

**The Healthy Homes Initiative:
A Preliminary Plan
(Full Report)**

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

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Executive Summary

In the FY 1999 Budget, HUD proposed a Healthy Homes Initiative that would protect children from housing conditions that are responsible for multiple diseases and injuries.

The Initiative departs from the more traditional approach of attempting to correct one danger at a time. This advance is possible because we now know that a limited number of building deficiencies contribute to many hazards. Substantial savings are possible using this approach, because access to a home by an inspector, public health nurse, or outreach worker comes at a significant cost. This approach has been implemented successfully in at least two locales: New York State's "Healthy Neighborhoods Program" and Cleveland's "Lead + Asthma Program."

In language accompanying the Appropriations Act, Congress agreed that "...the Healthy Homes approach appears superior to addressing problems one by one..." and appropriated \$10 million for the Healthy Homes Initiative in FY 1999, with the proviso that HUD consult with national experts, and develop a technical report and spending plan.

The costs of implementing multiple housing-based interventions are far lower than if they are implemented one at a time. For example, New York State's Healthy Neighborhoods program estimates that it costs them \$132 per unit visited, and that the benefits for burn, lead poisoning prevention and asthma reduction alone are at least \$285 per unit, which does not include estimated benefits associated with reduced injury, carbon monoxide poisoning and fire.

The HUD Office of Lead Hazard Control convened a meeting of the nation's leading experts on housing, public health, building science, asthma, lead poisoning, allergens, pesticides, medicine, code enforcement, and many other disciplines on December 8 and 9, 1998 (see the Acknowledgments section above for a complete listing). Through the evidence presented, the group confirmed that enough is known to implement the Healthy Homes Initiative and provided important insights on the current state of scientific knowledge on the housing-health connection.

Specifically, the group indicated that interventions addressing the following four areas can be expected to protect children from many adverse health outcomes:

- ↳ excess moisture
- ↳ dust
- ↳ ventilation & control of toxics
- ↳ education

For example, controlling moisture and dust will help prevent asthma, lead poisoning, "bleeding lung" diseases, certain allergies, cockroach and pest infestations and other problems. Correcting physical housing problems must be linked with public education efforts, such as the HUD FHA advertising campaign featuring Bob Vila, Tim Allen and others, to be as effective as possible.

In its spending plan, HUD will fund Healthy Homes activities mandated by Congress to:

- ☞ solve mold and moisture problems in inner-city housing by demonstrating the effectiveness of remediation methods that have been developed in the research setting, but not yet implemented in large numbers of urban houses;
- ☞ demonstrate and evaluate housing repairs that simultaneously prevent asthma, lead poisoning, pulmonary hemorrhage, injuries and other health and safety threats to children in several hundred homes in several cities;
- ☞ study ways to link housing and health databases together to better target resources, such as the American Housing Survey and CDC's disease surveillance systems;
- ☞ conduct public education targeted at low- and moderate-income families living in high-risk neighborhoods;
- ☞ institutionalize a new housing code/health code national council to bring health and safety considerations before the code inspection community and to create a forum for health and housing inspectors to minimize the gulf between the two at the local level;
- ☞ update the Basic Housing Inspection Manual, last issued by CDC and the American Public Health Association in the 1970's; and
- ☞ conduct focused measurement and remediation research to support the demonstration projects outlined above.

The activities will be executed through competitively-awarded cooperative agreements, contracts and interagency agreements. An interagency task force co-chaired by HUD and CDC will ensure that federal efforts are coordinated.

I. Introduction

Children are exposed to a number of safety and health hazards in the home environment capable of producing serious diseases and injuries, sometimes fatal. Most are entirely preventable if they are recognized and controlled at an early stage.

Children spend a greater amount of time indoors and homes are more damp than in times past, especially older substandard housing. Older homes are more prone to moisture intrusion due to deterioration, poor maintenance or design deficiencies. These conditions have contributed to disease and injury outcomes that only now are beginning to be recognized. For example, asthma rates among children have more than doubled in the past 10 years and a new type of fatal lung injury caused by exposure to toxic mold has appeared. These and other problems appear to be caused in part by certain housing conditions; low-income inner-city children are known to be at greater risk.

The tendency to respond to specific problems one at a time can be seen in the nation's efforts to address lead-based paint, radon, and asbestos. More comprehensive assessments have historically been performed by code inspectors. Yet that system is now largely driven by single-issue complaints and by a focus on structural safety and property-value preservation, according to experts in the field. Code inspectors do not systematically address most disease- and injury-causing conditions, which are typically under the jurisdiction of local health departments, just as most health departments do not address structural hazards.

This situation is strikingly different than the landscape at the turn of the century. At that time, a "sanitation movement" focused on sub-standard slum housing located near factories. Inspectors dealt with both safety problems and health problems (at that time, mainly communicable diseases). One of the essential elements in the nation's efforts to control communicable diseases was in fact a housing-based solution--indoor plumbing.

In the years since, this coordinated response split into the publicly-assisted housing movement and the public health movement. These two communities now have separate institutional bases, speak different languages, and typically find collaboration challenging.

HUD's experience with childhood lead poisoning prevention is a case in point. The solution to this public health problem lies in correcting a housing condition (lead-based paint hazards). HUD's lead-based paint hazard control grant program requires housing and health agencies on the local level to collaborate with each other and with community groups to deliver the necessary services. Those communities that have been able to achieve good coordination have produced an effective program; those that have attempted to "go it alone" by restricting the program within a local housing or health agency have been marked by long delays in implementation and other difficulties.

The costs of implementing multiple housing-based interventions are far lower than if they are implemented one at a time. For example, New York State's Healthy Neighborhoods program estimates that it costs them \$132 per unit visited, and that the benefits for burn, lead poisoning prevention and asthma reduction alone are at least \$285 per unit, which does not include estimated benefits associated with reduced injury, carbon monoxide poisoning and fire.

The HUD Healthy Homes Plan

This paper explains how the large number of adverse health and safety outcomes in children intersect with housing deficiencies. It also identifies the following beginning set of "healthy homes" principles and findings articulated by national experts:

- ✎ Uncontrolled moisture, ventilation, dust and inadequate exposure source control (e.g., carbon monoxide) in housing as well as inadequate knowledge of hazards among the public can all be linked to a large number of childhood health and safety problems;
- ✎ It is logical and efficient to simultaneously address health and safety problems that have common underlying housing causes.
- ✎ Sufficient scientific evidence is available to implement housing-based interventions in focused demonstration programs;
- ✎ HUD funding should be sufficiently flexible to enable communities to identify and address their most pressing housing, health, and safety needs and should empower the use of community-based organizations to deliver services and interventions;
- ✎ Preliminary cost data are available for some of these interventions, notably lead poisoning, mold, asthma and injury prevention;
- ✎ HUD funding is an important incentive in promoting the rebuilding of a coordinated housing and health presence at the local level;
- ✎ Injury prevention efforts can be integrated very inexpensively into housing-based disease prevention programs;
- ✎ Study is needed to find ways to better link housing and health databases together to properly target resources, such as the American Housing Survey and CDC's disease surveillance systems;
- ✎ Implementation of several simultaneous housing interventions makes evaluation of the effectiveness of those interventions challenging, but not impossible;

☞ A national institution is needed to encourage communication among code enforcement, health and housing agencies;

Public Outreach Campaign

HUD has already developed and implemented a significant public outreach campaign as part of the Healthy Homes Initiative. In 1998, HUD Secretary Andrew Cuomo announced a series of television advertisements, featuring Bob Vila, Tim Allen and other personalities. The advertisements, which have been running in major media markets, alert viewers to common household hazards and how they can obtain a brochure and additional information through 1-800-HUDS-FHA.

In addition to the focus on hazards, the advertisements enable the public to understand that FHA is part of HUD. With the effort to increase homeownership among low-income people comes a responsibility to educate first-time homebuyers on how to maintain a safe and healthy home. This campaign helps to fulfill that need. In addition to the television advertisements, a number of other organizations are helping to distribute the brochures (see Appendix A).

Because of the importance of public education, outreach efforts to communicate important principles and messages will be an integral part of the Healthy Homes Initiative.

II. Background

The FY 1999 appropriation for the Department of Housing and Urban Development establishes the Healthy Homes Initiative, and requests a report on the Department's plan for the Initiative. The plan is to identify problems to be addressed, key technical questions, and a spending plan.

A. Legislative Direction

The Department of Housing and Urban Development (HUD) is submitting this Preliminary Plan for the Healthy Homes Initiative (HHI) in response to the directive of the Committee on Appropriations of the U.S. House of Representatives, which the Conference Report ratified. Public Law 105-276 (the Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act of 1999) provides \$10 million for the Initiative to, in the words of the Committee's report, "develop and implement a program of research and demonstration projects that would address multiple housing-related problems affecting the health of children" of which at least \$4 million is to "be devoted to preventive measures to correct moisture and mold problems in inner-city housing occupied by families with infants in communities where toxic mold exposure has been linked to acute pulmonary hemorrhage and infant death." (See Appendix B of this Plan for the complete wording regarding the Initiative from the Appropriations Act and the Committee's report.)

The Committee asked HUD to submit a plan that "inventories the problems to be addressed, describes their intersections, identifies key technical questions, and provides a spending plan allocating funds among technical and policy studies, pilot projects, and emergency remediation." The Department is to perform research on moisture and mold prevention through proper ventilation and other means, and to develop and disseminate model standards appropriate to residential housing.

The Initiative is designed to build upon the Department's existing activities related to housing-related health and safety issues, including lead hazard control, building structural safety, electrical safety, fire protection, etc., to address childhood diseases and injuries related to housing more broadly. The Department will update the Plan as it gains further knowledge of the connection between housing deficiencies and health hazards and experience on the most effective means of implementing the Initiative.

B. Basis for the Initiative in Reducing Children's Environmental Risks and Safety Risks

The Initiative is part of the Administration's efforts to respond to the special environmental health and safety needs of children, pursuant to Executive Order 13045 on Children's Environmental Health Risks and Safety Risks. Housing-related diseases and injuries take a toll on children. For example, asthma and other chronic lung diseases now cause more than 4,500 deaths per year and cost the Nation \$6 billion annually. The prevalence of asthma has increased 50 percent in the past 10 years; it

is now the leading cause of absenteeism in school-age children. An outbreak of "bleeding lung disease" (pulmonary hemosiderosis) killed 10 children in Ohio and another 60 infants nationwide before it was traced to a toxic mold caused by inadequate home ventilation and humidity controls; at least 28 more children have died of this disease since the initial outbreak was detected. Eighty percent of all fire deaths now occur in the home, with residential fire fatalities occurring at a rate of 26 children under 6 years old per million; yet only 52% of households have working smoke alarms on every floor. Thousands of children die each year from exposure to pesticides, solvents and other chemicals improperly stored and used in the home. Housing-based solutions exist for all these issues.

C. Development of the Preliminary Plan

In developing this Plan, the Committee advised HUD to seek expert advice. HUD held a meeting on December 8 and 9, 1998 with experts from a broad range of professions, from Federal, State and local government agencies, and national and local practitioners in the private sector. This meeting, plus supplemental materials the experts provided, identified subjects and approaches on which general professional consensus exists.

HUD asked the peer reviewers to address the degree to which there are sufficient data to develop cost-effective programs to demonstrate and promote housing interventions that address multiple health, safety and environmental effects, and to identify those for which single-focus interventions are most appropriate.

To aid in this discussion, HUD prepared a discussion paper for the meeting titled, "HUD's Healthy Homes Initiative: Scientific, Implementation and Programmatic Issues - Background for Peer Review Meeting" (see Appendix C). The proceedings of the meeting are summarized by the National Institute of Building Sciences, which provided logistical and facilitation support for this meeting, in the "Report on HUD's Healthy Homes Initiative Peer Review Meeting" (see Appendix D).

III. Problems to be Addressed and Key Technical Questions

A. Inventory of Healthy Homes Issues

The experts assembled by HUD identified a fairly large number of hazards, diseases and safety issues that could potentially be addressed under the Healthy Homes Initiative, as follows:

- Lead
- Asthma/allergens
- Mold
- Insect pests
- Rodents
- Pesticides
- Other toxic chemicals
- Environmental tobacco smoke
- Combustion byproducts
- Radon
- Asbestos
- Take-home hazards (from work)
- Unintentional injuries (including fires)
- Uncontrolled moisture
- Inadequate ventilation
- Soil gases (other than radon)
- Hazardous building materials
- Drinking water contamination
- Sewage backup
- Swimming pools
- Noise and Vibration
- Crowding
- Firearms
- Faulty Construction
- Pets
- Appliances (ozone generators, humidifiers, unvented clothing dryers)
- Food handling sanitation

B. Intersections of Housing & Health

While each of these problems is important in its own right, attempting to address each and every one independently through the prism of Healthy Homes would be unworkable. Rather than attempt to determine which issues shown above should be included in a Healthy Homes agenda, experts felt it much more productive to examine common housing deficiencies that cause adverse health and safety effects in children. Correction of those antecedents would then result in multiple positive outcomes. For example, dealing with uncontrolled moisture will have positive outcomes for lead

poisoning prevention (reduced paint deterioration), allergens (particularly dust mites), asthma, mold, structural safety, and others.

Table 1 is an initial attempt to illustrate the intersections between housing condition and disease and injury in children. It is likely that other relationships will be recognized in the course of program implementation.

Table 1.

A Beginning List of Building Deficiencies and Associated Hazards

	Inadequate ventilation	Dust Traps	Moisture Intrusion/ Humidification systems	Broken Windows/Other Structural Defects	Inadequate Early Warning Alarms or Prevention Devices	Hobbies	Egress	Improper renovation	Deferred or Inadequate Maintenance
Lead Poisoning	X	X	X	X		X		X	X
Allergens/Asthma	X	X	X	X		X		X	X
Toxicogenic Mold	X	X	X	X				X	X
Insect Pests		X	X						X
Rodent Pests		X	X						X
Pesticide Exposure	X	X				X		X	X
Env Tobacco Smoke	X					X			
Carbon monoxide poisoning	X			X	X		X	X	X
Respiratory irritants	X		X				X	X	X
Radon exposure	X			X				X	X
Asbestos								X	X
Paraoccupational exposures	X								
Injury	X		X	X	X	X	X	X	X
Fire	X				X	X	X	X	X

C. Structuring Healthy Homes Issues

Based on consultation with experts, it is best to conceive of the many different Healthy Homes activities as falling into one or more of the categories shown below. Not all hazard control methods will necessarily be employed in each house or each demonstration project.

- ✍ Excess moisture reduction
- ✍ Dust control
- ✍ Improving air quality (e.g., combustion sources)
- ✍ Education
- ✍

Excess moisture reduction

A survey of 24 U.S. cities indicates moisture problems are evident in nearly half of the homes examined, according to experts convened by HUD. The average is higher in older urban areas and communities with humid climates. While high moisture levels alone are not sufficient to necessarily result in health hazards, it is a common precursor. Moisture problems can lead to paint deterioration (lead poisoning), mold formation (pulmonary hemosiderosis), higher concentrations of dust mites, cockroach infestation, asthma and allergen sensitization, and structural hazards associated with rot and rust (injuries). In addition, there is substantial evidence that the presence of moisture problems, per se, is a risk factor for respiratory illnesses and symptoms, especially in children.

While any area of a house may experience moisture problems, the issue is often most important in below-grade construction (basements and crawl spaces), attics and roofing systems, and plumbing. Air supplies and heating systems are often routed through basements or crawl spaces, distributing contaminants such as mold and soil gases throughout a building. If the basement is finished and used as a living area, exposures may be even higher. Moisture problems can come from inadequate ventilation of bathrooms, humidifiers, groundwater intrusion into basements, inadequate flashing, roof and plumbing leaks, floods, intrusion of warm humid ambient air in summer months, or condensation caused when warmer air contacts cooler building components, and capillary action through masonry. While many hazardous moisture conditions can be identified by simple visual inspection, better techniques are needed to detect hidden problems and to assess the potential for exposure to harmful molds.

Moisture problems require a variety of interventions to correct, ranging from simple patching to correction of basic drainage. In Cleveland, mold interventions, including repairs to ventilation systems and basement flooring, in the most heavily-contaminated

homes range from \$500 - \$5,000, with some costs also being dedicated to lead hazard control simultaneously through its lead+asthma program. Cleveland's experience shows that toxic molds were identified in 65% of homes within the target areas, compared to a national prevalence rate of 3%. The disease resulting from such exposures has a 30% mortality rate. Nationally, then, the mold-related diseases appear to have a fairly low prevalence, but a very high mortality rate.

Structural problems can allow moisture intrusion, as well as create safety and fire hazards and provide access for rodent and insect pests. Structural defects can result from improper construction, poor maintenance, or natural hazards. Holes in floors, open cracks or holes in walls, and broken plaster or peeling paint are present in more than one million, four million and three million homes, respectively.

Addressing mold problems in housing requires coordination among the medical, public health, microbiological, housing, and building science communities.

Dust Control

Dust sources, sinks and traps can serve as a vehicle for a variety of hazardous agents, such as lead, allergens, and pesticide residues. Settled and airborne dust can become problems where surface conditions hinder cleaning, such as rough or porous surfaces.

Dust is the principal pathway through which children are exposed to lead-based paint and mold and is also an exposure route for allergens, dust mites, asthma, and some pesticides. In young children, transmission occurs principally through normal hand-to-mouth contact. Some dust traps are relatively easily addressed, for example, the removal of carpets and sealing of floor surfaces. Dust remediation often consists of removal by using special vacuum systems, as well as controlling dustsources, such as sinks (e.g., carpets), sources (paint, exterior bare soil), unsafe work practices (uncontrolled renovation), and the creation of smooth and cleanable surfaces. New household vacuums with dust sensors are now available on the retail market and require study. Another key research need involves the sink and filtering action of carpets. Low-cost dust control methods are available and cost as little as \$250 per unit.

Improving Air Quality

Ventilation can be either a problem or an intervention. Proper ventilation supplies adequate oxygen and removes carbon dioxide and other pollutants, such as allergens.

Virtually no home ventilation system actively supplies clean fresh air; instead, infiltration through building "leakage" is the norm, although tighter building envelopes and better insulation typically reduce fresh air incursion. In some climates, increasing ventilation can result in increased moisture problems. Poorly-designed systems, such as the forced-air systems in Cleveland (which use basement air as supply air) can contribute to dispersal of mold, soil gases and other contaminants. Carbon monoxide

exposures can occur through combustion spillage caused by airflow reversal in chimneys or use of unvented heaters or appliances. Carbon monoxide alarms and airflow analysis that could detect dangerous air movements are rare in U.S. housing. Improperly-maintained or vented heating and cooking appliances may introduce hazardous gases and particulate matter into the living environment and are also related to fire hazards. Building materials, cleaning products, and appliances can emit gases with irritant, allergic, or other toxic properties. Ozone generators, for example, are known to increase indoor ozone levels with no positive impact on air quality.

Education

Education is an important part of most of the interventions that will be implemented. Occupant behavior can be modified using well-understood prompting tools and can be especially effective in preventing injuries at low cost (\$100-\$200 per unit), based on experience in Wisconsin. For example, provision of a thermometer (as a "prompting device") is known to result in dramatic reductions in scald injuries, because hot water heater temperatures are lowered and residents know to keep them lowered.

The Healthy Homes Initiative will also deliver important educational messages to the public at large, not just individual occupants whose homes are treated for hazards. These messages will use community-based delivery systems where they exist, and help to create them where they do not.

D. Key Scientific and Implementation Questions

It is not logical or efficient to address each housing-related environmental safety and health condition independently of every other such condition. A one-hazard-at-a-time approach is particularly inefficient when applied to many health and safety hazardous conditions with multiple causes, multiple effects and, often, multiple options for corrective strategies. Several communities are implementing programs capable of tackling more than one housing-related disease issue at a time, including Cleveland's Lead+Asthma program, New York State's Healthy Communities Program, Alameda County and others. Technical and implementation questions are described below and were presented to the panel of experts convened by HUD.

1. Scientific issues

- a. What is the causal relation of the housing hazard to health?
- b. What is the estimated prevalence of the hazard and burden of associated illness or injury?

- c. Are practical, valid, and reliable methods and protocols for assessing the hazard available?
- d. Is there scientific evidence to support practical, safe interventions that reduce or eliminate the hazard?
- e. Which of the hazards are high priority public health problems?
- f. For which hazards can action be taken without use of specialized personnel, elaborate testing, or laboratory analysis?
- g. Which corrective measures may introduce new hazards into the home environment or work at odds with interventions intended to control other hazards?

2. Implementation issues

- a. How should Healthy Homes activities address community-level hazards in relation to individual-home hazards?
- b. How can demonstration/evaluation projects be designed to test implementation models, and what are key elements to include in such demonstration projects?
- c. How can evaluation and assessment of housing-related health and safety problems be accomplished most efficiently?
- d. How can basic research on the specific causes and pathways of housing-related illnesses and injuries and building conditions be combined with demonstration projects?
- e. What are the best evaluation markers of Healthy Homes activities?
 - ☞ Rates of illness, injury, or other biological markers?
 - ☞ Economic data (e.g., healthcare costs, housing value, energy consumption)?
 - ☞ Knowledge/behavior of stakeholders (e.g., occupants, landlords, property professionals, public health professionals)?
 - ☞ Changes in environmental or housing conditions (vs. the actual conditions themselves)?
- f. How should target groups (e.g., populations, housing, communities) be selected?
- g. What lessons have been learned from the experience with asbestos, radon, lead-based paint and code enforcement in housing?

E. Toxic Mold

Toxic molds are a unique aspect of the Healthy Homes Initiative in that Congress set aside \$4 million to address this single problem, although it is likely that housing interventions to control mold will also control other hazards as well. Because of the setaside, HUD will expedite this part of the Healthy Homes agenda and is releasing a Notice of Funding Availability for Interventions to Control Mold and Moisture Problems in Inner-City Housing, which was published in the Federal Register in February, 1999. To the extent practical, HUD will be awarding grants to entities that demonstrate a superior ability to combine mold and moisture interventions in a way that combats the "bleeding lungs" outbreak, as well as other housing-based childhood risks simultaneously, in keeping with the overall Healthy Homes philosophy. The following discussion examines the main problems and key technical questions to be examined regarding toxic mold issues in housing.

1. Main Problems to be Addressed

The main problems to be addressed by these projects include the following:

- a. Identification of homes where intervention would be appropriate.
- b. Development of appropriate-scaled and efficient intervention strategies.
- c. Selection of efficient strategies for evaluating intervention effectiveness.
- d. Development of local capacity to operate sustainable programs to prevent and control toxic mold hazards in low and very-low income residences.
- e. Determination of biomarkers as to how much exposure to mold is dangerous.

2. Key Technical Questions

The technical questions to be addressed as part of these projects include the following:

- a. Can a cost-effective survey protocol be developed for identifying homes for moisture control interventions, and for screening out homes where structural or other conditions make interventions infeasible or impractical?
- b. Can a flexible set of intervention strategies be developed that take into account the range of conditions likely to be encountered in older inner-city housing while maximizing the number of housing units that receive an intervention?
- c. Can an efficient strategy be developed for evaluating the effectiveness of interventions in preventing moisture intrusion and controlling mold growth?
- d. Can a local program be built which will continue beyond the HUD funding period?
- e. What is the best way to foster cooperation among all levels of government, the private sector, and community-based organizations to identify and control moisture problems and associated mold hazards in inner city housing?
- f. Can mold- and lead-safe work practices be integrated into housing maintenance, repair, and improvements?

IV. Survey of Key Housing-Related Health Hazards

Historically in the United States and currently in many developing countries, the main health-related housing concerns focus on providing protection from the elements and preventing transmission of communicable diseases. Provision of safe water for drinking and personal hygiene, proper disposal of sewage, facilities for safe food preparation, and the absence of overcrowding are examples of how adequate housing can promote public health. Protection of occupants against temperature extremes and other natural hazards are also basic requirements of safe housing. The American Housing Survey documents the prevalence of basic housing deficiencies in the US, such as inadequate plumbing and sanitary facilities.

In addition, general markers of housing quality have been associated with health outcomes that are not obviously related to specific communicable diseases or other environmental hazards. Such linkages may be explained, in part, by the relation of housing quality to psychosocial stress and child development, which may, in turn, affect physical health.

In addition to deficiencies in basic housing facilities that may impact health, changes in the U.S. housing stock and more sophisticated methods of epidemiology and biomedical research have led to the identification of new and often more subtle health hazards in the residential environment. While such hazards will tend to be found disproportionately in housing that is substandard in other respects (e.g. structural problems, lack of adequate heat, etc.), such housing-related environmental hazards may also exist in housing that is otherwise of good quality. Disasters, such as hurricanes, heavy snowfall, flooding and so on can put children at both immediate and long-term risk. Healthy Homes considerations need to be included in disaster-relief operations. This section briefly describes the kinds of housing-associated health and injury hazards being considered by HUD. Additional hazards may be added to this list.

Lead: Exposure to lead, especially from deteriorating lead-based paint, remains one of the most important and best-studied of the household environmental hazards to children. Although blood lead levels have fallen nationally, a large reservoir of lead remains in housing. The most recent national survey, conducted from 1991-94, showed that nearly one million U.S. preschoolers still have elevated blood lead levels. Overall, the prevalence rate among all children under six years of age is 4.4%. Among low-income children living in older housing where lead-based paint is most prevalent, the rate climbs to 16%; and for African-American children living in such housing, it reaches 21%. HUD estimates that 64 million dwellings have some lead-based paint, and that 20 million have lead-based paint hazards. Of those, about 3.6 million house young children and of those, about 500,000 units have inadequate cash flow to respond to lead-based paint hazards.

Well-defined protocols exist to assess the risk of lead exposure in housing. Data exists on the effectiveness and costs of various measures to reduce exposure to lead in the residential environment and have been detailed in an earlier Report to Congress. Costs can range anywhere from \$500 to \$15,000 per unit. Corrective measures include paint stabilization, enclosure and removal of certain building components coated with lead paint, and cleanup and "clearance testing", which ensures the unit is

safe for young children.

Allergens and asthma: Experts estimate that 14 million Americans have asthma, with an associated annual cost of \$6.2 billion. For sensitized children, exposure to antigens from dust mites, certain pets, and cockroaches has been associated with more severe asthma. Some evidence also indicates that exposure to antigens early in life may predispose to or hasten the onset of allergies and asthma. Dozens of studies show a dose-response relationship between exposure and prevalence of asthma and allergies.

Cockroach allergens appear to be excessive in 30-50% of inner-city housing and affect 5-15% of the population. Asthma is now recognized as the leading cause of school and work absence, emergency room visits and hospitalization. Techniques exist for measuring antigen levels in household dust, but standardized protocols, action thresholds, and the infrastructure to support widespread testing and remediation are not yet available for key antigens. Interventions known to have beneficial effects include installation of impervious mattress and pillow covers, which can reduce allergens by 90%. Cleaning carpets with tannic acid solution has also been demonstrated to greatly reduce dust mites.

Asthma prevention program costs have been estimated at about \$500 per unit, which includes about \$150 for educational interventions. There is also anecdotal evidence suggesting that homes with lead-based paint hazards may also be more likely to pose asthma-related hazards.

Mold: Animal models demonstrate that exposure to satratoxins produced by stachybotrys fungi have the potential to produce inflammation and injury in gastrointestinal and pulmonary tissues. An investigation of a cluster of pulmonary hemosiderosis (PH) cases in infants showed PH was associated with a history of recent water damage to homes and with levels of *Stachybotrys atra* (SA) in air and in cultured surface samples. Associations between exposure to SA and "sick building" symptoms in adults have also been observed. Other related toxigenic fungi have been found in association with SA-associated illness and could play a role. For sensitive individuals, exposure to a wide variety of common molds may also aggravate asthma.

In Cleveland, where lead, asthma and mold intervention programs are being combined, the cost of mold-related work (when added to lead hazard control work) is as follows:

Intervention Program	Cost
Integrated pest management of cockroaches	\$ 150
Check, clean & tune furnace	60
Address basement cold air return system	360
Remove cellulose debris from basement	10
Vent clothes dryer	40
Cover dirt floor with impermeable vapor barrier	85
Install furnace filter + labor	20

Insect pests: The observed association between exposure to cockroach antigen and asthma severity has already been noted. In addition, cockroaches may act as vehicles to contaminate environmental surfaces with certain pathogenic organisms. Treatment of insect infestations often includes the use of toxic pesticides.

Rodent pests: Rodents can transmit a number of communicable diseases to humans, either through bites, arthropod vectors, or exposure to aerosolized excreta. In addition, humans can become sensitized to proteins in rodent urine, dander, and saliva. Such sensitization may contribute to asthma severity among children.

Pesticide residues: Animal models have demonstrated that exposure to chlorpyrifos (CP), a commonly used organophosphate insecticide, in the prenatal and early postnatal period may impair neurodevelopment. While CP is a biodegradable pesticide, substantial persistence of CP in house dust has been demonstrated. There are available data on hazard evaluation methods and remediation effectiveness regarding pesticide residues in the home environment.

Unintentional injuries/ fire: Unintentional injury is now the leading cause of death and disability among children younger than 15 years of age. In 1997, nearly 7 million persons in the United States were disabled for at least 1 full day by unintentional injuries received at home. During the same year, 28,400 deaths were attributable to unintentional home injuries, of which 1800 occurred among children 0-4 years of age. Among young children, three types of events accounted for more than 3/4 of deaths: fires/ burns, drownings, and mechanical suffocation. Falls and poisoning are the next most common.

Home visitation protocols have been shown to be effective in reducing exposure to such hazards. The "add-on" cost of injury prevention measures, when combined with other housing interventions are estimated at about \$100 per unit. This includes the cost of some injury prevention devices, such as smoke alarms, electrical socket covers, etc.

Combustion products of heating and cooking appliances Burning of oil, natural gas, kerosene, and wood for heating or cooking purposes can release a variety of combustion products of health concern. Depending upon the fuel, these may include carbon monoxide (a chemical asphyxiant), oxides of nitrogen (respiratory irritants), polycyclic aromatic hydrocarbons (e.g., the carcinogen benzo[a]pyrene), and airborne particulate matter (respiratory irritants). Improper venting and poor maintenance of heating systems and cooking appliances can dramatically increase exposure to combustion products.

Radon progeny:Epidemiologic studies of miners exposed to high levels of radon in inhaled air have defined the dose response relation for radon-induced lung cancer at high exposure levels. Extrapolation of these data has been used to estimate the excess risk of lung cancer attributable to exposure to radon gas at the lower levels found in homes. These estimates indicate that radon gas is an important cause of lung cancer deaths in the U.S. The National Academy of Sciences estimates that approximately 14,000 cases of lung cancer per year are related to radon exposure. Excessive exposures are typically related to home ventilation, structural integrity and location. Measurement and remediation methods are well-developed.

Asbestos:Asbestos was also shown to be a human carcinogen in studies of heavily exposed workers. As with radon, dose-response extrapolations suggest that lower level exposures, as may occur when asbestos-containing building materials deteriorate or are disturbed, may also cause cancer.

Take home hazards from work/ hobbies and work at homeWhen the clothing, hair, skin, or shoes of workers become contaminated with hazardous materials in the workplace, such contaminants may inadvertently be carried to the home environment and/or an automobile. Such “take-home” exposures have been demonstrated, for example, in homes of lead-exposed workers. In addition, certain hobbies or workplaces located in the home may provide an especially great risk of household contamination.

V. Spending Plan for FY 1999 and FY 2000

A. Spending Plan for FY 1999

The following summarizes the allocation of funding for FY 1999:

- \$4.0 million Funding to solve mold and moisture problems in inner-city housing by demonstrating the effectiveness of remediation methods that have been developed in the research setting, but not yet implemented in large numbers of urban houses (to be awarded competitively through a Notice of Funds Availability (NOFA));
- \$4.0 million Funding to demonstrate and evaluate housing repairs that simultaneously prevent asthma, lead poisoning, pulmonary hemorrhage, injuries and other health and safety threats to children in several hundred homes in several cities (NOFA & Interagency Agreements);
- \$500,000 Funding to build upon the Healthy Homes advertising campaign initiated last year by leveraging other private-sector resources from the other partners in the campaign, such as the Mortgage Bankers Association, American Academy of Pediatrics, hardware store and other retail outlets and others, to deliver key children's health and safety issues (Competitively-awarded contract);
- \$500,000 To develop a housing-based surveillance system that can be linked to a variety of adverse health and safety outcomes through an interagency agreement with the Centers for Disease Control and Prevention (CDC), which will combine housing data systems established at HUD (e.g. the American Housing Survey) with disease tracking systems in place at CDC;
- \$1.0 million Funding interagency agreements to establish epidemiological baseline data, develop the capacity of code enforcement agencies to take on certain health and safety housing issues, research methods of measuring mold and allergens in the housing environment, update the Basic Home Inspection Manual, last issued by CDC and the American Public Health Association in the 1970s, examine home energy design methodologies, and other projects.

Total = \$10 million

1. Toxic-Mold-Related Disease Projects

As noted above, the appropriation for FY 1999 directed HUD to initiate preventive action projects on mold and moisture in inner-city housing related to the bleeding lung disease in infants, which is often fatal. These projects are to be funded at a minimum of \$4 million.

The Department has decided to initiate the projects primarily by issuing competitively awarded cooperative agreements this fiscal year. In February 1999, HUD issued a Notice of Funds Availability in the *Federal Register* as part of the Department's SuperNOFA. (The Notice, and the application kit for the cooperative agreements, will also appear on HUD's Web site, at www.hud.gov/lea.) These cooperative agreements will include evaluation elements to allow HUD to assess whether and how the preventive measures tested in them can be applied to other types of housing, environmental conditions, and geographic settings and will use multi-factorial randomized trials to the extent possible. Eligible applicants will include units of State and local government (such as health or housing departments), universities and other research organizations, non-profit organizations, for-profit contractors with research capabilities, and combinations of these. The Department will evaluate proposals based on technical quality and cost. Awards are expected to be made by September 1999. In addition, HUD may undertake activities in this category through agreements with other Federal agencies.

2. Other Healthy Homes Projects

Other Healthy Homes Projects to be funded in FY 1999 include:

Demonstration Projects (\$4 million)

Funding for demonstration projects that combat multiple childhood diseases and injuries through single physical and educational interventions will be awarded through a NOFA issued in the summer of 1999, with awards to be issued in the fall of 1999. The projects will involve hundreds of units in several cities and will involve a combination of interventions with a strong evaluation component. The interventions must be multi-faceted and be focused on controlling moisture, dust, and/or improvements in house ventilation.

Education Projects (\$500,000)

Funding for public education projects that build on the on-going Healthy Homes advertising campaign will be awarded through a competitive contract. A key part of these awards will involve leveraging private-sector organizations with resources to reach out to specific at-risk populations, as well as the entire nation. These projects may be combined with the Demonstration projects described above, which will also include public education components.

Housing-Based Disease and Injury Surveillance Database Development (\$500,000)

Developing a housing-based surveillance system that can be linked to a variety of adverse health and safety outcomes through an interagency agreement with the Centers for Disease Control and Prevention (CDC), which will combine housing data systems established at HUD with disease tracking systems in place at CDC.

Interagency Agreements and Task Force Support (\$1 million)

Interagency agreements will be used to fund efforts to establish epidemiological baseline data, research methods of measuring mold, allergen loadings, and moisture in the housing environment, update the "Basic Housing Inspection Manual," originally issued by CDC and the American Public Health Association in the 1970's, and examine new, healthy home energy design methodologies.

Through the National Institute of Building Sciences, an institutional foundation to enable the national code inspection community to evaluate the possibilities for implementing code changes based on children's health will be formed. Currently, no such organizational entity exists. The foundation will develop a report on how code changes in the past have benefited children's safety and health with recommendations for future code changes.

HUD will begin developing model residential housing standards appropriate to Healthy Homes. This will include a review of the existing housing-related codes (e.g., housing, property maintenance, building, fire, electrical, plumbing, and mechanical codes) issued by the major private-sector model code organizations, and adopted (often with variation) by most State and local governments, for their utility in addressing the problems of concern to the Initiative. This review will also cover the "International" model codes now under development. Relevant code provisions will be reviewed for revision or replacement with provisions that better address the housing-related health issues covered by the Initiative. The review reports will be disseminated, and draft revised model code provisions will be developed. Participation by State and local housing code officials and technical experts will be sought for developing and evaluating the proposed model code provisions. The model code organizations will be contacted regarding participation in their model code committees. The first major goal of this participation is inclusion of the proposed provisions into revised model codes; the second is adoption of the revised model code provisions into State and local codes.

3. Interagency Task Force

HUD will also assemble an interagency task force on healthy homes, and co-chair it with CDC. The task force will include the Environmental Protection Agency (EPA), the Consumer Product Safety Commission, Department of Energy, National Institute for Standards and Technology, and other agencies with important roles in this field. This task force will be a forum for exchanging information about accomplishments, and ideas and suggestions for addressing unmet needs. The task force will promote interagency cooperation, help avoid duplication of effort, and encourage creative and efficient use

of Federal resources. It will accomplish its work through face-to-face meetings, telephone conference calls, an Internet-accessible database, and electronic mail exchanges, among other means.

C. Spending Plan for FY 2000

Future funding of the Healthy Homes Initiative will be needed to carry forward the beginning activities described here. The request for the Healthy Homes Initiative in the President's FY 1999 budget was \$25 million; \$10 million was actually appropriated. The Administration's request for FY 1999 is level at \$10 million, which among other things will continue the surveillance project initiated with CDC, continued support for the code enforcement network, and additional demonstration projects in other cities. With a combined \$20 million spread over two fiscal years, most of the originally-conceived Healthy Homes projects can be implemented and evaluated.

If Congress appropriates the Administration's request of \$10 million for FY 2000, HUD will complete the baseline assessment of available techniques and research on high priority issues, and initiate projects to promote implementation of techniques demonstrated to be successful. The funding will shift from that in FY 1999 to increase the portion for demonstration and outreach projects. The major elements of the plan for FY 2000 will extend the activities initiated in FY 1999, so the detailed justifications are not repeated here. These elements include:

- Pilot-testing (through competitively awarded cooperative agreements and interagency agreements) housing assessment, maintenance, renovation and construction techniques to identify and correct housing-related illness and injury risk factors.
- Implementing a public education campaign (through competitively awarded cooperative agreements) to prevent both emerging and well-recognized housing-related diseases and injuries, and promote the use of identified solutions.
- Conducting research (through competitively awarded cooperative agreements and interagency agreements) that evaluates the effectiveness of housing interventions and public education campaigns, and provides the knowledge base for recommending future use of the most cost-effective strategies.
- Participating in housing and building code council activities to develop means of incorporating healthy-homes-appropriate code provisions into the model codes, and evaluating and promoting use of these provisions in State and local codes.
- Continuing to co-chair, with CDC, the interagency task force on healthy homes to exchange information and ideas; an Internet-accessible database on the Initiative's projects and plans will be established.

Appendix A.
Healthy Homes Media Campaign

Appendix B.

Excerpts from House Appropriations Committee Report and Appropriations Act

1. Excerpt from House Appropriations Committee Report

A central goal of the Healthy Homes Initiative is to develop and implement a program of research and demonstration projects that would address multiple housing-related problems affecting the health of children. Examples of childhood illnesses and injuries that are often related to housing conditions include asthma (the prevalence of which has increased dramatically in recent years, with especially high rates among low-income and minority families) and the outbreaks of "bleeding lung" in infants that have been traced to toxic molds.

Because multiple hazards often have common causes (for example, moisture can cause paint failure and lead hazards, as well as mold and mildew, associated with asthma and other diseases), the Healthy homes approach appears superior to addressing these problems one by one. At the same time, designing and implementing cost-effective interventions to multiple housing quality problems is difficult. The Committee requests HUD to submit a plan by January 1, 1999 that inventories the problems to be addressed, describes their intersections, identified key technical questions, and provides a spending plan allocating funds among technical and policy studies, pilot projects, and emergency remediation. In developing this plan, HUD should seek input and advice from experts and researchers, other federal agencies, and experienced local practitioners.

Within the Healthy Homes Initiative, the Committee directs that a minimum of \$4,000,000 be devoted to preventive measures to correct moisture and mold problems in inner-city housing occupied by families with infants in communities where toxic mold exposure has been linked to acute pulmonary hemorrhage and infant death. In addition, as part of the initiative, the Committee also expects HUD to undertake research on moisture and mold prevention through proper ventilation and other means, and to develop and disseminate model standards appropriate to residential housing.

2. Excerpt from Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act of 1999

Title II. Department of Housing and Urban Development.

Office of Lead Hazard Control

For the Lead Hazard Reduction Program, as authorized by sections 1011 and 1053 of the Residential Lead-Based Hazard Reduction Act of 1992, \$80,000,000 to remain available until expended, of which \$2,500,000 shall be for CLEARCorps and \$10,000,000 shall be for a Healthy Homes Initiative, which shall be a program pursuant to sections 501 and 502 of the Housing and Urban Development Act of 1970 that shall include research, studies, testing, and demonstration efforts, including education and outreach concerning lead-based paint poisoning and other housing-related environmental diseases and hazards.

Appendix C

Draft Background Paper for Meeting of Experts

HUD'S Healthy Homes Initiative:

Scientific, Implementation and Programmatic Issues

Background for Peer Reviewer Meeting

December 8, 1998

Introduction

This paper is being provided as background information to outside experts who are being asked to provide comments to HUD on specific issues related to HUD's implementation of the Healthy Homes Initiative. Congressional report language accompanying HUD's FY 99 Appropriations Act states that "a central goal of the Healthy Homes Initiative is to develop and implement a program of research and demonstration projects that would address multiple housing-related problems affecting the health of children.... The Committee requests HUD to submit a plan by January 1, 1999 that inventories the problems to be addressed, describes their intersections, identifies key technical questions, and provides a spending plan. In developing this plan, HUD should seek input and advice from experts and researchers, other federal agencies, and experienced local practitioners." The paper presents a preview and overview of the kinds of information HUD is compiling to assist it in both short and long term planning for the implementation of the Healthy Homes Initiative, together with a list of key issues and questions upon which HUD requests comment. The comments will be considered by HUD as it develops its short term plans and long term strategies for implementation of Healthy Homes.

Background

It has long been recognized that housing quality can have an important impact on public health. While historical efforts to address public health concerns in housing may provide some useful lessons, new approaches are needed to address contemporary problems because of changes in the housing stock, in the relative importance of various public health problems, and in scientific knowledge.

What is the "Healthy Homes" initiative? Briefly, the initiative will consist of a mix of surveys, demonstration projects, policy changes, public education, interagency activities, and research aimed at understanding and reducing health risks to children posed by a range of hazards in the residential environment. By moving from efforts to address health concerns in housing on a hazard-by-hazard basis, the effectiveness and efficiency of such efforts will be greatly enhanced. The program will not necessarily be limited solely to programs funded by the Healthy Homes Initiative. Instead, as experience is gained, HUD will consider the ways of incorporating Healthy Homes approaches into other public and private programs aimed at improving housing quality.

The report language from Congress concerning Healthy Homes is as follows:

"A central goal of the Healthy Homes initiative is to develop and implement a program of research and demonstration projects that would address multiple housing-related problems affecting the health of children. Examples of childhood illnesses and injuries that are often related to housing conditions include asthma (the prevalence of which has increased dramatically in recent years, with especially high rates among low-income and minority families) and the outbreaks of bleeding lungs in infants that have been traced to toxic molds.

"Because multiple hazards often have common causes (for example, moisture can cause paint failure and lead hazards, as well as mold and mildew, associated with asthma and other diseases), the Healthy Homes approach appears superior to addressing these problems one by one. At the same time, designing and implementing cost-effective interventions to multiple housing quality problems is difficult. The Committee requests HUD to submit a plan by January 1, 1999 that inventories the problems to be addressed, describes their intersections, identifies key technical questions, and provides a spending plan allocating funds among technical and policy studies, pilot projects, and emergency remediation. In developing this plan, HUD should seek input and advice from experts and researchers, other federal agencies, and experienced local practitioners.

"Within the [\$10 million] Healthy Homes Initiative, the Committee directs that a minimum of \$4 million be devoted to preventive measures to correct moisture and mold problems in inner-city housing occupied by families with infants in communities where toxic mold exposure has been linked to acute pulmonary hemorrhage and infant death. In addition, as part of the initiative, the Committee also expects HUD to undertake research on moisture and mold prevention through proper ventilation and other means, and to develop and disseminate model standards appropriate to residential housing.

In its budget justification, HUD indicated that Healthy Homes funds would be awarded to entities that could implement and evaluate housing-based interventions that are likely to combat more than one childhood environmental disease or child safety hazard at a time. HUD is most interested in funding investigations into low-cost interventions in existing low-income housing, so that the lessons learned can be implemented as broadly as possible while still targeted to those at greatest risk. A central issue in the construction of the Healthy Homes Initiative will be how to balance the large number of issues that could conceivably fit under the umbrella of Healthy Homes with the need to build intervention protocols that focus attention on a manageable number of housing-related hazards that could reasonably be expected to be treated and understood in a single programmatic initiative.

The Impact of Housing on Health

Overall approach

To identify priority concerns for its Healthy Homes initiative HUD plans to take into account a number of factors relating to a given housing-related health hazard. These include: the relative strength of scientific evidence for a causal relation of the hazard to health; the estimated prevalence of the hazard and burden of associated illness or injury; the availability of practical,

valid, low-cost and reliable methods and protocols for assessing the hazard; and the strength of scientific evidence to support practical, safe interventions that reduce or eliminate the hazard. In its fully developed strategy, HUD will attempt to present a review of this kind of information related to each potential housing-related health concern. In the rest of this section, HUD provides an overview of the types of housing related hazards and health concerns for which information is being compiled.

General Housing quality and health

Historically in the United States and currently in many developing countries the main health related housing concerns relate to protection from the elements and transmission of communicable diseases (ref. WHO). Provision of safe water for drinking and personal hygiene, proper disposal of sewage, facilities for safe food preparation, and the absence of overcrowding are examples of how adequate housing can promote public health. Protection of occupants against temperature extremes and other natural hazards are also basic requirements of safe housing. The American Housing Survey documents the prevalence of basic housing deficiencies, such as adequate plumbing and sanitary facilities.

In addition, general markers of housing quality have been associated with health outcomes that are not obviously related to specific communicable diseases or other environmental hazards. Such linkages may be explained, in part, by the relation of housing quality to psychosocial stress and child development, which may, in turn, affect physical health. In developing plans for a Healthy Homes initiative HUD will consider scientific evidence on the relation of general housing conditions to health.

Specified housing-related hazards and health concerns

In addition to deficiencies in basic housing facilities that may impact health, changes in the U.S. housing stock and more sophisticated methods of epidemiology and biomedical research have led to the identification of new and often more subtle health hazards in the residential environment. While such hazards will tend to be found disproportionately in housing that is substandard in other respects (e.g. structural problems, lack of adequate heat, etc.), such housing-related environmental hazards may also exist in housing that is otherwise of good quality. HUD will, therefore, also compile and review available evidence on specific housing-associated health and injury hazards. The next section briefly describes the kinds of housing-associated health and injury hazards being considered by HUD.

Lead: Exposure to lead, especially that derived from deteriorating lead-based paint, remains one of the most important and best-studied household environmental hazard for children. Although blood lead levels have fallen nationally, a large reservoir of lead remains in housing and hundreds of thousands of U.S. preschoolers still have elevated blood lead levels. Well-defined protocols exist to assess the risk of lead exposure in housing. Data exists on the effectiveness and costs of various measures to reduce exposure to lead in the residential environment [Evaluation of the HUD Lead-Based Paint Grant Program, 1998].

Allergens and asthma For sensitized children, exposure to antigens from dust mites, certain pets,

and cockroaches has been associated with more severe asthma. Some evidence also indicates that exposure to antigens in early life may predispose to or hasten the onset of allergies and perhaps asthma. Techniques exist for measuring antigen levels in household dust, but protocols, action thresholds, and the infrastructure to support widespread testing and remediation is not yet present. Some data support the effectiveness of environmental interventions to reduce asthma severity; only limited data are available on the primary prevention effect of reducing early exposures to household antigen. Some suggest there may be common antecedents to lead poisoning and asthma.

Mold: Animal models demonstrate that exposure to atratoxins produced by *Stachybotrys* fungi have the potential to produce inflammation and injury in gastrointestinal and pulmonary tissues. An investigation of a cluster of pulmonary hemosiderosis (PH) cases in infants showed PH was associated with a history of recent water damage to homes and with levels of *Stachybotrys atra* (SA) in air and in cultured surface samples. Associations between exposure to SA and "sick building" like symptoms in adults have also been observed. Other related toxigenic fungi have been found in association with SA-associated illness and could play a role. For sensitive individuals, exposure to molds may also aggravate asthma.

Insect pests: The observed association between exposure to cockroach antigen and asthma severity has already been noted. In addition, cockroaches may act as vehicles to contaminate environmental surfaces with certain pathogenic organisms and toxic substances.

Rodent pests: Rodents can transmit a number of communicable diseases to humans, either through bites or exposure to aerosolized excreta. In addition, humans can become sensitized to proteins in rodent urine, dander, and saliva. Such sensitization may contribute to asthma severity among inner city children.

Pesticide residues: Animal models have demonstrated that exposure to chlorpyrifos (CP), a commonly used organophosphate insecticide in the prenatal and early postnatal period may impair neurodevelopment. While CP is a biodegradable pesticide, substantial persistence of CP in house dust has been demonstrated.

Other indoor toxics: A variety of chemicals volatilized from building materials, cleaning products, and other consumer products may be contaminate indoor air. Formaldehyde, for example, may be released from newly installed carpet. It is a respiratory irritant and potential sensitizer and carcinogen. Although not used indoors, lawn chemicals may also be associated with adverse health outcomes, through track-in and contamination of the indoor environment and/or through direct exposure in exterior play areas.

Environmental tobacco smoke Environmental tobacco smoke is a carcinogen and respiratory irritant. ETS can aggravate asthma and pulmonary hemosiderosis, especially in children. In addition, Children exposed to ETS suffer more respiratory illnesses than other children and have decrements in pulmonary function.

Combustion products of heating and cooking devices: Burning of oil, natural gas, kerosene, and wood for heating or cooking purposes can release a variety of combustion products of health concern. Depending upon the fuel, these may include carbon monoxide (a chemical asphyxiant), oxides of nitrogen (respiratory irritants), benzopyrene (a carcinogen), and airborne particulate matter (respiratory irritants). Improper venting and poor maintenance of heating systems and cooking devices can dramatically increase exposure to combustion products.

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Asbestos: Asbestos was also shown to be a human carcinogen in studies of heavily exposed workers. As with radon, dose-response extrapolations suggest that lower level exposures, as may occur when asbestos-containing building materials deteriorate or are disturbed, may also cause cancer.

Take home hazards from work/ hobbies and work at home: When the clothing, hair, skin, or shoes of workers become contaminated with hazardous materials in the workplace, such contaminants may inadvertently be carried to the home environment and/or an automobile. Such "take-home" exposures have been demonstrated, for example, in homes of lead-exposed workers. In addition, certain hobbies or workplaces located in the home may provide an especially great risk of household contamination.

Unintentional injuries/ fire: In 1997, nearly 7 million persons in the United States were disabled for at least 1 full day by unintentional injuries received at home. During the same year, 28,400 deaths were attributable to unintentional home injuries, of which 1800 occurred among children 0-4 years of age. Among young children, three types of events accounted for more than 3/4 of deaths: fires/ burns, drownings, and mechanical suffocation.

The intersection/ overlap of hazards

A central premise of the 'Healthy Homes' concept is that multiple housing-associated health hazards may co-exist in the same dwelling. In fact, a number of hazards share common underlying causes so it is likely that they will co-exist more frequently than would occur by chance. For example, excess moisture in building materials may predispose to growth of mold, deterioration of leaded paint, and insect infestation. Cockroach infestation with attendant contamination of the dwelling by sensitizing antigen may lead to treatment and potential contamination of a residence with toxic pesticides. A few housing deficiencies and their association with childhood disease and injury outcome are shown in Table 1.

Table 1. A Beginning List of Housing/Childhood Disease Intersections

	Paint Condition	Roof/Envelope /Plumbing Leaks Structural Gaps	Inadequate exhaust ventilation	Lack of Cleanable Surfaces	Inadequate Drainage	Broken Windows/Other Structural Defects	Inadequate Early Warning Alarms	Behavior/housekeeping (Should this be listed?)	Hobbies	Egress	Improper renovation	More
Lead Poisoning	x	x	x	x	x	x		x	x		x	
Allergens/As thma		x	x	x	x	x		x	x		x	
Toxicogenic Mold		x	x	x	x	x		x			x	
Insect Pests		x		x	x							
Rodent Pests		x		x	x							
Pesticide Exposure			x	x				x	x		x	
Env Tobacco Smoke			x					x	x			
Carbon monoxide poisoning		x	x			x	x			x	x	
Respiratory irritants		x	x		x			x		x	x	
Radon exposure		x	x			x					x	
Asbestos											x	
Paraoccupati onal exposures												
Injury		x	x		x	x			x	x	x	
Fire		x	x				x		x	x	x	
More												

Existing infrastructure

A large number of programs, codes, and regulations exist which have the potential to influence changes in the environmental conditions in housing. The potential exists, therefore, to incorporate knowledge, approaches, and technical tools developed in a Healthy Homes initiative into such existing infrastructure. HUD is reviewing such infrastructure to identify opportunities to test and implement Healthy Homes approaches in the context of existing activities. Examples of this infrastructure are briefly discussed below.

Categorical programs:The potential exists to use the assets, trained personnel, and other resources of categorical programs individual health hazards or other problems in housing to address a broader range of hazards. Such programs include childhood lead poisoning prevention programs and lead hazard reduction programs funded by grants from HUD. Rat control programs would be another example of categorical programs to address housing related health hazards. Weatherization and rehab programs, while not focused on health concerns per se, also involve activities with the potential to change environmental conditions in housing, such as moisture content.

Building and housing codesAmong the important functions of building and housing codes is to ensure that building structures and systems are safe for occupants. Health hazards addressed by building and housing codes tend to focus on issues related to structural soundness, fire and electrical hazards, and sanitation. Notable exceptions exist in some jurisdictions concerning, for example, lead paint hazards. Where clear design standards can be developed, the potential exists to address a wider range of health hazards through building and housing codes.

Financing:The manifold sources of financing for public and private housing, including public housing and rental subsidies, community development block grants, job development programs, economic development programs, insurance underwriting standards, and mortgage loans sometimes include requirements for inspections, repairs, or other measures to ensure certain structural or environmental problems are addressed. The potential, therefore, exists to incorporate Healthy Homes principles into financing provisions.

Maintenance: Operations and maintenance programs exist in larger multifamily housing developments and can be modified to ensure that routine maintenance operations do not create new hazards or leave existing hazards uncorrected.

Surveillance and information systemsThe development and monitoring of programs to improve the environmental conditions in housing and the setting of priorities for research requires data for determining the relative prevalence and distribution of health hazards in housing. A variety existing activities include measures of housing condition and specific hazards, either by direct observation (such as the American Housing Survey), or by occupant report (such as the Health Interview Survey). HUD is compiling information about relevant existing activities and identifying critical information gaps.

Key issues and questions for reviewers

The following sections provide a more detailed set of questions and an outline presenting overall implementation. In brief, the main questions for peer reviewers and outside experts are as follows:

Scientific issues

1. For the housing-related hazards discussed above, HUD is seeking information related to : the strength of scientific evidence for a causal relation of the hazard to health; the estimated prevalence of the hazard and burden of associated illness or injury; the availability of practical, valid, and reliable methods and protocols for assessing the hazard; the strength of scientific evidence to support practical, safe interventions that reduce or eliminate the hazard.
2. Based upon these considerations, which of the hazards are high priority public health problems?
3. Are other significant concerns omitted from HUD's list?
4. What are priority research questions concerning these or other housing-associated hazards?

Implementation issues

5. Addressing environmental hazards in housing often requires attending to community level problems. How should healthy homes activities relate to community-level hazards?
6. What kinds activities should HUD HHI support?
7. What would be feasible and reliable measures of success or failure?
8. How should HUD balance the breadth of the HHI with the need to retain programmatic focus?

Implementation Methods

- A. The 1998 HUD Appropriations Act calls for HUD to develop a strategic plan for the Healthy Homes Initiative (HHI) for submission to Congress. HUD plans to deliver a draft plan to Congress by January 1, 1999, with periodic updates as the program takes shape and as new lessons are learned.
1. Developing the HHI strategic plan:
 - a. Participation by peer reviewers in developing strategic plan:
 - i. Responding to draft question set.
 - ii. Discussing questions and related issues in facilitated group, December 8-9, 1998, to provide well-founded individual recommendations, identify subjects and approaches on which general professional consensus exists, and those on which significant divergence of opinion exists.
 - iii. Commenting on draft strategic plan. Based on the information provided by peer reviewers, and additional information collected from internal and external resources, HUD will prepare a draft strategic plan and provide it to peer reviewers for comment.
 - b. Role of HUD staff:
 - i. Drafting strategic plan.
 - (a) With assistance from others, such as the peer reviewers and other Government agencies, as needed, HUD staff will draft the strategic plan and present it to Congress, and then implement the plan.
 - (b) Spending plan element of the strategic plan: HUD will use information provided by the peer reviewers, and additional information collected from internal and external resources, to develop a spending plan as part of its strategic plan. Because developing this spending plan is an inherently Governmental function, HUD will not be asking the peer reviewers for spending recommendations, either in amounts or for specific projects.
 - ii. HUD will implement the strategic plan, through efforts of HUD staff, other governmental agencies, and the private sector.

B. Methods for implementing HHI:

1. Staff activities: The HUD Office of Lead Hazard Control (OLHC) is the organizational focal point for implementing HHI activities under HUD's FY1999 Appropriations law. OLHC staff include technical professionals (including 4 with doctorates; 3 staff are certified industrial hygienists, 1 a professional engineer, 2? environmental policy analysts, 2(?) are urban planners, 1 an architect and 1 a sanitarian) with considerable managerial experience, an outreach specialist, Government Technical Representatives for managing contracts, and budget and grant officials. OLHC will work on HHI in cooperation with other HUD offices, including the Office of Public Affairs, and with the Office of Policy Development and Research, the Office of Procurement and Contracts, and other offices.
2. Grants: The Office of Lead Hazard Control is empowered to award grants to non-Federal entities to implement HHI. These are generally awarded competitively through Notices of Funds Availability (NOFAs; HUD's term for requests for proposals) which appear in the Federal Register (and on HUD's Web site, www.hud.gov), and have formal scoring and awarding processes. In some cases, grants may be issued noncompetitively, such as when the Congress has specified a recipient for a certain activity.
3. Contracts and Interagency Agreements: The Office of Lead Hazard Control and the Office of Procurement and Contracts cooperate to award contracts to non-Federal entities, and interagency agreements with Federal agencies. Contracts are awarded competitively, with notice in the Commerce Business Daily (and on HUD's Web site).

II. Key Contextual Issues

- A. Rationales for multiple-focus and single-focus programs: In considering the topics below, peer reviewers should incorporate their assessment of the strength of the data in their respective fields of expertise and interest with respect to the legislative language emphasizing multiple-cause interventions. HUD recognizes that not every condition can be addressed in combination with all others, and that some programs are best implemented with single-focused efforts. In particular, with respect to the scope and approach for HHI, HUD asks that you address the degree to which there are sufficient data to develop solidly-founded efficient multiple-cause programs, or identify program categories where such approaches are premature because of insufficient data, contradictory findings, or confusion that would result from mixing multiple conceptual and/or organizational models. This balancing of multiple-focus and single-focus programs will enable HUD to prioritize the components of its strategic plan.
- B. Congress intends for HUD to obtain field-demonstration results in the near term. HUD believes that HHI's major efforts should apply well-understood techniques rather than be focused on advancing basic science, engineering or medical research. Applied research, such as innovative field demonstrations of *well-understood techniques* in novel combinations, with generalizable evaluations, is appropriate.

- C. *HHI should be focused on primarily on health issues, with safety and environmental issues as adjuncts.* HHI should avoid duplicating existing safety or environmental programs, particularly for those subjects which are well-understood. For example, home fire protection or injury avoidance methods could be integrated into HHI demonstration projects, but not be primary foci of research projects.
- D. HHI should address mitigation implementation as well as identifying causes of adverse conditions. Demonstration projects should, as appropriate, incorporate knowledge of building systems and occupant behavior, and applicable laws, regulations, codes, and consensus guidance.
- E. HHI should include formal effectiveness evaluation throughout its research and demonstration projects. These evaluations should clearly demonstrate their methodological reliability and, where feasible, be performed by entities independent of those performing the projects.

III. Existing Infrastructure.

- A. Codes and regulations.
 - 1. Highlight codes that are particularly relevant.
 - a. Housing codes.
 - b. Building codes.
 - c. Sanitation.
 - d. Health.
 - d. Environment.
 - e. Additional.
 - 2. Compliance assistance and enforcement patterns:
 - a. Functional limitations arising from existing code structures and agency missions.
 - b. Resource limitations arising from resource allocation and usage.
 - c. Strategies for improving compliance.
 - d. Consideration of incorporating healthy home orientation into codes and implementation programs.
- B. Health and safety programs with residential interventions (under each include a summary of the problem, basic intervention methods, major research issues, major program implementation strengths and limitations):

1. Lead poisoning prevention (e.g., dust, paint, soil, water).
 2. Environmental allergens and other asthma triggers.
 3. Pest control (e.g., insects, rodents; pesticide usage, integrated pest management).
 4. Unintentional injury prevention (e.g., falling, electricity, water).
 5. Fire protection (e.g., smoke alarms, exiting, combustibles storage control).
 6. Additional programs.
4. Housing-based programs (summary for each, the problem, basic intervention methods, major research issues, major program implementation strengths and limitations):
- a. Repair and maintenance (routine activities, typically performed by occupants or landlords).
 - b. Weatherization (e.g., thermal envelope protection, moisture protection).
 - c. Energy conservation (e.g., operational elements, appliances, heating/ventilation/cooling systems).
 - d. Renovation and remodeling (larger building changes).
 - e. Additional programs.
5. Existing programs with a healthy homes theme:
- a. Identify research programs of particular relevance to HHI.
 - b. Identify existing healthy homes-oriented demonstration or implementation projects (see attachment for some such programs; peer reviewers are invited to provide more).
 - c. Identify lessons that can be learned from existing programs, e.g., how well organized are these programs? what are their funding structures? how do they reflect the needs and participation of target groups?

IV. Key Issues and Questions for Implementation of HUD HHI

A. *As noted in section II.A, above, as you consider priorities for the Healthy Homes Initiative, please provide your assessment of the strength of the data in your field of interest on the role of single-cause and multiple-cause intervention programs.*

1. Cost-effectiveness of multiple-focus vs. single-focus evaluation and intervention programs. For what conditions/hazards is there sufficient evidence to implement intervention programs?
 - a. Use of epidemiological data for prioritizing foci.

- b. Use of social cost/benefit data and individual cost/benefit data for prioritizing foci.
 - i. Baseline health and safety costs.
 - ii. Costs, benefits and risks of optimizing programs to address a single factor efficiently, and of implementing such programs in coordination with each other.
 - iii. Costs, benefits and risks of developing multiple-factor programs.
 - c. Consideration of opportunity costs, e.g.:
 - i. Lost opportunity costs of single-focus strategies, e.g., adverse effects of deferral of addressing problems until after those initially addressed.
 - ii. Increased program development and implementation time and costs, and complexity-related failure risks, of multiple-focus strategies.
2. Selection of target groups: populations of people, housing, communities:
- a. What segments of the housing market should be addressed, and with what priorities? While the HHI legislation does not restrict its scope, HUD's policy is to prioritize efforts towards those who have fewer resources to address problems.
 - b. Program efficiency and effectiveness for single-focus strategies, vs. efficiency and effectiveness for coverage of broader populations with, on the whole, lesser or less-intense conditions.
 - c. Balance of focus on individual people and their homes, vs. communities as a whole: Allocation of effort within limited resources.
- B. Balance of HHI activities:
- 1. How should HUD's efforts be apportioned among such activities as:
 - a. Demonstration/evaluation projects to test implementation models? Are there key elements to include in all demonstration projects?
 - b. Surveillance of housing related health and safety problems?
 - c. Basic etiologic research?
 - d. Basic research on building conditions and environmental hazards?
 - 2. What results measures (not just output measures) should be assessed in evaluating controlled intervention trials, and with what emphasis?

- a. Epidemiologic results (e.g., illness, injury, biological markers).
- b. Economic results (e.g., healthcare costs and event/severity, housing value, energy consumption).
- c. Sociological results (e.g., occupant awareness of healthy homes issues, behavioral changes by occupants, landlords, property professionals).
- d. Additional results

D. Leveraging Resources: How should resources and expertise of other entities be leveraged or otherwise involved in the HHI?

- 1. Federal agencies.
- 2. State, local and Tribal agencies.
- 3. Private sector (for-profits / non-profits / unincorporated community groups).

v. **HUD Strategy**

A. Short term (1 year)

- 1. Identifying different approaches for different segments of the housing market
- 2. Investigative & control protocol development and evaluation
- 3. Community involvement
- 4. Public education, outreach, and training
- 5. Maintaining thematic focus

B. Medium term (1-3 years)

- 1. Identifying different approaches for different segments of the housing market
- 2. Investigative & control protocol development and evaluation
- 3. Community involvement
- 4. Public education, outreach, and training
- 5. Maintaining thematic focus

Appendix

This section provides summary abstracts of existing intervention programs and research efforts that are of particular relevance for the HUD Healthy Homes initiative. This is not intended to be a complete review of ongoing activities, rather it provides examples of selected projects that could provide valuable input into both the development of HUD's initial strategy and, with respect to research, future refinement of the strategy. Section I reviews selected programs with housing-based interventions, Section II lists programs with an education/outreach focus, and Section III lists some ongoing research activities.

I. Environmental Health Programs With Housing-Based Interventions

1) Healthy Neighborhoods Program (HNP)

Implementing organization: New York State Department of Health

Funding: Federal block grant

The New York State Department of Health developed the Healthy Neighborhoods Program (HNP) in 1992, in response to the Healthy People 2000 report. Four health risks were targeted for prevention: lead poisoning, home carbon monoxide poisoning, childhood hospitalizations for asthma, and burns and fire deaths. The Healthy People 2000 objectives include: reducing the prevalence of blood lead levels exceeding 25 µg/dL to zero among children age 6 months to 5 years; establishing and monitoring plans to track carbon monoxide poisoning; reducing asthma morbidity to no more than 160 hospitalizations per 100,000 people, and reducing residential fire deaths to no more than 1.2 per 100,000 people.

Current program participants include eight local health departments, other divisions of local/county government, state agencies, community agencies, and private industry. The program is funded with an allocation from a federal (HHS) block grant at approximately \$1.3 million/year. Participants are required to employ methods that demonstrate a substantive community involvement in the development and implementation of the program. To date, the HNP has developed two general types of preventative programs. One is door to door outreach which includes the identification of hazards in the home, educational

outreach, the distribution of materials (e.g., smoke detectors, lead cleaning kits), and the providing of network services. The second type of preventative program is a referral system, through which inspectors can refer cases to the Housing Code to correct environmental deficiencies, identify children at risk for lead paint poisoning, and/or refer residents for other preventative health services.

Thus far, HNP has completed 6,341 home safety checks of which 3,665 households have received primary prevention. Of the 27% of homes that had lead paint hazards upon an initial visit, only 9% still had the hazards upon random revisits. Available data will be used to quantify the program's impact with respect to reducing children's blood-lead levels and asthma morbidity.

Potential HUD Applications: successful interventions, essential program elements, establishing a network of participants

2) Seattle Healthy Homes (SHH)

Implementing organization: Seattle-King County Department of Public Health

Funding: National Institute of Environmental Health Sciences (NIEHS)

SHH began in September 1998 with an enrollment of 400 low-income households with asthmatic children. Funding was obtained through a grant from the NIEHS. The goal of the program is to improve the home environments of children with asthma by reducing indoor exposures to asthma triggers and toxins such as lead, pesticides, and volatile organics. SHH uses paraprofessional Community Home Environmental Specialists (CHES) and trained community volunteer Master Home Environmentalists (MHE) to conduct initial home environmental assessments and to work with participants to carry out selected interventions. Detailed protocols have been developed to assess exposure, provide education on exposure reduction, distribute materials needed to reduce exposures, and provide referrals for assistance in reducing exposures. Protocols specifically address the following agents and topics: dust mites, cockroaches, rodents, moisture and mold, environmental tobacco smoke, lead, pets, household toxins, reducing dust exposure, and landlord-tenant relations.

An eligible household is any that has a child, 4 to 12 years of age, who has had a hospital or emergency department discharge for asthma in the past six

months or an outpatient visit in the past year, meets the criteria for mild, persistent to severe asthma, lives in “project-targeted” housing, has an income less than 200% poverty, and spends at least 50% of nights in the particular household.

CHES and MHE volunteers conduct initial home environmental assessments of each household using a detailed questionnaire, the results of which are used to develop an action plan specific for each household. A computerized tracking system identifies intervention options and tracks progress towards addressing hazards. CHES also offer educational and social support to encourage behavior changes and provide materials (vacuums, bedding encasements, door mats, and cleaning supplies) needed to implement chosen interventions. Each household receives a total of nine visits over twelve months.

The evaluation of program effectiveness will use data collected by a questionnaire designed to measure the knowledge of environmental risks for asthma, self-protective behaviors, indoor environmental quality, asthma-related status, and health services utilization. Measures of stress and social support are also included. Spirometry is being used to assess changes in pulmonary function. A cost-effectiveness analysis is also being conducted from the perspectives of participants, the health system, and the community.

The project is overseen by a steering committee with representatives from low-income tenants, community agencies, community clinics and hospitals, environmental justice organizations, the local health department, the CDC-sponsored Seattle Urban Research Center, and the University of Washington. In addition, an advisory group of parents of asthmatic children in the target population was created to provide guidance on project implementation.

Potential HUD Applications: Using trained outreach workers from the target community; successful intervention strategies; critical program elements; establishing community partnerships; evaluation methods.

3) ZAP Asthma Program

Implementing organization: ZAP Asthma Consortium

Funding: multiple public and private sector sources

The ZAP Asthma program, initiated in June 1998, is a three year community-based prevention program that targets children residing in a nine square mile inner-city area of Atlanta with a high prevalence of childhood asthma. Participants include the CDC, EPA, Rollins School of Public Health, the American Association of Health Plans, other health organizations and academic institutions in the city of Atlanta, as well as local businesses, government officials, and the inner-city community. The majority of program funding comes from seven participating Atlanta HMOs and several pharmaceutical companies.

The ZAP program's quantitative goals are to: decrease the exposure of children with asthma to known environmental risk factors; decrease asthma morbidity in children by decreasing asthma-symptom severity and duration; evaluate the effectiveness of community-base health education and prevention programs in reducing the use of health care services, emergency department visits, and hospital admissions; and evaluate the effectiveness of a community-base health worker training program in asthma intervention, education, and prevention.

Twelve Community Health Workers (CHW) are the core of the program, and serve as the bridge between the health care system and the 400 children, 5-12 years of age, who are enrolled in this program. The CHWs are recruited from the program target area, and receive a six month training course designed by the CDC. The CHWs provide information to families on asthma and the resources that are available to them, and encourage families to follow a medically prescribed disease management regimen for their children. The CHWs can also advise families on how to decrease and control environmental agents that trigger asthma symptoms. The ZAP program also provides participants with a personalized clinical regimen for each child by a physician, household cleaning services, smoking-cessation programs for teens and adults, roach eradication efforts, and mite pads for bedding. Each child participating in the program is enrolled for at least one year and undergoes a baseline survey, regular home audits, and health screenings. Two sources are being used to measure the impact of the intervention: chart reviews and hospital billing data. Chart reviews include tracking the number of emergency room visits, lost days from school, and costs associated with lost days from work.

The cities of Detroit and Chicago are now in the process of forming programs similar to ZAP Asthma.

Potential HUD Applications: Using trained outreach workers from the target community; successful home-based interventions for asthma (e.g., specialized cleaning, mattress covers); leveraging resources through public/private partnerships; evaluation methods.

4) HUD Lead Hazard Control Grant Program

Implementing organization: Numerous state and local government grantees

Funding: U.S. Department of Housing and Urban Development (HUD)

The program provides grants of \$1-4 million to State and local governments for control of lead-based paint hazards in privately-owned, low income housing. Since 1993, six rounds of lead hazard control grants have been awarded, providing \$436 million to 107 grantees in 31 States, in addition to the District of Columbia. The work approved to date will lead to the control of lead hazards in more than 50,000 homes where young children live.

Homes selected for treatment under the program must have been constructed prior to 1978, and contain lead-based paint hazards, which may include lead-contaminated dust or soil. Each home also must be privately owned by or rented to families.

In addition to hazard control, grant funds can be used for blood testing in young children, inspection and testing of homes for lead-based paint and other lead hazards, temporary relocation of families during hazard control, community education and outreach, and data collection, analysis, and evaluation.

The National Center for Lead-Safe Housing is conducting a longitudinal evaluation of the Lead Hazard Control Grant Program (beginning in 1996), to determine the most cost-effective type of intervention. A final report will be completed in 2000.

Potential HUD Applications: necessary program elements; successful interim control methods; evaluation methods.

5) Toxicogenic Fungi Abatement Program

Implementing organization: Cuyahoga County (Ohio) Board of Health

Funding: local government, non-profit organizations, homeowners

The ultimate goal of this program is the prevention of pulmonary hemosiderosis in infants, which has been correlated with exposure to toxigenic fungi, in particular *Stachybotrys chartarum*, in residential housing. This program originated in response to a cluster of cases of infants with pulmonary hemorrhage that occurred in the Cleveland area from 1993 to 1996. Intervention efforts focus on the identification and mitigation of moisture intrusion into the home and the removal of molded and water-damaged components. Typical repairs include the removal and replacement of water-damaged wood and plaster or drywall, repair of kitchen and bathroom plumbing, gutter replacement, and repair of the HVAC system. To date, interventions have been conducted in ten units with per unit costs ranging from \$500 to \$5,000. Intervention costs are covered by funds from local government, home owners, and non-profit groups.

A two-page checklist is used to conduct the initial assessment of a dwelling.

Potential HUD Applications: moisture control techniques; assessing moisture problems.

II. Selected Education-Based Programs

1) Child Health Champion Campaign

Implementing organization: various

Funding: US Environmental Protection Agency (EPA)

This educational program was initiated by the EPA in response to President Clinton's Executive Order on childhood environmental health. Eleven communities have been chosen to pilot this program designed to empower local citizens and communities to take voluntary steps toward protecting their children from environmental health threats. Issues to be addressed include lead poisoning, allergens and asthma, healthy living, and safe homes. Goals of the program include determining what information communities need, how to best convey information, identify additional help communities need to sustain efforts,

and identify strategies that are effective in different kinds of communities. In each of the pilot communities, a team will be established which includes participants from the health care, education, government, citizens, business/agriculture groups, and housing-related sectors of the area. The teams will identify local children's environmental health issues from data such as hospital admissions and school absenteeism, set community-specific goals to protect children, and develop an action plan to achieve those goals.

The results from the eleven sites will be used to develop future plans for a national campaign. Funding is being provided by EPA and is estimated to be approximately \$35,000 for each pilot program in FY98.

2) Risk Watch

Implementing organization: participating schools

Funding: The National Fire Protection Association

Lowe's Home Safety Council

Risk Watch is a comprehensive school-based injury prevention curriculum aimed at the major risk areas that affect children in preschool through grade 8. The program hopes to create safer homes and communities for these children and their families by giving them information and support to make positive choices about their personal safety and well-being.

The program uses an experiential approach to learning. Students are actively involved in activities like creating a safety trade show and role-playing to encourage and brainstorm strategic solutions. The program is presented in five stages that correspond with different age levels. Teachers are provided with concise technical information for each risk area through a Risk Watch lesson book. Additionally, a Risk Watch video is provided. The program is expected to be ready for national use in early 1998.

3) National Asthma Education and Prevention Program (NAEPP)

Organization: National Heart Lung and Blood Institute (HLBI)

The NAEPP was initiated in March 1989 in response to growing chronic problem of asthma in the U.S. The goals of the program are to raise awareness of patients, health professionals, and the public that asthma is a serious chronic disease, to ensure the recognition of the symptoms of asthma by patients, families, and the public and the appropriate diagnosis by health professionals, and to ensure effective control of asthma by encouraging a partnership among patients, physicians, and others through modern treatment and education programs. Thus far, NAEPP has developed and distributed the *Expert Panel Report: Guidelines for the Diagnosis and Management of Asthma* which changed the common perceptions about asthma and its treatment. In 1992, the NAEPP sponsored the First National Conference on Asthma Management to encourage implementation of the recommendations from this report. Various additional documents, educational brochures, and media campaigns have been developed for target audiences such as emergency department personnel, pregnant women, the elderly, pharmacists, children, and specific high-risk ethnic groups.

4) Safe Kids Campaign

The National SAFE KIDS Campaign, chaired by Vice President Al Gore, is the only national organization dedicated solely to the prevention of unintentional childhood injury, the number one killer of children ages 14 and under. More than 200 State and local SAFE KIDS Coalitions in all 50 states, the District of Columbia, and Puerto Rico comprise the Campaign. Issues addressed include poisonings, falls, unintentional firearm injury, toy injury, airway obstruction injury, burns, residential fires, and drowning. The Campaign hopes to decrease preventable injuries through public awareness and education programs, safety device distribution, research, grassroots partnerships, and enactment and enforcement of laws.

III. Research Relevant to Housing-Based Interventions

1) Centers for Children's Environmental Health and Disease Prevention Research

Implementing organization: Various nonprofit grant recipients

Funding: EPA

As part of President Clinton's Executive Order on children's health in April 1997, \$10.6 million was allocated by the EPA for the establishment of eight centers to conduct research on children's environmental health issues. The overall goal of this program is to identify relevant environmental exposures, intervene to reduce those exposures, and ultimately decrease the prevalence, morbidity, and mortality of environmentally related childhood diseases, including asthma. The research to be conducted at each of the centers includes both basic research and applied field research assessing the effectiveness of specific intervention strategies.

The eight grantees and their areas of focus include the following: University of California Berkeley: \$1.18 million to examine the impact of pesticides in California's Salinas Valley on children's growth and development; University of Washington and the Seattle Department of Health: \$1.35 million to conduct research on children's vulnerability to pesticides in Yakima Valley; New York's Mt. Sinai School of Medicine, in collaboration with East Harlem Community Health Committee and the Boriken Neighborhood Health Center: \$1.4 million to research the developmental effects among inner-city children resulting from exposures to pollutants that occur in their diets and homes; University of California-Los Angeles School of Medicine: \$1.35 million to investigate the relationship between second-hand smoke, air pollution, and indoor allergens to the development of childhood asthma; Johns Hopkins University Children's Center, Columbia University School of Public Health, and the University of Michigan School of Public Health received \$1.31, \$1.48, and \$1.3 million, respectively, to investigate the relationship between environmental pollutants and the incidence of asthma in inner cities; University of Iowa College of Medicine received \$1.21 million to study respiratory illnesses in children from rural communities.

2) Environmental Intervention of the Primary Prevention of Asthma in Children

Implementing organizations: to be implemented

Funding: NIEHS, NIAID

The goal of this study will be to develop primary prevention strategies for asthma based on the hypothesis that reducing exposure to common indoor environmental allergens (including those from dust mites and cockroaches) during infancy and early childhood will prevent sensitization to allergens and will reduce asthma prevalence. The study will be designed as a two-phase clinical trial aimed at the primary prevention of asthma in low-income, at-risk children.

A pilot phase of the program has already begun to assess indoor allergen reduction and control strategies in the homes of inner-city residents and is being conducted in conjunction with NIEHS/NIAID Inner City Asthma Study (ICAS), a secondary asthma prevention program. The main phase of the study will be a six-year, randomized, controlled clinical trial. It will assess the effectiveness of allergen avoidance programs developed in the pilot phase. Ultimately, this study will provide information about the efficacy of environmental intervention in the primary prevention of asthma in low-income children and about various indoor allergen control tactics.

3) The Inner City Asthma Study (ICAS)

Implementing organizations: various nonprofit research organizations

Funding: NIEHS/NIAID

This study is a randomized, controlled trial of two interventions hypothesized to reduce morbidity among underserved, inner-city children, ages 4 to 12 years, with moderate-to-severe asthma. The first objective of this study is environmental control intervention, which involves developing, implementing, and evaluating a culturally-appropriate, comprehensive, and cost-effective program aimed at reducing asthma morbidity by modifying those potentially reversible factors, such as allergens and environmental tobacco smoke. The second objective involves clinician feedback intervention, which includes monitoring a child's asthma and providing feedback to his or her primary care physician with the goal of enhancing asthma therapy. The core protocol includes the following elements: medical treatment for asthma delivered in a health care facility, self-management by asthmatics and their families, and indoor environmental interventions including studies to measure, monitor, and improve exposure. About 144 children will be involved at each of seven sites (Boston, Manhattan, Bronx, Chicago, Dallas, Tucson, and Seattle) for a study-wide total of 1,008 children.

The environmental intervention will include both education and direct

remediation. Remediation involves dusting and vacuuming all rooms and upholstery with a HEPA vacuum cleaner, encasing the affected child's bedding with impermeable covers, improving the ventilation of the home, and elimination of other environmental triggers such as pets and cigarettes. This cleaning will be done every 3 months for 4 visits by the ICAS teams. Additionally, professional cockroach extermination services, remediation of moisture in the home, and rodent control will be done for those children sensitive to these respective agents. Follow-up evaluations will be done at 6, 12, 18, and 24 months after study entry to assess the impact of intervention during and after the completion of the study.

4) National Survey of Lead and Allergens in House Dust

Implementing organization: contractor

Funding: HUD, NIEHS

This survey, to be completed in 1998, will gather data on the levels of lead and certain allergens in dust from a nationally representative sample of US housing. Lead levels in soil and paint will also be assessed. Additional objectives include estimating the percentage of homes with dust and soil lead levels above HUD/EPA guidelines, identifying sources of lead in dust in housing, and preparing for future analysis of lead hazard control strategies, regulation policies, and costs.

The survey will also provide information needed to assess the magnitude of the public's exposure to household indoor allergens, and evaluate the differences in population exposure to the allergens based on factors such as region/geography, ethnicity, socioeconomic status, and housing type. In particular, the survey will focus on the impact of cockroach allergens commonly found in inner-city dwellings.

5) Evaluation of the HUD Lead Hazard Control Grant Program

Implementing organization: various HUD grantees

Funding: HUD

This evaluation is the largest and most comprehensive study of lead hazard control in housing ever initiated. Data collection began in 1994 and will continue until 1999, with a final report expected in 2000. The overall purpose of the evaluation is to measure the relative cost and effectiveness of the various methods used by 14 State and local government grantees to reduce lead-based paint hazards in housing. Measures include the levels of lead in dust, paint, and for some grantees, soil. Data are also being collected from most of the residents living in the dwelling units. Approximately 2,000 dwelling units will be followed for 12 months and approximately 750 units will be followed for 36 months.

In the latest interim report of September 1, 1997, approximately 2,900 treated units participated in the evaluation. Preliminary statistical analyses indicate that the housing interventions appear to be successful in severing the link between children's blood lead levels and dust lead levels six months after the interventions are completed. Additionally, blood lead appeared to be much more likely to decrease than increase from pre-intervention to six and twelve months following the intervention. After adjusting for the child's age and the season, instances of children having decreases of 3 $\mu\text{g}/\text{dL}$ (34%) or more were almost five times more likely than increases of 3 $\mu\text{g}/\text{dL}$ (7%) or more at six months. Similarly, instances of children having decreases of at least 3 $\mu\text{g}/\text{dL}$ (45%) were nine times more likely than increases of at least 3 $\mu\text{g}/\text{dL}$ (5%) at twelve months. Further, the evaluation shows that median dust lead levels on all tested surfaces (floors, window sills, and window troughs) declined following the lead hazard control work.

Evaluation on the cost of hazard control intervention shows that the median lead hazard control cost in single-family dwelling units was about \$700, while the median cost for units with window replacement and partial abatement of other components was just under \$10,000. For multi-unit dwellings, the median cost to conduct the interior treatments was \$500 for low-level intervention and over \$5,500 for partial abatement and window replacement.

Appendix D.

**REPORT ON THE
HEALTHY HOMES INITIATIVE
PEER-REVIEW MEETING
DECEMBER 8-9, 1998**

**U.S. Department of Housing and Urban Development
Office of Lead Hazard Control
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I. INTRODUCTION

The FY 1999 Appropriations bill includes funds for The U.S. Department of Housing and Urban Development (HUD) to begin a Healthy Homes Initiative (HHI) that includes, among other things a program of research and demonstration projects addressing multiple housing related problems affecting the health of children. Congress requested HUD to submit a plan that inventories the problems, describes their intersections, identifies key technical questions, and provides a program plan. Congress recommended that HUD seek input and advice from experts, researchers, other federal agencies and experienced local practitioners.

The HUD Office of Lead Hazard Control (OLHC) identified an interdisciplinary group of professionals (peer-reviewers) from federal agencies, state and local governments, academic institutions, private non-profit organizations, and for-profit business. The peer-reviewer group included expertise in medical, public health, environmental, building science, code enforcement, construction, and research activities related to the HHI. The peer-reviewers were asked to respond to a draft report and a series of questions relating to the definition and implementation of the HHI. A meeting was convened on December 8-9, 1998, involving the peer-reviewers and additional representatives of the OLHC, the Office of Community Viability, and the Office of Public and Indian Housing. This report is a summary of the one and one half days of discussion. The appendix to this report includes written comments and background materials submitted by meeting participants and other peer-reviewers not at the meeting.

The peer-review discussions focused on the scientific issues that define the scope of the HHI, as well as implementation programs and policies that may be undertaken under the auspices of the HHI. The objective of the discussions was to collect the ideas and opinions of the assembled peer-reviewers to help the OLHC develop a HHI plan to submit to Congress. Peer-reviewers were asked to avoid promoting specific projects. Consensus was not actively sought but where there was general agreement among participants it was noted.

II. OPENING CHARGE TO PEER REVIEWERS BY DAVID E. JACOBS: DEFINING HEALTHY HOMES

At its most basic level, Healthy Homes is about restoring, defining and implementing collaboration between the worlds of public health and housing. I say restoring because housing and health codes appear to have common antecedents but completely separate institutional bases today. Housing code inspectors rarely address health issues because they are the domain of the local health or environment department. The common antecedent that existed around the turn of the century was labeled the sanitation movement. It was principally focused on cleaning up squalid conditions in factory slums, but eventually became the impetus behind what we now call public health and public housing.

After many years of too little attention, HUD, in 1992, made a major policy and funding commitment to eliminating childhood lead poisoning caused by exposure to lead-based paint hazards in housing. HUD's experience with the lead hazard control grant program has taught us a painful lesson: In those areas where the public health and housing communities are unable or unwilling to work together, the grants fail. Where new productive relations are forged, lead hazard control is integrated into existing housing rehabilitation, finance and maintenance mechanisms resulting in many dwellings being made lead-safe, and the leveraging of many different funding sources.

The Department's experience with lead is serving as a springboard to other childhood housing-related concerns. Lead poisoning is a public health problem, but its solution today lies, for the most part, in housing. Other childhood hazards to children's health and safety are similar in origin, prevention and treatment. In this context, HUD's Healthy Home Initiative is about using the opportunity presented by housing-based interventions to address multiple causes for childhood diseases and injuries.

Reconnecting housing and health is a lofty, challenging goal. Virtually everyone, including Congressional staff, agrees that this is a good idea, but it hasn't been tested sufficiently to have a firm foundation in science. One of the reasons that HUD's lead program has received increasing support is because there are data to show that it works.

Studies are needed to provide evidence that healthy homes is a wise investment of taxpayer dollars. Some parts of Healthy Homes may in fact require little in the way of evaluation to demonstrate effectiveness (for example, we do not need research to know that installation of smoke detectors is worthwhile). Discerning where evaluation efforts

should be targeted will be key to the long-term viability of this initiative. We also need to lay the groundwork for practical, widespread implementation of the results of our studies through targeted outreach, training, and education efforts; and through working to incorporate technical knowledge into model codes and other existing standards of practice in the building community.

The objective of the peer-review meeting is to promote a full exploration of the programmatic and scientific areas of focus for a Healthy Homes Initiative.

III. SCIENTIFIC ISSUES

A. SCOPE OF HHI

The intention of the HHI is to address housing conditions that affect children's health and safety in multiple ways. The OLHC identified a set of 13 housing and children's health issues to be considered initially in defining the scope of the HHI. The peer-reviewers were requested to consider the initial list and identify other appropriate issues that should be part of the HHI and issues that should be deleted. In searching for the best balance, consideration was given to: 1) the strength of evidence linking the children's health and safety issues to housing conditions; 2) the prevalence of the condition and its burden on society; 3) the availability of tools to assess the problem; 4) the availability of practical and safe interventions; and 5) the intersections of both problems and solutions. The impact of the home environment on children's health and well being depends on the specific hazards listed and the general quality of the environment.

Some of the children's health and safety concerns listed below are currently addressed by HUD's public education initiatives and other federal programs; they may also be included in the HHI.

HUD initially-proposed HHI hazard concerns:

- . Lead
- . Allergens/asthma

- . Mold
- . Insect pests
- . Rodents
- . Pesticides
- . Other toxic chemicals
- . Environmental tobacco smoke
- . Combustion byproducts
- . Radon
- . Asbestos
- . Take-home hazards
- . Unintentional injuries (including fires)

Additional HHI hazard concerns identified by peer-reviewers:

- . Uncontrolled moisture
- . Inadequate ventilation
- . Soil gases (other than radon)
- . Hazardous building materials
- . Drinking water
- . Sewage backup
- . Swimming pools
- . Noise and vibration
- . Crowding
- . Firearms
- . Home business activities
- . Faulty construction
- . Pets

- . Appliances (e.g., humidifiers, ozone generators, unvented dryers)
- . Food handling sanitation
- . Health care products
- . Other

The peer-reviewers generally agreed that the scope of the HHI should be as broad as possible within its overall mission. The importance of any specific hazard is defined fully only with respect to the conditions in a specific home and the sensitivities of specific occupants. Not all hazards can be addressed to the same extent but no hazard should be totally excluded.

It was noted that the term "children's health" needs further definition before the importance of individual hazards can be considered. What is the age group to be considered? Infants are more susceptible to different hazards and different health problems than older children and teenagers. Based on the wording of the committee report for the HHI appropriation, HUD advised peer reviewers that HHI should focus on the immediate and near-term health status of children; however, it should also consider childhood exposures to hazards that affect health later in life.

Hazards in the home that affect children should be considered in terms of their source and pathways. The appropriate intervention may be to eliminate the source or the pathway - - in either case exposure to the hazard is eliminated. Some of the listed hazards, such as tobacco smoke and take-home hazards, do not relate to hazards caused by housing conditions or operations, but are housing-related pathway problems related to human behaviors. In some instances, the source (e.g. lead-based paint) can be eliminated. In others, the source (e.g., allergens) cannot be eliminated, but human behavior that creates the pathway can be changed. This distinction can often help identify the best intervention.

For some hazards the problem is related to a dynamic condition or flow. For example, moisture is continually produced as a byproduct of human activity. When the flow of moisture into and out of the home is unbalanced, moisture may result in the creation of hazards, such as from mold. A similar dynamic applies to air, animals, insects, and energy.

HHI related hazards can be considered examples of the triad formed by the source, pathway, and behavior. Risk factors, including the threshold for disease to occur or sensitivity to the hazard (if known), should also be considered as part of the pathways.

The definition of "homes" should include the entire residential environment including the premises and related structures. An inclusive approach can be used to create a holistic concept to protecting the health and safety of children beyond specific easily recognized hazards within home interiors. Similarly, the HUD program needs the flexibility to address specific concerns that are unique to individual communities.

The HHI plan should consider the target audiences as well as the specific hazards. Issues of concern to the peer-reviewers (physicians, scientists, engineers, builders, etc.) are probably different than issues that are perceived as important to home owners, landlords, parents and children. One of the objectives should be the empowerment of people to control their environment and protect themselves, their families, and their communities. The program needs to balance education and engineering solutions.

B. GLOBAL CATEGORIES

The taxonomy of healthy homes issues could be based on global categories such as moisture, dust, combustion, and air quality. At this stage in planning, attention to details in specific hazards or outcomes makes it difficult to find the intersections. The individual issues will surface when the program is ready for specific actions based on the level of concern and the availability of data.

A recent publication from Sweden, *The Air We Breath Indoors*, is an example of addressing a global issue. Allergies are recognized as a major problem in Sweden and were the initial motivation for the study, but the report addresses many problems related to indoor air quality.

Another approach to organizing the HHI issues is to categorize its efforts with respect to health outcomes (e.g. allergies, lead poisoning, pulmonary problems, neurotoxicity, etc.).

Interventions could also be used as the organizing issues. For a given intervention

what improvements in children's health are achieved? By undertaking the intervention and observing the results the effectiveness of the intervention in improving children's health can be evaluated. The problem is that in some cases before and after exposure measurements can be very difficult and expensive.

C. UNCONTROLLED MOISTURE

The outbreak of pulmonary hemorrhage in infants from then-unknown causes, involving 37 cases in Cleveland, Ohio between 1993 and 1998, has been linked to the presence of *Stachybotrys* mold. The presence of uncontrolled moisture in older houses, and heating systems that derive supply air from the basement or crawl space, have been directly linked to this outbreak and the growth of toxic mold and fungi that are related to a variety of health problems. Moisture problems are also related to lead-based paint deterioration, and environments that support colonization of dust mites, cockroaches, and other insect pests and rodents.

Studies undertaken world-wide indicate an increase in the morbidity of pulmonary related illness in homes with reported moisture problems. A survey of homes in 24 U.S. cities indicates moisture problems are evident in 50 per cent of the homes. The average is higher in older urban areas and communities with humid climates. This does not mean that all of these 50 per cent of homes in the study have conditions that threaten children's health and safety. Anecdotal evidence also indicates a correlation between pulmonary health problems and the presence of excess humidity (more than about 70% relative humidity) or persistent sources of bulk moisture. These conditions can occur in new homes as well as older dwellings.

Moisture problems can result from inadequate maintenance or be the unintended byproduct of improper renovations in older homes. In newer homes, moisture problems can be caused by faulty construction and improperly stored building materials. Chronic moisture problems are often caused by environmental conditions such as high ground water and poor drainage. Most moisture conditions are accompanied by mold growth. Biosensors have been developed that use mold to identify the presence and extent of moisture problems.

Moisture conditions in buildings are complex phenomena. Some problems can be easily diagnosed and others are difficult to identify. Some are easy and inexpensive to correct, and others are complex and very expensive. The source of some problems may be determined by visual inspections, but others require instrumentation or intrusive investigative methods. Small persistent moisture sources, that are difficult to find, can

cause health problems. The fundamental physics of moisture is always the same, but the conditions that control the flow of moisture may vary from home to home.

D. DUST

Dust, like moisture, is involved in several HHI issues. The presence of a dust problem is often found where surface conditions hinder cleaning (e.g. rough surfaces and surfaces with cracks and crevices). Difficult-to clean surfaces are also associated with cockroach infestations. Experience with lead hazard control has identified effective methods for controlling dust and improving the cleanability of surfaces.

The question is what to look for in dust. We have significant scientific data linking lead, cockroach allergens, and mites to health problems and data that shows the effectiveness of interventions. Prioritizing which hazardous substances should be analyzed in house dust, and its relationship to childhood disease remains an important research need.

Carpets and rugs may present significant hazards by acting as a sink for collecting dust and contaminants, but the interaction of dust in carpets and the filtering action of carpet fibers is poorly understood.

E. ALLERGENS

HUD is working with the National Institute of Environmental Health Science to study allergen loading in a nationwide survey of a representative sample of U.S. housing. When this study is completed the country will have an estimate of the number of houses in the U.S. that have allergen problems. We have sufficient scientific evidence to link allergens to asthma and other health problems, but sampling methods need to be established and additional data are needed establish allergen loading standards, and prove the effectiveness of interventions.

F. ASTHMA

Data collected by the Centers for Disease Control and Prevention (CDC) indicates an

increase in the incidence of asthma with a disproportionate share of the increase affecting children and minorities. Health care expenditures for asthma are in excess of \$ 10 billion per year. The National Cooperative Inner City Asthma Study has produced data that links exposure to allergens to the occurrence of asthma. Studies have also shown that asthma symptoms improve if the patient is removed from the allergen loaded environment.

We know that dust mites, cockroaches, rodents, pets, and mold are all sources of allergens. We do not know if the concentration of allergens in dust is important or if the key factor is the total load of allergens in the home, nor do we know exactly how to measure the problem. We also do not know if allergens in one area of the home are more critical than others. We know that there is a relationship to uncontrolled moisture but we do not know how other environmental factors affect allergens. We have identified methods to reduce allergens but we do not know which are most effective and most easily implemented in housing.

G. UNINTENTIONAL INJURIES

HUD's *Danger in The Home* brochure lists about forty hazards, most of which are related to unintentional injuries that are easily preventable. The morbidity and mortality for injuries to children is well known and is a significant part of children's health problems.

H. NOISE AND VIBRATION

While the dangers of high-level noise and vibration are well-recognized, the irritant effects of continual exposure to unwanted moderate-level noise and vibration should be considered. Isolation of sound and vibration generated within and outside of the home can be promoted through housing structure and furnishings.

I. VENTILATION

Ventilation can be a problem or an intervention. The objective of proper ventilation systems is to have controlled and balanced ventilation that provides oxygen and appropriate levels of moisture, and removes carbon dioxide, allergens and other

airborne toxins, while providing a clean supply of air to dilute remaining contaminants. In hot humid climates, increasing ventilation can increase moisture problems. Several studies in Denmark suggest that ventilation can be used to reduce dust mites. Supply air filters for heating, ventilation and air conditioning systems have also been shown effective in reducing dust and dust mite levels in homes. The American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) has undertaken research and developed standards for ventilation.

IV. IMPLEMENTATION

A. MULTI-HAZARD PROGRAMS

New York State Department of Health has in place a multi-hazard program funded by an annual \$1.3 to \$1.4 million Prevention Block Grant from CDC. Started in 1985, the New York Healthy Neighborhoods program grew out of a categorical rodent control program. The program distributes matching grants for multi-hazard control in homes to eight NY communities selected on a competitive basis. The communities determine the program focus and are required to show health outcomes in target areas. Programs generally include door-to-door surveillance and interventions that address lead-based paint hazards, fire safety, source and detection of carbon monoxide, and asthma related conditions. Interventions are generally simple and low cost, such as providing working smoke detectors and batteries, CO detectors, and furnace filters. The extent of interventions provided depends on the resources available to the community. The program also includes extensive data collection, and depends on making successful partnerships among local agencies.

B. SINGLE-HAZARD VERSUS MULTI-HAZARD APPROACHES

The peer-reviewers agreed that anecdotal evidence and common sense support a multi-hazard approach. Typically, housing-related health hazards tend to cluster; on the whole, this is expected from the consequences of poor condition of housing structural and operational components, and furnishings in homes where such clusters occur. Some hazards may need to be addressed one at a time; however, this is incompatible with the concept of addressing the overall environmental quality of the home at one time. In the past, single hazard interventions have at times solved one problem while creating another. By recognizing the relationships among selected environmental hazards, this is less likely to occur. A multi-hazard approach may require compromise and societal acceptance of some hazardous conditions because affordable solutions may not exist for all hazardous conditions. A multi-hazard approach may also be more efficient by reducing the number of agencies and number of work crews involved in a given home.

A single-hazard approach may be required for acute situations or specific problems. The solutions to specific problems may fortuitously abate multiple hazards because the sources overlap. For example, correcting a severe moisture problem may alleviate both lead-based paint deterioration as well as mold and mildew. The multi-hazard model is most often applicable when integrated into routine operations and maintenance

activities. This model may also facilitate outreach and education efforts by providing a holistic awareness of physical conditions and behaviors that affect environmental health.

C. HOUSING CODES

There are thousands of state and local agencies part of whose job it is to require owners to maintain their properties. Over the past half-century, implementation of housing code programs has shifted from health agencies to building agencies or housing agencies; in the process, some of the focus on public health and environmental health issues has been lost. Housing codes are generally adopted by local governments and are often based on state or national models with modifications to address local concerns and preferences. The scope of housing codes is very broad and overlaps with many of the environmental and health concerns in the HHI. For example, most housing codes address moisture sources, fire, tripping and falling hazards, and vermin and insect infestations. The question is whether it is necessary to expand the scope of the codes to achieve HHI objectives.

In some communities the effectiveness of housing code enforcement has been undermined by assigning peripherally related code and inspection responsibilities to the housing code agencies. In many instances, the agencies' scope of responsibilities has been increased without correspondingly increasing budgets and related resources. Consequently many housing code officials are averse to new responsibilities without additional resources.

Most housing code enforcement is complaint driven. Inspections are undertaken in response to complaints and owners are given orders to repair violations. Financial assistance for compliance is sometimes provided. Failure to comply is often followed by civil or criminal sanctions. In some communities inspections focus only on the complaint but in others inspections will address all observed code violations on the premises. Some communities also conduct programmed periodic inspections of rental properties. Inspections at the time of lease or sale are also conducted in some communities. Housing code programs are not entirely enforcement. Education of property owners and tenants is also an important part of protecting the public health, safety, and welfare.

The primary pragmatic objective for most code enforcement programs is to protect property values. Public health concerns may have been the initial justification historically for implementing housing codes, but they are now secondary or merely

incidental in many communities. A cause or consequence of the diminished public health focus is insufficient and ineffective communication between housing code agencies and public health agencies. Health and housing inspectors are often involved in the same problems but they seldom work together. Reuniting health and housing code activities should be a key aspect of HHI.

Data on housing code enforcement generally describe the number of inspections and the number of work orders issued. There are no data to describe the effectiveness of code enforcement in protecting property values or their effect on public health concerns. Also, housing code programs are local focused and managed. Some states have organizations to share information among communities but most do not and there is no mechanism to share information and data nationwide.

Most housing code programs currently address many of the children's health and safety concerns that have been discussed. In many cases we know how to apply effective interventions. The role of code enforcement with respect to healthy homes issues is to identify and persuade property owners and tenants of the net benefits of healthy homes and convince them to take the necessary corrective actions. If HUD is to convince communities and housing code officials to expand housing code enforcement programs to address more healthy homes issues and be more protective of children's health, some financial assistance for housing programs appears to be required. Additional funds applied to ongoing programs for housing improvement and weatherization can be similarly expanded to achieve health homes goals. Ideally, housing code programs, housing improvement programs and public health programs can work together to achieve common healthy home goals.

Housing inspectors inspect and enforce only what is in the applicable local codes. For example, indoor air quality and mold are generally not addressed in the codes but the most common root cause, uncontrolled bulk moisture, is addressed. Initiating changes in housing codes is a long-term effort. Housing code and HHI issues have common interests and concerns that can be the foundation of expanded healthy homes programs. Several issues such as energy, accessibility, structural soundness, and seismic safety have been addressed recently in the model codes (including the forthcoming International Codes) and may provide lessons for achieving healthy homes objectives. The key advantage that housing code programs bring to the HHI is that they do not require a child to be sick or injured to take action, rather, they can be part of primary prevention programs for safety and health.

In some communities housing inspectors work with social service agencies to assure social service clients are placed in properties that meet minimum housing requirements. To the extent current housing programs achieve healthy homes goals in

these cases, the housing inspection serves as primary prevention for at-risk children.

Housing inspectors are in thousands of homes every day; primarily in urban areas. If properly trained, these inspectors are in an ideal position to collect data on underlying causes of health- and safety-related housing problems discussed earlier in individual houses and at the block and other neighborhood levels. Healthy home-related housing inspection for suburban and rural communities will likely require programs strategized differently from those for urban areas, but can be as effective. Data collection will likely require new modestly-funded programs but integrating these programs with the existing housing code infrastructure would probably be most cost effective.

D. MEASURED RESPONSES

Health, housing code, and housing rehabilitation officials need to develop flexible calibrated responses with achievable goals. Resources will never allow homes to be made “100 percent healthy and safe.” The proper response may require hazards to be prioritized and healthy homes goals achieved with a long-term plan. Standards should be set at a level that is high enough to protect occupants’ (especially children’s) safety and health, but does not discourage compliance or worse, encourage significant abandonment of properties.

E. PROPERTY OWNER/TENANT TRAINING

Experience suggests that most people respond to training interventions by undertaking actions and implementing practices that improve environments for children. Underlying this finding is the recognition that people who obtain such training are at that point more predisposed to taking action if it demonstrated to be feasible. The operational problem for HHI is getting landlords, property managers and tenants to acquire the information they need to attend operations and maintenance practices, such as through classes. While voluntary training is most common, mandatory training, such found in Cleveland, where the housing court requires code violators to attend maintenance training classes, can also be effective in inducing behavioral changes.

F. DEMONSTRATION PROJECTS

Appropriately-designed demonstration projects may be provide results of research quality. Such projects provide the greatest confidence that the findings are applicable beyond the homes and communities in which they were performed. For demonstration projects to be effective for research purposes, the baseline sources, pathways and behaviors need to be known, the interventions and measurements need to be finite and pre-selected, and the projects must meet appropriate experimental design criteria. For HHI purposes, the interventions and measurements also need to be relatively inexpensive and effective, especially if the target is low and moderate income homes.

G. SURVEILLANCE SYSTEMS

No surveillance system to address housing conditions exists in the same way we track more typical public health issues. As a result, fact-based decisionmaking on housing policies and programs for public health improvement is hindered. A uniform system for data gathering (but, for privacy reasons, no national individually-identifiable database should be created) and a mechanism for compiling and analyzing healthy homes related data would help overcome this deficit. Current efforts are insufficient to overcome deficiencies in data on baseline risk levels, extent of hazards, and levels of risks found in housing nationwide. A national uniform reporting system is needed to determine the extent of housing related illness and injury, regional difference, temporal trends, and the efficacy of interventions.

HUD's American Housing Survey tracks changes in the housing stock by periodically surveying residents of a designated sample of housing units regarding the condition of their homes. In 1997, questions regarding paint deterioration were included in the survey. Other healthy homes measures could be included in the future. The data are currently gathered by census enumerators and does not include inspections by personnel trained in housing, safety, health or environmental issues.

We do not yet know how to measure some of the hazards that have been identified. Research is needed to develop evaluation methods as a prerequisite to surveillance. Additional healthy homes issues could be added to surveillance systems and community health plans at a later date.

H. RESEARCH

One approach to research on healthy homes issues is a three part system that involves

hazard assessment, intervention, and follow-up assessment. This model is similar to current [lead hazard control](#) programs. Health and housing data collection tools, similar to the lead and allergens survey, and standardized environmental sampling techniques can be developed in the hazard assessment phase. The tools can include a core component to address global issues and locally adjusted components to address community needs. The tools should change over time as we learn more about the problem. Interventions to be applied can be standardized but a particular set of interventions can be customized to the home. Tools, such as guidelines, field books and training materials, for creating, operating and maintaining healthy homes may be developed in this phase. In the third phase, the effectiveness of interventions can be measured in terms of housing conditions and health and safety outcomes.

HUD may be able to follow an approach used by NIH by developing a core program that organizes the HHI and allows other agencies to undertake specific tasks that relate to the agency's mission and the HHI objectives.

The randomized clinical control trial paradigm may not work with all of the complex interactive issues involved in the healthy homes program. Identifying a population of sufficient size with consistent medical and environmental problems may be infeasible. Randomized clinical control trials are workable for some specific healthy homes issues, such as asthma.

Data gathering for known and suspected hazards as well as information to identify the other unrecognized hazards should be a priority. Data collected for purposes other than the HHI may, after secondary analysis, prove helpful. A closer look at existing health and housing data may answer some questions and help direct further inquiry.

I. SETTING PRIORITIES

Priorities can be based on our current understanding of the health and safety problems (prevalence, severity, health costs) and the availability of cost effective interventions and interventions that address multiple problems. Housing interventions paired with ongoing clinical trials could also be cost effective.

To the extent that the cost/benefit ratio can be measured, it should be used to develop a program that delivers the biggest bang for the buck. An emphasis should be placed on using the information and techniques that we currently know will improve children's

health and safety. Environmental justice issues should also be used to allocate resources.

Education should be an important part of any program. Consideration should be given to using or adapting existing materials such as those produced by the state of Wisconsin. Education involving direct contact is most effective. This may require an emphasis on training trainers in the community.

The HHI should have the flexibility to address opportunities when interventions are most needed or when they can be most effective such as after a natural disaster or during an epidemic. The HHI message could be effective as a part of the information provided to new parents.

The HHI should include primary prevention to correct environmental problems before children are harmed and preventive maintenance activities before environmental hazards develop. Maintenance is easier and cheaper than remediation.

J. COSTS

Community-based home health projects in Cleveland have encountered mold-intervention costs of six to seven hundred dollars per house, plus the cost of lead interventions and heating system maintenance provided by others. In Connecticut, where interventions have been triggered by sick children, the costs have been six to seven thousand dollars per dwelling for more substantial interventions to address bulk water problems.

The cost of interventions will be greatly influenced by the standard of care employed. Costs can be reduced by training crews to undertake multiple tasks. Planners and contractors may do more than is necessary to cover their liability when they lack consensus-based or empirically-based standard specifications (whether written or behavioral) to reference.

Allergen intervention for asthma in inner cities, including cockroach and rodent extermination, cleaning, covers on beds and pillows, furnace filters and education, but not structural changes, has cost about one thousand dollars per unit. These

interventions are not permanent and may require follow-up evaluation and intervention.

When measuring the cost of interventions, expenditures that would normally be incurred during periodic maintenance should be factored in. The objective should be to make healthy homes objectives a part of routine maintenance activities. The cost of maintenance and interventions will be greatly influenced by the basic condition and degree of deterioration.

The cost of most moisture interventions can be predicted using construction cost estimating data. A major remaining problem is to identify which interventions will be most cost-effective over time periods in years.

The cost of establishing contact with the residents or owner can be considerable. Many basic home safety issues could be addressed for less than \$150 per unit by public health nurses, housing inspectors, or other agents who are visiting the home for other reasons. This type of program can include inspections, educational materials, smoke alarms, thermometers to check hot water temperatures and other low-cost interventions known to be effective.

V. WRAP UP COMMENTS

The peer-reviewers described significant themes and additional important points they had identified; these are summarized below (they are organized thematically and not in order of importance). Peer-reviewers were offered the opportunity to provide further comments after the meeting; the majority did so. Their comments will be considered in preparing HUD's plan for implementing the HHI.

1. Interventions need to address specific problems, but education needs to be holistic. For some people, education alone may achieve the desired healthy homes goals by inducing behavior modification. Training needs to be targeted to specific audiences, e.g., landlords, home owners, tenants; people with similar educational experiences, common languages, common urbanicity, etc.
2. The HHI needs to maintain its focus on children's health and safety.

3. Funds from HUD and other Federal, State and local agencies should be used to leverage private expenditures.
4. HUD-sponsored interventions should be coordinated with NIH-sponsored health research, and with EPA-sponsored environmental research.
5. The National Survey of Lead and Allergens in Housing now being conducted, and NHANES IV, to be conducted shortly, can be models for HHI.
6. Definition of the extent of housing related health problems is severely limited by the paucity of data on exposure to and consequences of residential hazards, and the building structure, usage, operation and maintenance factors that influence these exposures.
7. Academic medical centers and schools of public health are important stakeholders in community based public health research and intervention programs.
8. Managed health care organizations may be effective partners.
9. Partnerships with private-sector organizations with interests that intersect the interests of the HHI, such as specific national professional, trade, and labor groups, and State and local organizations, such as chapters of the national groups, private-sector intergovernmental entities, and community-based groups, can be very effective in helping HUD get the healthy homes message to the public.
10. HUD should emphasize partnerships with community based organizations to build on existing relationships and respond to local interests. HUD's Community Builder program can help identify community needs and facilitate the coordination of federal programs.

11. The lead hazard control program paradigm (assessment - intervention - assessment) has been proven very effective for demonstration programs.
12. HUD should explore with HHS encouraging use of Medicaid funds for selected environmental interventions by identifying them as a reimbursable medical expense. Medicaid managed-care providers may provide the opportunity. The program should include studies to show the impact of environmental interventions on medical costs.
13. It is important to understand how housing codes and health codes intersect, and to work to improve them and their implementation.
14. On the whole, HHI's multifaceted nature requires that cooperative efforts to define and achieve the HHI's objectives be sought among groups with similar goals even if they have divergent interests.