques, and remedial actions taken, including establishing the assessment criteria for program effectiveness.

- Determining, with involvement of residents, the pest population levels—by species—that will be tolerated, and setting action thresholds at which pest populations warrant action.

- Improving sanitation, waste management, mechanical pest management methods, and/or natural control agents that have been carefully selected as appropriate in light of allergies or cultural preferences of staff or residents.

- Monitoring and maintaining structures and grounds (e.g., sealing cracks, eliminating moisture intrusion/accumulation) and adding physical barriers to pest entry and movement.

- Developing an outreach/educational program and ensuring that leases reflect residents' responsibilities for (1) proper housekeeping; (2) reporting presence of pests, leaks, and mold; and (3) cooperating with specific IPM requirements such as obtaining permission of Housing Authority management before purchasing or applying any pesticides.

- Enforcing lease provisions regarding resident responsibilities such as housekeeping, sanitation, and trash removal and storage.

- Using pesticides only when necessary, with preference for products that, while producing the desired level of effectiveness, pose the least harm to human health and the environment, and, as appropriate, notifying management before application.

- Providing and posting "Pesticide Use Notification" signs or other warnings.

Also see: GSA Guidelines for Structural Pest Control Operations: http://schoolipm.ifas.ufl.edu/doc/bus_prac.html

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traditional pesticide treatment.[24] Useful case studies describing successful IPM programs in affordable housing can be found at: http://www.healthyhomestraining.org/ipm/Studies.htm.

Different types of pests depend to some extent on climate, locale, and type of building. However, the methods of detecting pests are fairly similar and are described in Chapter 4. Most states require that pesticide applicators be trained, certified, and licensed. Contract specifications, standard operating procedures, landlord and tenant training videos and educational materials are available at: http://www.bphc.org/programs/cib/healthyhomescommunitysupports/healthyhomes/healthypestfreehousing/Pages/Home.aspx or from http://www.stoppests.org.

Structural Interventions

Typical structural modifications used in implementing IPM include the following:

- Copper mesh screens to seal holes. Steel wool may rust and should not be used.

- Use of low VOC caulks or sealant to seal penetration openings, which also prevents moisture infiltration.

- Correction of all water leaks.

- Use of trash cans with tight-fitting lids.

- Regular cleaning of trash chutes.

- Elimination of exterior harborage, including sealing rat burrows and placing trash

dumpsters on concrete pads at least 50 feet away from the building.

- Information on controlling bedbugs can be found in the National Center for Healthy Housing report: What's Working for Bed Bug Control in Multifamily Housing: Reconciling best practices with research and the realities of implementation, which can be found at http://www.nchh.org/Portals/0/Contents/Bed_Bud_Report_2=12-10.pdf.

Rental Policies and Use of IPM Professional Services

In addition to structural modifications, programs need to establish guidelines for rental property owners and property managers about which services will be provided for pest management, responsibilities of maintenance staff in the short-term, and conditions under which trained IPM professionals should be engaged. Practices, roles and responsibilities vary by locality. However, all healthy homes programs should have guidelines addressing the following issues.

- Define who is responsible for applying low-toxicity pesticides (such as boric acid) along insect runways.

- Determine whether the program or property owner/property management firm will supply trash cans for tenants' use. Some programs have provided trashcans with tight-fitting lids for interior use by tenants.

- Establish a monitoring system to ensure the effectiveness of IPM. A monitoring system

Environmental Health Watch, a nonprofit organization in Cleveland, Ohio that is involved in community environmental health programs, reports that when tenants observe the immediate effect of flushing and vacuuming cockroaches, they are motivated to improve their daily cleaning practices. In many cases, residents whose homes have a history of pest problems feel it is useless to try to do anything. However, once they see results, they are willing to establish partnerships and accept division of labor to deal with pest management.

typically includes observation of sticky traps to determine if pests are re-emerging.

Pest management professionals should be used and can be certified by Green Pro, Green Shield Certified, or Eco-wise (see http://www.healthy-homestraining.org/ipm/PMP_comparisons.htm).

Principle #4: Keep It Safe

Key Principles of Injury Prevention

Fatal and nonfatal injuries are often caused by structural and other housing deficiencies ranging from construction, design, and installation issues as well as lack of monitoring or maintenance. Structural deficiencies in a home can account for falls, smoke inhalation from fires, burns and scalds, carbon monoxide and other forms of poisoning, drowning, and other injuries. See Figure 5.12 for ways to prevent certain injuries.

Healthy homes programs should focus on populations at greatest risk, including children and older adults. While safety hazards can exist in any home, other threats may be seasonal or regional in nature. For example, swimming pool risks may be higher in summer. Disaster preparedness in the home may take on added importance during tornado or hurricane season. While infrequent, healthy homes programs should help prepare the families for these emergencies throughout the year. Programs in earthquake-prone areas may need to consider other actions.

Figure 5.12 Principles for Keeping It Safe

- Educate residents/tenants.
- Prevent falls by installing railings on stairways and grab bars in bathrooms.
- Keep hot water temperature maximum at 120 degrees.
- Ensure that smoke and carbon monoxide alarms are working and in the right locations.
- Store chemicals and medicines properly.

Falls

Review of the Evidence

Falls account for 45 percent of all injuries in the home that require medical attention.[26] Residential injury-related deaths for persons aged 65 years and over account for approximately 60 percent of all household deaths due to falls.[27] Structural residential hazards associated with falls among older adults include lack of handrails on stairs, lack of grab bars and non-slip surfaces in the bathroom, tripping or slipping hazards (e.g., throw rugs without nonskid backings), waxed flooring, inadequate lighting, and the presence of electrical or telephone cords in the walkway.[28] Individual behaviors and physical ability levels also are important factors contributing to falls among older adults.[29]

Falls also are a major cause of nonfatal injury in children and result in an estimated 2.7 million emergency room visits each year.[30] Residential structural hazards associated with falls among children include a lack of safety devices such as safety gates and window guards, uncarpeted or concrete floors, missing or damaged window locks or catches, structural defects (e.g., inadequate spacing and height of railings, lack of handrails), and insufficient lighting over stairs and in other areas.[31]

There is evidence that certain structural modifications, such as installation of handrails, grab bars, and improved lighting, can reduce falls among older adults.[32, 33] Home modifications, including installation of stair rails, non-slip mats, and night lights, resulted in 30 percent decrease in falls compared to homes receiving no modifications. Additionally, handrail installation and improved floor coverings resulted in a 10 percent decrease in falls.[34] Yet another study showed that installation of grab bars and improved lighting also resulted in significantly fewer falls.[35]

A community-wide program to provide window guards in high-risk apartments demonstrated that window guards reduce childhood morbidity and mortality from falls. Falls declined 50 percent in the two years after the program's inception.[36] There is also a reduced risk of injury in homes with fitted stair gates and other safety devices.[37] A review of 37 studies showed that home education produced a statistically significant increase in the odds that a home would have a fitted stair gate and a modest, non-significant increase in the prevalence of installed window locks and other window guards.[38] Building codes that require window guards, safe stair and balcony design, and other modifications are likely to be effective for fall prevention.

Proper lighting has also been associated with reductions in falls and also in depression.[39] Installation of nonskid surfaces, such as abrasive strips on porch steps and use of throw rugs with nonskid backings, can help to prevents skids and falls.

Figure 5.13 Grab Bars, Window Guards, Stair Railings, and Stair Gates.

Grab bars can help to prevent falls in showers and baths.

Window guards help to prevent falls.
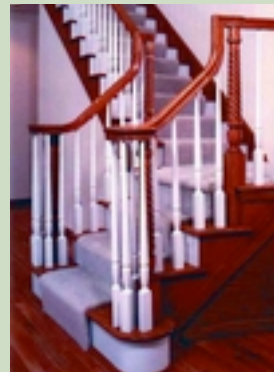
Stairs should have properly designed hand rails.

Stair gates can help to prevent falls by young children.

Intervention Strategies

Structural Interventions

Before implementing structural changes, programs should consult local codes to ensure that the modification does not conflict with local laws and regulations. Programs can reduce fall hazards by adopting the following protocols:

- Ensure that interior and exterior stairs and railings are in good repair. Ideally railings should be continuous (i.e., no breaks in the railings from one stairwell to the next) and they should be located on both sides of the stairwell.

- Install window guards and safety gates for households with young children.

- Install grab bars in baths, showers, and near toilets for households with older adults.

- Ensure that toilets, showers, and bath entries are at an appropriate height.

- Use nonskid surfaces in bathrooms.

- Increase lighting in stairwells, entryways, and hallways/passageways.

A home safety checklist for preventing falls can be useful for resident education, and is discussed at the end of this chapter.

Burns and Scalds

Review of the Evidence

In 2006, U.S. fire departments responded to 412,500 residential fires that resulted in 2,580 deaths, 12,925 injuries, and nearly seven billion dollars in property damage (Figure 5.14).[40] Groups at increased risk of fire-related injury and death include infants and young children (0–4 years) and the elderly (75 years and older), African Americans, Native Americans, low-income Americans, rural residents, and those living in manufactured (e.g., mobile) homes and substandard housing.[41, 42] The lack of functioning smoke alarms near or inside bedrooms and on every floor of a house, and lack of adequate escape routes in the event of a fire[43, 44] are the primary residential hazards associated with fire-related injuries. Other important causes of fire-related injury include faulty wiring, defective appliances, misuse and poor maintenance of electrical appliances, lack of arc fault circuit interrupters (AFCIs), and overloaded circuits and extension cords.[45]

Structural Interventions

Smoke alarms. Installing working smoke alarms is one of the most important intervention strategies to prevent fatalities and burns from fire (Figure 5.15). Be sure to consult local building codes.

Numerous studies demonstrate that working smoke alarms in the home reduce death and injuries from residential fires.[46, 47, 48, 49] Homes with working smoke alarms have a 40–50 percent lower fire death rate compared to homes without working smoke alarms.[50] A total of 70 percent of all home fire deaths occur in homes without working smoke alarms.[51] To have "working" smoke alarms, they must be properly located (outside sleeping rooms on each level) and properly and regularly maintained by replacing batteries at established intervals. Installing hard-wired smoke alarms (with a battery back-up) or alarms with sealed, ten-year lithium batteries is preferable as they reduce the need for annual maintenance. Fire extinguishers should be present and checked at least yearly.

Figure 5.14 Fire Facts

Residential fires resulted in over 2,500 deaths, nearly 13,000 injuries, and $7 billion in property damage in 2006. Many fatalities and burn injuries can be prevented by use of properly placed smoke alarms, implementing evacuation plans and installing anti-scald and anti-burn devices.

Figure 5.15
Smoke and Carbon Monoxide Alarms
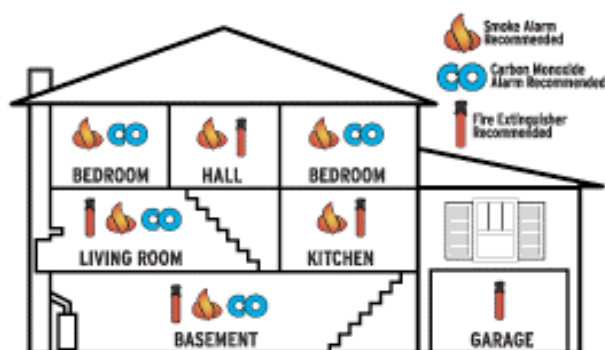
Evidence points to findings that education combined with community-based installation of smoke alarms reduces fire-related injuries in high-risk homes.[52] Further, community-based programs that install smoke alarms are significantly more effective than community-based programs that give away smoke alarms but do not install them.

Healthy homes programs should recommend that families adopt and practice a formalized fire escape plan, including alternative means of egress, particularly from upper floors (see Figure 5.16). The plan should include a nearby but offsite regrouping meeting place.

Temperature controls for water heaters. In 1997, an estimated 12,400 children were scalded, nearly a quarter of the burns caused by hot tap water.[53] Most scald-related deaths occur in children younger than four years old.[54, 55] Other

high-risk groups include the elderly and those with physical or mental disabilities.[56] Scald burns commonly occur from contact with hot foods or liquids and hot tap water, and are typically more severe from hot tap water. Most occur in the bathtub or shower, but may also occur in the kitchen or bathroom sink. Primary residential deficiencies associated with scalds include lack of anti-scald devices for showerheads and faucets (see Figure 5.17) and water heater thermostats set above 120° F.[57] New hot water heaters may be pre-set at higher temperatures and service companies may reset temperatures at higher levels than appropriate.

In addition to keeping water heater temperatures below 120° F, healthy homes programs should recommend installation of safety knobs for stoves and ovens to prevent burns (Figure 5.17).

Other Safety Interventions

Poisoning. Injuries and fatalities can stem from improper storage of household chemicals and medicines. When young children are present, cabinets should be equipped with childproof locks (Figure 5.17).

Residents should not use portable fuel-fired electrical power generators indoors because of carbon monoxide exposure. Stoves and ovens should not be used to heat the home. Attached garages should be sealed and/or placed under slight negative pressure with respect to the living space. Some observers advocate housing codes changes that require exhaust fans in garages. Healthy homes programs support all these

Figure 5.16
Fire Escape Plan

Example of a fire escape plan.
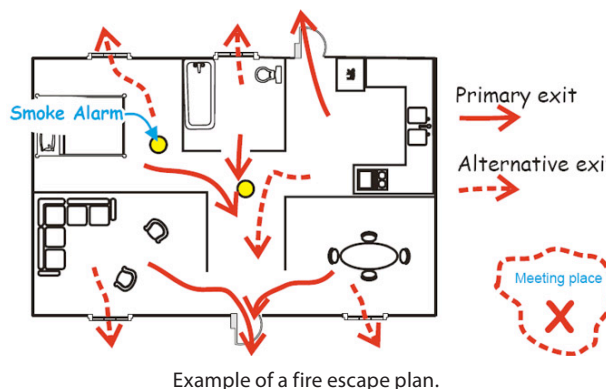
Figure 5.17 Anti-Scald Hot Water Faucets, Oven Knob Covers and Cabinet Locks

Intervention Strategies

measures, plus installation of carbon monoxide alarms which can be located next to smoke alarms and are often available as a single device.

Carbon monoxide alarm. Similar to smoke alarms, carbon monoxide alarms should be placed on each floor of the house and adjacent to bedrooms.

Choke hazards. Securing ends of window curtain pull strings so that they are out of reach of children is an inexpensive yet effective measure to prevent choking hazards. Cord wind-ups are a simple intervention as well as cutting loops in pull strings a no-cost strategy for preventing strangulation.

Drowning and Pool Fencing. An average of 823 drowning deaths (across all ages) occurs in or on home premises yearly.[58] In 2004, for every child under 15 years who died from drowning, five additional children received emergency room care for nonfatal submersion injuries, which can result in brain damage and long term disability.[59] The risk of drowning is also high for adults 70 years and older. Forty-five percent of drowning cases occur in swimming pools and 33 percent in bathroom tubs and showers. Primary structural deficiencies associated with residential drowning include lack of barriers (e.g., having an unfenced

or uncovered swimming pool) and lack of pool or door alarms.[60] Drain vents for pools should always be kept clear. Four-sided (fully-enclosed) pool fencing significantly reduces childhood drowning (see Figure 5.18) [61, 62, 63, 64] and performs significantly better than three-sided perimeter fencing. Note the pool fence with wire mesh that completely surrounds the pool in Figure 5.18. The height of the fence should comply with local codes.

Firearms control and security systems. Healthy homes programs should include information on keeping firearms and ammunition in a secure location away from children and teens. Owners should use trigger locks and store ammunition separately. This general rule also applies to knives, bows and arrows, and tools.

Home safety and disaster planning. Healthy homes programs should provide information on key components of a home emergency kit that can be easily transported in the event of evacuation. There are also materials available on what occupants can do to protect themselves during cleanup following floods, hurricanes, and other natural disasters. Arrange a place for rapid dissemination of such materials if such a disaster strikes. The Federal Emergency Management Agency provides information on disaster planning at www.fema.gov/plan/index.shtm.

Figure 5.18 Fully Enclosed Pool Fencing

Principle #5:
Keep It Contaminant-Free

Asbestos

Inhalation of asbestos fibers causes cancer. If asbestos is maintained in an intact, non-friable condition within materials and is not disturbed, there is no opportunity for exposure. Typically, asbestos remediation takes place when there is a danger of fibers being released into the air. The remediation involves, either controlling airflows by putting the area under negative pressure and/or using glove bags or other containment systems that prevent fibers from getting into the air. Common sources of asbestos include pipe and boiler insulation, floor tiles, siding, vermiculite insulation, and roofing materials. Respiratory protection, proper waste disposal and special cleanup procedures, and air sampling are all part of asbestos abatement jobs. Individuals performing such tasks must be trained and certified. More information is available at http://www.epa.gov/asbestos/pubs/pubs.html.

Lead-based Paint Hazards

Reducing exposure to lead-paint hazards can be accomplished by numerous methods, including abatement and interim controls, such as keeping lead-based paint intact, covering bare soil with mulch, plantings, or other coverings, or hiring certified firms and workers to handle renovation, repair, and painting work in older housing. Lead-safe work practices and other methods of controlling lead-based paint hazards are detailed elsewhere[65, 66] (see the "Keep It Maintained" section below).

Combustion Products

Combustion by-products include carbon monoxide, oxides of nitrogen, particulates and other substances. Proper exhaust ventilation for combustion sources, including adequate makeup air, helps minimize entry of these gases into the living space (see ventilation section). Attached garages should be air sealed between the living space and garage. Carbon monoxide alarms will also help prevent harm from combustion products (see safety section). Regular servicing and maintenance of furnaces is essential because cracked heat exchangers are a source of combustion by-products.

Stoves should not be used for heating and all fuel burning appliances should be vented to the outside.

Volatile Organic Compounds (VOCs)

VOCs are a class of carbon-containing chemicals that become gases at room temperature and, when inhaled, can produce a variety of adverse health effects. Examples of VOCs include toluene, benzene, methyl ethyl ketone and paradicholorbenzene. They are present in cleaners, adhesives, carpets, air fresheners, mothballs and many other home products. To the extent possible, exposure to VOCs should be minimized by controlling or eliminating the sources. For example, air fresheners merely add these substances to indoor air without providing a benefit, and can conceal odors that indicate problems that should be addressed. Healthy homes programs should advise residents not to use air fresheners indoors.

Exposures to some substances like formaldehyde can produce sensitization, making even low levels of future exposures risky to health. (See ventilation section above for more detailed information.)

Products and substances containing VOCs, particularly fuels, gasoline, paint thinners, and paints, should be stored in well-ventilated exterior locations, not inside the building. If this is not feasible, then such products and substances should be stored in a place that is sealed to the living area. In all cases, they should be stored in airtight containers. Old paint, banned pesticides, and other products that will not be used should be disposed of properly. Most local jurisdictions have household hazardous waste disposal locations.

> ### Figure 5.19 Principles to Keeping It Contaminant-Free
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> - Safely address lead-based paint hazards.
> - Be aware of volatile organic compounds when making purchases.
> - Control occupational take-home hazards.

Radon Control

An EPA review of radon mitigation studies concluded that 97 percent of houses with high baseline radon level (76 percent had baseline radon level ≥ 10 picoCuries per liter (pCi/L) could be remediated with active soil depressurization systems to less than 4 pCi/L.[67] A national survey showed that 95 percent of remediated homes had < 4 pCi/L, and 69 percent actually had < 2 pCi/L (n=238 houses) levels.[68] The durability of these active systems has been assessed in relatively small studies, with the exception of one that showed 95 percent of houses had < 4 pCi/L levels 18 months after installation.[69] Another found that 11 of 13 houses evaluated had levels below 4 pCi/L two years after installation.[70]

A qualified or licensed contractor is necessary to guarantee proper installation of the various radon mitigation systems. Many national and local green building standards now include radon-resistant elements.

Passive radon mitigation. Passive radon mitigation techniques are used most often in new construction. A passive system is comprised of a pipe that runs from beneath the foundation slab up thorough the house (usually in a wall void) to above the roof where the radon gas vents. This system may not be effective in consistently reducing indoor radon level to less than 4 pCi/L. These systems are described in greater detail by EPA in Radon Reduction Techniques for Existing Detached Houses: Technical Guidance (Third Edition) for Active Soil Depressurization Systems.[71] While sealing cracks and other openings in the foundation reduces the loss of conditioned air and makes other radon reduction techniques more effective and cost-efficient, sealing has not been shown to lower radon levels significantly or consistently by itself.

Radon-resistant new construction measures should always be implemented in EPA Zones 1 and 2 as indicated on its radon map. The techniques involve the use of gas impermeable membranes at the foundation and sealing of all penetrations. Chapter 5 of the HUD/CDC Healthy Homes Reference Manual describes the installation process in detail. For new construction, details are available at: www.epa.gov/radon/rrnc/index.html.

In some instances, sealing crawl spaces, which has other benefits, increases radon levels in the home; thus, radon testing should always be done in concert with crawl space sealing. Further details are at: www.epa.gov/radon/index.html.

Active radon soil depressurization. Active soil depressurization is in most applications the most effective radon mitigation technique. It can be used in mitigating radon exposure in existing homes and installed as a system in new homes at the time of construction. It is comprised of a vent pipe with a fan in it that runs from beneath the foundation slab up (either outside or inside the home) to above the roof where the radon gas is vented. EPA's current recommended standard of practice for these systems is ASTM E 2121. Merely sealing the basement is usually inadequate due to the stack effect and also because most buildings are under negative pressure with respect to the exterior. The stack effect means that air rises from lower to higher levels in most buildings.

Particulate Matter

Inhalable particles, which can trigger asthma, can be controlled by use of efficient filters in air handlers, use of High-Efficiency Particulate Air Filter (HEPA) vacuum cleaners, elimination of "dust sinks" like older soiled carpets, adoption of smoke-free housing policies, and regular cleaning. Central vacuum cleaners, if available, are another way of reducing exposures. Although studies to date provide insufficient evidence of effectiveness, portable air cleaning devices are available for use. They have been used as part of multi-component interventions to improve asthma control for children and are appropriate to control small particles that stay suspended in the air (e.g., environmental tobacco smoke, mold spores, pet allergens). However they are not appropriate for control of larger particles such as the allergens associated with cockroaches and dust mites. Devices that produce ozone, however, should be avoided. (See ventilation section for more details on filtration of indoor air.)

Secondhand Smoke

Also known as environmental tobacco smoke (ETS), secondhand smoke is a major issue in both single- and multi-family housing. A number

of studies in non-residential settings have demonstrated the effectiveness of smoking bans in improving health and reducing exposure to ETS.[72, 73, 74, 75] Because ETS can migrate between apartments, smoking bans are particularly relevant for multifamily buildings. Research has shown that children living in multifamily housing have greater exposure to ETS, regardless of whether or not there is a smoker in the immediate household.[76] Many green building programs now include bans on smoking (e.g., Enterprise, LEED).[77] The cost of cleaning and maintaining units in which smoking has occurred is substantially greater than for non-smoking units. Adopting smoke-free policies is an effective intervention and described in detail in the "Keep It Clean" section below.

More and more landlords, property management companies and condominium associations are making properties completely smoke-free. Many take this step because they value the health of their residents; many want to reduce fire risk; and many are responding to the demand for smoke-free living. Just like prohibiting pets, landlords and associations can prohibit smoking. It is entirely legal. Simply write into your lease, "No Smoking anywhere on the property, including inside any apartment." Refer to Boston Smoke Free Homes for model lease language (bostonsmokefreehomes.org). Having smoking cessation assistance available to residents will increase the chances of success.

Occupational Take-Home Health Hazards

Healthy homes programs should include information on how exposures to toxic substances on the job can be inadvertently transferred to the home environment on clothing (especially shoes) and in family automobiles. Some OSHA standards, such as the one on lead, provide requirements for decontamination before leaving worksites. Decontamination measures include:

• Removing work shoes and or clothes if necessary before entering the family automobile or home.

• Shower immediately after arriving home

• Laundering work clothes separately from the family laundry.

Contact one of the following for more information on occupational health and take-home hazards: Occupational Safety and Health Administration: http://osha.gov/workers.html or the Center to Protect Workers' Rights: http://www.cpwr.com/about-overview.html.

Principle #6: Keep It Clean

Proper cleaning and maintenance, including preventive maintenance, represent two important and related healthy housing principles. Cleaning is typically the occupant's responsibility (except for common areas in multi-family housing) although there are exceptions to this general rule such as cleaning at unit turnover. Maintenance is typically the owner's responsibility. Information on cleaning education and controlling asthma triggers are discussed in the resident education section at the end of this chapter. Cleaning to control asthma triggers should be consistent with recommendations of the National Guidelines for the Diagnosis and Management of Asthma Expert Panel Report 3 (2007): http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm.

Review of the Evidence

Cleaning and maintenance alone are usually not sufficient to create healthy housing because sources of hazards must also be addressed. For example, Tohn et al., (2003)[78] showed that even repeated professional cleanings alone do not prevent childhood exposure to lead-contaminated dust. It is important to note, however, that cleaning is often appropriate as an immediate, short-term fix for many housing-related health hazards and as a component of multi-faceted interventions.

Figure 5.20 Principles for Keeping It Clean

• Assure smooth and cleanable surfaces.

• Reduce exposure to environmental tobacco smoke.

• Use low toxicity cleaning supplies only as directed.

Structural Interventions

Cleanable surfaces

Difficult-to-clean surfaces, although not hazards in and of themselves, may facilitate a host of problems. For example, if food preparation surfaces are not smooth, they cannot be adequately cleaned to prevent food-borne communicable diseases. Food particles can also become available to pests. Difficult-to-clean surfaces on floors and window sills may also make the re-accumulation of lead-contaminated dust and subsequent exposure more likely.

Carpets

Carpets are not appropriate for wet areas, such as kitchens, baths and laundry rooms because they are more difficult to dry and keep clean. Carpets in other rooms can also act as dust reservoirs if not routinely cleaned. Carpet removal and substitute materials have been the subject of numerous studies, with mixed evidence as a means to reduce airborne dust levels or biological and chemical contaminants in settled dust (NCHH July 2008 Fact Sheet).[79] If your program chooses to replace carpet, consider the following practices:

• If you choose to install new carpet, check whether the product has the Green Label Plus designation from the Carpet and Rug Institute, an organization that sets product standards for indoor air quality and identifies those with very low VOC emissions. Also, low pile carpeting is easier to clean than higher pile carpeting.

• Use low-VOC adhesives when installing wood underlayment and padding.

Heating, ventilation, and air conditioning systems

Inadequate cleaning of these systems can lead to mold from blocked coils and higher fuel bills due to energy inefficiency. Condensate drains should be kept clear. Furnace filters should be changed when they become overly loaded in order to permit proper air movement throughout the dwelling and adequate removal of particles. Cooling coils should also be kept clean (Figure 5.22).

There is little evidence to support the need for routine cleaning of ductwork because particulate matter settles inside the ducts and is likely to stay, barring physical disturbance of the ducts. Therefore, duct cleaning is often unnecessary and, if performed, may produce more hazards.[80] Extensive wetting of ducts and mold infestation are exceptions. In this situation, ductwork should be cleaned and the source of moisture removed and in some cases the duct work may need to be replaced. Depending on the size of the mold infestation, duct cleaning may require mold professionals and ventilation specialists. Bare metal ductwork can be cleaned, but for fiberglass duct board, flexible ducts, and metal ducts with interior liners, the efficacy of cleaning is questionable and are typically replaced when contaminated.

Figure 5.21 Carpets

The following green building guidelines recommend against wall-to-wall carpet in certain areas:

• Enterprise Community Partners' Green Communities Criteria: Requires the use of materials that have smooth, durable, cleanable surfaces in wet areas.

• U.S. Environmental Protection Agency Energy Star with Indoor Air Package: Prohibits wall-to-wall carpet adjacent to toilets and bathing fixtures (i.e., tubs and showers).

• National Association of Home Builders Green Builder Guidelines: Prohibits carpets in bathrooms.

• U.S. Green Building Council's LEED for Homes: Requires water-resistant flooring in kitchens, baths, and spa areas and within 3 feet of exterior doors

Source: NCHH, 2008 Fact Sheet: Carpets and Healthy Homes

Figure 5.22 Dirty Cooling Coils Should Be Cleaned

Asbestos may be present in pipe and boiler insulation and other building insulation systems. Cleaning operations should not disturb such insulation. If it deteriorates or is disturbed, cleaning should be performed by a licensed asbestos contractor.

Adopting a Smoke-Free Rental Policy

Public housing authorities and others have begun to adopt smoke-free rental policies, not only because of health benefits but also because it reduces costs of cleaning, repairs, and component replacement at unit turnover (Figure 5.23).

Low-Toxicity Cleaners and Safe Use and Storage of Supplies and Equipment

Some cleaning agents carry their own health and safety hazards. Bleach and ammonia compounds are common cleaning products that can cause severe eye and skin injuries if not handled properly. If mixed, they release dangerous gases (such as phosgene and other gases) that can cause severe respiratory injury and even death. If the instructions call for dilution, then use of the undiluted product may cause high exposures as well as damage to building structures. Products (such as bleach and ammonia) should never be mixed and instructions on the product label must be followed. Proper eyewear and skin protection should also be worn if exposures are likely. If eye contact with cleaning agents does occur, then a full 15-minute immediate rinsing of the eyes is critical. Avoidable eye injuries have occurred because injured persons attempted to seek medical attention instead of performing

Figure 5.23 Smoking and Non-Smoking Housing Costs

Boston One Touch: Action Steps for Healthier and Greener Homes for Boston Families reported sizeable cost differences in smoking and non-smoking units.[81]

the rinsing, resulting in permanent damage to the eyes on the way to the hospital.

New "non-toxic" cleaning products are appearing on the market, some carrying "green" or "natural" labeling. While intuitively appealing, such products may not, in fact, be any safer than others. Therefore, healthy homes programs should instruct occupants to read product labels closely to ensure proper use of all cleaning products. While voluntary labeling programs exist, there are no national standards that enable consumers to make truly informed choices.

Cleaning Guidelines

- Use low toxicity products.
- Use cleaning products only according to the label instructions.
- Use appropriate eye and skin protection when using cleaning products.

All carpets should be vacuumed periodically. Normal household vacuum cleaners can emit fine particulates through the exhaust, which can lead to increased levels of airborne particulate matter. Use of High-Efficiency Particulate Air (HEPA) vacuum cleaners is one solution. HEPA vacuums are equipped with special filters to remove nearly all of the small particles from

the vacuum exhaust that would otherwise re-enter the room air, and are now widely available and affordable. Some healthy homes programs offer a HEPA vacuum rental or loan services. All vacuums used on carpeted floors should be equipped with a beater bar to dislodge bound particulate matter. Conventional vacuums with micro-filtration bags may also be effective.[82] Vacuum cleaner reviews and rating are available from Consumer Reports at www.consumerreports.org/.

Another option is to install a central vacuum system, which filters the indoor air and deposits the exhaust air outside the house. Central vacuum systems are increasingly used in new construction; retrofits into existing housing may be quite expensive.

All cleaning agents, as well as other products containing poisons, irritants, or VOCs should be stored in locked areas that children cannot access.

Portable Air Cleaners

The ability of portable room air cleaners to remove particulate matter of certain size ranges from air is well established (Figure 5.24). Specifically, air cleaners are known to be able to achieve a 30–70 percent reduction in the half-life of airborne particulate matter between 0.3 to 1 microns.[83] However, portable air cleaners do not reduce larger airborne particles between 1 to 5 microns because they deposit at rates that are much higher than the equivalent loss rate due to typical residential ventilation. Air cleaners are less effective as the particle size increases and they have not been demonstrated to reduce volatile organic compounds or other gases such as carbon

monoxide, oxides of nitrogen and others.[84] It is also unlikely that these systems can adequately control exposures to environmental tobacco smoke; source control through smoking cessation will be far more effective. This has led the National Academy of Sciences to conclude that there is only limited evidence that air cleaners are effective in reducing asthma.[85] This is most likely because allergens may be concentrated in the larger particle size ranges. EPA provides information on air cleaner technology for the home environment at: http://www.epa.gov/iaq/pubs/airclean.html.

Some air cleaners emit high levels of ozone under the theory that this reactive gas will clean the air. Exposures to ozone should always be avoided because it is a strong lung irritant and has many adverse health effects. These devices should not be used in the home environment. Occupants should be encouraged to avoid using ozone generating air cleaners. EPA provides additional information on ozone generators sold as "air cleaners" at http://www.epa.gov/iaq/pubs/ozonegen.html.

Principle #7: Keep It Maintained

Structural Interventions

The previous sections of this chapter have described conditions that require correction to create a healthy home. However, simply correcting the deficiencies will not have a long-term impact unless a regular maintenance program is implemented so that new deficiencies are promptly addressed (Figure 5.26). Regular

Figure 5.24 Portable Air Cleaner

Figure 5.25 Principles for Keeping It Maintained

- Conduct preventive maintenance and regular inspections.

- Respond to maintenance concerns in a timely manner.

- Keep dust levels low through regular cleaning.

- Address hoarding behavior.

inspections are part of maintenance.

For example, if existing leaks only in the roof are repaired without implementing a system that identifies roof conditions before leaks occur, mold damage can take place before it is discovered. Similarly, if enclosures that prevent exposure to lead-based paint fall into disrepair, lead paint that previously did not present a hazard because there was no exposure could become a hazard. Condensate drainage systems that are not kept clean can fail to drain properly, leading to mold and moisture problems. Radon mitigation systems can fail if not monitored.

Some building systems become so aged and deteriorated that proper maintenance is no longer feasible or financially viable. Healthy homes programs refer these homes to Community Development Block Grant (CDBG) housing rehabilitation programs for capital improvements or building code enforcement for condemnation and/or demolition.

Maintenance and cleaning operations apply to both the interior of the home and the site. Vegetation should be trimmed and maintained to avoid moisture and mildew problems or water ponding on the grounds. Furnace filters should be changed regularly.

Routine Maintenance Schedule

A simple checklist for owner-occupied single-family housing has been developed by the National Center for Healthy Housing (Appendix 5.2). For multifamily large apartment complexes, schedules with more frequent inspections may be necessary, depending on the complexity

> ### Figure 5.26 Maintenance
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> Maintenance is a key component of a healthy home. Key educational messages include the following:
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> - Maintenance needs should be addressed promptly.
>
> - A regular schedule for maintenance can be adopted to help ensure deferred maintenance does not lead to major repairs later.

and operation of the building systems. The sample checklist is not exhaustive but is a good indication of key items that should be examined on a regular, ongoing basis.

Cleaning for the Control of House Dust Containing Lead

There are numerous resources on how to clean effectively to control lead dust after disturbing lead-based paint. Contractors and maintenance staff should take a formal lead-safe work practices course and the EPA-certified renovator training. EPA now regulates many renovation, repair and painting activities. Occupants can use many of these same practices to continue to keep dust levels low after renovation. Key lead-safe work practices include:

- Clean from ceiling to floor.

- Vacuum all surfaces first with a HEPA vacuum, then wet wash using separate containers for soapy water and clean rinse water, and repeat vacuuming.

- Use cleanable floor mats in the entryway and remove shoes before entering the living space to avoid track-in of lead-contaminated soil.

- Wash hands and face before eating, drinking, smoking, or applying skin lotions if in contact with lead-contaminated dust or soil.

- Wash clothes that may have been in contact with lead-contaminated dust or soil separately from the rest of the household's laundry.

The New England Lead Coordinating Committee's Don't Spread Lead video provides a simple review of these practices, as well as lead-safe work practices for "do-it-yourselfers." Detailed information on lead hazard control is discussed in the cleaning section above.

This lead-contaminated dust cleaning protocol can also reduce exposure to other contaminants in dust.

Hoarding

Healthy homes practitioners should be aware that some occupants may suffer from the compulsion to hoard, resulting in clutter. Hoarding increases risk of pest infestations,

injuries, and other problems. In some cases, this may require a referral to professionals for mental health services.

Hoarding situations must be handled in a multidisciplinary manner. Healthy homes programs should address hoarding as part of a team that may include the sufferer, family members, the housing provider, local health departments, representatives of the judicial system, and providers of therapeutic, social and clean-up services. Long-term case management and monitoring is needed.

Energy Efficiency

Healthy homes programs should build ties with local programs that weatherize or otherwise improve energy efficiency. Installed and used correctly, there is evidence that energy-efficient measures indirectly improve respiratory health[86, 87, 88] by reducing drafts, increasing thermal comfort and controlling excess moisture and mold. There is also evidence that sealing building envelopes below prescribed building tightness limits can necessitate adding additional fresh air supply to prevent the creation of other health hazards, such as mold.

A Seattle-based Healthy Homes project[89] incorporated a variety of green, healthy homes and energy efficiency measures that produced significant health improvements for asthmatic children. The diagram below shows some of the interventions, including fresh filtered air ventilation, high-efficiency windows, and a heat recovery system (Figure 5.27).

Improving energy efficiency can also significantly increase household disposable income for low income families, which can improve health through better nutrition and diet.

Security

Figure 5.27 Healthy Housing Interventions Used In New Construction at Seattle's High Point "Breathe Easy" Homes
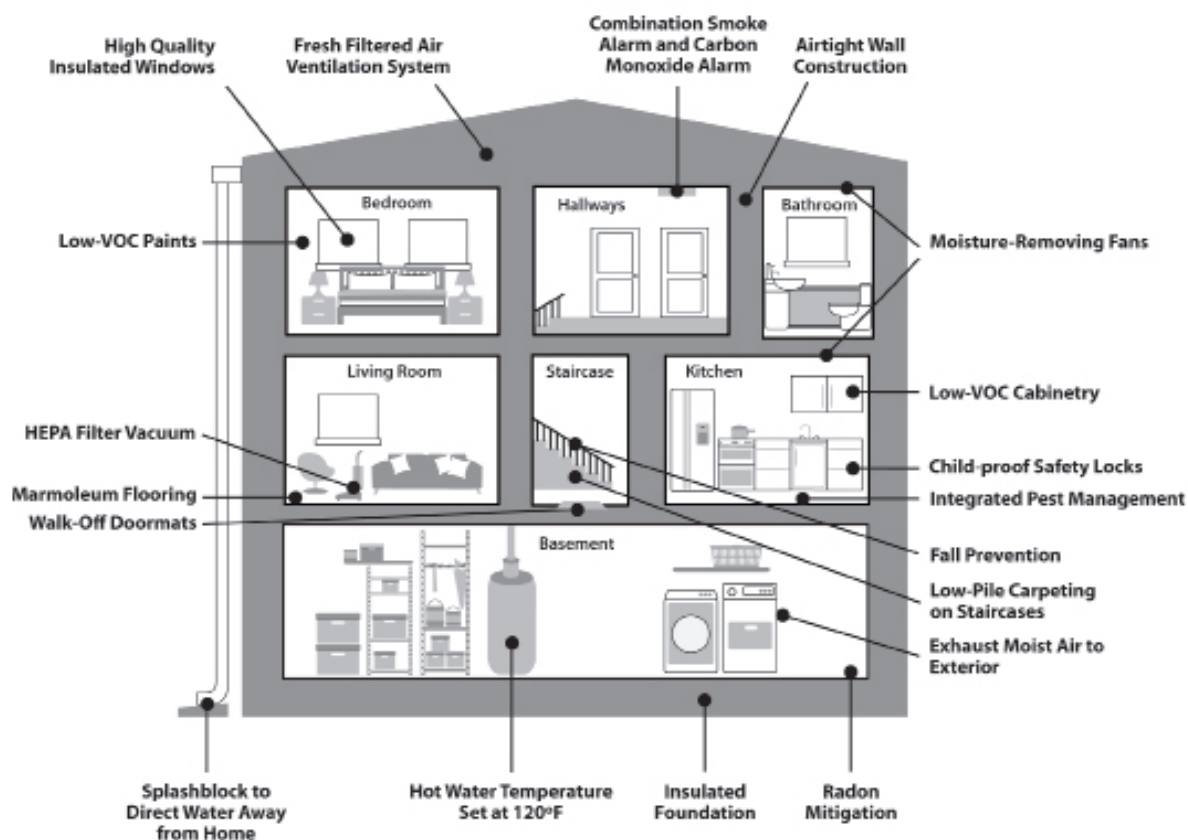
Inadequate security can increase stress, which in turn has been associated with encouraging or worsening asthma. Broken windows, non-operational locks, and inadequate lighting have all been associated with adverse health outcomes. Crime and fear have also been associated with adverse health outcomes. Healthy homes programs should determine if program clients are concerned about security issues and, if so, tailor interventions to improve their sense of security.

Resident Knowledge and Education

Introduction

Residents in housing units served by healthy homes programs can be either tenants or owner occupants. In rental property, it is crucial that tenants and property owners and maintenance staff work together to assure a healthy living environment. Program considerations for healthy homes interventions aimed at resident education and behavior change are delineated in Figure 5.28.

Video instructional tools can also be very useful for tenant education. Examples of short,

practical videos for tenant education in English and Spanish can be found at: http://www.healthyhomestraining.org/ipm/videos.htm.

Keep it Dry

Resident behavior has a significant impact on moisture levels in a home. For example, failure to turn on kitchen and bathroom fans during cooking and bathing, respectively, can raise moisture levels significantly. Elimination of cardboard boxes and other cellulose building materials in areas prone to high moisture levels helps to control mold and moisture problems.

Tenants should promptly report leaks, condensation and other moisture problems to the property owner. Education programs should address how to use exhaust ventilation to remove moisture while showering and cooking. Tenants should also be taught how to use and maintain equipment properly such as humidifiers, dehumidifiers, and drains.

Keep it Ventilated

Use of supplemental unvented heating equipment, such as kerosene heaters, should be discouraged because they can produce high levels of carbon monoxide and other combustion gasses. Also, residents should be taught how to assess that kitchen and bathroom exhaust fans are vented to the outside and are working properly. A simple test is to hold toilet or tissue paper over a bathroom fan intake vent. If the paper is not kept aloft by the fan, there is insufficient exhaust. Also, since many low-income families worry that running fans will increase electricity bills, they should be provided with information on the average monthly cost to run this equipment compared to home repair and health costs that can result from non-use. Families can also be prompted to watch for signs of excess humidity, such as water condensing on windows and bathroom mirrors taking a long time to clear after showering.

Keep it Pest-Free

It is important that tenants understand the life cycle of pests common to their region and begin pest control as soon as the problem is first observed. Although a new problem may

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Figure 5.28 Behavioral Change

Programs that demonstrate the most significant and permanent behavioral change also:

- Engage Community Health Workers from the same cultural or socioeconomic background to deliver the training.

- Conduct multiple home visits to build trust, deliver education at "teachable moments," and engage family members in demonstration and return demonstration of specific practices.

- Provide resources residents may need to accomplish the behavioral change. Many programs provide cleaning supplies referred to as "cleaning buckets," or "home cleaning kits," as an incentive for participation and to support behavior change.

- Provide education on the seven healthy homes principles.

Intervention Strategies

appear trivial, it may be far more serious than it seems. Pests such as cockroaches colonize in large groups behind walls; others, such as rats, prefer to live outside but enter buildings to find food and water. Pests can be a health hazard. For example, cockroach and mouse allergens are important asthma triggers. Critical educational messages include:

- Promptly clean up food and drink spills.

- Remove clutter (such as cardboard boxes or paper) so pests have fewer places to hide.

- Put food in tightly sealed containers. Do not leave open containers of food on counters or in cabinets. Put pet food dishes away overnight.

- Keep trash in a closed container and take it out frequently, every day if possible. Do not let trash pile up inside or outside.

- Use roach baits properly and only when necessary. Place baits out of the reach of children and pets.

- Put baits close to the pests' hiding places. Baits must be closer than other sources of food.

- Good spots for baits are next to walls, baseboards, under sinks, in cabinets and near plumbing fixtures. Place baits in areas of roach activity.

- Do not spray pesticides, as it will keep the pests away from the baits.

Keep it Safe

The Home Safety Council's checklist can be used as part of your education strategy to help occupants find and fix hazards in their homes. While not all-inclusive, it is helpful (http://www.homesafetycouncil.org/SafetyGuide/sg_safetyguide_w001.asp).

Keep it Contaminant-Free

There are numerous ways residents can reduce or prevent exposure to contaminants such as lead dust and environmental tobacco smoke. They should be instructed to report chipping or peeling paint promptly to their property

owner so that is can be safely repaired. Products containing VOCs should be limited to minimize exposures. Vacuuming should be conducted regularly to keep dust levels low. Exposure to secondhand smoke can be minimized by smoking outside of the housing unit.

Keep it Clean

"Cleanliness" is a concept with powerful cultural and emotional connotations. Few individuals want to hear they do not live in a "clean" house, even when evidence of clutter, mold, or pests is obvious. Moreover, many low-income families lack the resources for cleaning supplies readily available to higher income families. Others may feel that the source of their problem is out of their control, such as failure of owners and property maintenance staff to address holes, leaks, and pests. As a result, tenants can give up. They lose the motivation to undertake action that would protect their health without clear support and engagement of rental property owners and managers in the process.

Low toxicity cleaning supplies should be used whenever possible. Reducing clutter and storing food and trash in pest-proof containers are important aspects of integrated pest management. Regular cleaning and mopping of horizontal surfaces—counters, tables and floors—and vacuuming should be conducted to reduce dust levels, pet dander and food sources for pests.

Regular washing of bedding in hot water is effective in reducing dust mites. If pets are present, controlling dander is also helpful, especially for those with asthma. Pets can also be kept out of the bedrooms to help minimize exposures. Extensive clutter can promote pest infestation and result in injuries, such as trips and falls and should be eliminated.

Keep it Maintained

Resident knowledge of maintenance practices should be a key focus of healthy homes programs in support of physical interventions. Tenants need to report maintenance needs to rental property owners promptly and with confidence their requests will be respected and addressed. Furnace filters should be checked each time the

season changes and replaced as needed.

Special Focus on Asthma

Residents need to recognize and address conditions that trigger allergic or asthmatic reactions (Figure 5.29). Responses call for a multi-faceted, comprehensive approach focused on those allergens/irritants to which the person with asthma is sensitive. Common measures include:

- Regularly washing bedding and toys kept in the bed in hot water (120° F) to control dust mites, as well as using breathable mite-proof mattress and pillow covers. Other furniture used as beds, such as sofas, should be kept clean.

- Damp-dusting or mopping floors and horizontal surfaces.

- Slow and careful vacuuming, preferably with vacuums equipped with dirt sensors and bags to trap collected dust and debris. HEPA vacuums should be used if feasible to control emission of particles from vacuum exhaust.

- Controlling exposure to pet dander by restricting pets' access to sleeping areas.

- Avoiding secondhand tobacco smoke.

- Controlling mold and moisture.

- Minimizing carpet and dust-collecting items in the bedrooms of asthmatics.

- Storing food in pest-proof containers and trash in containers with secure lids.

- Reducing clutter in order to prevent conditions where pests can live and breed.

- Dry steam cleaning of upholstered furniture to kill and remove dust mites.

Figure 5.29 Asthma Education Issues

- Identification and control of asthma triggers such as pet dander control, dust mite control, actions to reduce colonization by mold or pests.

- Use of non-toxic cleaning products and product storage.

- Use of allergen-proof covers to encase mattress and pillows in. Weekly washing of sheets and blankets in hot water.

- Reducing indoor humidity to less than 60 percent, ideally between 30–50 percent.

- Minimizing the number and weekly washing of stuffed toys.

- Reducing cockroach and rodent allergen exposure with an integrated pest management approach including a combination of blocking access, low toxicity pesticides, traps, and vacuuming and cleaning.

- Controlling pet allergen by (ideally) removing the pet from the home or barring it from the bedroom and keeping it off upholstered furniture and carpets.

- Taking such mold and moisture control measures as:

  ▶ Fixing leaks and other sources of moisture that support mold growth.

  ▶ Cleaning moldy surfaces with soap and water and drying thoroughly.

  ▶ Discarding and replacing items that can not be cleaned and dried effectively.

  ▶ Do not use the oven to heat the home and, if available, use the stove vent when cooking.

- Instituting a smoke-free home policy.

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Notes

6

Evaluating Your Program

Evaluation of Your Program's Implementation

6

Every healthy homes program faces the challenge of showing that its activities made a difference in the lives of the clients it serves. Similarly, all programs seek to improve the quality of their activities, whether in targeting, service delivery, or efficient use of resources.

Ongoing evaluation can help programs engage in continual quality improvement and enhance the effectiveness of their interventions. As noted in Chapter 3, evaluation should be incorporated into every step of your program's operations; it should not be considered a separate or end-stage activity. In fact, much of the data needed for program evaluation are collected as part of your program's daily operations. The important lesson is to organize, analyze, and use this information effectively.

This chapter provides an overview of evaluation issues pertinent to healthy homes programs. It relies heavily on the HUD Office of Healthy Homes and Lead Hazard Control's 2010 Draft Evaluation Guide for Healthy Homes Grantees (Draft Evaluation Guide).[1] The Centers for Disease Control and Prevention (CDC) also issued a Framework for Program Evaluation in Public Health in 1999 that contains useful guidance on selecting evaluation measures, data collection strategies, and dissemination of findings.[2] Please refer to both documents for a more in-depth discussion of specific program evaluation issues.

Key Messages

- Evaluation is a continual process in order to achieve quality improvement. Planning for evaluation needs to begin during the program design phase.

- Planning for evaluation includes considerations of who should be part of the team, how to secure good quality data, and ways to measure qualitative and quantitative accomplishments.

- Logic models can serve as an important program planning and evaluation tool.

- Evaluation measures include process (outputs), outcomes, and costs.

- Disseminating evaluation findings is critical to program sustainability.

CDC's Evaluation Working Group website (http://www.cdc.gov/eval/index.htm) and its Asthma Program website (http://www.cdc.gov/asthma/program_eval/default.htm) contain other important evaluation tools.

Considerations in Planning Evaluation

All healthy homes programs have some evaluation activities and audiences in common, but there are important differences. New programs tend to focus on whether they reached their recruitment targets, if their staffing, activities, and infrastructure operated as planned, and whether program deliverables were met. Mature programs often set more ambitious goals for evaluation, such as determining the comparative costs and benefits of alternative strategies to reach target populations, and whether to expand service areas or implement new intervention strategies. Established programs may also want to look in a more nuanced way at the outcomes of their activities, such as how long the effects of interventions or behavioral change strategies last, or which intervention has the most impact on health or housing conditions.

Ultimately, the specific questions that your program seeks to answer will guide the development of your evaluation plan. Broad questions that every healthy homes program should answer as a part of their evaluation are:

- Was the program implemented as planned?

- Were program participants representative of the target populations? Who was excluded and why?

- Were the services provided implemented consistently with program protocols?

- How many participants received each of the project's services or interventions?

- Was there a meaningful improvement in the condition of the target housing units?

- Was there an improvement in the health of the target housing units' occupants?[3]

Operationally, evaluation assesses a program's reach, processes (practices) and outcomes (effects). Healthy homes programs should engage in a combination of process and outcome evaluations. Along with these broad questions, every program faces decisions about:

- Who should be part of the evaluation team?

- How can we assure high quality evaluation data?

- How will we measure success?

- How can we track our costs?

- How will we ensure that evaluation findings are used internally to enhance our effectiveness and ability to use resources more efficiently?

- How do we plan to communicate the evaluation findings to various audiences?

Finally, programs need a framework for assessing the overall quality of the evaluative effort. General standards for assessing the overall quality of an evaluation effort include:

- Utility: Are the needs of the intended users being met?

- Feasibility: Is the evaluation effort practical and achievable?

- Propriety: Is the evaluation effort conducted with regard for the rights and interests of those involved or affected by the program?

- Accuracy: Are the findings correct and reported with impartiality?[4]

Setting the Stage

Several factors are important to setting the stage for evaluation:

Planning. A well-designed program is the result of rigorous planning. Programs that lack a documented program plan are difficult to evaluate. Logic models are especially useful in developing both a well-designed program and a well-executed evaluation. (Logic model development will be addressed in more detail later in the chapter.)

Piloting. For an evaluation to be accurate, the intervention itself, the measurement tool, and data collection forms (e.g., instrument or questionnaire) need to remain the same throughout program implementation (such as between pre- and post-intervention data collection). While mid-course corrections may be needed, changing a protocol during program implementation may compromise interpretation of evaluation data. For this reason, it is important to pilot services, interventions and tools before conducting a full-scale evaluation.

Monitoring. Regular discussion among staff delivering services and those responsible for

evaluation is important to continually adapt program activities and data collection in accordance with the evaluation design. These meetings can identify and solve problems arising from data collection, implementation of treatments or services, or program participants.

Commitment. Meaningful evaluation requires organizational and programmatic dedication. Programs that value evaluation view it as an integral part of their day-to-day work. This is demonstrated by program leadership action to ensure the capacity and resources to carry out the evaluation. Leadership must also commit to applying the lessons learned.

Protection of clients' interests. All evaluation staff should be familiar with and mindful of basic principles governing the protection of human subjects. Appendix 6.1 includes an overview of federal protections.

Building the Evaluation Team

The organizational structures of healthy homes programs vary. As a result, evaluation systems—staffing, communication, documentation, data review—will look different within each program. It is important that programs plan and budget for this effort appropriately. Unless restricted by grant or other agency policy, a rule of thumb is to dedicate ten percent of costs to evaluation efforts.

A key decision is to determine who needs to be involved in the evaluation and what information they need. In most programs, the bulk of the evaluation will be conducted in-house in response to grant reporting or internal agency requirements. Common staff positions and their responsibilities include the following:

Senior Program Staff/Principal Investigators. An organization's leadership team needs to be briefed regularly on the program's ability to meet deliverables, lessons learned, and implementation challenges faced by the program. Senior staff members fulfill a critical role in disseminating findings to elected and non-elected officials, the media, potential funders, and community representatives. These stakeholders need quantitative data to answer questions about scope, effectiveness, and cost of services. But they also need qualitative or testimonial data in order to "put a face on the

Tour guide plays a post-tour game with youth.

problem" or show the more intangible benefits of program activities. If research grant funding is part of the project, the Principal Investigator—whether part of the agency or a third party—needs to be engaged directly throughout the course of the evaluation in briefing senior agency staff on the progress and findings of the evaluation.

Program Managers. Program managers need timely and accurate data on program outputs (measurable activities), program outcomes (changes in health and housing conditions), and costs. Program managers need to be able to track and project performance measures throughout the life of the project, usually through the use of spreadsheets or database systems. They especially need to be able to identify deviations from what was expected or planned. This means that evaluation data should be available to the program manager on a real-time basis, and reviewed at least monthly to ensure program deliverable dates are met according to the planned time frames.

Program Service Delivery. Any staff member who is engaged in direct services (intake, outreach, home visits, assessment, and intervention) produces evaluation data and needs to be kept aware of the progress of the program. If these staff do not understand the importance and the impact of their work, the quality of service delivery may suffer. Weekly or biweekly team meetings, regular staff briefings, case review, and periodic staff retreats help to build a shared understanding and can also identify unexpected consequences or problems with implementation. Written protocols, regular chart reviews and case conferences are also

ways to evaluate and standardize the delivery of services. Research assistants and data entry staff need to be engaged in this process in order to understand the relationships between data quality and program implementation and evaluation. (A more detailed discussion of data quality issues follows later in this chapter).

Clients of the program. Some healthy homes programs establish an advisory board composed of stakeholders to participate in program planning and provide feedback on program progress and outcomes. Community-based partners and recipients of program services should be part of this advisory effort. Genuine community involvement is critical to assuring that the program stays true to its mission and services actually meet community needs. Client satisfaction surveys can also be an important tool. Moreover, the qualitative data that come from focus groups and community meetings are important for understanding the context in which services were provided.

Data analysts. Advanced expertise (such as epidemiology, statistics, or economics) may be required to determine the degree to which observed program effects occur by chance or are directly related to the program's activities. Some agencies have the capacity to conduct this analysis in-house, either directly or through partnership with other offices. These analysts need to be engaged early in program decision making so they can determine whether proposed evaluation measures have the validity, reliability, and sensitivity to meet evaluation needs. They also need access to high-quality statistical analysis tools, such as SAS®™, SPSS®™, STATA™®, etc. Finally, they need dedicated time to the project throughout the life of the initiative, not just at the conclusion of the program when an evaluation report is being produced.

Agency information management or information technology (IT) staff. Lack of computing capacity or the appropriate statistical analysis program can hinder in-house evaluation efforts. It is important that decisions about data collection and security be made early and with the involvement of IT staff. In most cases, access to a current version of word-processing, spreadsheet and database software is sufficient for most members of the evaluation team. It is important, however, that all members of the

team have the same version of these programs and are trained to use them appropriately.

Third-Party Evaluators. While most healthy homes programs do the bulk of their evaluation in-house, sometimes outside evaluators are engaged if programs lack the necessary in-house resources. Independent evaluation consultants are often located in academic institutions and may already be program partners. However, selecting an appropriate outside evaluator involves finding an individual or team experienced in both housing and health evaluation, understands your project's activities, structure, and the target population, communicates with your program in ways that you and your staff understand, is willing to spend time on site, and focuses on the evaluation questions or hypotheses that are important to you and your audience for evaluation. For more details on selecting a third party, see Draft Evaluation Guide and Project Planning and Evaluation Guidebook: a Manual for Practitioners and Managers of Self-Sufficiency Demonstration Projects.[5]

Using Logic Models to Develop an Evaluation Framework

Logic models link a program's framework to the evaluation plan. They are a visual method of describing the relationships among program elements. Some HUD and most CDC and EPA grant programs require the development of a logic model as part of the grant application, as do many private funders. While there are many guidelines for building a logic model (see Draft Evaluation Guide, Sundra et al, 2003[6]; Kellogg, 2004[7]; Project Planning and Evaluation Guidebook[8]), at their most basic level, logic models serve several purposes:

1. To identify short-term, intermediate, and long-term outcomes for the program.

2. To link expected outcomes to the program's intended activities and inputs (staff, resources, behavioral and physical interventions). Logic models challenge program designers to articulate assumptions about cause and effect. They also help to specify program milestones such as what activities must be completed before certain outcomes can be expected.[9]

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Figure 6.1 Elements of a Logic Model

- Resources or inputs can be financial, human, organizational, system-oriented or community-based—the factors needed to support program activities.

- Activities include services such as education, home visits, environmental assessment and home intervention.

- Outputs are counts of activities related to recruitment/intake, education, completed housing interventions and case management.

- Outcomes and impact are changes in short, intermediate and long term measures, such as health or housing conditions.

Figure 6.2 A Proposed Logic Model Related to Healthy Homes

Program Focus	Inputs	Activities	Outputs	Short Term Outcomes	Mid-Term Outcomes	Long-Term Outcomes
Asthma Healthy Homes Pilot	Health Department Staff Home Visiting Programs Home Inspectors Community Organizations Advocacy Organizations Rental Property Owners Pest Management Professionals Contractors Elected Officials Clinicians Health Insurers Foundations Funding Equipment Supplies	Educate families about environmental triggers in the home Conduct visual assessments Provide supplies for dust control and pest management Interventions including integrated pest management (IPM), moisture control, lead hazard reduction, etc. Refer families to smoking cessation programs Refer families to housing rehab services to address issues beyond program scope Refer housing units to code enforcement	Number of home visits completed Number of referrals to partner organizations Counts of supplies delivered Number of visual assessments for pests, mold, and moisture completed Number of homes receiving specific interventions such as IPM Number of housing inspections for housing code violations	Increased use of mattress and pillow covers, IPM supplies after one month Improvement in family Knowledge, Information, and Behavior (KIB) scores in one month Increase number of units where family limits smoking in the home	Reduction in counts of pests in units after three months Reduction in the reported number of symptom days after 3 months Reduction in the number of asthma triggers Reduction in ER and hospitaliztions at 12 months Increased number of units enrolled in housing rehab programs	Reduction in mold and moisture conditions observed at 12-month visual assessment Families show long term improvement on KIB scores Health insurers reimburse or pay for home visits and low cost environmental interventions Property owners adopt preventive policies

3. To establish program boundaries to prevent "mission creep." Knowing what cannot be accomplished through project activities is often as important as specifying what should be accomplished, especially if community expectations for a program are high.

Sundra et al. suggest that building a logic model can start from left-to-right (specification of activities → outcomes) or right-to-left (specification of outcomes → identification of inputs and activities). In the left-to-right approach, each link in the model is accompanied by the question, "Why?" (such as Why is this input needed for a planned activity? or Why will this activity produce the expected short-term change?).[10] In the right-to-left approach, the critical question is "How?" (such as How would asthma rates be influenced by the intermediate outcomes expected from a particular activity?). By working left-to-right and right-to-left, program evaluators begin to identify potential weaknesses in program design, as well as activities that may be extraneous to accomplishing program goals.

(See Appendix 6.2 for CDC's proposed logic model for Healthy Homes Programs.)

Assuring High Quality Data

Quality improvement and credible evaluation rely on accurate, precise, and reliable data. Data quality management tools can range from simple checklists to detailed Quality Assurance Plans (QAP) that outline staff responsibilities for program oversight, data collection methods, quality control procedures, maintenance of records to support reporting and fiscal administration, and a data analysis plan.

Two data quality documents—a data collection plan and data analysis plan—are especially important to develop early in the program design and implementation stage. A written data collection plan provides direction to staff or program partners responsible for collecting information needed to evaluate the program. Input from field staff is almost always needed to produce these plans as these individuals collect most of the raw data and have unique insights from the field into the target population. Data collection policies and procedures need to be simple and clear so that project staff understand why they are collecting the information and how it will be used. Their involvement in piloting data collection tools and procedures is also highly recommended.

A data analysis plan keeps the program on track by identifying critical data elements that the evaluators will study and qualitatively evaluate for program impact. Data analysis plans should be developed in the program design phase to minimize collection of extraneous data. Similarly, preliminary data analysis needs to be conducted early in the process of implementation, once all data collection instruments are finalized. Outcome data (change in health or housing conditions) associated with interventions conducted in the first units enrolled should be analyzed as soon as possible. Waiting to analyze data until the end of the program impairs the program's ability to make mid-course corrections when needed.

Best Practices

Strategies for good data collection, data entry, and data management include:

- Clearly written protocols, policies, and procedures.

- Thorough training of staff to assure high levels of accuracy in data entry, protection of confidential client information, and data security.

- Periodic refresher training for all staff on protocols, policies and procedures. Cross-training and periodic assessment of inter-rater reliability of data collected by different staff members to assure consistency is recommended.

- Use of data collection instruments with known validity and reliability whenever possible.

- Implementation of double data entry (in which two individuals enter the same data and then reconcile discrepancies). Data entry staff should also be trained to inspect their work for missing data and errors.

- Routine checks for data quality and completeness by program managers.

- Site visits by supervisors who periodically accompany staff on home visits to assess whether services are being delivered according to program protocols.

- Regular data cleaning by running simple statistical reports (e.g., counts, frequencies) and correcting out-of-range values.

- Familiarity with the laboratory quality control measures and chain of custody requirements if environmental sampling is conducted. It is important to assure that the laboratory used meets certification requirements, such as the National Lead Laboratory Accreditation Program (NLLAP—http://www.epa.gov/oppt/lead/pubs/nllap.htm) and the Environmental Microbiology Laboratory Accreditation Program (EMLAP—http://www.aihaaccreditedlabs.org/AccredPrograms/EMLAP/Pages/default.aspx).

- Security of physical data (i.e., locked and secured files).

- Security of electronic data (i.e., password protection or limited access to data, regular backups of data).

Figure 6.3 Standard Program Forms Used for Evaluation

- Program intake forms (household characteristics, housing characteristics, and housing conditions)

- Environmental assessment forms

- Resident interviews (also referred to as Environmental Questionnaire)

- Environmental sampling

- Construction forms (documenting treatments and costs)

- Health indicator questionnaires

- Health measurements (physiologic measures)

- Program tracking tools (reports of community outreach efforts, trainings, and number of attendees)

Source: Draft Evaluation Guide, p. 23.[11]

Common Problems

Some data management and analysis practices to avoid:

- Failure to use available data management tools appropriately, such as hand-counting data rather than using electronic spreadsheets.

- Poor record management, such as storage of records in multiple locations and lack of version control on data collection instruments.

- Failure to clearly state criteria to interpret a result, such as what constitutes "high" or "low."

- Failure to consider and report alternative explanation of findings.

- Failure to limit conclusions to the situations, contexts, and period for which the data are applicable.

In-depth discussion of data quality and a QAP template can be found at http://portal.hud.gov/hudportal/documents/huddoc?id=DOC_36504.doc, and in the Evaluation Guide.

To implement the Healthy Homes Surveillance System at CDC, the Healthy Homes and Lead Poisoning Branch developed the Healthy Homes and Lead Poisoning Surveillance System (HHLPSS) application. HHLPSS is a web-based surveillance system used primarily in state health departments. Local health departments will be able to access the application through a web browser. State and local health departments will use HHLPPS to track home-related risk factors and interventions, and to report to CDC. Other programs may also use HHLPPS, but it may require upgrades to their systems' hardware and software. The application is provided at no charge.

Figure 6.4 Sources of Qualitative and Quantitative Measures

Program evaluation information and data can come from documents routinely produced by the program:

- Grant proposals and quarterly reports

- Newsletters, publicity materials and press releases

- Meeting minutes and administrative records

- Registration and enrollment forms

- Publications and journal articles

- Prior evaluations

- Asset and needs analyses

- Client satisfaction surveys

- Databases

- Reports held by funders or partner agencies

- Websites

- Graphs, maps, charts, photos, and videos

- Feedback collected at meetings or interviews with key individuals, including clients and non-participants, staff, general public, key informants, critics, staff of other agencies, representatives of advocacy groups, policy-makers, funders, and federal, state, and local health and housing officials.[12]

Measuring Success

Defining the intended audiences of the evaluation helps to determine what measures to use and how to best to report the findings. If the audience is interested in program activities and efficiency in service delivery, a process evaluation may be appropriate. If the audience is interested in change in behaviors, or health and housing conditions, more outcome measures are needed. Increasingly, all programs are required to demonstrate that program funds are used efficiently and effectively. Most healthy homes programs use a combination of evaluation strategies and measures.

As described in Chapter 4, there are numerous validated assessments and tools that can be used to evaluate the effectiveness of healthy homes interventions. Appendix 4.1 adapted from the Evaluation Guide provides links to these tools, describes the tools' comprehensiveness, indicates if a tool has been validated, and comments on ease of adaptation and burden of use.

Process Evaluation Measures

Process evaluation measures program reach (i.e., who the program has influenced or touched), activities and services, and documents program operations. The goal of process evaluation is to fully understand how a program is implemented. Process evaluation answers the questions:

- Did the program serve its intended audience (as defined and characterized by the level of environmental health risk and by demographics)? How many people were served? How many were not served and why?

- Were services delivered as planned, within target timeframes and budget, and in a way that left recipients satisfied?

Process evaluation provides information to make mid-course corrections, if needed, to enhance a program's success (see Figure 6.5). It reviews information on the characteristics of families or residents receiving program services and analyzes a program's performance against established benchmarks (deliverables) that reflect the intended goals. Benchmarks need to be established for each program phase and shared with project staff and partners.

Any changes to program operations or interventions should be systematically documented. This can be done through program staff meeting summaries or coalition meeting minutes that communicate challenges, accomplishments, and changes in strategic direction. The documentation can then be used to compile a lessons learned document on conclusion of the program.

Process evaluations typically focus on the outputs of program operations. These measures typically come from data collection forms and protocols established to track activities within each program phase, such as intake forms, scopes of work, visual assessment forms, environmental questionnaires, environmental sampling documentation, health indicator forms and questionnaires, and program service delivery tracking tools.

Outcome Evaluation Measures

Outcome evaluation focuses on the degree to which any change in health status or housing condition is attributable to a program's services or interventions. The purpose of this type of evaluation is to measure the impact or the effect of the program and identify changes or benefits to clients due to program participation.

Outcomes are directly tied to program goals. Changes in attitudes, values, knowledge, skills, behaviors, health status, and indoor environmental quality are examples of outcome measures. Outcome evaluation determines if your program is providing the right services to bring about the changes that you want to see in your target population's health and their housing.

If your program wishes to attribute improvements in health and housing conditions to your interventions and not to chance, you will need to pay special attention to statistical methods and your evaluation design. This is addressed in detail in the Draft Evaluation Guide and in Appendix 6.3. HUD's 2007 evaluation of its healthy homes grantees found the majority of Demonstration grantees employed a pre-/post-intervention design using the results of the visual assessment and participant surveys to measure the effects of interventions and changes to attitudes and behaviors before and after intervention.[13] In general, strengths of the pre/post design include

Figure 6.5 In Newport, Rhode Island, Process Evaluation Leads to Changes in Interventions, Referrals, and Policy

Healthy Residents, Healthy Homes Coalition was dedicated to using coordinated health, housing and social service responses to reduce the burden that asthma placed on families and individuals living at the Newport Housing Authority. The coalition included the Newport Housing Authority, local health and social service providers, Rhode Island state health officials, and regional organizations.

The evaluation team met weekly to review progress. The team included all staff who did home visits and the maintenance staff from public housing. One benefit of this approach is that different interpretations could be gleaned from the same data. For example, consistent mold and moisture problems in bathrooms led the maintenance staff member to suggest a change to the interventions: use porcelain pedestal sinks near bathtubs rather than cabinet–style sinks that are susceptible to moisture intrusion if water splashed out of the tub.

Regular reviews of the data also showed that at baseline 51 percent of the family housing and 29 percent of senior or disabled housing units had at least one family member who smoked in the home. Smoking in homes was common. Participants requested referrals to smoking cessation services in large numbers, but the program had no health partners to provide those services. This led to identification of new partners for smoking cessation. On the housing intervention side, it also led to recognition that a policy change could reduce exposures to ETS throughout the properties and provided the basis for a new Housing Authority initiative—a smoke-free housing policy.

simplicity and the ability to use data routinely collected in the field. However, the design is susceptible to biases that make it difficult to determine whether changes in observed outcomes are affected by confounding factors such as other outside events, individual growth and development, and the process of being observed.[14]

Figure 6.6 Common Program Outputs

- Program Outreach and Community Education
  - ▶ Number and type of presentations
    - – Audience (health care personnel, parents, contractors, educators, community, rental property owners, tenants, owner-occupants). Audiences can be divided into public and professional.
    - – Number of individuals reached
  - ▶ Number of health fairs
    - – Number of interactions (participants, names recorded on sign in sheets, requests for follow up information)
    - – Pieces of literature distributed
  - ▶ Number of housing units reached through door-to-door canvassing
  - ▶ Number of media events
    - – Paid vs. unpaid

- Program Referrals
  - ▶ Number of referrals from medical providers
  - ▶ Number of referrals from community-based organizations
  - ▶ Number of requests for information and enrollment associated with different media placements
  - ▶ Number of referrals by healthy housing programs to other housing programs
  - ▶ Number of referrals by healthy housing programs to other health or social service programs

- Families/Individuals Recruited
  - ▶ Demographics of participants and nonparticipants
  - ▶ Level of housing risk in units of participants and non-participants

- Case Management/Care Coordination and Education
  - ▶ Number of children tested for lead exposure
  - ▶ Number of home visits
  - ▶ Number of families receiving educational intervention
  - ▶ Number of referrals provided to families for supportive health and social services
  - ▶ Number of referrals to other services completed and not completed
  - ▶ Number of families receiving cleaning supplies

- Home Assessment
  - ▶ Number of questionnaires administered
  - ▶ Number of homes with assessments conducted
  - ▶ Number of homes with environmental samples collected
  - ▶ Number of environmental samples collected

- Housing Unit Remediation
  - ▶ Number receiving enhanced ventilation and moisture control interventions
  - ▶ Number receiving integrated pest management
  - ▶ Number receiving lead hazard reduction
  - ▶ Number of fire alarms and carbon monoxide detectors installed

- Work Force Development Activities
  - ▶ Number of contractors recruited
  - ▶ Number of contractors recruited from the target population and area
  - ▶ Number of individuals trained

Use of a control group provides a stronger basis for analyzing program effects. Control groups are groups of housing units or individuals that are comparable in terms of location, condition, residential characteristics or demographics but do not receive program services or interventions. Randomized control trials, in which participants are randomly selected and assigned to a treatment or control group, are the "gold standard" for experimental research designs.

Use of control groups and randomized designs is generally confined to research and is rarely used for evaluating programs. Ethical issues associated with the use of control groups in housing intervention research are reviewed in a publication by the NAS/IOM.

Health and Well-Being Outcomes

Health outcomes commonly tracked by healthy homes programs are listed in Figure 6.7.

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Figure 6.7 Common Health and Well-Being Outcomes

- Lead poisoning
  - Reduction in post-intervention blood lead levels of resident children < 6 years of age
- Asthma
  - Decreased symptom severity
  - Increased number of symptom-free days
  - Improved child and caretaker quality of life
  - Reduced number of missed school and work days
  - Reduced number of emergency department visits and hospitalizations
  - Decreased medical costs
  - Reductions in use of rescue medication
  - Reduced number of unscheduled doctor or clinic visits
- Unintentional injuries
  - Reduced number of emergency department visits and hospitalizations
  - Decreased medical costs
- Changes in knowledge, attitude and behavior
  - Increased evidence of smoking outdoors or participation in smoking cessation programs
  - Increased storage of food in pest-proof containers
  - Increased use of lead-safe work practices
  - Use of more effective cleaning practices

Figure 6.8 Common Housing Outcomes

- Change in level of pest infestation
- Change in concentrations of common allergens (e.g., dust mite, cockroach, mouse in floor dust)
- Change in number and type of injury hazards and other indicators of home safety
- Changes in number and concentration of contaminants in air or other media
- Reduction in lead-based paint hazards
- Reduction in mold or moisture-damaged materials
- Presence of a working smoke or carbon monoxide detector after 12 months
- Reduction in radon levels
- Improved ventilation
- Increase in the number of homes where smoking is not permitted indoors

Housing Outcomes

Allergen, pest and moisture control are complex processes that often depend on structural changes in the home and behavioral changes by the residents. All housing interventions (treatments) are appropriate for outcome evaluation. Commonly tracked housing outcomes are listed in Figure 6.8.

Cost Measures

Fiscal accountability requires that programs use their funding in the most efficient and

transparent way possible. Increasingly, healthy housing programs have been asked to produce per capita service delivery costs as a way to justify continued or new funding and as a basis for selecting service delivery methods. Mason and Brown's (2010) publication on estimating costs for housing-related interventions to prevent specific illnesses highlights five types of cost studies employed in the public health and housing sectors. These include:

- Cost-of-illness (COI) studies that quantify the public health burden created by an illness by including all medical, non-medical, and productivity costs associated with an adverse health outcome.

- Cost analysis (CA) studies that focus on the costs of implementing an intervention, and may also document the costs saved as a result of the intervention (or the net costs after subtracting the total program costs from the cost of illnesses).

- Cost-effectiveness analyses (CEA) that calculate the ratio of net costs (as defined above) per improvement in health associated with the intervention (such as the costs

Figure 6.9 In Seattle: Outcome Evaluations with Demonstrated Health and Housing Benefits

Seattle's Breathe Easy healthy homes project (BEH) renovated 35 units in a public housing authority development to reduce asthma triggers. Interventions included improvements to building ventilation and energy efficiency, use of building materials with limited potential to outgas, treatments to assure smooth and cleanable floors, smoke-and pet-free policies, extensive client education on reducing asthma triggers, and asthma case management services provided by Community Health Workers. Evaluation data were collected at the initiation of the one-year CHW intervention in the old home and at one year after the move into the renovated housing units. A 2010 evaluation report compared pre- post data on 34 residents of BEH to a comparison group of 68 participants in an earlier year-long asthma-project who received the same CHW education model but whose units did not receive structural repairs. Clinical evaluation criteria included a detailed assessment of asthma severity, medication and health services use, administration of the pediatric quality of life tool, skin test

sensitization, and pulmonary function tests. The pre-post comparison for BEH residents showed statistically significant changes (that is, results beyond what would be expected by chance) in:

- Increases in the number of symptom-free days;

- Reductions in number of urgent care visits;

- Reductions in measured asthma triggers in house dust in the home; and

- Improvements in pulmonary function.

Comparison of the BEH residents to the control showed that the BEH group improved more on most measures, but there were few statistically significant differences apart from reduced nighttime symptoms. However, the mean number of environmental triggers in the BEH homes at one year were significantly reduced, with a modest construction cost of $5000–7000. The authors suggest that these costs can be recouped in a relatively short time through the potential cost savings in asthma care costs and missed work and school days.

Source: Takaro, TK, Krieger, J, Song, L, Sharify, D and Beaudet, N. 2011[16]

associated with symptom-free days). This is used to assess the relative efficiency of two or more interventions.

- Cost-utility analysis (CUA), a type of cost-effectiveness analysis in which the health outcome measure includes quality- adjusted life years (prolonged life and quality of life).

- Cost-benefit analyses (CBA), the "gold standard" that compares the costs and consequences (positive and negative) of intervention strategies.[17]

Typically, healthy homes programs use cost analysis and cost-of-illness, and link these monetary values to program outputs. Most programs will not have the expertise to perform the more intensive economic analyses. (Refer to the Evaluation Guide for more details on these issues.)

However, Mason and Brown note that all programs need to be thoughtful in determining

the audience perspective for looking at the costs associated with different outcomes. Since low-income families typically bear more of the adverse health outcomes associated with poor housing, a societal perspective on costs and benefits, rather than one that focuses on who pays for specific services at a local or state level, may more equitable. Moreover, intangible costs, such as social justice, may be hard to monetize and include in the analysis, but are important.[18]

Healthy homes programs need to develop a cost-tracking system that includes the costs of implementation not only by activity, but ultimately on a per unit and intervention level. Quantifying the cost of service systems or program activities needs to include all direct labor costs, fringe benefit and indirect costs, educational, office and field supplies and materials, travel, and laboratory analyses. Examples of programmatic costs to track and quantify are illustrated in Figure 6.11.

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Figure 6.10 In Phoenix: Lessons Learned from Outcome Evaluations Improve the Next Round Research

From 2003—2006, the Phoenix Healthy Homes Demonstration funded a study of respiratory and injury risk-reduction in 67 homes. Residents were low-income, primarily Hispanic, home-owners with at least one child in the home under age[15]. The program targeted for recruitment families with children with a diagnosis of asthma through the Phoenix Children's Hospital, Phoenix Head Start, Arizona Department of Health Services' Childhood Lead Poisoning Prevention Program, and the City of Phoenix Neighborhood Services Department's Housing Rehabilitation Section. A multidisciplinary team of a health educator, bilingual home assessor, injury specialist, and a pediatric pulmonary nurse practitioner oversaw a pre-post intervention educational and assessment home visit. Interventions in the home included structural repairs, supplies and education, with a median cost of $1,139 and an average of $5,440 (excluding staff time). Thirty-six potential hazards were assessed including 7 potential respiratory health hazards. The total number of hazards declined from an average of 14 at baseline to 3.4 following intervention. The declines were statistically significant for 30 of the 36 potential hazards.

Of the 62 caregivers who completed the questionnaire, 97 percent reported that their homes were safer after being part of the project. Nearly all respondents reported that the health of the child with asthma was better than before the project. The average number of respiratory health hazards per home dropped from 3.3 to 0.9 from baseline to post-intervention (p<0.001). Observed dust in carpets and bedding, observed dust in the heating and cooling system, poor housekeeping, musty smell, and observed cockroach infestation were hazards in 52–69

percent of the homes at baseline and were significantly reduced at post-intervention with the percent of homes with improvements ranging from 77 to 98 percent.

Injury-related hazards observed in at least 80 percent of the study homes at baseline included: no fire escape route; no functional smoke alarms; improper storage of vitamins, medications, and household products; no emergency telephone numbers; sharp objects improperly stored; and no first aid kit. All individual structural injury hazards were significantly reduced from baseline to post-intervention with improvements in 88–100 percent of the homes with hazards at baseline.

The project received a second round of funding in 2009. It revised its protocol to address lessons learned during the earlier outcome evaluation. These included:

- Assigning a staff member to track families more closely and to be sure that medical data and the post-intervention home visits were conducted in a more timely manner.

- Tracking asthma and injury outcomes through objective measures and over a longer period of time to supplement parent self-reports.

- Using more pictures and demonstrations during home visits to compensate for the fact that many of the families enrolled had low literacy levels in both English and Spanish.

- More effort to assess the effect of individual interventions.

- More evaluation of the educational components of the program.

Source: Dixon SL, Fowler C, Harris J, Moffat S, Martinez Y, Walton H, Ruiz B, Jacobs DE. 2009.[16]

Appendix 6.4 offers an example of a cost-benefit analysis that calculates health benefits, energy savings, and increased housing value as a result of window replacement and paint stabilization, and includes a formula that can be used by your program to calculate costs specific to your locality.

Disseminating Findings

Ultimately, evaluation results are only meaningful if they are used by decision-makers and stakeholders to improve the effectiveness of programs and develop or refine policies to protect the community from housing hazards. A

Figure 6.11 Programmatic Cost Data

- Outreach and Education Costs
  - Forms and outreach materials (development and production) costs
  - Free media and paid media costs (press releases, public service announcements, marketing campaigns; staff time needed for media interviews, health fairs)
  - Public education and training offerings
- Health Intervention and Assessment Costs
  - Home visits (education, case management)
  - Visual assessments
  - Environmental sampling
  - Laboratory analysis
- Housing Intervention Costs
  - Treatment (specification) costs
  - Average cost per housing unit
  - Range of housing unit costs
  - Specific intervention costs (IPM, moisture control, lead hazard reduction, safety kits)

dissemination plan should include the provision of information to the following stakeholders:

- **Program Participants.** Specific information on the housing assessment and the outcome of the interventions should be provided to all housing occupants and owners in a timely manner. This is consistent with legal requirements that results of lead-based paint hazard testing, control treatments, and dust clearance are provided to owners (see Lead Disclosure Rule) and occupants are notified (see Lead Safe Housing Rule). Although there are few required notification standards for healthy homes treatments, it is recommended that similar information be provided to owners and occupants.

  Providing a summary of what was learned as a result of the program as a whole and how this information will be used to advance healthy homes initiatives is a meaningful

way to acknowledge participation and raise awareness of the program's next steps. It is important to provide the information in a format that is clear and understandable. Guidance can be found at http://www.plainlanguage.gov/.

- **Media.** The media—print, radio, television, and social-media—can be used to raise awareness of the program at the onset and to lay the groundwork for dissemination of results. When planning to share information about the program and its impact with the media, it is advantageous to identify a family or families who benefited from the program who are able and willing to interact with the media.

- **Community.** Community involvement in planning, implementing, and evaluating healthy homes programs can result in more effective and sustainable programs. Sharing information about program results, their meaning, and future activities can strengthen existing partnerships, assure the community's continued support for the program, and demonstrates respect for their contributions.

- **Elected and Other Officials.** Providing outcome information to elected officials, that highlights the impact on their constituents, is an effective way to assure future support and funding for your healthy homes program. Some programs have had good results when community members served by the program deliver this information. "Report cards" that compare an elected official's district to other districts and the city and state as a whole provide meaningful contextual information.

- **Funders.** Most funders require regular program reports as a condition of financial support. When disseminating information about the program—at any stage—it is crucial to acknowledge the funding source(s).

- **Health Plans.** Insurance companies and HMOs may be interested in the costs of services and impact of interventions on use of health care (emergency room visits, hospitalization, and medication use). Some health plans are working with asthma programs to provide or reimburse for the costs of asthma case management.

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- **Partners.** Sharing information about the program's outcomes, what it means for future efforts, and brainstorming next steps provides the opportunity to celebrate a program's partnerships and their importance in achieving positive change in health status and housing outcomes. This type of celebration can be used to conclude a program formally and solidify the partnership for the future.

- **Peers/Colleagues.** A robust evaluation can lay the groundwork for sharing your program's outcomes and lessons learned on a national scale through conference presentations, poster sessions, and publications in peer-reviewed literature. Academic partners who serve as external or third-party evaluators are great resources for this level of dissemination.

Recognize that evaluative information on the program also needs to be distributed in ways appropriate to the target audience. Press releases, press conferences, fact sheets, and maps are helpful for the media and elected officials. Community groups and program participants may prefer more graphics and pictures, as well as summaries in plain language. Websites provide a useful tool for dissemination to all audiences.

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Evaluation of Your Program's Implementation

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Program Sustainability

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Program sustainability has traditionally been viewed narrowly as the act of decreasing dependence on one source of funding and shifting financial support for program implementation to a new funding stream. In reality, program and organizational sustainability is a much more complex and dynamic process.

Program sustainability actually means different things depending on the developmental stage of your program. Newer programs may want to concentrate on sustaining their activities or infrastructure once initial funding ends. Experienced programs may want to enlarge their target population, transfer their best practices to other programs, build new relationships with other agencies, or promote broader policy initiatives. However, in either case—new or experienced—programs should work to better ensure sustainability by creating more efficient mechanisms for funding, such as the repurposing of existing resources through improved alignment, and coordination of complementary activities and resources.

Planning for sustainability needs to begin long before the program faces the end of its initial funding cycle. For example, newer programs must focus on the need to collect data to demonstrate program effectiveness. Concerns about sustainability are important, however, because unsustained programs can result in a loss of investment. Discontinued programs are likely to disillusion stakeholders and result in barriers to community engagement for future initiatives.[1] Program sustainability must be a fundamental component of the initial and ongoing program plans.

Achieving program sustainability requires time

Key Messages

- Include a Sustainability Plan for the program in the initial work plan.

- Sustainability can be supported by data that demonstrate program efficiencies and effectiveness; community advocacy; funding diversification; collaborative partnerships that can maximize resources; the capture of generated savings; and the attraction of new investments.

- Healthy homes programs can be sustained by integrating and coordinating them with other health and housing programs and services such as code enforcement, weatherization, energy efficiency, and lead poisoning prevention.

- Policy-level change is key to institutional-izing programs for long-term sustainability

- Not achieving sustainability may result in failure to achieve the "mission critical" goals in reducing the number of homes with residential health and safety hazards, thereby reducing the adverse health effects attributable to poor housing conditions.

and commitment. Ultimately, sustainability involves learning from experience (ongoing evaluation), making decisions about which elements of the program to sustain, selecting the right strategies, and using the right tools to build support for your program. The experience of prior healthy homes programs suggest that there are at least five general strategies that have been used to promote program growth and sustainability:

- Evaluation and continual quality improvement;

- Building and strengthening organizational capacity;

- Expanding partnerships;

- Identifying new funding streams and diversifying sources of funding; and

- Building a case for systems or policy change.

This chapter will illustrate how different programs have used these strategies and tools to build a climate of ongoing support for their activities.

Deciding What to Sustain

The first step in planning for sustainability is to assess whether continuation of a service, program or organization is warranted. If you want to assure that the program continues when grant funding ends, political leadership changes, or you experience turnover in human resources, you need to plan for it to become a permanent part of your organization or community. To do this you must institutionalize your initiative by purposely planning for its sustainability.[2]

Tools for Sustainability

The next step is to determine what resources are available to build a climate of support for your program. The U.S. Environmental Protection Agency's National Asthma Forum has produced a document titled A Systems-Based Approach for Creating and Sustaining Effective Community-Based Asthma Programs—Snapshot of High-Performing Asthma Management Programs (https://www.epaasthmaforum.com/Documents/Resources2008/Forum_Snapshot.pdf).[3] This document highlights key factors to consider, and provides examples of how programs have sustained their systems of high quality asthma care in their communities.

Common tools include:

- **Strategic planning by program leadership.** Programs or organizations with leadership that has assessed program strengths and weaknesses, opportunities, and threats are in better position to survive challenges to funding and expand program scope.

- **Open communication.** Information flow within a program, among partners, and with the community as a whole is essential. Programs that are flexible and communicate regularly with their stakeholders are in a better position to identify new opportunities for funding or new arenas in which to apply best practices.

- **Persuasive program data.** Qualitative and quantitative data must be presented in a way that interested parties can understand and embrace promotes support.

- **Active support by community advocates.** Advocacy organizations, especially those having contacts with the media and political stakeholders, can often make the case for program needs and impact in ways that program officials cannot.

- **Engagement of elected and appointed officials.** Program champions in the wider political arena are important to promoting funding and organizational infrastructure, as well as critical to creating broader policy

Figure 7.1 To Sustain or Not to Sustain?

- Does the community need your healthy homes program and/or services?

- Do your evaluation results demonstrate that you are making a difference?

- Does the community value the program and its services?

- Do you need to sustain the entire program?

- What parts of the program are the most effective and needed?

- Can you coordinate funding from multiple sources to sustain your program?

Emily Gantz McKay of Mosaica—The Center for Non¬profit Development and Pluralism. Nonprofit Organization Sustainability. November 2006. http://www.mosaica.org/Home.aspx

Program Sustainability

change.

- Media involvement. While programs may want to control their message by limiting media contact, the reality is that an invisible program is not a viable program. Judicious, sustained, and positive media engagement is optimal.

How these tools and approaches support program sustainability is demonstrated in the following examples from the field:

Funding Strategies

Policymakers and practitioners recommend that healthy homes programs secure support from multiple funding streams. Diversified funding is a cornerstone to achieving sustainability. This can include grant funding from government programs and private sources (e.g., foundations) and tax levy funding. Support can also be achieved by leveraging resources through partnerships, such as sharing costs for services with other agencies, assessing fees for services, and mainstreaming healthy homes activities with existing initiatives.

Governmental grants. Federal grants often provide seed money for healthy homes programs, but they also require programs to demonstrate their ability to sustain activities via matching or leveraged funding from public or private sources. Appendix 7.1 provides an overview of federal funding for healthy homes and related categorical programs. The Delta Institute's publication Creative Funding Strategies for Remediation of Lead and Other Healthy Housing Hazards: A Guide for Increasing Private-Sector Financing is targeted both to lenders—explaining how they can benefit from financing healthy homes programs—and government and non-governmental organizations, delineating

how they can provide incentives and reform existing subsidy programs. http://delta-institute.org/sites/default/files/1-DeltaREDI_CreativeFundingStrategiesForRemediationOfLead.pdf.[4]

Private sector foundation funding. In an era of limited funding, many local government agencies have received funding from philanthropic organizations to advance healthy housing goals. Pursuing foundation funding is one way to leverage local funding and diversify your funding streams. It should not be assumed that private foundations prohibit grants to local government agencies. Agencies may be able to apply individually or in partnership with local or national nonprofit organizations. The Foundation Center (http://foundationcenter.org/) maintains a searchable listing of foundations and training resources, as well as newsletters, webinars, and other tools that can help with the identification and development of foundation proposals. Additional sources of philanthropic support can come from family and community foundations, local grant-making cooperatives (e.g., "Giving Circles"), and through other local civic organizations. Other

Figure 7.2 Examples from the Field: Leveraging Public and Private Sector Funding in Philadelphia

Philadelphia Healthy Homes for Child Care leveraged HUD Healthy Homes grant funding with contributions from the YMCA to furnish relocation units, and $150,000 from the Nonprofit Finance Fund to cover additional safety-related repairs to 28 homes that house family child care programs.

Figure 7.3 Example from the Field: Annie E. Casey Foundation (AECF) and the Coalition to End Childhood Lead Poisoning.

The Annie E. Casey Foundation, the nation's largest Foundation focused on children, recognized the nexus between its core mission of helping build better futures for disadvantaged children and the successful work being done by the Coalition to End Childhood Lead Poisoning in Baltimore's most distressed neighborhoods. The case for investment from Casey's educational outcomes portfolio began around the dramatic results the Coalition was achieving in reducing lead poisoning and creating critical policies and legislation to further advance this work. Casey's investment was sustained through the Coalition's performance in achieving outcomes, building capacity, and translating lessons learned into effective public policy. Most recently, the Foundation provided critical support for the Coalition's development of the national Green and Healthy Homes Initiative. In turn, the Coalition has been able to leverage Casey's support as match funding to attract federal, state and local grants and additional investment from many other national, regional and community foundations.

potential funding sources include corporate foundations or corporate charitable investment committees. In addition, regional, state and local funder affinity groups offer helpful fundraising resources including grant-writing workshops and regular announcements of proposal deadlines.

Here are some simple tips on planning for foundation funding:

1. Identify your needs. Develop a clear understanding of what you can accomplish with funding. Donors want to fund areas of programs that will have the most impact in fulfilling your mission. It is important to have estimated costs and be able to show how the request fits your strategic plan.

2. Analyze your audience. A case statement reflects and addresses the funder's giving priorities, geographic focus and other guidelines. As such, case statements need to be fine-tuned for each foundation.

3. Compile story components. Story components can include your program's history, leadership, data related to need and impact, areas of excellence and innovation, summary of your strategic plan, and basic budget information.

4. Write it. State the problem, describe your solution(s), explain why you are the best program or organization with the best people to implement it, and demonstrate why the need is urgent. Simply stated, be clear about what you are requesting funding for and why the foundation needs to support your efforts.

Figure 7.4 Example from the Field: Children's Mercy Hospital's Environmental Health Program Negotiates Costs through Hospital Services

The Environmental Health Program of Children's Mercy Hospital charged fees for home assessments of asthma environmental triggers. The program tried to obtain Medicaid and health insurance reimbursement for the services, but was not successful. However, because the program was offered through a hospital, it could negotiate fees in the interest of supporting the hospital's mission to provide services regardless of the ability to pay.

5. Shape it. Remember that your case statement will change over time and should be tailored for each foundation in relationship to its funding goals.[5]

Recovering Program Costs through Reimbursement. Some services essential to healthy homes programs, such as inspection and case management, are eligible for reimbursement. Costs of environmental investigations and case management home visits to the homes of children with elevated blood lead levels have been reimbursed by Medicaid since the last decade. Since each state must document and negotiate rates of reimbursement, however, rates vary widely. Hospitals and health insurance programs are also beginning to reimburse for home visiting programs or case management for asthma control based on the impact of these services in reducing medical costs.

Dedicated Revenue Sources. Dedicated sources of funding and incentives to comply with housing standards can fulfill an important role in sustaining healthy homes efforts. Some municipalities have secured funding for lead hazard control from dedicated taxes on paint and gas and dedicated fees from annual inspectional and certification requirements. In Maine, the Lead Poisoning Prevention Fund was established and is funded by a 25 cents-per-gallon fee on all paint sold in the state. The fund is used for education, outreach, and training to identify and reduce lead paint hazards. Other approaches are highlighted in Figure 7.5.

Strategies to Improve Organizational Capacity

One way to build sustainability is to strengthen organizational capacity. Community Wealth Ventures, Inc. (http://www.communitywealth.com) pinpoints the characteristics important to organizational capacity. (See Figure 7.6.)

In some cases, sustainability occurs when services or interventions become routine within an organization, such as when a pilot or demonstration project becomes part of an agency's or a department's standard services.[6] Pilot and demonstration projects should be encouraged so that programs continually strive for greater effectiveness and cost efficiency. However, these innovations need to be evaluated to determine if the activity or intervention is effective and identify which elements need to be improved.

Program Sustainability

Figure 7.5 Examples from the Field: Rental Property Fees, Dedicated Uses of Sales Tax Revenues, or Liability Protection in New Jersey and Maryland

In 1996, the State of Maryland adopted critical legislation to sustain lead safe housing. The "Reduction of Lead Risk in Housing" law requires owners of rental properties built before 1950 to register their units with the State's Department of the Environment, distribute specific educational materials, meet specific lead paint risk reduction standards, and pass a lead dust clearance test prior to sale or lease of older rental units. Owners in compliance with this law are eligible for limited liability protection. Owners of rental units built between 1950 through 1978 may voluntarily opt–in to receive these protections. The net result of these laws has been a 98% reduction in lead poisoning cases from 1993 to 2010. http://mde. maryland.gov/Land/Documents/LeadFactSheets LeadfsOwnersRightsResponsibilities.pdf.

In 2004, New Jersey adopted the Lead Hazard Control Assistance Act that expanded funding available to landlords and property owners to support lead hazard control activities. A $20 fee was added to all properties covered under the State's Hotel and Multiple Dwelling Law, with the revenues forming the basis for Lead Hazard Control Assistance Fund administered by the Department of Community Affairs. In addition, a percentage of the State's sales tax collected on the sale of paint (up to $7,000,000 or 50 cents per container) was allocated to the Fund. Finally, all multi-unit buildings with three or more units inspected by the Department of Community Affairs as a part of its five year inspection cycle for the Hotel and Multiple Dwelling Law are required to be assessed for lead hazards. http://www.njcitizenaction.org/lead.html.

Figure 7.6 Characteristics of Sustainable Organizations

- Strong Leadership: Solid and visionary leadership exists at all levels of the organization or program (management, staff and community).

- Community Engagement: Awareness and buy-in from the community are present. The organization and its partnerships are perceived as credible.

- Relevance: The program or organization meets the community's needs.

- Adaptability & Agility: The program or organization has the ability to anticipate and respond productively to the changing external environment.

- Efficiency and Effectiveness: The program or organization has demonstrated its ability to make an impact and achieve positive outcomes in a cost-effective way.

- Robust Infrastructure: There are established internal practices (business model) that are effective in guiding the organization's or program's work.

- Financial Health: The program or organization has a strategic funding plan that includes diversified funding sources, multi-year funding and internal revenue generation.

prevention, housing rehabilitation, energy efficiency, and property maintenance.

Creating Healthy Housing by Expanding Lead Programs. It is common for healthy homes programs to refer homes or families to local childhood lead poisoning prevention or lead hazard control programs, or include the identification and remediation of lead-based paint hazards as part of their services. The reverse is true: lead programs themselves can also transition into more comprehensive healthy homes programs by expanding the scope of their assessment and interventions. While program activities supported by specific funding sources must be accounted for, healthy homes interventions related to moisture control, pest management, and home safety can be integrated into lead poisoning prevention program services. Transitioning a lead program into a broad healthy homes program requires:

Experimentation implies that not every program or intervention is worth continuing. Thus, sustainability is based on efficacy.[7]

An important aspect of organizational capacity is to ensure there is a staffing succession or continuity plan to address turnover at the staff and management level. This can be achieved through cross training, mentoring and prioritizing workforce development issues. Programs can also be sustained by mainstreaming healthy homes practices into other programs such as those addressing lead poisoning

- Pilot testing of new program service systems and supporting documentation;

- Additional staff training;

- Expanded assessment/inspection protocols;

- Revised case management procedures and family education modules; and

Figure 7.7 Example from the Field: Transitioning Lead Programs in Baltimore into a Public-Private Partnership for Healthy and Sustainable Homes.

Recognizing the benefits of strong cross sector collaboration, the City of Baltimore has transitioned its program from a stand-alone lead poisoning prevention program in the health department to a public-private partnership on Healthy Homes. The City began to implement a health-based housing intervention standard for it weatherization, energy efficiency, home repair and home rehabilitation programs and to align those programs with its lead and asthma intervention work. Recognizing the cost effectiveness and program efficiencies of implementing a comprehensive strategy of aligning and coordinating these programs, the City created the Green, Healthy and Sustainable Housing program in the Department of Housing and Community Development. This program works closely to align its resources with that of key Healthy Homes programs at the Coalition to End Childhood Lead Poisoning (through its Green and Healthy Homes Initiative) Civic Works, Rebuilding Together and the Job Opportunities Task Force, as well as local philanthropic partners in order to deliver more sustainable healthy homes that reduce asthma morbidity, lead poisoning, and trip and fall injuries.

Key benefits of this transition included:

1. The development of a Learning Network for shared data and best practices;

2. Cross training of all home visiting programs (code enforcement, visiting nurses, foster care, fire safety, non-profit programs) in the use of a comprehensive assessment for home based environmental health and safety hazards;

3. Realignment of programs under one departmental entity to create a more efficient and comprehensive housing intervention program; and

4. Establishment of an effective post-remediation maintenance program.

- Additional contractors or contractor training to conduct healthy homes interventions.

Creating Healthier Housing through Building Codes. Housing codes, when enforced, provide the strongest and most direct legal tool for preventing and remediating indoor health hazards. Historically, housing codes were developed to address public health concerns of overcrowding, sanitation, and fresh air and water. As these measures were successful in controlling the spread of disease, the public health community became less involved over time in the health and safety of housing. The resulting separation of public health from housing and building codes has resulted in a fragmented approach to remediating housing-based health hazards. For lead and healthy homes programs, housing and building codes offer an opportunity to use an existing infrastructure—laws, staff, inspection and enforcement systems—to improve the health and safety of high risk homes.[8] Appendix 7.2 highlights and compares healthy homes regulations at the local, state and national level.

Integrating Energy Efficiency and Healthy Housing. Energy efficiency efforts can improve the health and safety of the living environment by reducing contaminants, improving ventilation, reducing moisture and condensation, increasing safety, and improving thermal comfort.[9] The U.S. Department of Energy's weatherization assistance programs are natural partners for healthy homes initiatives, but careful planning is needed to address their priorities and cost constraints, which may differ from those of health or other housing program partners (see: http://www.nchh.org/Policy/National-Safe-and-Heatlhy-Housing-Coalition/Policy-Summit. aspx). It is important for energy retrofit or upgrade programs to consider incorporating the following health and safety activities and interventions:

- Installation of smoke and carbon monoxide alarms;

- Repair of interior and exterior water leaks and elimination of standing water;

- Assurance of adequate ventilation for vented combustion appliances;

- Elimination of un-vented combustion appliances;

• Exhausting kitchen and bath fans and clothes
dryers to the outside;

• Using lead-safe practices in older homes and
lead dust cleaning and clearance testing upon
completion;

• Installing a working air conditioner in at least
one room of hot climate homes;

• Conduct radon testing following intervention;
and,

• Sealing all leaks in ductwork.[10]

**Linking Property Maintenance and Healthy
Housing.** Property owners, managers, and
residents can promote healthy housing through
routine property maintenance. Enterprise
Community Partners (ECP) recently released
a comprehensive set of educational cards and
training modules to empower residents to
maintain their green building. (See http://www.
greencommunitiesonline.org/tools/toolkits/
resident_training.asp.) Property managers
and resident coordinators can customize
the Resident Education Cards to provide

green tips and information specific to their
development. The Resident "Training in a Box"
contains educational modules for trainers that
cover a variety of green and healthy living
practices. Additionally, ECP continues to offer a
Sustainability Training Grant to support project
teams to develop and deliver customized
educational materials and trainings for residents.

Similarly, Greater Boston's Local Initiative
Support Corporation (LISC) is in the process
of finalizing a document that can be used by
community development corporations, owners,
and managers of affordable housing. The
policies represent a sample of green and healthy
practices that LISC found to be practical in two
Boston community development corporations
and their management companies, as well as
ways to resolve questions about responsibility
for implementing the policies. This document
will be published on the Boston LISC website in
2011 (http://www.bostonlisc.org/).

Expanding Partnerships

Significant evidence documents that coalitions and partnerships are an effective means of leveraging resources and wielding influence in the pursuit of improved community health. Based on these findings, the Robert Wood Johnson Foundation established the Allies Against Asthma initiative (Allies) in 2000 by funding seven community-based coalitions nationwide to develop, implement, and sustain comprehensive asthma management programs aimed at effecting long-term community change (http://www.asthma.umich.edu). Similarly, the U.S. Environmental Protection Agency's Community Action for a Renewed Environment (CARE) program is committed to creating self-sustaining, community-based partnerships that continue to improve the local environment after EPA funding ends. The CARE program has produced a Sustainability Checklist that can be found at http://www.epa.gov/care/library/CARE_Sustainability_Checklist.pdf.

Success for a coalition or partnership means, in part, establishing the kind of relationships that lead to mutual benefits, and produces results beyond the level that organizations or individuals could realize on their own.[11] Partnerships support sustainability through:

- Comprehensive and coordinated efforts;

- Joint funding and larger grants;

- Decreased competition for funding;

- Reduced duplication of effort;

- Efficient fundraising efforts; and

- Increased access to and credibility with elected officials and policy makers.[12]

System-level Sustainability— Public Policy

Some programs are institutionalized at a higher level through legislation requiring standardized services. Public policy is an important component of organizational sustainability as it affirms and institutionalizes specific activities by mandating them as a part of a government agency's core mission. In the case of healthy homes, public policies generally cover housing or building codes, ordinances, or rules on inspection and remediation of housing-based health hazards. Some experts argue that programs must be supported at the policy level for true sustainability to be realized.[13]

Creating Healthy Housing through Public Policy. State and local building codes that address health and safety issues are often the only mechanisms to address high-risk housing.[14] Codes, however, do not guarantee safe and healthy housing. Because of limited resources, many local code enforcement agencies rely on complaints to trigger an inspection and tenants may be reluctant to file a complaint due to fear of retaliation. As a result, mandated systematic inspections are recommended for rental housing located in areas considered to be high risk.[15]

Figure 7.10 Examples from the Field: Expanding Partnerships in Baltimore and South Central Los Angeles

Los Angeles' Esperanza Community Housing Corp. collaborated with St. John's Well Child and Family Center and Strategic Actions for a Just Economy (SAJE) to develop a coordinated approach to referrals, home visiting programs and tenant education. Physicians at St. Johns' seven centers completed a "Medical Evidence Form" that noted any environmentally-driven conditions in children seen at clinical visits (including elevated blood lead levels, vermin bites, etc.) The completed form triggered a visit from an Esperanza promotoras de salud who provided client education on the risks of lead poisoning and other environmental health threats. Promotoras also conducted lead dust sampling, assessed mold and moisture, monitored cockroach infestation and provided cleaning kits and IPM supplies. The community health worker's report to the physician after the visit then resulted in letters from the physician to the landlord about the relationship between housing conditions observed and the child's health condition. In order to limit the threat of evictions, the physicians sent these letters only in cases where there was a positive relationship between the tenant and the rental property owner. SAJE conducted workshops in the community on tenants' rights and worked with the city attorney to ensure owner compliance. Esperanza and SAJE were founding members of the Healthy Homes Collaborative that is an association of community-based organizations committed to eliminating environmental threats in homes. The Healthy Homes Collaborative also provides leadership for negotiating with the City of Los Angeles for stronger code enforcement. The Collaborative sponsored the first South Los Angeles Conference on Health and Human Rights in 2009, attended by 700 individuals.

Healthy homes programs can create or take advantage of existing public policies at the local, state, and federal levels that require the inspection and remediation of housing hazards to advance health outcomes. (See Figure 7.11)

Marketing Healthy Housing in Public and Private Housing. Smoke-free housing policies illustrate the use of the marketplace to drive demand for healthy homes principles.

Building National Coalitions to Support Policy Change. Building momentum for long-term policy change can require coordinated activity among multiple partners. Funders such as the Robert Wood Johnson Foundation, California Endowment, Blue Cross Blue Shield Foundation of Minnesota, and others convene policy forums on healthy housing-related issues to promote discussion of policy initiatives.

Incorporating Healthy Housing as a Principle of Sustainability. Many communities have begun to establish commissions to link land use, transportation, and other public service planning to resource conservation and sustainable development. An often overlooked issue in sustainability discussions is how public health can be affected by issues such as urban sprawl, absence of sidewalks, walkable communities, and the location of jobs in areas with limited access to public transportation. Incorporation of healthy housing principles into sustainable growth discussions represents an important way to raise awareness of and strengthen healthy homes efforts. HUD's Office of Sustainable Housing and Communities can serve as a resource for the creation of sustainable communities. http://portal.hud.gov/hudportal/HUD?src=/program_offices/sustainable_housing_communities.

Figure 7.11 Examples from the Field: Coordinated Policy Initiatives in Oregon and Maryland

The City of Portland provided leadership for a city-appointed task force that developed recommendations for code enforcement related to its healthy homes efforts.

The City of Gresham established a systematic inspection program that mandated inspection of rental housing units selected through a sampling process. The program includes a complaint-driven component. Violations found in one unit of multi-family housing triggers inspections of adjacent housing units.

Multnomah County, Oregon passed a resolution and ordinance related to improving rental housing conditions in the unincorporated areas of the county. This legislative infrastructure provides renters with a mechanism to improve substandard housing.

The State of Oregon worked to make health and housing a priority through improved property maintenance regulations, and passed legislation supporting managed care reimbursement for services for chronic respiratory disease.

A City of Baltimore ordinance requires all owner-occupied and rental units with gas appliances to have carbon monoxide monitors on all floors. Enforcement began March 2010.

Figure 7.12. Federal, State, Local, and Private Examples of Smoke-Free Housing Initiatives

In 2009, HUD issued PIH-2009-21 (HA) that encouraged public housing authorities to implement smoke free policies in public housing (see: http://www.hud.gov/offices/pih/publications/notices/09/pih2009-21.pdf). The federal Americans with Disabilities Act also provides for smoke-free workplaces and public accommodations for individuals with substantial physical impairments that limit major life activities, including breathing.

California's Smokefree Workplace Act prohibits exposure to smoke in common areas of multifamily properties. New York City has similar prohibitions. Registries of NYC smoke-free properties are available at http://www.smokefreehousingny.rentlinx.com/Map.aspx. Registries in Michigan are available at http://www.mismokefreeapartment.org/listing.html. Maine has at least 13 smoke- or tobacco-free public housing authorities. MaineHousing also awards a one point incentive for smoke-free to developers of affordable housing who apply for Low Income Tax credits (see http://www.smokefreeforme.org).

For a private sector perspective, Enterprise Community Partners provides extra points in allocation of Low Income Tax Credits. via their Green Communities criteria that include smoke-free housing. http://www.greencommunitiesonline.org/tools/criteria/index.asp

Final Notes on Sustainability[16]

Planning. Continuation of programs doesn't happen by itself. Sustainability should be planned for with intention and, ideally, incorporated into the initial program plan.

Funding Diversification. Programs usually begin with one funding source and diversify over time to enlarge their program or add service components. Sustainable organizations are not dependent on any single funding source but obtain resources from a variety of avenues. Funding usually includes both multi- and single-year grants and contracts that overlap.

Program Qualities. Sustainable programs are characterized by their effectiveness, ability to demonstrate positive results, inspired and committed leadership, strong financial and program management policies and procedures, and an established constituency of individuals and organizations that value their services.

Community Support for Programs. Community support can only be authentically harnessed if residents and community-based organizations are treated as full partners. Programs should not postpone reaching out to community groups to a time when community support is needed. Partnerships with the community should be fostered from the beginning; they are central to program planning and design. Constituent support is a key component of advocacy for programs and services, and can be influential in securing political will.

Supporting Non-profit Organizations. If a public health or housing program wants to nurture community involvement in program planning, outreach, service delivery, evaluation and/or advocacy, it should have a reasonable expectation of what nonprofit organizations can do with and without funding. It is important to support the work of community-based organizations that are also challenged by sustainability issues.

External Environment. Paying attention to the economic, political, and social issues prepares

Figure 7.13 Example from the Field: National Safe and Healthy Housing Coalition

The National Safe and Healthy Housing Coalition is a broad coalition of organizations working to improve housing conditions nationwide, especially for low-income families, through education and outreach to key national stakeholders and federal public decision-makers. The Coalition is guided by a 15-member Steering Committee representing green building design, public health, health care financing, low-income housing development, realtors, building inspectors, and children's health and safety organizations. Priorities include national partnership building, federal legislation and federal regulations and administrative policies. See http://www.nchh.org/Policy/National-Safe-and-Healthy-Housing-Coalition.aspx.

programs for emerging challenges. Programs and organizations need to be adaptable to changing conditions—ready to meet possible threats as well as capitalize on opportunities as they arise.

Achieving Sustainability. Attaining and maintaining sustainability is an ongoing process that begins with an active commitment to delivering effective programs and sound management.

Figure 7.14 Example from the Field: Incorporating Healthy Housing as a Principle of Sustainability in Baltimore

Baltimore's 2009 Sustainability Plan has been incorporated into the city's comprehensive master plan. The Sustainability Plan highlights seven priority areas: (1) cleanliness, (2) pollution prevention, (3) resource conservation, (4) "greening" of the city's physical space and food supply, (5) transportation, (6) environmental awareness, and (7) promoting a green economy. Each focus area has multiple goals, each with a set of strategies for sustainability, timelines for implementation, and recommendations that agencies should take in promoting specific priority areas. The priority areas and strategies were developed over a two-year process through multiple meetings with governmental and private sector leaders and broad-based community engagement of over 1000 members of the public.

Healthy homes strategies incorporated into the plan include:

- Improving enforcement of the current sanitation code;

- Improving the energy efficiency of existing homes and buildings;

- Mandating efficiency upgrades to homes at the point of sale;

- Using green cleaning products in schools, government offices, and businesses;

- Improving the health of indoor environments;

- Exploring the feasibility of making all Baltimore multi-family dwellings smoke-free;

- Increasing and coordinating all healthy housing efforts;

- Ensuring coordination among weatherization, lead remediation, and healthy homes activities;

- Adopting a policy and plan for elimination of pesticide use and other toxic chemicals; and

- Creating green jobs and preparing city residents for these jobs.

See http://www.baltimoresustainability.org/uploads/files/Sustainability_Plan.pdf

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Notes

Glossary

Active environmental sampling system: the use of an air sampling pump that pulls air at a known flow rate through a filter or other collection, which is then sent to a laboratory for analysis.

Active radon mitigation system: a system comprised of a vent pipe with a fan in it that runs from beneath the foundation slab up to above the roof where the radon gas is vented.

Allergen: proteins with the ability to trigger immune responses and cause allergic reactions in susceptible individuals. They are typically found adhered to very small particles, which can be airborne as well as present in settled household dust reservoirs.

Arc fault circuit interrupter (AFCI): a safety device designed for homes, which works by responding to early arcing and sparking conditions in wiring to prohibit or reduce the potential for electrical fires.

Asbestos: an incombustible, chemical-resistant, fibrous material form of pure magnesium silicate used for fireproofing, electrical insulation, building materials, brake linings, and chemical filters.

Asthma: a complex condition that involves the interaction of many environmental agents, and genetic and other factors on different cells in the airway, which alters the function and expression of genes associated with immune responses. It is characterized by episodic airway obstruction caused by extensive narrowing of the bronchi and bronchioles. The narrowing is caused by spasm of smooth muscle, edema (swelling from fluid accumulation) of the mucosa, and the presence of mucus in the airway resulting from an immunologic reaction induced by allergies, irritants, infection, stress, and other factors in a genetically predisposed individual.

Attic: any story or floor of a building situated wholly or partly within the roof, and so designed, arranged, or built to be used for business, storage, or habitation.

Back drafting: the reversal of airflow due to negative pressure in chimneys, water heater exhaust vents and other devices, which results in dangerous combustion gasses being released into the living space.

Basement: the lowest story of a building, below the main floor and wholly or partially lower than the surface of the ground.

Blower Door: an instrument consisting of pressure gauges, a variable speed fan and temporary covering, mounted in a doorframe, used to pressurize and depressurize a house to measure air leakage.

Building: a fixed construction with walls, foundation, and roof, such as a house, factory, or garage.

Building Envelop: the roof, walls, doors, foundation, windows and other penetrations in the exterior of a building.

Building Performance Testing: a method of assessing how well building ventilation and other systems work.

Bulk container: any metal garbage, rubbish, or refuse container having a capacity of 2 cubic yards or greater and which is equipped with fittings for hydraulic or mechanical emptying, unloading, or removal.

Carbon monoxide: a poisonous odorless, colorless and tasteless gas that is a byproduct of the incomplete combustion of carbon-based fuels, such as natural or liquefied propane gas, kerosene, oil, gasoline, wood or coal, and is made of a single atom of carbon and one atom of oxygen, which can cause human health problems or be fatal if present in high concentrations.

Case management: the assessment of health and social service needs, development of an action plan, and ongoing referral and support.

Central heating system: a single system supplying heat to one or more dwelling unit(s) or more than one rooming unit.

Chimney: a vertical shaft, usually of reinforced concrete, or other approved noncombustible, heat-resisting material enclosing one or more flues, for the purpose of removing products of combustion from solid, liquid, or gaseous fuel.

"Cleveland Drop": a ventilation system first identified in a number of Cleveland, Ohio-area houses in which air is drawn from a moist basement instead of a tempered (heated or cooled) living area, potentially resulting in moisture and mold being dispersed throughout the house.

Condensation: moisture that is created when air that is sufficiently warm and moist comes into contact with a cold surface, forming water.

Community Development Corporation: a type of nonprofit entity characterized by its community based leadership and work primarily in housing production and/or job creation. Community Development Corporations are typically formed by residents, small business owners, faith-based congregations, and other local stakeholders to revitalize a low and/or moderate income community in order to produce affordable housing, create jobs for community residents, and provide a variety of social services within its target area.

Cost-of-Illness: a study that qualifies the public health burden created by an illness by including all medical, non-medical, and productivity costs associated with an adverse health outcome.

Cost analysis: a study that focuses on the costs of implementing an intervention, and may also document the costs saved as a result of the intervention (or the net costs after subtracting the total program costs from the cost of illnesses).

Cost-effectiveness analysis: an analysis that calculates the ratio of net costs per improvement in health associated with the intervention, which is used to assess the relative efficiency of two or more interventions.

Cost-benefit analysis: an analysis that compares the costs and consequences of intervention strategies.

Data analysis plan: a written plan that enables a program to stay on track by identifying critical data elements that evaluators plan to study and report, and how they plan to justify conclusions.

Data collection plan: a written plan that provides direction to staff or program partners responsible for collecting information need to evaluate the program.

Detector Tubes: a glass tube containing a solid chemical that changes color when air containing a contaminate is drawn through the tube, also called a length-of-stain tube.

Dilapidated: in a state of disrepair or ruin and no longer adequate for the purpose or use for which it was originally intended.

Dormitory: a building or a group of rooms in a building used for institutional living and sleeping purposes by four or more persons.

Dosimeter: a device that measures and indicates the amount of chemical, energy, noise, x-rays or radioactivity, which is usually worn by a person to measure dose.

Drain Trap: a U-, S- or J-shaped pipe located below or within a plumbing fixture, normally containing water to prevent gases from entering through the pipe.

Dwelling: any enclosed space wholly or partly used or intended to be used for living, sleeping, cooking, and eating. (Temporary housing, as hereinafter defined, shall not be classified as a dwelling.) Industrialized housing and modular construction that conform to nationally accepted industry standards and are used or intended for use for living, sleeping, cooking, and eating purposes shall be classified as dwellings.

Dwelling unit: a room or group of rooms located within a dwelling forming a single habitable unit with facilities used or intended to be used by a single family for living, sleeping, cooking, and eating.

Egress: arrangements and openings to assure a safe means of exit from buildings.

Electrochemical sensor: a type of chemical detector with a fuel cell designed to produce a current that is precisely related to the amount of chemical in the atmosphere, such as carbon monoxide.

Elevated blood lead level: excessive absorption of lead in a confirmed concentration in whole blood, usually measured in micrograms per deciliter or micrograms per liter. Such levels can trigger responses to reduce or eliminate exposure and are often established by the U.S. Centers for Disease Control and Prevention and/or local jurisdictions.

Energy Star: a joint program of U.S. EPA and the U.S. Department of Energy designed to help save money and protect the environment through energy efficient products and practices.

Enterprise Green Community Standards: a program developed by Enterprise Community Partners, which incorporates an integrated design process in low-income housing to facilitate sustainable, energy conservation, health and other green features.

Environmental Justice: the fair treatment and meaningful involvement of all people regardless of race, color, national origin, culture, education, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.

Extermination: the control and elimination of insects, rodents, or other pests by eliminating their harborage places; by removing or making inaccessible materials that may serve as their food; by poisoning, spraying, fumigating, trapping, or any other recognized and legal pest elimination methods approved by the local or state authority having such administrative authority. Extermination is one of the components of integrated pest management.

Fair market value: a price at which both buyers and sellers will do business.

Family: one or more individuals living together and sharing common living, sleeping, cooking, and eating facilities (See also Household).

Flashing: thin continuous pieces of sheet metal or other impervious material installed to prevent water from leaking into a structure through an angle or joint.

Flush toilet: a toilet bowl that can be flushed with water supplied under pressure and that is equipped with a water-sealed trap above the floor level.

Garbage: animal and vegetable waste resulting from handling, preparation, cooking, serving, and non-consumption of food.

General dilution ventilation: a system that moves larger volumes of air (compared to local exhaust ventilation) and operates by diluting contaminants with uncontaminated air.

Grade: the finished ground level adjacent to a required window.

Ground fault circuit interrupter (GFCI): a home safety device that will turn off power to an affected electrical circuit when any disruption in current is sensed as a result of the grounding of an electrical appliance.

Guest: an individual who shares a dwelling unit in a non-permanent status.

Habitable room: a room or enclosed floor space used or intended to be used for living, sleeping, cooking or eating purposes, excluding bathrooms, laundries, furnace rooms, pantries, kitchenettes and utility rooms of less than 50 square feet of floor space, foyers, or communicating corridors, stairways, closets, storage spaces, workshops, and hobby and recreation areas.

Habitable space: space in a structure for living, sleeping, eating or cooking. Bathrooms, toilet rooms, closets, halls, storage or utility spaces, and similar areas are not considered habitable spaces.

Harborage: those areas where pests are able to take shelter.

Health officer: the legally designated health authority of the jurisdiction or that person's authorized representative.

Healthy Home Rating System (HHRS): a visual assessment tool adapted from the British Housing Health and Safety Rating System (HHSRS) to examine 29 hazards, or categories of hazards, to determine the risks to occupants' health and safety. Ann assessment using the HHRS is made based on the condition of the whole dwelling.

Heating device: all furnaces, unit heaters, cooking and heating stoves and ranges, and other similar devices.

Household: one or more individuals living together in a single dwelling unit and sharing common living, sleeping, cooking, and eating facilities (see also Family).

Housing Health and Safety Rating System (HHSRS): a visual assessment tool developed in Great Britain that uses home assessment data to quantitatively rank home health. Users of this tool base their conclusions on the condition of the whole dwelling after carrying out an in-depth visual inspection and then using a formula to calculate a numerical score, to allow comparison of both the major and minor health and safety hazards.

Immunoassay: a laboratory technique that makes use of the specific binding between the antigen associated with an allergen and its homologous antibody in order to identify and qualify a substance in a sample.

Infestation: the presence within or around a dwelling of any insects, rodents, or other pests.

Integrated pest management: a coordinated approach to managing roaches, rodents, mosquitoes, and other pests that combines inspection, monitoring, treatment and evaluation, with special emphasis on the decreased use of toxic agents.

Kitchen: any room used for the storage and preparation of foods and containing the following equipment: sink or other device for dishwashing, stove or other device for cooking, refrigerator or other device for cold storage of food, cabinets or shelves for storage of equipment and utensils, and counter or table for food preparation.

Kitchenette: a small kitchen or an alcove containing cooking facilities.

Lead-based paint: any paint or coating with lead content equal to or greater than 1 milligram per square centimeter, or 0.5% by weight, pursuant to Title X of the Housing and Community Development Act of 1992.

Lead-based paint hazard: a condition in which exposure to lead from lead-contaminated dust, lead-contaminated soil, or deteriorated lead-based paint would have an adverse effect on human health. Lead-based paint hazards include deteriorated lead-based paint, leaded dust levels above applicable standards, and bare leaded soil above applicable standards.

LEED: a green building certification system developed by the U.S. Green Building Council and launched in 2000, which provides third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics, including energy savings, water efficiency, carbon dioxide emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. LEED is the acronym for Leadership in Energy and Environmental Design.

Local exhaust ventilation: a system designed to move a relatively small amount of air (compared to general dilution ventilation) containing a contaminant at the point it is generated before it can enter the indoor air at large.

Logic model: a visual method of describing the relationships among program elements, which can (1) identify short-term, intermediate, and long-term outcomes; (2) link expected outcomes to a program's intended activities and inputs; and (3) establish program boundaries to prevent "mission creep." Elements of a logic model include resources or inputs, activities, outputs, and outcomes and impact.

Mildew: a non-technical name commonly used to refer to any fungus that is growing on fabrics, window sills or bathroom tiles.

Moisture meter: a device that measures water content in building materials through gauging changes in electrical resistance/capacitance.

Mold: a non-technical name that commonly refers to any fungus that is growing in the indoor environment or on housing exteriors. Molds are characterized by a visible vegetative body, or colony, composed of a network of threadlike filaments, which infiltrate the mold's food or habitat. Mold colonies may appear cottony, velvety, granular or leathery, and may be white, gray, black, brown, yellow, greenish or other colors. They can live off many materials found in homes, such as wood, cellulose in the paper backing on drywall, insulation, wallpaper, glues used to bond carpet to its backing, and everyday dust and dirt.

Multi-Family Housing: any dwelling containing four or more individual dwelling units (this definition may vary by jurisdiction).

Mycotoxin: a toxic metabolite, such as a volatile organic compound, that can be a health hazard to humans, birds and mammals upon exposure (i.e., ingestion, dermal contact or inhalation).

Occupant: any individual that is living, sleeping, cooking, or eating in or having possession of a dwelling unit or a rooming unit; except that in dwelling units a guest shall not be considered an occupant.

Outcome evaluation: an evaluation that focuses on the degree to which any changes are attributable to a program's services or interventions.

Owner: any person who alone, jointly, or severally with others (a) shall have legal title to any premises, dwelling, or dwelling unit, with or without accompanying actual possession thereof, or (b) shall have charge, care or control of any premises, dwelling, or dwelling unit, as owner or agent of the owner, or as executor, administrator, trustee, or guardian of the estate of the owner.

Passive environmental sampling system: a system that relies on the contaminant being absorbed onto special collection media via diffusion or another sampling system that does not use pumps.

Passive radon mitigation system: a system that is comprised of a pipe that runs from beneath the foundation slab up through the house to above the roof where the radon gas vents and does not incorporate the use of an exhaust fan. A passive system can be turned into an active one with the installation of an exhaust fan.

Pesticide: a substance or mixture of substances used to control pests, such as insects, rodents, weeds, fungi or bacteria.

Plumbing: all of the following supplied facilities and equipment: gas pipes, gas burning equipment, water pipes, garbage disposal units, waste pipes, toilets, sinks, installed dishwashers, bathtubs, shower baths, installed clothes washing machines, catch basins, drains, vents, and similarly supplied fixtures, and the installation thereof, together with all connections to water, sewer, or gas lines.

Privacy: the existence of conditions which will permit an individual or individuals to carry out an activity commenced without interruption or interference, either by sight or sound by unwanted individuals.

Process evaluation: an evaluation that measures program reach, activities and services, and documented program operations.

Radon: an odorless, colorless radioactive gas that is a decay product of uranium that moves through fractures and porous substrates in the foundations of buildings and can collect in high concentrations in certain areas. Radon may also enter a house through water systems in communities where groundwater is the main water supply, most commonly in small public systems and private wells (i.e., closed systems that do not allow radon to escape).

Rat harborage: any conditions or place where rats can live, nest or seek shelter.

Rat proofing: a form of construction that will prevent the entry or exit of rats to or from a given space or building, or from gaining access to food, water, or harborage. It consists of the closing and keeping closed of every opening in foundations, basements, cellars, exterior and interior walls, ground or first floors, roofs, sidewalk gratings, sidewalk openings, and other places that may be reached and entered by rats by climbing, burrowing, or other methods, by the use of materials impervious to rat gnawing and other methods approved by the appropriate authority.

Rat slab: a thin concrete slab poured over a durable vapor retarder, such as 6 mil or thicker polyethylene plastic, which covers the entire bare earth floors in a basement or crawl space to prevent rodents from burrowing through and entering the space.

Refuse: leftover and discarded organic and non-organic solids (except body wastes), including garbage, rubbish, ashes, and dead animals.

Refuse container: a watertight container that is constructed of metal, or other durable material impervious to rodents, which is capable of being serviced without creating unsanitary conditions.

Rubbish: non-putrescible solid wastes (excluding ashes) consisting of either: (a) combustible wastes such as paper, cardboard, plastic containers, yard clippings and wood; or (b) noncombustible wastes such as cans, glass, and crockery.

Space heater: a self-contained heating appliance of either the convection type or the radiant type and intended primarily to heat only a limited space or area such as one room or two adjoining rooms.

Sphincter: a circular or structural muscle that maintains control over a natural body part and relaxes to permit release of waste material. Rodents release elongated droppings due to sphincter action, while cockroaches release spherical droppings because they have no sphincter.

Systems theory: the concept proposed to promote the dynamic interrelationship of activities designed to accomplish a unified system.

Temporary housing: any tent, trailer, mobile home, or other structure used for human shelter that is designed to be transportable and which is not attached to the ground, to another structure, or to any utility system on the same premises for more than 30 consecutive days.

Thermography: a method of identifying moisture problems behind walls and other building cavities by using a special camera that photographs infrared spectra.

Toxic substance: any chemical product applied on the surface of or incorporated into any structural or decorative material, or any other chemical, biologic, or physical agent in the home environment or its surroundings, which constitutes a potential or actual hazard to human health at acute or chronic exposure levels.

Vapor Retarder: any material, usually plastic or foil, which resists diffusion of water through building materials. (Also called a vapor barrier.)

Volatile organic compounds: a class of carbon-containing chemicals that become gases at room temperature and, when inhaled, can produce a variety of adverse health effects.

Abbreviations and Acronyms

Abbreviations and Acronyms

ADA	Americans with Disabilities Act	CPR	cardiopulmonary resuscitation
AFCI	arc fault circuit interrupter	CPSC	Consumer Product Safety Commission
AHHS	American Healthy Homes Survey	CSREES	U.S. Department of Agriculture's Cooperative State Research, Education, and Extension Service
ALA	American Lung Association		
AMI	area median income	DDT	dichlorodiphenyltrichlorethane
ANSI	American National Standards Institute	DOE	U.S. Department of Energy
APHA	American Public Health Association	EBL	elevated blood lead level
AFCI	arc fault circuit interrupter	ELISA	Enzyme-linked immunosorbent assay
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers	EPA	U.S. Environmental Protection Agency
		ETS	environmental tobacco smoke
ASME	American Society of Mechanical Engineers	FEMA	Federal Emergency Management Agency
ASSE	American Society of Structural Engineers	FHA	Federal Housing Administration
ASTM	American Society for Testing Materials	GFCI	ground fault circuit interrupter
ATSDR	Agency for Toxic Substances and Disease Registry	HEPA	high-efficiency particulate air
		HHRS	Healthy Home Rating Systems
BTU	British thermal unit	HHS	U.S. Department of Health and Human Services
CAA	community action agencies		
CARE	U.S. Environmental Protection Agency's Community Action for a Renewed Environment program	HHSRS	Housing Health and Safety Rating System
		HIPAA	Health Insurance Portability and Accountability Act
CBO	community-based organization	HMO	health maintenance organization
CBR	community-based participatory research	HQS	Housing Quality Standards
		HSC	Home Safety Council
CDBG	Community Development Block Grant	HUD	U.S. Department of Housing and Urban Development
CDC	U.S. Centers for Disease Control and Prevention	HVAC	heating, ventilating and air conditioning
CFR	Code of Federal Regulations	IAQ	indoor air quality
CHW	community health worker	ICC	International Code Council
CLPPP	Childhood Lead Poisoning Prevention Program	IPM	integrated pest management
CO	carbon monoxide	IPMC	International Property Maintenance Code
CO2	carbon dioxide		

IRB	Institutional Review Board	OSHA	U.S. Occupational Safety and Health Administration
ISO	International Standard Organization	pCi/L	picoCuries per liter
kg	kilogram	PACE-EH	Protocols for Assessing Community Excellence in Environmental Health
LEAP	U.S. Department of Housing and Urban Development's Lead Elimination Action Program	PMP	pest management professional
LEED	Leadership in Energy and Environmental Design	ppm	parts per million
		psi	pound per square inch
MARIATM	Multiplex Array for Indoor Allergens	PVC	polyvinyl chloride
MERV	Minimum Energy Rating Value	PW	potable water
NACCHO	National Association of County and City Health Officers	QA	quality assurance
		QAP	quality assurance plan
NCEH	National Center for Environmental Health, part of CDC	QC	quality control
NCHH	National Center for Healthy Housing	SDWA	Safe Drinking Water Act
NCI	National Cancer Institute	SEER	seasonal energy efficiency ratio
NCIPC	National Center for Injury Prevention and Control	T&P	temperature-pressure
		TSP	tri-sodium phosphate
NHANES	National Health and Nutrition Examination Survey	UF	urea-formaldehyde
		UL	Underwriters Laboratories
NIA	National Institute on Aging	USCB	U.S. Census Bureau
NICHD	National Institute of Child Health and Development	USDA	U.S. Department of Agriculture
		USFA	U.S. Fire Administration
NIEHS	National Institute of Environmental Health Sciences	USGS	U.S. Geological Survey
NIST	National Institute of Standards and Technology	VA	U.S. Veteran's Affairs
		VOC	volatile organic compound
NLLAP	National Lead Laboratory Accreditation Program	WAP	Weatherization Assistance Program
NOx	Oxides of nitrogen	WHO	World Health Organization
NSF	National Science Foundation	XRF	X-ray fluorescence
NSLAH	National Survey of Lead and Allergens in Housing	µg/dl	micrograms per deciliter
OHHLHC	U.S. Department of Housing and Urban Development's Office of Healthy Homes and Lead Hazard Control		

Appendices

Appendix 1.1 Resources
Neighborhood and Community Health and Safety Issues

Issue	Resource
Brownfields	EPA: http://www.epa.gov/brownfields/
	The Brownfields and Land Revitalization Technology Support Center: http://www.brownfieldstsc.org/
Built Environment	CDC: http://www.cdc.gov/nceh/ehs/Topics/BuiltEnvironment.htm
Climate Change	EPA: http://www.epa.gov/climatechange/
	National Oceanic and Atmospheric Administration: http://www.noaa.gov/climate.html
Disaster Planning	FEMA: http://www.ready.gov/america/index.html
	CDC: http://emergency.cdc.gov/
Extreme Cold and Heat	CDC: http://emergency.cdc.gov/disasters/winter/
	CDC: http://emergency.cdc.gov/disasters/extremeheat/
Flood Cleanup	http://www.fema.gov/hazard/flood/aftrfld.shtm
	National Center for Health Housing: http://www.centerforhealthyhousing.org/FloodCleanupGuide_screen_.pdf
Indoor Air Quality	http://www.epa.gov/iaq/homes/retrofits.htm
Natural Disasters	FEMA: http://www.ready.gov/america/index.html My Emergency Planning Kit and My Emergency Widget—to get online updates on disasters
	CDC: http://emergency.cdc.gov/disasters/
Neighborhood Safety	National Crime Prevention Council: http://www.ncpc.org/topics/home-and-neighborhood-safety
Noise Pollution	EPA: http://www.epa.gov/air/noise.html
Outdoor Air Quality	EPA: http://www.epa.gov/air/
Rural Housing	USDA Rural Development Housing and Community Facilities Programs: http://www.rurdev.usda.gov/rhs/
Violence	CDC: http://www.cdc.gov/ViolencePrevention/index.html
Water Quality	EPA: http://www.epa.gov/safewater/
Workforce/Green Jobs	http://www1.eere.energy.gov/wip/retrofit_guidelines.html
Workplace Hazards	Occupational Safety and Health Administration: http://www.osha.gov/
	National Institute for Occupational Safety and Health: http://www.cdc.gov/niosh/
	NIEHS: National Clearinghouse for Worker Safety and Health Training http://tools.niehs.nih.gov/wetp/

Appendix 1.2 Case Study
Opportunity Council, Bellingham, WA
Weatherization Partnership

Program Overview

Purpose. The purpose of the project was to address the needs of children with asthma living in low-income housing by reducing environmental triggers.

Target Population. The program targeted very low-income families with children, from birth to age four, and home-based child care programs served by Opportunity Council weatherization and home rehabilitation programs. The target households included Native American children, who have an exceptionally high prevalence of asthma, and recently-settled immigrants from the Ukraine. The target area was comprised of four counties in the northwest corner of Washington State.

Partnerships. The Opportunity Council provided leadership for this initiative. As a community action agency they are responsible for multiple programs and community services including child care, early childhood education, homeless and transitional housing, health care, and community information and referral services.

Program partners included Northwest Clean Air Agency (the regional air pollution authority), Whatcom County Health Department, City of Bellingham Community Development Department, Opportunity Council Head Start, and Childcare Resource and Referral programs. In collaboration with over 30 public and private organizations, the Opportunity Council conducted a two-year public education campaign focusing on healthy homes interventions.

Community Involvement. The Indoor Air Coalition of Whatcom County (IACWC) served as the steering committee for the project and focused on defining the target population as they served to leverage.

Planning. Partner agencies serving the target population coalesced to implement the healthy homes program. Opportunity Council Head Start program recruited families who were receiving weatherization program services. The Northwest Clean Air Agency has the ability to assess in-home hazards in low-income households where children with asthma lived.

Interventions

Recruitment. Families were enrolled using the following eligibility criteria on a "first come, first served" basis:

- Income: The participant family income needed to be 125 percent of poverty or less.

- Health: Family or child care providers must have at least one child clinically diagnosed with asthma. Households with indoor cigarette smoking or pets were not eligible.

- Home conditions: The dwelling needed to be in a condition such that reasonable repairs or weatherization measures and available funding could address imminent hazards.

- Home ownership: Program participants (both families and child care providers) had to be homeowners.

Interventions. Healthy homes program services include:

- Pre- and post-renovation air and dust samples.

- Pre- and post-renovation education to help families identify and control asthma triggers.

- Weatherization services, including enhanced ventilation systems and pollutant mitigation.

- Supplies for the families, including green cleaning kits, HEPA vacuums, walk-off mats, and mite-proof bedding covers.

- Training of Head Start home visitors, child care monitors, health department staff, and other community social service providers in asthma trigger prevention and the "Seven Steps to a Healthy Home" model.

- Dissemination of information to the weatherization network regarding Healthy Home principles.

- Two tools created to support the interactive curriculum:

  - How Your House Works, which is based on the "house as a system" approach.

  - Home Asthma Reduction Training Workbook, a tool to help families create a plan to reduce asthma triggers in their home.

Program Staff. The program used the Opportunity Council's in-house weatherization staff for all repairs except where specialty contractors, such as electricians, plumbers, and HVAC installers, were needed. All in-house staff received training on healthy homes concepts, program parameters, and other topics.

Systems and Policies

The Opportunity Council in collaboration with ICF Consulting and Tohn Environmental Strategies developed the Weatherization Plus Health model and related protocols and training for Department of Energy Weatherization Assistance Programs (WAP).

Funding and Leverage

Funding Sources:

- HUD Healthy Housing Demonstration grant.

- Weatherization program funding and technical expertise was leveraged.

- A private donor committed $100,000 per year in support of energy efficiency retrofits.

Program Costs. The average cost to combine the weatherization program with healthy homes interventions is estimated at $5,620 per housing unit, with a range of $1,500–$6,000.

Evaluation and Outcomes

Housing Outcomes. The visual assessment tool was used to evaluate housing units post-renovation. The tool covered observations of mold and moisture, pest and pesticide use, presence of carbon monoxide detectors, condition of appliances, lead-based paint hazards, environmental tobacco smoke, poisoning, and fire hazards.

Northwest Air Pollution Authority and Opportunity Council staff collected pre- and post-renovation dust tape lifts, air samples, and carpet dust samples. While the results of post-testing varied, in aggregate there were noticeable improvements in the reduction of dust levels in most home and child care environments.

Health Outcomes. Family members reported on children's health, asthma status, family health maintenance, and home cleaning practices at baseline and follow-up visits. The program reported that frequency of unit turnover had decreased in housing units receiving healthy homes program services.

Sustainability

Under the current expanded program, the Opportunity Council continues to follow the Weatherization Plus Health Model, using private sector leverage to cover the additional costs of the health-related assessments and additional upgrades. This is possible mainly because of the existing infrastructure of the weatherization program. Homes asthma trigger reduction strategies have been integrated into the existing weatherization and housing rehabilitation program production systems. With funding from the American Recovery and Reinvestment Act of 2009, the Opportunity Council has expanded its on-line training resources through its Building Performace Center. It has also become an accredited training provider through the U.S. Department of Energy.

Best Practices

- Integrating the resources of a Community Action agency that offers weatherization, Head Start, child care resource and referral, and home visiting to serve the same target group.

- Leveraging existing weatherization funding with Healthy Homes grants.

Appendix 1.3 Case Study
Baltimore City Health Department
Transitioning from Lead to Healthy Housing

Program Overview

Purpose: In 2007, the U.S. Centers for Disease Control and Prevention (CDC) chose the Baltimore City, Maryland Health Department's Childhood Lead Poisoning Prevention Program (CLPPP) to transition from a lead program to a comprehensive Healthy Homes Program. The Healthy Homes Demonstration Project pilot's goal was to develop, implement, and evaluate a cost-effective, outcome-focused, replicable model for transitioning from an urban childhood lead poisoning prevention program to a comprehensive healthy homes program. The program aimed to reduce lead exposure, asthma risks, injury risks and hazards, carbon monoxide poisoning, and fire morbidity and mortality.

Target Population: The program targeted children with elevated blood levels (EBL) and children aged 0–6 years and pregnant women living in housing with hazards identified through its Primary Prevention Initiative (PPI).

Partnerships: CDC, University of Maryland, Coalition to End Childhood Lead Poisoning, Health Care Access.

Community Involvement: The Health Department obtained input through a variety of different mechanisms:

- One-on-one meetings with various individuals and organizations across the city, including community organizations, community leaders, and government agencies.

- A newly developed healthy homes advisory board.

- Focus groups with representatives of the target population.

The program relied on input from clients for ongoing feedback. During baseline visits, field staff asked clients about their home and family priorities. The staff used the client-identified needs to devise a specific and appropriate action plan for each client.

Planning. A pilot team of two field staff representatives, field staff supervisors and managerial staff, was formed to draft, discuss, and revise the assessment forms, protocols, and education materials. In developing the protocols for the program, the pilot team cyclically reviewed scientific studies and other healthy homes protocols and approaches, analyzed Baltimore City health and housing data, and received feedback from field staff. After piloting the protocols and assessment forms in ten healthy homes visits, the pilot team integrated feedback from staff to create the final documents. The program also relied heavily on field staff with lengthy home-visiting experience to shape the protocol, resources, supplies, and assessment form.

During the first year of the transition, the program developed new protocols, assessment forms, referral resources, and completed 90 hours of staff training. Extensive evaluation occurred after the first year, showing statistically significant health outcomes. Stage two of the transition required additional ongoing work, including applying for funds to expand services, building a career ladder for health department staff, implementing a quality improvement initiative, and expanding community outreach. Milestones during the transition year included:

1. Convening the pilot team;

2. Initiating a broad range of trainings for the project staff;

3. Finalizing the healthy homes protocols and two assessment forms (visual and medical);

4. Training the entire staff on the protocols and assessment forms; and

5. Staff-wide expansion of the program.

Interventions

Recruitment. Children with elevated blood lead levels are automatically reported to the Health Department's Healthy Homes Division for case management due to mandated reporting laws. Families under case management were

automatically included in the pilot. Additional cases came from maternal and infant nursing home visiting programs serving high-risk pregnant and post-partum women.

Interventions. All families received two initial home visits (a visual assessment conducted by a sanitarian and a health educational assessment conducted by a community health worker) and one follow-up visit after three months.

Staff members educated families during home visits and provided education materials and healthy homes supplies. Topics addressed included lead and carbon monoxide exposure, fire hazards, moisture/mold and pest problems, indoor smoking, ventilation, physical hazards, and easy accessibility to pesticides. Supplies included books for children, roach disks, caulk, non-toxic cleaning supplies, cribs, covered trash cans, and outlet covers.

The environmental team made referrals to the Baltimore City Fire Department for free smoke alarm installation and to the Coalition to End Childhood Lead Poisoning for legal advocacy, relocation assistance, and lead abatement. In addition, the program worked with Baltimore City Maternal and Child Health on the Safe Sleep Initiative. Through this initiative, the program installed cribs in homes where children under one year old had no safe place to sleep.

During both the initial and the follow-up assessments, caseworkers asked clients to identify any concerns they had with their home and/or family. Then using the client-identified issues, caseworkers developed an appropriate action plan. During follow-up visits, field staff paid attention to client-identified issues and used them as reference points.

Program Staff. In May 2006, the Baltimore City Health Commissioner announced the appointment of the first major U.S. City Assistant Commissioner for Healthy Homes in the nation. From 2006–2009, the Health Department's Healthy Homes Division was comprised of 60 staff members working on five healthy housing programs and initiatives, including an integrated healthy homes inspection and health services program, a fire safety initiative, a lead abatement funding program, and an integrated pest management (IPM) pilot program in housing units owned by the Housing Authority of Baltimore City.

Staff attended approximately 90 hours of training in the first year. Staff attended didactic and interactive training seminars on home environmental health topics, childhood lead poisoning prevention, lead-safe work practices, and behavioral health. Additional topics covered at the trainings included community resources, injury prevention, safe sleep, water testing, blood-borne pathogens, mold prevention, carbon monoxide poisoning, fire safety, and IPM.

Funding and Leverage

Funding Sources. CDC, HUD, EPA, State of Maryland, and City of Baltimore.

Evaluation and Outcomes

The program had statistically significant changes in health and housing outcomes:

- At the initial visit, 50 percent of the homes showed evidence of smoking and only 37 percent at the follow-up visit (90 percent statistically significant).

- At the initial visit, 58 percent of infants had their own cribs and 89 percent had their own cribs at the follow-up visit (95 percent statistically significant).

- At the initial visit, 65 percent of families reported smoking indoors and only 45 percent reported indoor smoking at the follow-up visit (99 percent statistically significant).

- At the initial visit, 33 percent of homes "appeared clean," and 54 percent of homes "appeared clean" at the follow-up visit (99 percent statistically significant).

- At the initial visit, 36 percent of homes were free of garbage or debris and 68 percent of homes were free of garbage or debris at the follow-up visit (99 percent statistically significant).

Sustainability

The Health Department's Healthy Homes Division served as a key consultant in the city's receipt of major Weatherization funds. Healthy homes priorities are being incorporated into weatherization services city-wide.

CDC has produced a report titled Healthy Homes Transition Report—A Study of the Baltimore City Healthy Homes Division for use by other jurisdictions as they evolve from single issue lead poisoning prevention programs to more comprehensive healthy homes programs.

Best Practices

- Conducting focus groups to assess the perspective of program participants directly impacted by the transition.

- Using client-identified needs to help prioritize issues and create an appropriate action plan.

Appendix 1.4 Case Study
Boston Public Health Commission & Boston Inspectional Services Department
Health Care and Housing Code Enforcement Partnership

Program Overview

Purpose. Breathe Easy at Home (BEAH), a program of the Boston Public Health Commission and Boston Inspectional Services Department and the Boston Inspectional Services Department, is a web-based service system designed to allow clinicians to make on-line referrals for housing code inspections for their patients with asthma.

Target Population. BEAH targets children and adults with asthma living in public or private rental housing in Boston neighborhoods with high rates of asthma and multifamily rental housing. Physicians, nurses, social workers and other health workers identify and refer their patients in need of environmental asthma trigger reduction in their homes.

Model. BEAH is an on-line system for referring Boston residents with asthma for housing code inspections. Online referrals originate from clinical sites. Home inspections are conducted by the Boston Inspectional Services Department (ISD) inspection staff. Boston ISD enforces the Massachusetts housing code in the city of Boston. The program is managed out of the Boston Public Health Commission, whose program coordinator works with the program advisory board to undertake planning, outreach and recruitment and evaluation. Referring clinicians receive electronic updates on the status, findings and resolution of the case. Inspections may result in issuance of a notice of violation, with a maximum time to correct the violation. The "correction order" specifies the violations that must be remedied to resolve the case and a required time frame. A case is closed when the violation is corrected. Common asthma triggers covered by the Massachusetts state sanitary code for housing include presence of cockroaches, rodents, excessive moisture or mold, damaged, wet or dirty carpets, excessive heat or absence of heat among others.

Partnerships. Boston's Public Health Commission works with the City of Boston Inspectional Services Department, Boston Medical Center, Boston Housing Authority, Boston Urban Asthma Coalition, Children's Hospital Boston, and Committee for Boston Public Housing and Medical Legal Partnership. These partners worked together to envision the on-line system, implement a pilot project and evaluate, monitor and expand the program.

Interventions

Recruitment. Doctors, nurses and other healthcare professionals located at hospitals and health centers.

Interventions. The program enforces the State Sanitary Code Chapter II: Minimum Standards of Fitness for Human Habitation (Massachusetts Housing Code). Inspections may result in issuance of a notice of violation, with a maximum time to correct the violation. Common asthma triggers covered by the Code include the presence of cockroaches, rodents, excessive moisture or mold, damaged, wet or dirty carpets, excessive heat or absence of heat, among other issues.

Program Staff. The program structure includes a program coordinator employed by the Boston Public Health Commission who works closely with housing inspection staff from ISD. This system capitalizes on integrating core functions of the two city agencies. ISD inspectors conduct all the inspections and the Boston Public Health Commission manages the program, conducts outreach to the health institutions, program evaluation and communications.

The Boston Public Health Commission and Boston Inspectional Services Department co-sponsored annual inspector trainings to increase awareness and skills addressing housing conditions that contribute to asthma. Program staff has also received training in safe pest control practices.

Systems and Policies

The program enforces the Massachusetts Housing Code, officially titled the State Sanitary Code Chapter II: Minimum Standards of Fitness for Human Habitation. Inspections are conducted by Boston ISD's Housing Inspection Division. This healthy homes program leverages an existing regulation and enforcement infrastructure and uses staff whose job responsibilities were broadened to focus on asthma triggers.

Funding and Leverage

The program is dependent on extensive leveraged resources from the Boston Inspectional Services Department. Financial support is also provided by the City of Boston, Boston Public Health Commission, which has secured grants to support the program pilot and supplement city funds for program coordinator support.

Evaluation and Outcomes

Evaluation includes:

- Focus groups with ISD inspectors for feedback and recommendations on program needs.
- Interviews with clients to capture satisfaction and information on environmental and health benefits of the program.
- Interviews with clinician referrers on utility and ease of the on-line system and program benefits.
- Program measures such as housing conditions cited, case resolution rates and timelines.
- Overall referral numbers and by referring institution and neighborhood.
- Health outcome evaluation in planning stage.

Sustainability

This program has been institutionalized within the ISD and the Boston Public Health Commission and uses the current housing code. It is not dependent on grant funding.

Best Practices

- Community-based organizations advocated for local efforts on housing issues that impact asthma management.
- Collaboration with the key housing agencies in the City of Boston resulted in a sustainable service systems and policy change.
- Strong relationships with health care institutions facilitated awareness of housing concerns and their impact on the patients' health.
- Building on existing infrastructure makes the program less dependent on external fundraising.

Appendix 1.5 Case Study
Case Western Reserve University School of Medicine
Swetland Center for Environmental Health
Healthy Homes and Babies Program (Cleveland, Ohio)

Program Overview

Purpose. The purpose of the program is to provide home health and injury hazard assessments and interventions to pregnant women, infants, and geriatric patients. The program also provides the opportunity for physicians-in-training to learn about housing-related health hazards by participating in the environmental assessments of their patients' homes.

Target Population. The target area included the City of Cleveland and its first-ring suburbs. The program targeted homes with young infants as a prevention measure and the elderly to support independent living and aging in place.

Partnerships. The Swetland Center for Environmental Health at Case Western Reserve University School of Medicine provided leadership for the program. Partners include the Departments of Pediatrics and Family Medicine and the Center for Geriatric Medicine at the University Hospital's Case Medical Center, Environmental Health Watch (EHW), a grassroots community-based nonprofit organization, Community Housing Solutions, a nonprofit affordable housing organization, and the Lead Programs of the Cleveland Department of Public Health and the Cuyahoga County Board of Health. The program provided follow-up referrals to weatherization, home repair lead hazard control grant programs as needed.

Community Involvement. Neighborhood Leadership Institute (NLI) organizes and manages a Community Advisory Board to bring community concerns and suggestions to the program. NLI offers a 14-week training program in partnership with Cleveland State University for community residents who wish to improve their grassroots advocacy and leadership skills.

Planning. This project evolved from existing partnerships related to lead poisoning prevention and healthy homes. As these partner

organizations became more familiar with each other's strengths and service areas, they were able to identify a variety of program needs and resources. The long term partnership between Case Western Reserve University, EHW, and the city and county health departments was significant in gaining political support and funding. Demonstration programs and technical studies were used to pilot the assessments and interventions.

Interventions

Recruitment. Medical residents recruited their pregnant, infant, and elderly patients for participation in the project and accompanied the EHW inspector to their patients' homes for the assessment.

Interventions. The assessment included an occupant interview, visual assessment of paint condition, collection of dust and soil samples for lead analysis, tap water and refrigerator temperature measurements, observations of child/elderly fall and injury hazards, infant's sleep environment, and visual evidence of smoking, mold, roaches, rodents, dust mites, pets, pesticides, space heaters, faulty combustion appliances, and the presences of smoke and carbon monoxide (CO) detectors.

Four types of interventions were provided: (1) health and safety items; (2) low-level repairs/improvements; (3) referral to other programs for higher-level repairs or improvements; and (4) a written plan for behavioral changes that the family agreed to make. These plans were expected to be reinforced by the medical resident in future visits.

1. Health and safety items: A standard and a variable set of health and safety items were provided to the families, differing somewhat for the infants and elderly, and tailored to the specific needs found in the health-oriented home inspection. The standard items included allergen vacuum, fire extinguisher, smoke

and CO detectors, digital thermometer (mercury thermometers are removed from the household for proper disposal to eliminate breakage risk), door mats, and cleaning supplies. In addition, site specific items were provided, depending on the hazards found.

2. Low-level building interventions: Based on the inspection and the lead sampling results, EHW home environmental specialists conducted low-level building repairs, modifications, and hazard remediation. These were limited interventions that could be performed by EHW staff in rental properties without the owner's permission. The interventions included installation of safety items, environmental cleaning to reduce lead dust and other contaminants, moisture reduction measures, and integrated pest management (IPM).

3. Referral for building interventions: Based on the paint condition and lead dust sampling results, referrals were made to the City of Cleveland and Cuyahoga County Lead Hazard Control Programs. For other repairs and weatherization, referrals were made to Community Housing Solutions and weatherization program. EHW staff worked with the families and the landlords to establish eligibility and complete application forms. EHW's Affordable Green Housing Center has also developed a set of no cost/low-cost recommendations for electricity, gas, and water use reductions for low-income housing.

4. Education and behavioral change: During the inspection, families were educated about their role in reducing home health hazards. Medical residents reinforced these recommendations in the clinic setting.

Interventions for frail elderly clients focused primarily on fall prevention, IPM, lighting, and addressing deferred maintenance and clutter. Electrical repairs were one of the most frequent referrals due to the age of the housing and the medical equipment needs of the elderly clients.

Systems and Policies

The program developed referral networks with multiple health and housing programs in the community and facilitated the application process to assure comprehensive services to families and homes in need.

Funding and Leverage

Funding Sources. HUD Healthy Homes Demonstration grant funding was matched with in-kind support provided by Case Western Reserve University. As the program expanded, private funds were leveraged to partner with HouseCalls, a program designed to serve frail, home-bound seniors. The project received another HUD Healthy Home Demonstration grant to support a Healthy Homes and Patients.

Program Costs. Pediatric home inspections and interventions averaged $927 (ranging from $509 to $4197), and geriatric home inspections and interventions averaged $577 (ranging from $247 to $936). Visits for pediatric patients were more expensive in direct costs because additional health and safety items were required.

Sustainability

The program is being brought to the Greater Cleveland Asthma Coalition with the goal of obtaining Medicaid reimbursement for home visits as a cost-effective means to achieve the health benefits of prevention.

Project staff believes that the residency training component could be replicated in any community where a connection exists with an organization that provides home assessments and/or interventions.

Best Practices

- The inspector used a personal data assistant (PDA) to conduct the visual assessment. As technology has evolved, the program converted to an Access database and a tablet PC for data collection. The computerized assessment guided the inspection through each area of the house, documented building and behavioral conditions, explained the related hazard, provided drop-down alternatives to enter observations, and listed available corrective actions and who would perform the action (e.g., EHW, family, physician, owner), transforming the inspection process and assessment tool into

an educational opportunity for the medical resident and the family member. The action plan was computer-generated, based on the assessment data.

- An established relationship between the patient and doctor eased the process of scheduling home visits, resulting in a much lower rate of cancellations and "no shows."

- The program demonstrated that medical residents benefit from participating in home inspections of their patients. The doctors reported that the experience influenced their practice of medicine, resulting in a more focused environmental history-taking.

Appendix 1.6 Case Study
Children's Mercy Hospitals and Clinics
Clinic/Medical Partnership (Kansas City, Missouri)

Overview

Purpose. The purpose of the Children's Mercy Hospital Environmental Health Program (CMH-EHP) is to create healthy and sustainable indoor environments for children wherever they spend time. The program has four focus areas: patient-centered environmental health, health provider education and training, safe and healthy school and childcare programs, and community education and training programs. Through extensive collaborations with a wide variety of stakeholders the CMH-EHP is able to offer unique and comprehensive environmental health services that might impact families within the community through different community-based channels. Once concerns for a pediatric patient are identified, the CMH-EHP staff can offer multiple services and resources addressing exposure-related health issues in any setting where the patient spends time.

Target population. The CMH-EHP worked with asthmatic children two to 17 years old.

Partnerships. Program partners include Kansas City, MO Health Department Lead Poison Prevention Program; Kansas Department of Health and Environment's Healthy Homes and Lead Hazard Control Program; Metropolitan Energy Center; Wyandotte County, KS, Health Department; EPA's Indoor Environment, Environmental Justice , and Children's Health Protection Departments in Region 7; Mid-America Pediatric Environmental Health Specialty Unit (MAPEHSU); and 60 other community organizations. CMH-EHP is also a member of the Healthy Indoor Environments Coalition of the Heartland.

Interventions

Recruitment. Families may be referred by their private physician or through the entire hospital information system via an internal environmental consult process or by contacting the program staff directly. Families are asked to enroll in a four to six month healthy home program that involves from three to six visits. Some aspects of the program are research-related and require participation in an informed consent process.

Interventions.

- Depending on the severity of a patient's health condition families are offered one of two levels of participation; basic and advanced. In either case, home assessments are conducted to both educate families on healthy home best practices and to identify any issues about the home and its maintenance that represent a significant hazard or might be contributing to health problems of the occupants. Interventions are comprehensive but usually focused on controlling environmental irritants and allergens, including asthma triggers, sources of lead exposure, and safety and injury prevention. For patients with significant health issues, an advanced home environmental health assessment that includes environmental monitoring and sample collection is performed to more specifically identify sources of contaminants. This information is then used to identify targeted interventions to eliminate contaminant sources and exposure.

- All families who agree to participate in the program receive a healthy home kit that includes cleaning supplies, safety supplies and healthy home supplies including a HEPA vacuum, furnace filters, allergen bedding, a pocket hygrometer,

- For families receiving advanced home assessment services, a list of targeted interventions is developed and resources are identified to address the concerns identified. A case review takes where members agree to a list of interventions related to one of five healthy home domains; airflow and ventilation, allergens and dust, moisture control, chemical exposure and safety and injury prevention. Community partners oversee the intervention work and a follow up assessment is performed to verify that any contaminant sources have been removed and the family has begun the process of changing behavior to create a healthier home.

Program Staff. The project utilizes a program manager, an office coordinator, environmental hygienists and environmental health coordinators (e.g., respiratory therapists, health educators, advocates), and social workers. Environmental hygienists are trained in-house on environmental health, environmental assessment protocols, indoor environmental hazard measurements and sampling techniques, basic building science, and healthy homes and school practices. Training is supplemented through outside education opportunities. Environmental health coordinators are trained in environmental health, asthma, and safe and healthy home and school practices. They also serve as the primary educators in all settings. Some training is provided by outside sources.

Systems and Policies

Partial Medicaid reimbursement has been received for some home assessment service. CMH-EHP is currently working with a state-wide stakeholder group in Missouri to establish a policy for Medicaid reimbursement for all home environmental health assessment services.

A relationship between Missouri Legal Aid and the program staff enables advocacy for families on home environmental problems, code violations, lease disputes, or other issues that impede the families' ability to make changes in their homes.

The program is currently exploring expanding services through community partners to assist elderly adults with home environmental concerns.

Funding and Leverage

Funding Sources. Funding has been secured from HUD, EPA, MAPEHSU, corporate sponsors, and health insurance reimbursement.

School-based services are paid for through annual contracts with individual districts.

Because of the mission of Children's Mercy Hospitals and Clinics to serve the community and benefit all children, many services are in-kind or services fees are negotiated down to a level families indicate they can afford.

Program Costs.

- Basic home environmental health assessments include a visual assessment and healthy home education and case management: $100 to $300 per home.

- Advanced home environmental health assessments include a visual assessment, healthy home education and case management, Environmental Measurements and Sample collection and analysis: $500 to $800 per home, depending on the number of environmental samples collected, if any.

The program charges a fee for a home assessment. Attempts are made to obtain reimbursements from health insurance companies, including Medicaid and HMOs. In some cases, families pay for the service out of pocket, and in other cases, a family can negotiate the fee down to little or nothing.

Leveraged resources. The CMH-EHP partners with the two area lead hazard control programs, two local weatherization programs, small home repair programs, and some neighborhood associations to fund housing repairs. They are currently working with local Habitat for Humanity programs to develop volunteer efforts to benefit families in need of assistance with healthy home issues.

EPA funds are used for an Asthma-Friendly Child Care Program for home-based child care operations. This program supports assessments of home-based child care.

The CMH-EHP also receives financial support from private companies:

- Allergy Zone provides furnace filters and N95 masks to all families participating in the Healthy Home Program.

- Mission Allergy provides significant discounts on allergen encasement for mattresses and pillows.

- True Value hardware stores provide special pricing on healthy home supplies.

- Mar-Beck Appliance provides reconditioned HEPA vacuums at a special price for the Healthy Home Program.

Sustainability

School Partnership. CMH-EHP developed the School IEQ Program to provide training related to the indoor environment, asthma, and healthy schools to school district staff. This program also provides an environmental health assessment of school facilities. This effort led to two school districts signing contracts with the CMH-EHP to provide indoor environmental health management programs. To date, the School IEQ Program had assessed over 1400 classrooms.

Training Center. CMH-EHP established a Healthy Homes Training Center for Region VII through a partnership with the National Center for Healthy Housing, the Kansas City, MO, Health Department, and the Kansas Department of Health and Environment's Healthy Homes and Lead Hazard Control Program.

Center for Environmental Health. The program is in the process of converting from CMH-EHP into a Center for Environmental Health. The CMH-EHP addresses indoor environment issues in areas where children spend most of their time (e.g., schools, child care facilities, hospitals, and homes). The program offers training classes on indoor environmental health and asthma for physicians, clinicians, school nurses, home health staff, social workers, public health workers, child care providers, code enforcement inspectors, and families.

Best Practices

- Patchwork funding from a variety of sources including private donations.

- Comprehensive care coordination based on routine communication between environmental health coordinators, health care providers, school nurses, and families.

- A comprehensive, school-based program that focuses on the safety of the environment and classroom-based and hands-on healthy homes training. Staff receives regular training to keep their knowledge current.

Appendix 1.7 Case Study
Esperanza Community Housing Corporation
South Los Angeles Healthy Homes Program

Program Overview

Purpose. The purpose of this program was to prevent lead exposure in pregnant women and children under six years, reduce asthma triggers for families living in substandard housing without jeopardizing their tenancy, and create systemic changes in health and housing agencies by demonstrating that healthy housing is an important health intervention.

Target population. The program targeted low-income families in 13 census tracts in South Central Los Angeles with a particular focus on families with children under age six at high risk for lead poisoning and other consequences of substandard housing.

Partnerships. Esperanza Community Housing Corporation (Esperanza) collaborated with St. John's Well Child and Family Center (St. John's) and Strategic Actions for a Just Economy (SAJE) in leading this project. The Los Angeles Healthy Homes Collaborative, an association of community-based organizations committed to eliminating environmental threats in homes and communities spearheaded the code enforcement aspect of this project. Additional partners were the Los Angeles Community Action Network (LACAN), Inner City Law, Los Angeles Housing Department City Code Enforcement Program, and Eisner Pediatric & Family Medical Center.

Community Involvement. Esperanza was founded as a result of a four-year organizing effort by community residents in the Figueroa Corridor of South Central Los Angeles. Esperanza's project staff are a team of Promotoras de Salud (community health promoters) specializing in healthy homes interventions. They are community residents who are graduates of Esperanza's six-month intensive Community Health Promoters Training, followed by years of specialized training in lead dust sampling, lead-safe work practices, and Healthy Homes related protocols. The program was designed entirely with their input as they were from the community and knew first-hand the needs and housing conditions of the families in the neighborhood.

Interventions

Recruitment. Families were identified and recruited through:

- Referrals from the St. John's Well Child and Family Center;

- Tenant-organizing activities by SAJE; and

- Door-to-door outreach to other families living in the buildings visited by the Healthy Homes Team as a result of any referral.

Interventions. The program is a coordinated, tri-discipline approach involving: (1) community outreach, in-home environmental assessment, and education; (2) tenant rights and displacement prevention; and (3) progressive clinical monitoring of environmentally-caused illness and injury.

The housing interventions included an initial home visit, administration of the Health and Housing Survey, education and management of housing conditions, and monitoring of home environmental triggers. Lead dust samples, moisture meter readings, and cockroach sampling were conducted. Families participating fully in the data collection procedures received a Bucket Cleaning Kit. The kit contained a mop, gloves, baking soda, vinegar, two rags, and a spray bottle, as well as Healthy Homes and poison prevention material.

Program Staff. The project utilized a project manager and data analyst (both trained Promotoras), Esperanza executive director, finance director, and a team of Healthy Homes Promotoras, community organizers, tenant organizers at SAJE, clinicians, and a part-time evaluation consultant. Most of the Esperanza team were certified lead sampling technicians and had years of training in lead-safe work practices and integrated pest management.

Systems and Policies

Esperanza's work, as part of the Los Angeles Healthy Homes Collaborative, has resulted in important State Policy: the development and enactment of Senate Bill 460, put into law January 2002. This law empowers and mandates both local code enforcement agencies and local health departments to stop unsafe work practices and makes the disruption of lead hazards a violation of both housing code.

The South Los Angeles Healthy Homes Program has focused on housing as a highly significant determinant of health, documenting negative health impacts of substandard housing and positive impacts of quality, affordable housing. As a result of this partnership our clinical partners have adopted a "zero-tolerance" for blood lead policy that has resulted in systems of universal testing of all children and universal reporting of all results to the Healthy Homes program.

The partnership between the Los Angeles Healthy Homes Collaborative and the City's Systematic Code Enforcement Program (SCEP) has integrated healthy homes concerns into Los Angeles code enforcement activities. Community outreach workers, whether Promotoras or tenant organizers, work with the City Code Enforcement Inspectors to make their work more impactful, correctly focused on an expanded menu of housing code violations, and specifically beneficial (rather than threatening) to the tenants.

Funding and Leverage

Funding Sources. HUD and in-kind services from project partners.

Leveraged Resources. Leveraged financial support for the project totaled $1,500,000 for the three principal partners combined. St. John's Well Child and Family Center also received a 2009 Everychild Foundation Grant to continue the work of the collaborative. Both SAJE and Esperanza received funding from the California Endowment and California Wellness Foundation.

Housing units were also referred to the City of Los Angeles' Lead Hazard Remediation Program.

Evaluation and Outcomes

Data Management. Significant emphasis was placed on data clean-up and quality in data entry. The Project Manager regularly supervised the data clean-up and provided follow-up training to staff as needed. The Project Manager also made quality assurance calls and visits to households following Promotoras' home visits to ensure that project protocols were properly adhered to.

Health and Housing Outcomes. Participant awareness of lead hazards increased significantly as a result of this initiative. At baseline, 30 percent were aware that chipping and peeling paint can cause lead poisoning. At the time of the follow-up survey, this number increased to 75 percent; by the time of the final survey, it had reached 94 percent.

Records kept by St. John's on 550 asthma patients who are receiving intensive case management services revealed the following results:

- 80 percent reduction in the percentage of clients visiting the ER due to asthma.

- 67 percent reduction in the percentage of clients hospitalized due to asthma.

- 65 percent reduction in the percentage of clients visiting the clinic/doctor due to an asthma attack.

- 55 percent reduction in the number of school days missed because of asthma.

- 69 percent reduction in the percentage of children missing one or more days of school due to asthma.

- 100 percent of clients have had a routine asthma visit.

- 100 percent of clients have a written asthma action plan.

- 100 percent of working caregivers report reduction in the number of missed work days per month due to asthma (one or more missed work days).

- 68 percent of clients report daytime symptoms two days or fewer per month.

- 76 percent of clients report nighttime symptoms two days or fewer per month.

- 73 percent of clients with persistent asthma symptoms taking controller medication.

- 47 percent reduction in treatments for vermin bites, cockroaches, and environmentally-associated skin conditions.

- At the initial visit, more than half of the participants reported having cockroaches; by the final visit, only 14 percent reported having roaches.

Sustainability

- Advocacy is impacting policy change and enforcement of City housing codes.

- The health and human rights model championed by the South Los Angeles Healthy Homes Program is a key sustainability framework; the concept that having access to good housing and healthcare is a fundamental right and not merely a privilege. This framework is currently gaining traction in South Los Angeles, and influence in Los Angeles County.

Best Practices

- The use of Promotoras (representatives of the target community) in recruitment and enrollment, outreach, tenant education, and home visits. Promotoras served as the bridge for other health and housing agencies to gain entry to the home, such as the housing inspectors. The Promotoras' involvement encouraged trust among community and organizations.

- Developed a team trained in both healthy homes protocols and comprehensive community health, such as domestic violence and tenants' rights; cultivating relationships between local families and a cadre of community health leaders that helps build a stable community.

- Linked tenant environmental health education with referrals to tenants' rights clinics and protections to prevent displacement.

- The "Medical Evidence Form" developed under our partnership allowed physicians to note environmentally-driven conditions that children manifest in clinical visits, such as elevated blood lead levels, vermin bites, rashes, and upper respiratory distress. The completed form triggers a visit to the home by health Promotoras who report back to the physician about the status of remediation for some of the housing conditions. The physician may send a letter to the landlord stating the effect of the housing conditions, considered code enforcement violations, on the health of the child and recommendations for remediation practices. This letter is only sent if there is an established relationship between the families and the tenant organizers to limit threats of eviction of tenants.

Appendix 1.8 Case Study
Public Health—Seattle and King County
Evolution of a Healthy Homes Program

Program Overview

Better Homes for Asthma and Breathe Easy Homes represent later stages in the evolution of multiple initiatives conducted in Seattle/King County. All of these projects addressed housing conditions of low-income children with diagnosed asthma. The first two NIEHS grants focused on the development of protocols for visual assessments and behavioral interventions conducted by Community Health Workers (CHW). The later Healthy Homes Projects received HUD funding and included renovations to the homes.

First Stage. The first study, a randomized controlled trial, compared two interventions:

1. Low intensity intervention: Consisting of a single home visit by a trained CHW, a home environmental assessment, preparation of a behavioral action plan for the household with priority actions jointly developed between a family member and the CHW, limited education on asthma triggers, and distribution of bedding encasements. This control group was offered the full range of high intensity services one year after the baseline visit.

2. High intensity intervention: Consisting of four to eight additional visits by the CHW after the baseline visit over the course of a year, an environmental assessment and action plan, distribution of a more comprehensive package of asthma-trigger supplies (allergy-control mattress and pillow covers, low-emission vacuums, door mats, cleaning kits, roach baits, rodent traps), referrals to smoking cessation clinics, free allergen skin-prick tests, and assistance with pest eradication and advocacy for improved housing conditions.

The study demonstrated that both groups benefited from the home visit experience, but that substantially greater improvements in caregiver quality of life scores and reductions in use of urgent care services were associated with the high-intensity intervention. The researchers attributed much of this success to the use of

CHW who resided in the same community as the families, the ability to individualize the training and interventions to the families' needs, and the provision of resources to address the asthma triggers.

Second Stage. A second randomized controlled study compared the effect of asthma management education (that included both medical and environmental aspects of self-management) and support provided by trained nurses in a clinic situation compared to in-home education and support by a nurse in combination with a CHW who made home visits. While both conditions led to improvements in many measures, the families served in their home CHW showed greater levels of improvement on a number of measures, with statistically significant improvements in behavioral changes, symptom-free days and caregiver quality of life.

Third Stage. Public Health Seattle and King County's Better Homes for Asthma grant was designed to combine the CHW home visits of the earlier projects with remediation of structural conditions in the rental properties where the families with asthmatic children lived and test the marginal benefit of the renovation. The earlier studies showed that some of the environmental conditions identified as high-priority items in the family action plans were outside the family's control, such as the temperature of hot water, the ability to remove carpets, mold that could not be controlled through cleaning alone, and roach infestation in multi-family apartment buildings.

This project intended to address those structural conditions in properties owned by the Seattle Housing Authority and private landlords and to determine whether there were additional benefits beyond the Community Health Worker one-year intervention. Due to the complexities of the human subjects application and contracting for renovations, this project was not completed.

Fourth Stage. The Seattle Breathe Easy Homes project was the next effort to address

childhood asthma triggers through structural intervention and in-home education and asthma management plans provided by CHW educators. Thirty-five (35) new units in the Seattle Housing Authority's High Point HOPE VI redevelopment community were constructed as Breathe Easy units. In addition to meeting the Seattle BuildGreen design criteria, these units also included enhancements to the exterior envelope, foundation, interior finishing, flooring, and the ventilation system to reduce moisture infiltration and mold growth, provide smooth and easy-to-clean floors, reduce out-gassing of building materials, increase fresh air exchange, and reduce allergy triggers related to landscaping.

BREATHE EASY HOMES

Program purpose: To provide new, affordable housing for low-income children with asthma and to assess whether this new housing provided more health benefits than achieved through the intensive CHW education and behavioral change program.

Target population: The target population was the High Point HOPE VI development in West Seattle. Families with children aged 3–17 with health-care provider diagnosis of persistent asthma, who agreed to meet all required criteria for documenting low-income status for residents of public housing, passed credit and background checks, and agreed to meet the lease requirements for living in the asthma-friendly units. The project had originally intended to limit enrollment to families that had lived in the High Point development before rehabilitation, but found that some residents chose not to return after relocation so recruitment was opened to others with asthma who qualified for subsidized housing.

Partnerships, agencies, coalitions, and community organizations: Public Health Seattle and King County (PHSKC), Simon-Fraser University, King County Asthma Forum, Seattle Housing Authority (SHA), and Enterprise Community Partners (for a later phase of the project to build an additional 25 Breathe Easy units).

How was the community involved in decision making, implementation, and evaluation?

A community activist and resident of the High Point community raised the possibility of building asthma-friendly units during early discussions of the HOPE VI redesign. A community advisory board was active throughout the project.

Interventions

How were homes and families identified, recruited, and retained? The composition of the surrounding neighborhood changed from the time that the HOPE VI reconstruction was first discussed. At the time of recruitment, the majority of neighborhood residents did not speak English as their first language. Recruitment of the families was achieved through referrals from clinics, hospitals, physicians, community-based organizations, flyers, and word-of-mouth.

In order to be eligible for housing in the Breathe Easy units, the families had to agree to work with the program for one year before placement. Using the CHW model developed in previous projects, at baseline a CHW and translator conducted a visual assessment, collected dust samples from the child's bedroom, and provided bedding covers and education. Subsequent home visits reinforced the educational and behavioral management plan.

Education and/or housing interventions: In addition to meeting the Seattle BuildGreen design criteria for all units in the High Point development, these units also included enhancements to the exterior envelope, foundation, interior finishing, flooring, and ventilation system to reduce moisture infiltration and mold growth, provided smooth and easy-to-clean floors, reduced out-gassing of building materials, increased fresh air exchange, and reduced allergy triggers related to landscaping.

Systems and Policies

What policies, regulations, or government service systems supported or impeded the program's effectiveness?

Although new CHW needed to be hired and trained, the process worked efficiently. The program also had experience working with non-English speaking families and had translated

educational materials available. Healthy Homes I and II projects also prepared the project staff for unique cultural practices that might impact asthma (such as use of incense) and strategies to redirect those behaviors in culturally acceptable ways.

The High Point community had an active citizen base that was actively engaged in the "green" housing design process.

Funding and Leverage

Sources of funding: Healthy Homes Grant for enhancements, Hope VI for basic housing costs.

Leveraged resources: Additional Enterprise Community Partners funding for 25 units.

Evaluation and Outcomes

How were program services monitored and evaluated? The project used a pre-post with historical comparison group evaluation design. Clinical evaluation included a detailed assessment of asthma severity, medication and health services use, administration of the Juniper scale quality of life measurement, skin test sensitization, and a methacholine challenge.

This latter physiologic test is considered the most effective test for pulmonary function, airway sensitivity and a measure of the child's current asthma activity. These evaluation measures were made at the beginning of the one-year CHW intervention in the old home. Additional data was collected after one year of working with the CHW in the old home, after participants moved to their new home, and after one year in the new home (three separate time points). This enabled a pre-post comparison between the established CHW intervention in the old home and the impact of the new home on the same asthma endpoints described in previous studies with the addition of the very sensitive methacholine challenge test.

The study showed:

- BEH residents' asthma-symptom–free days increased from a mean of 8.6 per 2 weeks in their old home to 12.4 after one year in the BEH.

- The proportion of BEH residents with an urgent asthma-related clinical visit in the previous three months decreased from 62 percent to 21 percent.

- BEH caretakers' quality of life increased significantly.

- The BEH group improved more than did the comparison group, but most differences in improvements were not statistically significant.

- Exposures to mold, rodents, and moisture were reduced significantly in BEHs.

Best Practices Across All Programs

- Multiple asthma triggers need to be addressed for sustained health benefits. The studies continued to demonstrate the value of a comprehensive assessment and repairs tailored to observed asthma triggers, as opposed to a "one size fits all" approach.

- Homes specifically designed to reduce asthma triggers may add additional benefit than those obtained through CHW interventions alone and may be particularly desirable for clients who will have difficulties implementing the behavioral changes required in other interventions. More research is needed to understand the impact and role of asthma-friendly homes.

- Use of CHW and the need for systematic training: The CHWs served as role models to the community. They have proved effective in connecting with participants and gaining their trust. They helped families change behaviors, secure resources and ultimately improve control of their children's asthma. CHWs also acquired marketable skills that are sustainable and transferable to other employment situations, such as client counseling. The program has continued to use and value the CHWs, as they were accepted and trusted by the community.

- Multiple CHW visits were important to facilitating residents' behavioral change. Currently, the program recommends one intake visit, three follow-up visits and optional fourth and fifth visits if needed.

- Caregivers need resources and incentives to maintain a home-based asthma trigger reduction program. Distributing cleaning

and other materials at baseline increased credibility of the project with the residents.

- The need for continuous quality improvement: A staff retreat, including all the CHW, was held to identify lessons learned and strategies to overcome obstacles for future projects.

- Home-visiting programs need sustainable sources of funding to assure continuity of services.

Appendix 1.9 Case Study
Cincinnati Children's Hospital Medical Center
Injury Prevention Program Model

Program Overview

Purpose. The purpose of this program was to reduce exposure to injury hazards in the homes of young children from birth through four years of age. This project developed and validated the Home Observations and Measures of the Environment (HOME) Injury Survey that identifies and remediates injury hazards for young children in the home. This project also tested an intervention in which injury hazards in homes were minimized through installation of multiple safety devices.

Target population. Homes of children less than five years of age, living in pre-1978 homes within a five-county study surrounding the City of Cincinnati, Ohio.

Partnerships. Cincinnati Children's Hospital Medical Center, Center for Children's Environmental Health, University of Cincinnati Department of Pediatrics, National Institute for Environmental Health and Safety (NIEHS), U.S. Department of Housing and Urban Development (HUD, U.S. Environmental Protection Agency (EPA), National Center for Injury Prevention and Control (NCIPC) at the U.S. Centers for Disease Control and Prevention (CDC), and National Institute for Child Health and Development (NICHD).

Planning. The HOME Injury Survey was developed by analyzing the leading residential mechanisms for emergency visits, hospitalizations and deaths for U.S. children and reviewing surveys used in other studies.

Interventions

Recruitment. Expectant mothers visiting any of five participating obstetrical practices for prenatal care were screened for potential eligibility. Expectant mothers had to be at least 18 years of age, less than 19 weeks gestation, living in pre-1978 homes within the five-county study area encompassing the City of Cincinnati and not living in public housing, shelters, group homes, or trailer homes. Invitational letters were sent out to potential eligible mothers.

Interventions. Households enrolled, consented, and randomized to the intervention portion of the injury hazard control project underwent a comprehensive, standardized, and validated survey of all living spaces of the home, including stairways, finished basements, and attics (the IPV). Hazard counts and densities (i.e., number of hazards per area) were developed comprehensively for the indoor environment and by high exposure rooms (i.e., kitchen, main activity room, stairways, child's bedroom, and bathroom).

Surveys and interventions were directed primarily at areas below one meter in height (i.e., 39 inches and the 75th percentile in height for a three-year-old male). The recommended interventions were reviewed with the mother who had the option of choosing in rank order from the most passive and durable safety device to the least passive and non-durable (e.g., a self-closing and locking stair gate bolted to a wall as compared to a pressure-mounted stair gate).

Trained research assistants then installed all consumer safety devices suggested to and agreed upon by the enrolled mother (and landlord when the home was rented). Recommended devices not installed were noted and tabulated in the counts of hazards and hazard density during follow-up surveys.

Program Staff. Program staff included intervention technicians, home survey assistants, and phone survey assistants. They worked as teams. Staff was trained on the study protocols and survey forms and how to recognize child neglect and abuse.

Funding and Leverage

Funding Sources. National Institute of Child Health and Development (NICHD, National Institute of Environmental Health Sciences) and the U.S. Environmental Protection Agency.

Program Costs. The intervention cost, on average, was $700–$800 per home:

- $300–$350 per home for consumer safety products.

- Two to three hours to install the consumer safety products properly, averaging $300–$400 in labor costs per home.

Evaluation and Outcomes

This was the first trial of home safety to demonstrate both a reduction in injury hazards and subsequent, medically attended injury in enrolled children randomized to an intervention. The HOME Injury Survey correlated with reported risk factors for childhood injury (i.e., externally valid), including maternal depressive symptoms, household income, and maternal age. Four high-risk, high-exposure rooms (i.e., kitchen, main activity room, child's bathroom, and child's bedroom) identified by parents in previous reports were shown to be representative of similar injury hazards found throughout the entire household.

The primary outcomes for the study were a reduction in medically attended (i.e., office, clinic, or emergency visits) injuries for children from birth through three years of age in the intervention group as compared to the control group.

Maternal reports of injury events, phone calls, office visits, and emergency visits for residential injuries in their child were outcomes assessed in the first 24 months of the trial. The primary outcome measure for this analysis was an emergency visit for a residential injury. Maternal reports of emergency visits were verified by checking medical records using a countywide injury surveillance system.

HOME Injury Surveys were also conducted in homes of families randomized to the lead abatement portion of the trial at baseline, and annually throughout the four-year study period. Injury hazards were similar at baseline but did not change in this control group, and injury rates were significantly higher for preventable, medically attended mechanisms in the lead intervention group. Although lead intervention group children had geometric mean blood leads that were not different from control group children, they had better scores on cognitive and motor development as compared to control children.

The density of unintentional injury-related hazards (i.e., number of hazards per area) was found to be a more reliable and valid measure of childhood residential hazards than the total number of hazards.

Sustainability

The HOME Injury Survey, a 55-item tool to quantify unintentional injury hazards in the indoor environment of homes with young children, was identified as reliable, valid, and reproducible between different users and over time.

Best Practices

- Tailored interventions were developed (e.g., consumer safety product installation) based on family needs and hazards identified during the HOME Injury Survey.

- For replication purposes, it was found that complete and comprehensive installation of consumer safety products or built-in safety devices and mechanisms is more effective than education or provision of free or reduced-cost safety devices.

Appendix 1.10 Case Study
Philadelphia Department of Public Health
Healthy Homes Child Care Program

Program Overview

Purpose. The objective of the Healthy Homes Child Care Program (HHCC) was to educate home-based child care providers about environmental health and safety issues in their homes and remediate lead-based paint and safety hazards.

Target population. Licensed child care providers in the City of Philadelphia in 18 zip codes. The project selected the geographic targets based on the large numbers of children with elevated blood lead levels, children with emergency room visits for asthma, and licensed family child care providers located in those areas.

Partnerships. Key agencies included the Philadelphia Department of Public Health's (PDPH) Childhood Lead Poisoning Prevention Program (CLPPP), National Nursing Centers Consortium (NNCC), Philadelphia Early Childhood Collaborative (PECC), the State of Pennsylvania Keystone Stars Initiative, Drexel University's School of Public Health, Environmental Protection Agency's Agency for Toxic Substances and Disease Registry (ASTDR), YMCA of Philadelphia, University of Pennsylvania Center for Community Partnerships, Nonprofit Finance Fund (NFF), AmeriCorps, Penn State Integrated Pest Management, Delaware Valley Association for the Education of Young Children, and Pest-Free Maintenance.

Community Involvement. The following agencies provided ongoing support and served as members of the project's advisory board: Public Citizens for Children and Youth, United Communities of Southeast Philadelphia, the Philadelphia Fire Department, the American Red Cross, Easter Seals of Philadelphia County, the PA Department of Public Welfare, Philadelphia Department of Licenses and Inspections, the City of Philadelphia, National Center for Healthy Housing (NCHH), and Enterprise Community Partners (ECP).

Planning. In preparation for a grant application, members of the advisory board met to determine target activities and define eligibility for services. A variety of child care regulatory and licensing agencies also participated in the planning process.

The PDPH mapped lead poisoning, asthma and injury rates, income levels, locations of home-based child care providers, and other factors to determine optimal neighborhoods for services. It took one year to establish all policies, procedures, and interagency agreements.

Interventions

Recruitment. Child care providers were recruited through partner agency referrals, including Keystone Stars child care quality improvement program. HHCC staff utilized the list of certified child care providers located in the 18 zip code target area. These providers received an invitation to attend an orientation meeting at a location in their community.

HHCC accepted individual providers on the basis of location, income-eligibility for HUD funding, and enrollment in the Keystone Stars program. Individual providers were enrolled on a "first come, first served" basis. If they had a child with an elevated blood lead level, asthma, or allergies in their care, they received a higher priority when interventions were scheduled.

Interventions. Child care providers attended Healthy Homes Orientation meetings at the start of the project to educate them about the "Seven Principles of Healthy Homes" and enroll them into the program. Additional workshops on topics such as infant and child first aid and CPR, emergency preparedness and "greening" your home-based day care were also provided.

The initiative involves (1) child care facility risk assessment, (2) tailored interventions, and (3) hazard remediation. Trained staff visited licensed home-based child care businesses and completed a comprehensive assessment in 150, tested for the presence of lead, and documented pest problems, asthma triggers,

food safety, as well as fire and carbon monoxide hazards. The assessment determined the remediations required for each unit, from the following options:

- Safety Interventions: Railings, gates at the top and foot of stairs, repairs of stair treads and risers, gun locks, secure cubbies to walls, secure loose bathroom sinks and toilets, fencing and gates, hallway lighting, electrical outlets, baseboard repairs, rubber matting on exterior surfaces where children play, first aid kits, and smoke detectors.

- Respiratory Interventions: Exhaust fans, bathroom ventilation/air purifiers, carpet removed and replaced with tile, air conditioners, stove hoods and fans, and pest control.

- Energy interventions: Awning repair, roof cornice replacement, new stack pipes, weather stripping, ceiling and wall repairs, door replacement/repair, and new stoves.

- Lead hazard control interventions: Paint stabilization, window replacement, door replacement, and smooth and cleanable flooring.

The PDPH Lead Abatement Services Supervisor used the combined results of the health and safety and lead risk assessment to prioritize repairs up to an established program funding cap. Eighty-five (85) homes were remediated.

All participants received a HHCC "Cleaning Bucket." The Bucket included a variety of household cleaning supplies, such as non-toxic furniture polish and window and surface cleaners, rubber gloves, sponges, smoke detectors, water temperature gauge, and written information materials. Participants were instructed on cleaning methods to keep their home free of lead dust and allergens.

Program Staff. Key staff members included the Project Manager, the Health and Safety Coordinator, the Environmental Health Services Risk Assessor, and the CLPPP Lead Abatement Supervisor. All staff attended lead risk assessor, "Essentials for Healthy Homes Practitioners," and lead clearance technician training courses.

Systems and Policies

The project integrated established procedures used in several projects, including the Philadelphia Lead Hazard Control Grant, the Philadelphia Healthy Homes/Home Safe Grant, the Lead-Safe Babies program, and the Home-Based Child Care Lead Safety Program.

Funding and Leverage

Funding Sources. HUD Office of Healthy Homes and Lead Hazard Control Healthy Homes Demonstration Grant and Lead Hazard Control Grants, and in-kind contributions from partner agencies.

Leveraged resources.

- The Nonprofit Finance Fund provided $150,000 for safety-related repairs.

- The YMCA supplied furnishings to the lead-safe relocation site.

Evaluation and Outcomes

The program administered a questionnaire to child care providers during the enrollment process and found:

- 67 (79 percent) had no safety gates at either the bottom or top of staircases to prevent child access to stairs;

- 53 (62 percent) had unsecured tall or heavy furniture;

- 47 (55 percent) had toxic cleaning supplies not in a secure location;

- 44 (52 percent) lacked a carbon monoxide monitor;

- 43 (51 percent) had non-intact painted surfaces; and

- 30 (32 percent) reported they did not test their smoke detectors regularly.

Sustainability

- Partnerships between CLPPP, PECC, NNCC, YMCA, NCHH, PA Keystone Stars, and Delaware Valley Association of the Education of Young Children.

- This project demonstrated and developed a model for a home-based child care health and safety program that can be replicated in other jurisdictions.

Best Practices

- The rules of three regulatory agencies with the Childcare Environmental Rating Standards were combined to form the HHCC's EHS Assessment Instruments, Weighted Hazard Scoring and Decision Protocol, and project evaluation tools.

Appendix 2.1
Potential Stakeholders and Their Assets

Type of Organization	Strengths and Assets	Examples
Anti-crime/block clubs; civic and neighborhood associations	• Knowledge of the territory • Available nights and weekends • Trust of the residents • Understanding of community concerns • Ability to generate crowds/participation at large events • Institutional memory • Relationship with local government as constituents • Experienced as advocates	• Esperanza Community Housing Corporation, Los Angeles, CA • King County, WA—High Point Community
Existing coalitions and task forces (health, housing, or Issue-focused)	• Shared interests • Organizational structure and processes for decision-making • Possible source of data, meeting space, personnel, funding • Understanding of community concerns • Institutional memory • Relationship with local government as constituents • Experienced as advocates • Policy development and advocacy skills • Interagency referral networks	• Los Angeles Healthy Homes Collaborative • Indoor Air Coalition of Whatcom County, WA • Coalition to End Childhood Lead Poisoning, Baltimore, MD • King County, WA Asthma Forum • Healthy Indoor Environment Coalition, Kansas City, MO • Asthma Regional Council, Boston, MA • Boston Urban Asthma Coalition, Boston, MA • Robert Wood Johnson Funded Allies Against Asthma Coalitions
Local health departments or regulatory agencies	• Leadership • Ability to bring together multiple groups • Access to other government resources • Access to elected officials • Funding • Ability to enforce health and housing codes • Source of meeting space, data, policies and procedures, staff, speakers • Institutional memory • Jurisdiction and legal enforcement tools • Access to public officials and the media • Ability to dedicate resources and link to existing healthy homes programs and service systems	• City of Los Angeles Code Enforcement • Northwest Air Pollution Authority • Philadelphia Department of Public Health Childhood Lead Poisoning Prevention Program • Cleveland Department of Public Health and Cuyahoga County Board of Health Childhood Lead Poisoning Prevention Programs • Public Health Seattle King County • Baltimore City Department of Health Childhood Lead Poisoning Prevention Program, Baltimore City Healthy Homes Division, Baltimore City Health Homes Asthma Program, Baltimore City Maternal and Child Health Safe Sleep Initiative • Kansas City Health Department, Kansas Department of Health and Environment Healthy Home and Lead Hazard Control Program • Boston Public Health Commission, Division of Healthy Homes and Community Supports

Type of Organization	Strengths and Assets	Examples
Parents' groups (school-based or support groups associated with specific health condition)	• Ability to "put a face" on the problem • Passion • Ability to generate crowds or participation at large events • Direct experience with local conditions/services • Constituents of public officials and service agencies • Meeting space, volunteers	• Boston Urban Asthma Coalition Parent Asthma Leaders
Local health, housing, or social service providers Grassroots organizations and community-based and non-governmental organizations. Community Action Agencies	• May be able to expand service delivery to address Healthy Homes concerns • Institutional memory • Subject matter expert • Likely to be trusted in community • Access to public officials and the media • Ability to leverage resources, programs and service systems • Many are weatherization assistance program subgrantees	• Esperanza Community Housing Corporation, Los Angeles, CA • YMCA of Philadelphia and Vicinity • Opportunity Council, Bellingham, WA weatherization program • Environmental Health Watch, Cincinnati, OH • Community Housing Solutions • Seattle Housing Authority • Boston Housing Authority
Police, fire, and EMS services	• Knowledge of the territory • Present in target areas on nights and weekends • May or may not understand community concerns • Source of data, educational materials, speakers	• City of Philadelphia Fire Department • Baltimore City Fire Department
Public officials, Political action organizations (parties, advocacy groups)	• Constituents • Advocacy and policy skills • Data • Decision-making power	• Philadelphia Citizens for Children and Youth • Los Angeles City Council
Academic/ universities	• Grant funding, staff (students and faculty), meeting space • Subject matter expertise (housing construction, engineering, architecture, public health, public policy, law, medicine and nursing, nutrition, social work, counseling, education, media and marketing, management, finance) • Skills in program design, data analysis, evaluation, mapping (usually have more sophisticated IT capabilities) • Translator services	• Case Western Reserve, Schools of Medicine and Public Health, Cleveland, OH • Drexel University, School of Public Health, Philadelphia, PA • University of Pennsylvania, Center for Community Partnerships • University of Washington • Harvard School of Public Health • Tulane University School of Public Health • Tufts Medical School • Boston University School of Public Health

Type of Organization	Strengths and Assets	Examples
Organizations that represent or work with at-risk or vulnerable populations	• Trust of the residents • Ability to generate crowds or participation at large events • Ability to "put a face" on the problem • Passion • Knowledge of local conditions/services • Translator services (both language and the ability to describe experiences in terms that policy-makers understand) • Constituents • Advocacy and policy skills	• Esperanza Community Housing Corporation, Los Angeles, CA • Strategic Actions for a Just Economy, Los Angeles, CA • Neighborhood Leadership Institute, Cleveland, OH • Youth Build • AmeriCorps • Missouri Legal Aid
Health care providers, clinics, hospitals, health care insurance	• Trust of the residents • Knowledge of local conditions • Data, staff, and funding resources	• St. Johns' Well Family and Child Center; Eisner Pediatric Center, Los Angeles, CA • Case Western Reserve University School of Medicine, Swetland Center for Environmental Health, Departments of Pediatrics and Family Medicine, and Center for Geriatric Medicine, Cleveland, OH • National Nursing Centers Consortium, Philadelphia, PA • Cincinnati Children's Hospital Medical Center • University of Cincinnati Dept. of Pediatrics • Children's Mercy Family Health Partners, Kansas City, MO • Pediatric Environmental Health Specialty Unit
Child Care providers, resource and referral agencies, early childhood education	• Required to meet standards for safe and sanitary facilities • Access to target population • Located in the target area	• Philadelphia Early Childhood Collaborative • State of Pennsylvania Keystone Stars • Head Start • Children's Environmental Heath Network
Property owners	• Required to comply with health and building codes • Leveraged funding for housing repairs	
Realtors, landlord associations	• Access to rental property owners • Ability to mobilize around public policy	
Contractors	• Training and certification for lead hazard control	• Integrated Pest Management, Inc., Philadelphia, PA

Type of Organization	Strengths and Assets	Examples
Tenants' rights organizations	• Ability to organize to implement housing programs and advance public policy • Access to the target population • Familiar with housing issues in geographic target area • Provide legal representation to tenants involved in landlord issues	• Esperanza Community Housing Corporation—Strategic Actions for a Just Economy (SAJE) • Children's Mercy Hospital—Missouri Legal Aid
Media (TV, radio, specialized media)	• Ability to raise awareness of healthy homes issues • Advertise program services for recruitment purposes	• 2010 National Ad Council Campaign • Tulane University's New Orleans Healthy Homes Technical Study
Foundations and philanthropic organizations	• Provide funding • Provide technical assistance in program design • Serve as program partner • Link to other community services	• Nonprofit Finance Fund, Philadelphia, PA • W.K. Kellogg Foundation • Annie E. Casey Foundation • Robert Wood Johnson Foundation
Chambers of Commerce/ local financial institutions	• Identify program partners • Private sector funding for healthy homes initiatives	• Metropolitan Energy Center, Kansas City, MO

Appendix 2.2
Data Available from Different Sources

Types of Data	National Data	State-Level Data	Local Data	Neighborhood-Level Data
Demographic	• U.S. Census: http://www.census. gov/. Decennial census data can be downloaded by county, Congressional and legislative district, zip code, or census track/block. Quick Facts will compare localities to the state and national values for the indicators. • U.S. Census also administers the more frequent American Community Survey, which estimates population, economic, and housing indicators by county subdivisions, Metropolitan Statistical Areas (SMAs), Congressional districts, and other factors between decennial censuses. These estimates are derived from surveys of households in geographic areas with 20,000 or more inhabitants. The most recent data are from 2005–2007 surveys.	• State Offices of Planning often track population changes on key economic and demographic features. State offices of Planning also have extensive Geographic Information System (GIS) capabilities.	• City and county plans for comprehensive development, zoning, and sustainability often contain demographic projections for neighborhoods, as well as projections for services. The larger communities will have GIS capabilities. • Local universities, especially departments of public health or sociology may have the ability to generate this data.	• Windshield (or drive-by) surveys are quick methods to identify areas where services are delivered and the characteristics of the population who use them at different times of the day. • Community meetings and focus groups can service as vehicles to identify groups in need of services. • Interviews with key informants from the community.
Health Status, Health Care Consumption, Quality of Life	• Healthy People 2010: http://www. healthypeople.gov/. Environmental Health Mid-course review: http:// www.healthypeople.gov/data/ midcourse/html/focusareas/ FA08TOC.htm. Injury and Violence Mid-course review: http://www. healthypeople.gov/data/midcourse/ html/focusareas/FA15TOC.htm. Respiratory Disease Mid-course review: http://www.healthypeople. gov/data/midcourse/pdf/FA24. pdf. Access to Quality Health Care Services Mid-Course review: http://www.healthypeople.gov/ data/midcourse/html/focusareas/ FA01TOC.htm.	• State Healthy People 2010 plans: http://www.healthypeople.gov/ Implementation/stateplans.htm. • U.S. Centers for Disease Control and Prevention, National Environmental Public Health Tracking Network: http://ephtracking.cdc.gov/ showStateTracking.action. • National Survey of Children's Health, 2007 State Profiles Pages: http://www.nschdata. org/Content/States.aspx?rid=5. The 2007 survey contains data on neighborhood safety and family mental health ratings.	• Local health department annual reports. • National Association of Counties, Healthy Counties Database identifies strategies used in other locations to address obesity, nutrition, and housing: http://www. naco.org/Template. cfm?Section=New_ Technical_Assistance& Template=/cffiles/healthy counties/search.cfm.	• Community surveys can assess perception of community needs and knowledge of health behaviors. These can be administered by neighborhood associations to their members, or at community events, such as health fairs. Models for these surveys can be found at (1) Enterprise Community Partners: Step- by-Step Tutorials: http://www. enterprisecommunity.org/ resources/tutorials/resident_ services/design_process.asp;

Types of Data	National Data	State-Level Data	Local Data	Neighborhood-Level Data
	• Healthy People 2020: http://www.healthypeople.gov/2020/about/default.aspx • America's Children: Key National Indicators of Well-Being, 2009: http://www.childstats.gov/americaschildren/index.asp. • U.S. Centers for Disease Control and Prevention, National Health Information Survey (NHIS): http://www.cdc.gov/nchs/nhis.htm. • U.S. Centers for Disease Control and Prevention U.S. Department of Health and Human Services, National Health and Nutrition Examination Survey (NHANES): http://www.cdc.gov/nchs/nhanes/nhanes_products.htm. • U.S. Centers for Disease Control and Prevention, National Health Care Surveys (NHCS): http://www.cdc.gov/nchs/nhcs.htm. • U.S. Centers for Disease Control and Prevention, Behavioral Risk Factor Surveillance System: http://www.cdc.gov/brfss/. • National Health Statistics Reports provide national summary data from a variety of health-related surveys, including NHIS, NHANES, and BRFSS: http://www.cdc.gov/nchs/products/nhsr.htm. • U.S. Centers for Disease Control and Prevention, Injury Prevention and Control: Data and Statistics (WISQARS™) provides a web-based injury statistics query and reporting system http://www.cdc.gov/injury/wisqars/index.html • U.S. Environmental Protection Agency, America's Children and the Environment. http://www.epa.gov/envirohealth/children/.	• BRFSS Selected Metropolitan/Micropolitan Area Risk Trends (SMART): http://apps.nccd.cdc.gov/BRFSS-SMART/. • Healthy States webpage from the Council of State Governments: http://www.healthystates.csg.org/. • Agency for Health Care Research and Quality—Health Care, Cost, and Utilization Project: http://www.ahrq.gov/data/hcup/; state in-patient and ambulatory care data and 2008 State Snapshots http://statesnapshots.ahrq.gov/snaps08/index.jsp?menuId=1&state=NY. • Robert Wood Johnson Foundation, Commission to Build a Healthier America, State-by-State Data: http://www.commissiononhealth.org/StateByStateData.aspx. • Annie E. Casey Foundation, Kids Count website: http://datacenter.kidscount.org/data/bystate/Default.aspx provides state, county, and selected locality data on a variety of health and social indicators. • National Governors Association, "Shaping a Healthy America" website reviews state-level demographic and health data and provides model best practices implemented in the states: http://www.nga.org/portal/site/nga/menuitem.9123e83a1f6786440ddcbeeb501010a0/?vgnextoid=fbdb2f2d98ac6110VgnVCM10000001a01010aRCRD.		(2) CDC's and the National Association of City and County Health Officials' Community Environmental Health Assessment Protocol for Assessing Community Excellence in Environmental Health (PACE-EH) Guidebook: http://pace.naccho.org/DownloadPage.asp.

Types of Data	National Data	State-Level Data	Local Data	Neighborhood-Level Data
Characteristics of the Housing Stock, Neighborhood conditions, Transportation systems, Quality of housing stock	• American Housing Survey (AHS): http://www.census.gov/hhes/www/housing/ahs/ahs.html. • National Center for Healthy Housing, State of Healthy Housing webpage: http://www.nchh.org/Policy/State-of-Healthy-Housing/Supporting-Documentation.aspx—provides an easy-to-use comparison of 20 indicators from the AHS incorporated into two general indices of housing (Basic Housing and Healthy Housing). This enables users to compare more than 40 Metropolitan Statistical Areas (MSAs) on a variety of factors including interior and exterior deterioration, pests, and heating issues. The indices also allow users to compare within the MSA central city v. areas outside the central city, and owner-occupied v. rental properties. • American Planning Association, Health Communities Through Collaboration website: http://www.planning.org/research/healthy/index.htm	• American Planning Association, state chapters contact information: http://www.planning.org/chapters/#1 • National Association of Counties, Healthy Counties Database, "Built Environment": http://www.naco.org/Template.cfm?Section=New_Technical_Assistance&Template=/cffiles/healthycounties/search.cfm provides program models that address housing development and transportation planning related to obesity reduction, greenways, school safety, transportation corridors, open space preservation. • National Conference of State Legislatures (NCSL), Healthy Community Design and Access to Healthy Food Legislative Database: http://www.ncsl.org/IssuesResearch/EnvironmentandNaturalResources/HealthyCommunityDesignandAccesstoHealthyFoo/tabid/13227/Default.aspx. • Association of State and Territorial Health Officials (ASTHO), Built and Synthetic Environment website contains the ASTHO Smart Growth Toolkit with models for legislative action and policy development: http://www.astho.org/programs/environmental-health/built-and-synthetic-environment/.	• Every community that receives federal rehabilitation funding must submit a Consolidated Plan to HUD every three to five years and must update that plan annually. The Plan will include information on key housing problems and plans for use of funds to address these problems. • The National Association of Housing and Redevelopment Officers (NAHRO). • National Association of Counties Indoor Air Quality Project, which ended in 2007, developed a CD with model practices, fact sheets, educational campaigns, and other materials related to mold, asthma, radon, ETS, and school indoor air quality: http://www.naco.org/Template.cfm?Section=New_Technical_Assistance&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=62&ContentID=14017.	• National Association of County and City Health Officers (NACCHO) provides a variety of Healthy Community Design toolkits that can be used by professionals and community residents to assess neighborhood fall hazards and other hazards: http://www.naccho.org/toolbox/veritysearch/search.cfm?keywords=&p=Healthy+Community+Design+Toolkit%7C14&st=ALL&x=68&y=14. • The Alliance for Healthy Homes (AFHH) Community Environmental Health Resource Center provides a number of hazard assessment tools that community residents can use: http://www.afhh.org/res/res_cehrc.htm. • American Association for Retired Persons (AARP) Livable Communities: An Evaluation Guide provides tools for residents to use to assess affordability, design, access to services, et cetera: http://assets.aarp.org/rgcenter/il/d18311_communities.pdf.

Types of Data	National Data	State-Level Data	Local Data	Neighborhood-Level Data
Energy-Related	• U.S. Department of Energy's Residential Energy Consuption Survey (RECS): http://www.eig.gov/consuption/residential. • The U.S. Energy Information Administration (EIA) administers the Residential Energy Consumption Survey (RECS) to a nationally representative sample of housing units. Energy characteristics on the housing unit, usage patterns, and household demographics are collected. This information is combined with data from energy suppliers to these homes to estimate energy costs and usage for heating, cooling, appliances, and other end uses. Data from the 2009 RECS are tabulated for the four census regions, the nine census divisions, and 16 states.			

Note: Please note that URLs can change and that these web addresses were accurate at the time the Guidance Manual was published.

Appendix 3.1
Available Educational Materials on Healthy Homes
Free and available for reproduction from PDF

Source	Document/ website name	Website link	Purpose
U.S. Department of Housing and Urban Development, Office of Health Homes and Lead Hazard Control, Outreach website	Help Yourself to a Healthy Home	http://www.hud.gov/offices/ lead/library/outreach/ How2Maintain HealthyHome_ booklet.pdf	58 pages. Comprehensive overview for program staff and clients. Available in English and Spanish.
	How To Maintain a Healthy Home	http://www.hud.gov/offices/ lead/library/outreach/ How2Maintain HealthyHome_ booklet.pdf	Seven pages. 2006 Alameda County brochure. Appropriate for distribution to families.
	Making Homes Healthier for Families webpage	http://www.hud.gov/offices/ lead/healthyhomes/index.cfm. pdf	Link to two pages. Healthy Homes Maintenance Checklist. Also contains links to seven web pages that provide guidance for families on allergies, asthma, carbon monoxide, Integrated Pest Management, lead, mold, and radon.
	How to Make Your Own Green Cleaning Materials	http://www.hud.gov/offices/ lead/library/outreach/ How2Make GreenCleaning.pdf	One page. Alameda County Lead Poisoning Prevention, adapted from Toxics Use Reduction Project, U. of Mass. Lowell. Appropriate for distribution to families.
	Asthma Triggers Checklist	http://www.hud.gov/offices/ lead/library/outreach/Asthma TriggersChecklist_Eng.pdf	One page. Alameda County Healthy Homes Project. Appropriate for distribution to families. In English and Spanish.
U.S. Department of Agriculture, National Institute of Food and Agriculture, Healthy Indoor Air for America's Homes website	Healthy Indoor Air for America's Homes website	http://www.csrees.usda.gov/ nea/family/in_focus/housing_ if_epa.html web site under development	Consumer awareness educational campaign for use by agricultural extension agents and community leaders.

Source	Document/ website name	Website link	Purpose
U.S. Environmental Protection Agency	EPA's Indoor Environmental Media Campaigns webpage	http://www.epapsa.com/	Asthma and radon PSAs in English and Spanish.
	Indoor Air Quality Publications webpage	http://www.epa.gov/iaq/pubs/index.html	Variety of publications, including Care for Your Air: A Guide for Indoor Air Quality.
	The Inside Story: A Guide to Indoor Air Quality	http://www.epa.gov/iaq/pubs/insidest.html	Overview of key indoor air quality threats with links to resources and technical publications. Useful for program planners.
	Indoor Air Quality House: Care for Your Air webpage	http://www.epa.gov/iaq/iaqhouse.html	Interactive tour of a home that highlights common environmental triggers. Helpful for families.
	Asthma Awareness Month planning materials planning kit	http://www.epa.gov/asthma/awm/index.html#Event Planning Kit	
	Asthma Environmental Checklist	http://www.epa.gov/asthma/pdfs/home_environment_checklist.pdf	Eight page checklist and action plan for families.
	Dusty the Asthma Goldfish and His Asthma Triggers Funbook	http://www.epa.gov/asthma/pdfs/dustythegoldfish_en.pdf	Funbook in English and Spanish.
	IAQ Tools for Schools: Managing Asthma in the School Environment	http://www.epa.gov/iaq/schools/pdfs/publications/managing_asthma.pdf	Overview of the IAQ Tools for Schools Program.
	Radon webpage	http://www.epa.gov/radon/index.html	Includes A Citizen's Guide to Radon and media campaign toolkits for Living Green and Healthy Starts from the Ground Up.
	Indoor Air Plus webpage	http://www.epa.gov/indoorairplus/index.html	Guidance for contractors who wish to meet Energy Star and additional healthy housing criteria for national certification.
	Carbon Monoxide webpage	http://www.epa.gov/iaq/co.html	
	Pesticides and Integrated Pest Management	http://www.epa.gov/pesticides/ipm/index.htm	Includes IPM in Schools toolkit.

Source	Document/ website name	Website link	Purpose
	Smoke Free Homes and Cars Program publications website	http://www.epa.gov/ smokefree/publications.html	Includes links to English and Spanish versions of Secondhand Smoke and the Health of Your Family and the Smoke Free Pledge kit.
	Ground Water and Drinking Water webpage	http://www.epa.gov/safewater/	Consumer information on drinking water, well head protection, water treatment in emergency situations, lead in drinking water.
U.S. Centers for Disease Control and Prevention (CDC)	Healthy Homes Webpage	http://www.cdc.gov/ HealthyHomes/	This site offers health and safety tips about the home structure and land and things to do at home to protect health and lower risks for the leading causes of death.
	Air Pollution and Respiratory Health webpage	http://www.cdc.gov/nceh/ airpollution/links.htm	Links to CDC and other agency publications on asthma, carbon monoxide, outdoor air quality.
	Carbon Monoxide Poisoning webpage	http://www.cdc.gov/co/	Includes PDFs in multiple languages of You Can Prevent Carbon Monoxide Poisoning.
	Asthma webpage	http://www.cdc.gov/asthma/	Includes Asthma-friendly schools initiative toolkit.
	Mold webpage	http://www.cdc.gov/health/ mold.html	Includes Protect Yourself from Mold.
	Childhood Lead Poisoning webpage	http://www.cdc.gov/co/	Publications, prevention tips, data and surveillance, policy, training tools.
U.S. Consumer Products Safety Commission	Neighborhood Safety Toolkit	http://www.cpsc.gov/nsn/nsn. html	Resources on Child Safety, Fire Safety, Carbon Monoxide, Older Adults, Drowning Prevention and ATV Safety.
	Indoor Air Quality Publications webpage	http://www.cpsc.gov/cpscpub/ pubs/iaq.html	Includes 28 CPSC fact sheets on asbestos, carbon mon-oxide, lead, mercury, paint strippers, cleaning of air hu-midifiers, use of generators. Many available in English and Spanish.
Ready America website (Federal Emergency Management Agency)	Emergency Supply List	http://www.ready.gov/ america/_downloads/checklist. pdf	List of additional items to add to an emergency supply kit.

Source	Document/ website name	Website link	Purpose
	Make A Plan	http://www.ready.gov/america/makeaplan/index.html	Directions on how to make a family emergency plan.
	Be Informed webpage	http://www.ready.gov/america/beinformed/index.html	Webpage providing information on many emergency types such a Biological threats, blackouts, earthquakes, fire, flood, severe weather, tsunamis, radiation, and disease.
	Outreach materials for media	http://www.safekids.org/media/	Collection of media documents, including research and reports and press statements.
	Safety Resources By Risk Area Website	http://www.safekids.org/safety-basics/safety-resources-by-risk-area/	Contains fact sheets and other materials by the following topics: Bicycling and Skating, Car Seats, Boosters and Seat Belts, Choking, Suffocation and Strangulation, Falls, Drowning, Fire, Burn and Scalds, In and Around Cars, Pedestrian, Playground, Poison, and Toys.
Safe Kids USA	Outreach materials for parents	http://www.safekids.org/parents/	Informational and preventive campaign for parents. Categorized by age. Includes safety resources in links.
	Outreach materials for educators	http://www.safekids.org/educators/	Collection of safety-related materials and activities for educators to adapt for school-room use.
	Outreach materials for media	http://www.safekids.org/media/	Collection of media documents, including research and reports and press statements.
	Safety Resources By Risk Area Website	http://www.safekids.org/safety-basics/safety-resources-by-risk-area/	Contains fact sheets and other materials by the following topics: Bicycling and Skating, Car Seats, Boosters and Seat Belts, Choking, Suffocation and Strangulation, Falls, Drowning, Fire, Burn and Scalds, In and Around Cars, Pedestrian, Playground, Poison, Sports and Recreation, and Toys.

Source	Document/ website name	Website link	Purpose
American Red Cross	Preparedness Fast Sheets	http://www.redcross.org/ portal/site/en/menuitem.86f46 a12f382290517a8f210b80f78a0 /?vgnextoid=92d51a53f1c3711 0VgnVCM1000003481a10aRCR D&vgnextfmt= default	Comprehensive fact sheets for preparation of the following topics: Earthquake Safety, Fire Prevention & Safety, Flood Safety, Flu Safety, Heat Wave Safety, Hurricane Safety, Landslide Safety, Pet and Disaster Safety, Power Outage, Taking Care of Emotional Health, Thunderstorm Safety, Taking Care of People with the Flu, Tornado Safety, Wild Fire Safety, and Winter Storm Safety. Available in Spanish, Arabic, Chinese, French, Haitian-Creole, Korean, Tagalog and Vietnamese.
American Lung Association	Protecting Your Air at Home webpage	http://www.lungusa.org/ healthy-air/home/protecting- your-air-at-home/	Includes annual State of the Air report.

Appendix 4.1
Housing and Health Assessment Tools for Use by Healthy Homes Programs

This document provides additional information on leading tools and methods that can be used by Healthy Homes Demonstration programs to select appropriate interventions and help evaluate their effectiveness. The tools are based on the following unranked criteria:

1. Comprehensiveness

2. Validated/Used in Published Evaluation

3. Practicality and Ease of Adapting to Local Conditions

4. Potential Burden on Occupant and Inspector

Because local programs and conditions differ, there is no single best tool that can currently be applied universally. Each has its own strengths and weaknesses. Healthy homes programs should evaluate these tools and methods to determine which elements can be adapted to their programs and local conditions. Appendix 6.2 contains extensive literature describing how each tool was developed. This list is not intended to cover the pros and cons of all tools that could be used by healthy homes programs, only those offering the greatest promise at this time.

Table 1. Comparison of Leading Healthy Housing Assessment Tools

Tool Name	Link or Source	Comprehensiveness/ Topics (see key below)	Validation/ Used in Published Evaluation	Practicality and Ease of Adaptation	Burden
Healthy Housing Inspection Manual, 2008	http://www.cdc.gov/nceh/publications/books/inspectionmanual/default.htm	High AS, GH, HC, IS, MM, OP, PA, TC	No (earlier version used in HUD Programs)	Low	Medium
NCHH Survey for Housing-Related Disease and Injury—Adaptation of the CDC National Health Interview Survey	National Center for Healthy Housing http://www.nchh.org	High AS, GH, HC, IS, MM, OP, PA, TC	Evaluation pending (used in two previous studies)	Medium	Medium
Asthma Control Questionnaire—Measuring quality of life in children with asthma	http://ajrccm.atsjournals.org/cgi/reprint/162/4/1330 (Juniper Quality of Life Survey)	Medium AS	Validated	Medium	Low
Asthma Therapy Assessment Questionnaire—For health professionals only	http://www.asthmacontrolcheck.com/asthma_control/asthma controlcheck/hcp/index.jsp	Medium AS	Validated	Low	High
Asthma Control Test—Measuring asthma control of persons 12 years of age and older	http://www.qualitymetric.com/WhatWeDo/DiseasespecificHealthSurveysAsthmaControlTest%20%20 %20ACT/tabid/190/Default.aspx	Medium AS	Validated	Medium	Medium

Table 1. Comparison of Leading Healthy Housing Assessment Tools (continued)

Tool Name	Link or Source	Comprehensiveness/ Topics (see key below)	Validation/ Used in Published Evaluation	Practicality and Ease of Adaptation	Burden
Childhood Asthma Control Test—Measure of asthma control of children 4–12 years of age	http://download. journals.elsevierhealth. com/pdfs/journals/ 0091-6749/PIIS 0091674907001674.pdf	Medium AS	Validated	Medium	Low
Asthma Core Care-giver Survey—Allies Against Asthma	http://asthma.umich. edu/mediaeval_ autogen/core_ caregiver.pdf	Medium AS	Uses Juniper plus other questions	Medium	Low
EPA Asthma Home Environmental Checklist	http://www.epa.gov/ asthma/pdfs/home_ environment_checklist. pdf	Medium MM, PA,OP	No	High	Low
Seattle- King County HomeBASE	http://www.kingcounty. gov/healthservices/ health/chronic/asthma/ homebase/ questionnaires.aspx	High AS, HC, IS, MM, PA, OP, TC	Evaluation published (prev. edition)	Medium	Medium
Cuyahoga County Mold and Moisture Project: Visual Assessment and Testing	http://www.ehw.org/ Healthy_ House/HH_VAT.pdf	High HC, MM, PA, OP, TC	Evaluation published	High	Medium
Home Moisture Audit	http://www.ehw.org/ Healthy_House/HH_ Moist_Audit.htm	Medium MM	No	Medium	Medium
Allergen Trigger Screening Questions— NCHH	National Center for Healthy Housing http://www.nchh.org	Low HC, MM, PA	Evaluation publication pending	High	Low
Assessment Questions for Environmental and Other Factors that can Make Asthma Worse— NIH	http://www.nhlbi. nih.gov/guidelines/ asthma/06_sec3_ comp3.pdf (Figure 3-17)	Low MM, PA, OP	No	High	Low
Community Environmental Health Resource Center	http://www.cehrc.org/ res/res_cehrc.htm	Medium HC, MM, OP, PA	Evaluation publication pending	High	Low
Pediatric Environ- mental Health Assessment	http://www. healthyhomes training. org/Nurse/PEHA_ Start.htm	Medium HC, IS, MM, OP, PA, TC	No	High	Low

Table 1. Comparison of Leading Healthy Housing Assessment Tools (continued)

Tool Name	Link or Source	Comprehensiveness/ Topics (see key below)	Validation/ Used in Published Evaluation	Practicality and Ease of Adaptation	Burden
Housing Health and Safety Rating System (UK)	http://www. communities.gov. uk/documents/ housing/pdf/property questionnairegeneral. pdf	Medium HC, MM	No	Medium (May only be applicable to UK Housing)	--
LARES	http://www.euro. who.int/Housing/ LARES/20080506_3	High AS, GH, HC, IS, MM, PA, TC	Evaluation published	Low (May only be applicable to European housing)	--

Survey Topic Key: AS: Asthma Symptoms and Health Effects; GH: General Health; HC: Housing Conditions—General; IS: Injury/Safety Conditions; MM: Mold/Moisture; OP: Other Pollutants/Irritants; PA: Pests/Animals; and TC: Temperature/Comfort

Healthy Home Rating System — SCORING SHEET

ADDRESS

Survey date

Surveyor

DWELLING House or flat | hse | flat | **HMO** | Non | HMO | **Age of dwelling**

HAZARDS

Physiological		Psychological		Safety	
Damp & mold etc	01	Crowding & space	11	Falls in baths etc	19
Excess cold	02	Entry by intruders	12	Falling on the level	20
Excess heat	03	Lighting	13	Falling on stairs etc	21
Asbestos (& MMFs)	04	Noise	14	Falling between levels	22
Biocides	05			Electrical hazards	23
Carbon monoxide etc	06	**Infection**		Fire hazards	24
Lead	07	Domestic hygiene etc	15	Flames, hot surfaces etc	25
Radiation	08	Food safety	16	Collision/entrapment	26
Uncombusted fuel	09	Personal hygiene etc	17	Position of amenities etc	27
VOCs	10	Water supply	18	Explosions	28
				Structural collapse	29

HAZARD & No. [ ] **Item/s**

LIKELIHOOD

5600	3200	1800	1000	560	320	180	100	56	32	18	10	6	3	2	1
< 4200	2400	1300	750	420	240	130	75	42	24	13	7.5	4	2.5	1.5 >	

Justification

OUTCOMES

	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >		Class IV
Class I	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4		100-(I+II+III)
Class II	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4		
Class III	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4		
	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >		

Justification

RATING

A	B	C	D	E	F	G	H	I	J
<5000	2000	1000	500	200	100	50	20	10 >	

Score (if calculated) [ ]

HAZARD & No. [ ] **Item/s**

LIKELIHOOD

5600	3200	1800	1000	560	320	180	100	56	32	18	10	6	3	2	1
< 4200	2400	1300	750	420	240	130	75	42	24	13	7.5	4	2.5	1.5 >	

Justification

OUTCOMES

	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >		Class IV
Class I	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4		100-(I+II+III)
Class II	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4		
Class III	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4		
	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >		

Justification

RATING

A	B	C	D	E	F	G	H	I	J
<5000	2000	1000	500	200	100	50	20	10 >	

Score (if calculated) [ ]

HAZARD & No. [ ] **Item/s** [_____]

LIKELIHOOD

5600	3200	1800	1000	560	320	180	100	56	32	18	10	6	3	2	1
< 4200	2400	1300	750	420	240	130	75	42	24	13	7.5	4	2.5	1.5 >	

Justification [_____]

OUTCOMES

	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >	
Class I	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4	[ ]
Class II	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4	[ ]
Class III	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4	[ ]
	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >		

Class IV $100-(I+II+III)$ [ ]

Justification [_____]

RATING

A	B	C	D	E	F	G	H	I	J
<5000	2000	1000	500	200	100	50	20	10 >	

Score (if calculated) [ ]

HAZARD & No. [ ] **Item/s** [_____]

LIKELIHOOD

5600	3200	1800	1000	560	320	180	100	56	32	18	10	6	3	2	1
< 4200	2400	1300	750	420	240	130	75	42	24	13	7.5	4	2.5	1.5 >	

Justification [_____]

OUTCOMES

	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >	
Class I	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4	[ ]
Class II	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4	[ ]
Class III	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4	[ ]
	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >		

Class IV $100-(I+II+III)$ [ ]

Justification [_____]

RATING

A	B	C	D	E	F	G	H	I	J
<5000	2000	1000	500	200	100	50	20	10 >	

Score (if calculated) [ ]

HAZARD & No. [ ] **Item/s** [_____]

LIKELIHOOD

5600	3200	1800	1000	560	320	180	100	56	32	18	10	6	3	2	1
< 4200	2400	1300	750	420	240	130	75	42	24	13	7.5	4	2.5	1.5 >	

Justification [_____]

OUTCOMES

	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >	
Class I	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4	[ ]
Class II	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4	[ ]
Class III	0	0.1	0.2	0.5	1.0	2.2	4.6	10.0	21.5	31.6	46.4	[ ]
	<0.05	0.15	0.3	0.7	1.5	3	7	15	26	38 >		

Class IV $100-(I+II+III)$ [ ]

Justification [_____]

RATING

A	B	C	D	E	F	G	H	I	J
<5000	2000	1000	500	200	100	50	20	10 >	

Score (if calculated) [ ]

Appendix 5.1
Examples of Healthy Housing Criteria for Housing Rehabilitation and New Construction

The two sets of criteria for housing rehabilitation and new construction provided here include information reprinted from:

- Enterprise Green Community Criteria (2008) http://www.practitionerresources.org/cache/documents/666/66641.pdf; and

- EPA Indoor airPLUS Construction Specifications (2009) http://www.epa.gov/indoorairplus/construction_specifications.html.

- 2011 Green Community Standards http://www.greencommunitiesonline.org/tools/criteria/

Enterprise Green Community Criteria (2008)

Enterprise Community Partners' Green Communities criteria for new construction and rehabilitation promote smart growth, public health, energy conservation, operational savings, and sustainable building practices in affordable housing design. As a result, the methods and materials referenced in the following pages enhance affordable housing and communities as a whole. In addition to increasing resource efficiency and reducing environmental impacts, green building practices can yield cost savings through long-term reduction in operating expenses. The benefits include improved energy performance and comfort, a healthier indoor environment, increased durability of building components, and simplified maintenance requirements.

Alignment with LEED for Homes Rating System (LH)	Criteria	Mandatory Provisions and Eligibility Point System
Healthy Living Environments		
7.1 LH	Low/No Volatile Organic Compounds (VOC) Paints and Primers Specify that all interior paints and primers must comply with current Green Seal standards for low-VOC limits.	Mandatory
7.2 LH	Low/No VOC Adhesives and Sealants Specify that all adhesives must comply with Rule 1168 of the South Coast Air Quality Management District. Caulks and sealants must comply with Regulation 8, Rule 51 of the Bay Area Air Quality Management District.	Mandatory
7.3	Urea Formaldehyde-free Composite Wood Use particleboard and MDF that is certified compliant with the ANSI A208.1 and A208.2. If using non-rated composite wood, all exposed edges and sides must be sealed with low-VOC sealants.	Mandatory
7.4 LH	Green Label Certified Floor Coverings Do not install carpets in below grade living spaces, entryways, laundry rooms, bathrooms, kitchens or utility rooms. If using carpet, use the Carpet and Rug Institute's Green Label certified carpet, pad and carpet adhesives.	Mandatory (if providing floor coverings)
7.5a LH	Exhaust Fans—Bathroom: New Construction and Substantial Rehabilitation Install Energy Star-labeled bathroom fans that exhaust to the outdoors and are connected to a light switch and are equipped with a humidistat sensor or timer, or operate continuously.	Mandatory

Alignment with LEED for Homes Rating System (LH)	Criteria	Mandatory Provisions and Eligibility Point System
7.5b LH	Exhaust Fans—Kitchen: New Construction and Substantial Rehabilitation Install power vented fans or range hoods that exhaust to the exterior.	Mandatory
7.5c	Exhaust—FansKitchen: Moderate Rehabilitation Install power vented fans or range hoods that exhaust to the exterior.	5
7.6a LH	Ventilation: Except for Moderate Rehabilitation Install a ventilation system for the dwelling unit, providing adequate fresh air per ASHRAE 62.1-2007 for residential buildings above three stories or ASHRAE 62.2 for single family and low-rise multifamily dwellings.	Mandatory
7.6b	Ventilation: Moderate Rehabilitation Install a ventilation system for the dwelling unit, providing adequate fresh air per ASHRAE 62.1-2007 for residential buildings above three stories or ASHRAE 62.2 for single family and low-rise multifamily dwellings.	10
7.7 LH	HVAC Sizing Size heating and cooling equipment in accordance with the Air Conditioning Contractors of America Manual, Parts J and S, ASHRAE handbooks, or equivalent software.	Mandatory
7.8	Water Heaters: Mold Prevention Use tankless hot water heaters or install conventional hot water heaters in rooms with drains or catch pans with drains piped to the exterior of the dwelling and with non-water sensitive floor coverings.	Mandatory
7.9a	Materials in Wet Areas: Surfaces In wet areas, use materials that have smooth, durable, cleanable surfaces. Do not use mold-propagating materials such as vinyl wallpaper and unsealed grout.	Mandatory
7.9b	Materials in Wet Areas: Tub and Shower Enclosures Use fiberglass or similar enclosure or, if using any form of grouted material, use backing materials such as cement board, fiber cement board or equivalent (i.e., not paper-faced).	Mandatory
7.10a	Basements and Concrete Slabs: Vapor Barrier Provide vapor barrier under all slabs. For concrete floors either in basements or on-grade slab install a capillary break of 4 four inches of gravel over soil. Cover all gravel with 6-millimeter polyethylene sheeting moisture barrier with joints lapped 1 foot or more. On interior below grade walls, avoid using separate vapor barrier or below grade vertical insulation.	Mandatory
7.10b LH	Basements and Concrete Slabs—Radon: New Construction and Substantial Rehabilitation In EPA Zone 1 and 2 areas, install passive radon-resistant features below the slab along with a vertical vent pipe with junction box available, if an active system should prove necessary. For substantial rehab, introduce radon-reduction measures if elevated levels of radon are detected.	Mandatory

Alignment with LEED for Homes Rating System (LH)	Criteria	Mandatory Provisions and Eligibility Point System
7.11	Water Drainage Provide drainage of water to the lowest level of concrete away from windows, walls and foundations.	Mandatory
7.12 LH	Garage Isolation Provide a continuous air barrier between the conditioned (living) space and any unconditioned garage space. In single-family houses with attached garages, install a CO alarm inside the house on the wall that is attached to the garage and outside the sleeping area, and do not install air handling equipment in the garage.	Mandatory
7.13 LH	Clothes Dryer Exhaust Clothes dryers must be exhausted directly to the outdoors.	Mandatory
7.14 LH	Integrated Pest Management Seal all wall, floor and joint penetrations with low-VOC caulking. Provide rodent-proof and corrosion-proof screens (e.g., copper or stainless steel mesh) for large openings.	Mandatory
7.15	Lead-Safe Work Practices: Rehabilitation For properties built before 1978, use lead-safe work practices during renovation, remodeling, painting and demolition.	Mandatory
7.16	Healthy Flooring Materials: Alternative Sources Use non-vinyl, non-carpet floor coverings in all rooms.	5
7.17	Smoke-free Building Enforce a "no smoking" policy in all common and individual living areas in all buildings. See full criteria for "common area" definition.	2
7.18 LH	Combustion Equipment: Includes Space and Water-Heating Equipment Specify power vented or combustion sealed equipment. Install one hard-wired CO detector for each sleeping area, minimum one per floor.	Mandatory
Operations and Maintenance		
8.1 LH	Building Maintenance Manual Provide a manual that includes the following: a routine maintenance plan; instructions for all appliances, HVAC operation, water-system turnoffs, lighting equipment, paving materials and landscaping, pest control and other systems that are part of each occupancy unit; an occupancy turnover plan that describes the process of educating the tenant about proper use and maintenance of all building systems.	Mandatory

Alignment with LEED for Homes Rating System	Criteria	Mandatory Provisions and Eligibility Point System
8.2 LH	**Occupant's Manual** Provide a guide for homeowners and renters that explains the intent, benefits, use and maintenance of green building features, along with the location of transit stops and other neighborhood conveniences, and encourages additional green activities such as recycling, gardening and use of healthy cleaning materials, alternate measures for pest control and purchase of green power.	Mandatory
8.3 LH	**Homeowner and New Resident Orientation** Provide a walk-through and orientation to the homeowner or new resident using the Occupant Manual from 8-2 above that reviews the building's green features, operations and maintenance along with neighborhood conveniences.	Mandatory

Notes:

(1) Standards are subject to change.

(2) LEED Rating System can be found at http://www.usgbc.org.

(3) Mandatory Provisions and Eligibility Point System: To be eligible for Green Communities grants, loans and tax credit equity through Enterprise, a project must comply with all of the mandatory provisions of the Green Communities criteria. In addition, new construction projects must earn 35 points from the Optional Criteria, while moderate rehabilitation projects must earn 30 points from the Optional Criteria.

(4) This table is a partial representation of the eight criteria.

EPA Indoor airPLUS Construction Specifications (2009)

These specifications for new construction were developed by the U.S. Environmental Protection Agency (EPA) to recognize new homes equipped with a comprehensive set of Indoor Air Quality (IAQ) features. They were developed with significant input from stakeholders, based on best available science and information about risks associated with IAQ problems, and balanced with practical issues of cost, builder production process compatibility, and verifiability. Although these measures were designed to help improve IAQ in new homes compared with homes built to minimum code, they alone cannot prevent all IAQ problems. Occupant behavior is also important. For example, smoking indoors would negatively affect IAQ and the performance of the specified Indoor airPLUS measures.

Indoor airPLUS Verification Checklist

United States Environmental Protection Agency

Address or Div/Lot#:

City/State/Zip: Date: **Verified by**

Section		Requirements (see Indoor airPLUS Construction Specifications for details)	N/A	Builder	Rater
Moisture Control		**Water-Managed Site and Foundation**			
	1.1	Site & foundation drainage: sloped grade, protected drain tile, & foundation floor drains		☐	☐
	1.2	Capillary break below concrete slabs & in crawlspaces (Exception - see specification)	☐	☐	☐
	1.3	Foundation wall damp-proofed or water-proofed (Except for homes without below-grade walls)	☐	☐	☐
	1.4	Basements/crawlspaces insulated & conditioned (Exceptions - see specification)	☐	☐	☐
		Water-Managed Wall Assemblies			
	1.5	Continuous drainage plane behind exterior cladding, properly flashed to foundation		☐	☐
	1.6	Window & door openings fully flashed		☐	☐
		Water-Managed Roof Assemblies			
	1.7	Gutters/downspouts direct water a minimum of 5' from foundation (Except in dry climates)	☐	☐	☐
	1.8	Fully flashed roof/wall intersections (step & kick-out flashing) & roof penetrations		☐	☐
	1.9	Bituminous membrane installed at valleys & penetrations (Except in dry climates)	☐	☐	☐
	1.10	Ice flashing installed at eaves (Except in Climate Zones 1 - 4)	☐	☐	☐
		Interior Water Management			
	1.11	Moisture-resistant materials/protective systems installed (i.e., flooring, tub/shower backing, & piping)			☐
	1.12	No vapor barriers installed on interior side of exterior walls with high condensation potential		☐	☐
	1.13	No wet or water-damaged materials enclosed in building assemblies		☐	☐
Radon	2.1	Approved radon-resistant features installed (Exception - see specification)	☐	☐	☐
	2.2	Two radon test kits & instructions/guidance for follow-up actions provided for buyer (Advisory-see specification)	☐	☐	☐
Pests	3.1	Foundation joints & penetrations sealed, including air-tight sump covers			☐
	3.2	Corrosion-proof rodent/bird screens installed at all openings that cannot be fully sealed (e.g., attic vents)		☐	☐
HVAC	4.1	HVAC room loads calculated, documented; system design documented; coils matched			☐
	4.2	Duct system design documented & properly installed OR duct system tested (check box if tested) ☐	☐		☐
	4.3	No air handling equipment or ductwork installed in garage; continuous air barrier required in adjacent assemblies			☐
	4.4	Rooms pressure balanced (using transfer grills or jump ducts) as required OR tested (check box if tested) ☐	☐		☐
	4.5	Whole house ventilation system installed to meet ASHRAE 62.2 requirements			☐
	4.6	Local exhaust ventilation to outdoors installed for baths, kitchen, clothes dryers, central vacuum system, etc.			☐
	4.7	Central forced-air HVAC system(s) have minimum MERV 8 filter, no filter bypass, & no ozone generators			☐
	4.8	Additional dehumidification system(s) or central HVAC dehumidification controls installed (In warm-humid climates only)	☐		☐
Combustion Pollutants		**Combustion Source Controls**			
	5.1	Gas heat direct vented; oil heat & water heaters power vented or direct vented (Exceptions - see specifications)	☐		☐
	5.2	Fireplaces/heating stoves vented outdoors & meet emissions/efficiency standards/restrictions	☐		☐
	5.3	Certified CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720			☐
	5.4	Smoking prohibited in common areas; outside smoking at least 25' from building openings (Multi-family homes only)	☐	☐	☐
		Attached Garage Isolation			
	5.5	Common walls/ceilings (house & garage) air-sealed before insulation installed; house doors gasketed & closer installed	☐		☐
	5.6	Exhaust fan (minimum 70 cfm, rated for continuous use) installed in garage & vented to outdoors (controls optional)	☐		☐
Materials	6.1	Certified low-formaldehyde pressed wood materials used (i.e., plywood, OSB, MDF, cabinetry)		☐	☐
	6.2	Certified low-VOC or no-VOC interior paints & finishes used		☐	☐
	6.3	Carpet, adhesives, & cushion qualify for CRI Green Label Plus or Green Label testing program	☐	☐	☐
Final	7.1	HVAC system & ductwork verified dry, clean, & properly installed			☐
	7.2	Home ventilated before occupancy OR initial ventilation instructions provided for buyer		☐	☐
	7.3	Completed checklist & other required documentation provided for buyer		☐	☐

Rater/Provider: **Builder:**

Company: **Company:**

Signature: **Signature:**

Guidance for Completing the Indoor airPLUS Verification Checklist:

1. Only ENERGY STAR qualified homes verified to comply with these specifications can earn the Indoor airPLUS label. See Indoor airPLUS Construction Specifications for full descriptions of the requirements, terms, exceptions, abbreviations, references, and climate map used in this checklist. Verification is not complete until this checklist is completed in full and signed.

2. Check one box per line. Check "N/A" for specifications that do not apply for specific conditions (e.g., climate) according to the Exceptions described in the Indoor airPLUS Construction Specifications. Check either "Builder" or "Rater" for all other items to indicate who verified each item. Items may be verified visually on site during construction, by reviewing photographs taken during construction, by checking documentation, or through equivalent methods as appropriate. If using a performance testing alternative to meet requirement 4.2 or 4.4, the box marked "Tested" must be checked and testing documentation must be provided in the Home Energy Rating System/Builder Option Package (HERS/BOP) file.

3. The rater who conducted the verification, or a responsible party from the rater's company, must sign the completed verification checklist. The builder must sign the checklist if any items in the "Builder" column are checked, and by so doing accepts full responsibility for verifying that those items meet Indoor airPLUS requirements.

4. The builder provides one copy of the completed and signed checklist for the buyer. The HERS/BOP provider or rater files a copy with HERS/BOP and ENERGY STAR documentation (e.g., Thermal Bypass Checklist) for the home.

5. The checklist may be completed for a batch of homes using a RESNET-approved sampling protocol when qualifying homes as ENERGY STAR. For example, if the approved sampling protocol requires rating one in seven homes, then the checklist will be completed for the one home that was rated.

Note: The Indoor airPLUS Construction Specifications are designed to help improve indoor air quality (IAQ) in new homes compared with homes built to minimum code. These measures alone cannot prevent all IAQ problems; occupant behavior is also important. For example, smoking indoors would negatively impact a home's IAQ and the performance of the specified Indoor airPLUS measures.

Notes:

For further information on the Indoor airPLUS program, visit epa.gov/indoorairplus.

Qualified homes earn the
Indoor airPLUS label.
Place it next to the
ENERGY STAR label.

All Indoor airPLUS qualified homes meet strict
guidelines for energy efficiency set by ENERGY STAR,
the nationally-recognized symbol for energy efficiency.

Appendix 5.2
Healthy Homes Maintenance Checklist

The following information is also available at
http://www.nchh.org/Portals/0/Contents/Maintenance_Checklist2009.pdf

Yard & Exterior

	Spring	Fall	Annual	As Needed	Pro Needed?
Water drains away from house	◉				
No trip, fall, choking, sharp edge hazards	◉	◉			
Fence around pool intact	◉	◉			
Check for signs of rodents, bats, roaches, termites	◉	◉			
Drain outdoor faucets and hoses		◉			
Clean window wells and check drainage	◉	◉			
Clean gutters and downspouts	◉	◉			

Exterior Roof, Walls, Windows

	Spring	Fall	Annual	As Needed	Pro Needed?
Shingles in good condition	◉				
Check chimney, valley, plumbing vent, skylight flashing	◉				
Make sure gutters discharge water away from building	◉				
Check attic vents		◉			
Check attic for signs of roof leaks	◉				
Check for icicles and ice dams			winter		
Look for peeling paint	◉				
Look for signs of leaks where deck attaches to house	◉				
Check below window & door that flashing intact	◉				
Repair broken, cracked glass		◉			
Look for signs of leaks at window and door sills	◉				
Clean dryer vent	◉	◉			
Check exhaust ducts are clear	◉	◉			

Basement & Crawlspace

	Spring	Fall	Annual	As Needed	Pro Needed?
No wet surfaces, puddles	◉	◉			
Sump pump and check valve working	◉	◉			
Floor drain working	◉				
Vacuum basement surfaces	◉				
Check for signs of rodents, bats, roaches, termites		◉			

Interior Walls, Ceilings, Windows, Doors

	Spring	Fall	Annual	As Needed	Pro Needed?
Check for signs of water damage			●		
Check operation of windows and doors	●				
Lubricate and repair windows and doors				●	

Appliances

	Spring	Fall	Annual	As Needed	Pro Needed?
Clean kitchen range hood screens				●	
Clean dryer vents and screens	●				
Clean exhaust fan outlets and screens	●				
Clean outdoor air intakes and screens		●			
Clean air conditioning coils, drain pans	●				●
Clean dehumidifier coils, check operation	●				
Clean and tune furnaces, boilers, hot water heaters		●			●
Clean and tune ovens and ranges		●			●

Plumbing, Fixtures and Appliances

	Spring	Fall	Annual	As Needed	Pro Needed?
Check washer hoses-connections			●		
Check dishwasher hoses for leaks			●		
Check toilet supply/shut-off valve			●		
Clean & check refrigerator drip pan-icemaker connections			●		
Check shower-tub surrounds for signs of damage			●		
Check traps and drains under sinks, tubs, showers for leaks			●		
Check hot water heater for leaks		●			
Check boiler for leaks		●			
Check water main/meter or well pump for leaks or sweating		●			
Check water main/meter or well pump for leaks or sweating		●			
Clean septic tank			2 yrs		
Check drain and supply time for leaks	●	●			
Check bath and kitchen fans operation	●	●			

Electrical Equipment

	Spring	Fall	Annual	As Needed	Pro Needed?
Check for damaged cords	●	●			
Test ground fault interrupters	●				
Test outlets for proper hot, neutral and ground			once		
Check smoke and CO alarms	●	●			

Garage

	Spring	Fall	Annual	As Needed	Pro Needed?
Ensure storage of fuel cans	●	●			
Proper operation of garage door safety shut-off	●	●			
Check for signs of water damage	●				
Check for signs of rodents, bats, roaches, termites	●	●			

HVAC Equipment - Replace filters

	Spring	Fall	Annual	As Needed	Pro Needed?
Warm air furnace (merv 8)		●			
Air conditioner (central air merv 8)	●				
Dehumidifier	●				
Outdoor air to return to heat recovery ventilation		●			

Attic

	Spring	Fall	Annual	As Needed	Pro Needed?
Check for signs of rodents, bats, roaches, termites		●			
Check for water damage		●			
Ensure insulation in place		●			
Check that fans still exhaust to outdoors (check ductwork connections)				●	

Appendix 6.1
Special Considerations in Human Subjects Research

Since healthy homes programs affect human behavior and health as well as the condition of housing stock, evaluators should be familiar with special protections required under federal law whenever human subjects are involved in formal research activities. The U.S. Department of Health and Human Services (HHS) defines research and the protections of human subjects (45 CFR 46.102(d)) as:

> … a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge…Human subject means a living individual about whom an investigator (whether professional or student) conducting research obtains:
>
> (1) Data through intervention or interaction with the individual; or
>
> (2) Identifiable private information.

Common Rule. HHS oversees the protection of human subjects during the course of research via application of the "Common Rule" (45 CFR Part 46). Not all projects that collect information on individuals are subject to these protections.

Informed Consent. Clients have a reasonable expectation of privacy for their health information. They also have a reasonable expectation of knowing the results of any interventions performed on their homes and the potential effects on their health and wellbeing. There are many mechanisms to address these concerns. At a minimum, enrollment information should specify what data will be collected on the household, who will have access to the data, how the participant can get obtain the information, and how they can withdraw from the project. This information needs to be contained in the consent to participate in the project.

Institutional Review Board. The Institutional Review Board (IRB) process represents further protection for clients. The IRB addresses data privacy, assures participant protection, sets standards for recruitment and retention, and requires that all program documents and procedures be reviewed by third parties with no direct interest in the outcome of the research. IRBs are usually attached to academic institutions but can also be housed at health departments, hospitals, and health insurance companies. If your project includes an academic partner to conduct third-party evaluation, they can facilitate preparation of the IRB application and support the approval process. It is important to note that many IRBs are more familiar with medical research and may need to be educated on public and community health interventions and evaluation.

The IRB review process includes expedited reviews for studies that involve minimum risk to human subjects, which usually describes healthy homes programs. In general, expedited reviews take between one and three months while full reviews can take longer. The recruitment, enrollment and informed consent forms are at the heart of much of the IRB review. Programs should take the time to understand their IRB's requirements for consent and to build in time for approval as a part of project "start up."

Health Insurance Portability and Accountability Act. If health-related data are collected, healthy homes programs will also need to determine what data will be shared internally, with program partners, the community at large, and with funders. Health Insurance Portability and Accountability Act (HIPAA) data protection requirements are likely to apply to any projects where health departments, health care providers, or health insurance agencies are involved. In many cases, these agencies will have their own required policies and training for data protection. (See Alliance for Healthy Homes. Overcoming Barriers to Data-Sharing Related to the HIPAA Privacy Rule: A Guide for State and Local Childhood Lead Poisoning Prevention Programs. June 2004. http://www.afhh.org/res/res_pubs/HIPAA_CLPPP_June_2004.pdf).

Resources

- HHS's Office of Human Research Protections provides a variety of guidance materials on application of the Common Rule, including decision charts for individual projects. See

http://www.hhs.gov/ohrp/humansubjects/guidance/decisioncharts.htm

- As a matter of good practice, all healthy homes project staff should undergo training on the protection of human subjects. Free training can be found at http://ohrp-ed.od.nih.gov/CBTs/Assurance/login.asp.

- The Agency for Healthcare Research and Quality (AHRQ) has developed a toolkit for informed consent in research that poses minimum risk: http://www.ahrq.gov/fund/informedconsent/

Appendix 6.2
Developing a Healthy Housing Program—
Logic Model

Developing a Healthy Housing Program—Logic Model

<u>Situation</u>: Increasing need to address housing-related health issues, including lead exposure, in a more comprehensive manner.

Inputs
- Health Dept. Staff
- Home Visiting Programs
- Home Inspectors
- Potential Partner Organizations
- Elected Officials
- Clinicians
- Foundations
- Data
- $$$$
- Equipment
- Supplies

Activities

Community Analysis: Examine local, existing data to determine what you program should address

Training and Education: Identify training needs to build a sustainable program

Policy: Review housing, sanitation and habitation statues or codes, and enforcement authorities within jurisdiction of the program

Program Experience: Examine organizational capacity and assess the knowledge, skills, and experience of personnel

Partnerships: Examine effectiveness of existing partnerships and identify new partners

Referrals: Develop a monitoring process when making referrals

Program Evaluation: Evaluate performance by examining the processes and impact of current activities on the overall goals and objectives of your program

Surveillance: Determine efficiency of surveillance efforts in conducting ongoing, systematic, examination of community needs

Output

Identified target area, health/ housing issues, and community demographics

List of trainings and associated costs to train staff/ partners

List of existing policies and enforcement, as well as policy gaps

Identified programmatic strengths and weaknesses

List of existing and potential partners

Referral tracking system

Evaluation framework to use during planning

Surveillance system assessment

Objectives

Improve understanding of needs of your jurisdiction and the ability of your program to meet those needs

Improve understanding of external resources that currently exist or are being undertaken which could contribute to a holistic Health Homes Program

Improve understanding of gaps in current resources which will need to be addressed or developed to create a holistic Health Homes Program

Goal

Establish a strategic plan, partnerships, and tools in order to implement a holistic Healthy Housing program, ready to address the needs of residents and housing in your jurisdiction.

Assumptions and External Factors

Strengths, Weaknesses, Opportunities and Threats (SWOT) and Political, Economic, Social and Technological (PEST) Analyses

Appendix 6.3
Evaluation Design Strategies

One-group design

This design assesses people and/or housing units after the program has been completed based on assumptions of what the conditions were before the program began; there is no comparison with people who did not receive services. This design is least robust and provides the least evidence that the changes observed were the result of the program. Outcome data can be derived from health records and interviews.

Pre/post design

This design includes assessment of individuals and housing units prior to the implementation of interventions. Differences in health status and housing condition are quantified by comparing conditions at baseline and post-intervention. While preferable to a one-group design, the Asthma Health Outcomes Project reports that programs using this design, without a comparison group, were more likely to report positive, but possibly unreliable results due to biases such as the test itself, participant maturation and other confounding factors.

Time series design

This design includes a series of measurements on key health or housing outcomes and conducts measurements at periodic intervals from the beginning to the end of the program (often including more than one post-intervention measurement). Time series seeks to document the persistence of program effects.

Comparison group design

The use of a comparison (control) group that did not receive program services results in the ability to measure impact without the high cost and complexity of a randomized controlled trial. A comparison group should be carefully selected to ensure that they are as similar to the intervention group as possible in all ways except for participation in the interventions. With demographic and other data on participants in both groups, statistical modeling can be used to control for small differences between the groups.

Appendix 6.4
Window Replacement Cost-Benefit Analysis

Introduction

Cost-benefit analysis is an important tool for justifying program expenditures and can influence funding decisions made by federal, state, and local governments and foundations. Program activities are more likely to receive ongoing and/or increased funding if there is clear evidence that program benefits exceed program costs.

Regulatory analysis and academic studies have shown that window replacement combined with paint repair and lead-safe work practices yield public and private benefits that far exceed the costs of interventions.[1] Window replacement, mainly to increase energy-efficiency, appears to explain a significant part of the decline in lead paint hazards in older homes from 1990–2000.[2] New windows combined with home maintenance and reinvestment could explain why older homes in high-income neighborhoods are much less likely to have lead paint hazards than similar-age homes in low-income neighborhoods.

Lead-safe window replacement results in:

- Long-term energy savings when Energy Star windows are used to replace old, single-pane windows;

- Elimination of lead hazards; and

- Lower lead dust levels through specialized post-intervention cleaning and clearance testing.

[1] U.S. Department of Housing and Urban Development, 1999, Economic Assessment of the Final Rule on Lead-Based Paint, Office of Lead Hazard Control, Washington DC; Nevin R. (2009) Energy-efficient housing stimulus that pays for itself (2010), Energy Policy 38:4–11; Nevin, R. and D. Jacobs. (2006), Windows of opportunity: lead poisoning prevention, housing affordability, and energy conservation, Housing Policy Debate 17(1), 185–207; Nevin, R., D. Jacobs, M. Berg, J. Cohen, (2008), Monetary benefits of preventing childhood lead poisoning with lead-safe window replacement, Environmental Research 106, 410–419.

[2] Jacobs, D. and R. Nevin (2006), Validation of a 20-year forecast of U.S. childhood lead poisoning: Updated prospects for 2010, Environmental Research, 102 (3), 352–364.

Net Benefits of Lead-Safe Window Replacement

Lead safe window replacement costs, annual energy savings, and related market value benefits vary by housing unit size and the number of windows replaced. Lead hazard reduction benefits vary by age of housing and the average number of young children living in the housing unit each year.

Table 1 shows average costs (per housing unit), benefits, and annual energy savings resulting from lead-safe window replacement in three homes of different sizes and types. This is followed by an explanation of how each average cost and benefit was determined and how specific lead and/or healthy homes programs can collect and track data to determine how their local program's costs and benefits compare to these average values.

Window replacement costs and market value benefits: Window replacement costs and the associated average increase in a home's market value are from Remodeling Magazine's annual "Cost vs. Value"[3] estimates. These are based on U.S. Department of Housing and Urban Development estimates from 1999 for replacing seven windows in an 800 ft[2] attached home, and Remodeling Magazine's estimates to replace 16 windows in 1993 and 10 windows in 2005 (Alfano, 2001–2005), all updated to 2005 dollars. The cost estimates include contractor and supplier labor, material, overhead, and profit. The average cost per window when a program engages in a large volume purchase may be lower than this retail cost. Higher home market values associated with new energy-efficient windows are mainly due to a 15 percent to 25 percent reduction in energy bills, an average increase in home value of $20 for every dollar per year in energy bill savings, and an appearance value of about $100 per window.[4]

[3] Alfano, S., Cost vs. Value Reports, Remodeling Online.

[4] Nevin, R. and G. Watson (1998), Evidence of rational market valuations for home energy efficiency, Appraisal Journal 66:401–09; Nevin, R., H. Gazan, C. Bender (1999), More evidence of rational market values for home energy efficiency, Appraisal Journal 67:454–60.

Table 1 Lead-Safe Window Replacement Costs, Benefits, and Energy Savings

	800 ft² Attached 7 Windows	1200 ft² Detached 10 Windows	1800 ft² Detached 16 Windows
Costs			
Window Replacement	$6,118	$9,684	$15,494
Weighted Average Interior Paint Stabilization	$146	$146	$146
Weighted Average Exterior Paint Stabilization	$291	$291	$291
Specialized Cleanup	$386	$510	$510
Lead Dust Clearance Testing	$175	$219	$219
Average Cost	$7,116	$10,850	$16,660
Annual Energy Savings (15%–25%)	$130–216/yr	$194–324/yr	$292–486/yr
Market Value Benefits			
Windows	$5,485	$8,681	$13,890
Weighted Average Interior Paint Stabilization	$144	$144	$144
Weighted Average Exterior Paint Stabilization	$270	$270	$270
Average Market Value Benefit	$5,899	$9,095	$14,304
Average Lead Hazard Reduction Benefit			
Weighted Average in Pre-1940 Housing	$6,847	$6,847	$6,847
Weighted Average in 1940–1959 Housing	$2,847	$2,847	$2,847
Weighted Average in 1960–1977 Housing	$632	$632	$632

Any lead or healthy homes program can track their own data on window replacement costs (including labor, material, and overhead) and develop comparable market value benefit estimates as follows:

- Obtain data on the average annual energy bill for each upgraded home (total annual cost for electricity, natural gas, and/or fuel oil);

- Assume that replacing single-pane windows with Energy Star windows reduces annual energy bills by 20 percent;

- Multiply that annual energy savings by 20, and add $100 per window replaced to estimate market value benefit.

Paint stabilization costs and market value benefits: Regulatory analysis shows that approximately 95 percent of the cost of lead-safe paint stabilization is recovered through an increase in a home's market value. Lead and/or healthy homes programs can track their own cost information through contractor estimates or invoices (per housing unit) for this portion of the scope of work. This cost can be multiplied by 0.95 to develop a comparable market value benefit estimate.

Cleanup and clearance testing costs: The average cost for lead dust cleanup and clearance testing assumes whole-house cleanup and testing. Lead and healthy home's programs can track their own data on cleanup and clearance testing costs through documenting contractor cost estimates and/or invoices for this portion of the work, inspector clearance testing costs based on time and materials, and laboratory analysis costs.

Lead hazard reduction benefits: The health benefit of lead-safe window replacement is based on extensive regulatory analysis and research quantifying the value of increased average lifetime earnings associated with the prevention of preschool lead exposure. This benefit reflects the average loss of IQ due to lead exposure, and associated losses in education attainment and earnings.

These benefits vary by the age of housing because lead paint hazards are more common in older housing. The benefit calculation also reflects the savings in pre-intervention risk assessment costs by using single-pane windows as a presumption of lead hazards. Almost all pre-1940 homes with single-pane windows have lead paint on window surfaces and/or lead dust hazards. Therefore, lead-safe window replacement in pre-1940 homes with single-pane windows almost always yields lead hazard reduction benefits for current and future resident children.

About 40 percent of 1940–1959 homes and 10 percent of 1960–1979 homes with single-pane windows have lead paint on window surfaces. This means 60 percent of 1940–1959 homes and 90 percent of 1960–1979 homes with single-pane windows are less likely to have lead paint hazards, reducing the average lifetime earnings benefit of lead safe window replacement in these homes, although the benefits still exceed the costs. Lead safe window replacement in these homes still yields energy savings and market value benefits, including the market benefit of routine paint repair as needed.

Conducting Cost-Benefit Analysis

Table 2 illustrates how programs can track their program costs and benefits by collecting data on each home upgraded with lead-safe window replacement. These costs are based on collecting cost information for window replacement, paint stabilization, lead- dust cleaning, and clearance testing in each upgraded home. In summary:

- The benefit of window replacement in each home would equal $100 per window plus a 20 percent reduction in that home's average annual energy bill compared to the year prior to window replacement.

- The benefit of paint repair/stabilization in each home equals 95 percent of paint repair costs.

- The benefit of lead hazard reduction in each home equals $6,847 in a pre-1940 home, $2,847 in a home built from 1940–1959, and $632 in a home built from 1960–1977.

When the costs of window replacement, paint stabilization and lead dust cleanup are tracked for each home that is treated as a part of your lead or healthy homes program, costs-benefit analysis can be conducted as demonstrated in Table 2.

Table 2 Program-Specific Lead-Safe Window Replacement Costs and Benefits

Costs	
Window Replacement: Actual Installed Cost	$
Paint Stabilization: Actual Cost	$
Cleanup and Lead Dust Clearance Testing: Actual Cost	$
Total Cost = A	$ Sum of all homes
Market Value Benefits	
Windows Market Benefit = $100/window +	
(20% of the previous year annual energy bill) x 20)	$
Paint Stabilization Market Benefit = 95% of Actual Cost	$
Total Market Value Benefit = B	$ Sum of all homes
Lead Hazard Reduction Benefits	
Pre-1940 units multiplied by $6,847	$
1940–1959 units multiplied by $2,847	$
1960–1977 units multiplied by times $632	$
Applicable Lead Hazard Reduction Benefit = C	$ Sum of all homes
Net Benefits: B + C - A	$

Appendix 7.1
Federal Government Resources

EPA/CDC/ATSDR Federal Grants Guide for Community Environmental and Public Health Activities

The U.S. Environmental Protection Agency (EPA), U.S. Centers for Disease Control and Prevention (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR) are collaborating to achieve community environmental and health goals through a Memorandum of Understanding signed in July 2007. By leveraging their knowledge and resources, the three agencies' goal is to maximize the help they offer communities, state governments and tribes. EPA/CDC/ATSDR Federal Grants Guide for Community Environmental and Public Health Activities, is a comprehensive document that provides information on funding in support of healthy homes activities.

http://www.epa.gov/air/care/documents/EPA_CDC_ATSDR_Grants_Guide_web_061708.pdf

U.S. Department of Housing and Urban Development (HUD)

Office of Healthy Homes and Lead Hazard Control (OHHLHC): HUD's OHHLHC established its Healthy Homes Program in 1999 in response to a congressional directive to protect children and their families from housing-related health and safety hazards. The Healthy Homes Initiative builds upon HUD's Lead Hazard Control programs by supporting efforts that address a variety of environmental health and safety concerns. OHHLHC grants focus on demonstrating and researching low-cost, effective home hazard assessment and intervention methods as well as public education.

http://www.hud.gov/offices/lead/hhi/index.cfm

Community Planning and Development: HUD's Community Development Block Grant (CDBG) program funds local governments to undertake a wide range of activities intended to create suitable living environments, provide decent affordable housing and create economic opportunities, primarily for persons of low and moderate income. CDBG and HOME Investment Partnership-funded housing programs are required to evaluate and reduce lead based paint hazards and comply with the federal lead-safe housing rule. Many jurisdictions use a percentage of these funds to support minor home repair, building inspection/code compliance, energy efficiency, public health and community capacity building initiatives.

http://www.hud.gov/offices/cpd/communitydevelopment/programs/

U.S. Centers for Disease Control and Prevention (CDC)

Grant Funding: CDC supports healthy homes initiatives through two grant programs:

- Building Capacity in Environment Healthy Service Delivery and

- Building Strategic Alliances for Healthy Housing Pilot.

http://www.cdc.gov/HealthyHomes/ByAudience/Programs_Comprehensive.html

Training: Through a cooperative agreement, CDC is the primary funder of the National Healthy Homes Training Center and Network (Training Center) operated by the National Center for Healthy Housing. The Training Center brings together public health and housing practitioners to promote practical and cost-effective methods for making homes healthier. It also serves as a forum for exchanging information on new research and best practices.

http://www.nchh.org/Training/National-Healthy-Homes-Training-Center.aspx

Single Issue Programs: The CDC also advances healthy homes through single issue programs that provide funding, training and technical assistance. These include:

- Asthma Control;
- Carbon Monoxide Poisoning Prevention;
- Air Pollution and Respiratory Health;
- Injury Prevention;
- Healthy Aging;
- Environmental Health Services; and
- Smoking and Health.

http://www.cdc.gov/healthyhomes/ByAudience/Programs_SingleIssue.html

U.S. Environmental Protection Agency (EPA)

Grant Funding: The EPA funds healthy homes through the following grant programs.

- Community Action for a Renewed Environment (CARE) Program http://www.epa.gov/care
- Environmental Education Grant Program www.epa.gov/enviroed
- Environmental Justice Collaborative Problem-Solving Program http://www.epa.gov/compliance/environmentaljustice/grants/ej-cps-grants.html
- Environmental Justice Small Grants Program http://www.epa.gov/compliance/environmentaljustice/grants/ej-smgrants.html
- State Indoor Radon Grant Program http://epa.gov/radon/sirgprogram.html

National Childhood Asthma Media Campaign: EPA has developed media materials, including Public Service Announcements, video news releases, fact sheets and tips for managing asthma. Local healthy homes programs, in partnership with local media, can use the media campaign materials to raise awareness in their jurisdictions.

United States Department of Agriculture (USDA)

The Healthy Homes Partnership is a network of state coordinators that provide information about home health hazards and steps that can be taken to avoid them. The initiative is a partnership between the USDA and HUD.

http://www.csrees.usda.gov/nea/family/in_focus/housing_if_healthyhomes.html

U.S. Department of Energy

The U.S. Department of Energy's (DOE) Weatherization Assistance Program (WAP) provides energy efficiency improvements to low income homes using the most advanced technologies and diagnostic testing protocols available in the housing industry. The energy conservation resulting from the efforts of states and local agencies decreases the cost of energy for families in need while ensuring the health and safety of their homes. WAP programs use advanced technologies, such as blower door directed air sealing that help ensure that sufficient building ventilation remains following air sealing. The incorporation of combustion safety testing, pressure diagnostics, and moisture mitigation under the umbrella of energy-related building science creates healthier homes. The WAP, operating in all 50 states, the District of Columbia, U.S. Territories, and Native American Tribes, comprises the largest group of home energy upgrade experts in the country (see: http://www1.eere.energy.gov/wip/wap.html).

DOE's Weatherization Plus Health initiative, implemented by the National Association for State Community Services Programs (NASCSP), is a national effort to comprehensively and strategically coordinate resources to improve the energy efficiency, health, and safety of low income homes. Weatherization Plus Health facilitates essential connections between energy efficiency and healthy home programs (see: http://nascsp.org/Healthy-Homes/776/Weatherization-Plus-Health.aspx?iHt=47).

Appendix 7.2
Comparison of Regulatory Approaches to Healthy Homes

	Housing/Property Maintenance Code	Health/ Sanitation Code	Landlord-Tenant Law	Product Standards	Hazard Management Law
National Requirements	Yes, for federally-assisted housing No, for other housing	No	Lead disclosure and fair housing	Yes, for specific products and general standards.	Yes for specific hazards such as lead, asbestos, and pesticides.
State Requirements	Several states	Several states	Most States	Yes, for pesticides. All must be consistent with federal.	Generally yes for specific hazards in addition to federal such as carbon monoxide and radon.
Local Requirements	Common except in rural areas	Common but limited scope	Common in large urban areas	Uncommon	Larger community for specific hazards in addition to federal and state.
Current National Models	Yes, International Property Maintenance Code (IPMC)	No	Yes, Uniform Residential Landlord and Tenant Act (URLTA)	Industry Consensus Standards	Federal government and some associations issue guidelines to address specific hazards.
For More Information	http://www.healthyhomes training.org/Codes/HQS.htm http://www.healthyhomes training.org/Codes/IPMC.htm	http://www.healthyhomes training.org/Codes/APHA.htm	http://www.healthyhomes training.org/Codes/URLTA.htm	http://www.healthyhomes training.org/Codes/Product_Stds.htm	http://www.healthyhomes training.org/Codes/Hazard_Stds.htm http://www.healthyhomes training.org/Codes/EPA_RRP.htm

http://www.healthyhomestraining.org/Codes/Code_Table.htm