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CDC uses a blood lead reference value of 3.5 micrograms per deciliter (µg/dL) to identify children with higher levels of lead in their blood compared to most children. This level is based on the 97.5th percentile of the blood lead values among U.S. children ages 1-5 years from the 2015-2016 and 2017-2018 National Health and Nutrition Examination Survey (NHANES) cycles. Children with blood lead levels at or above the BLRV represent those at the top 2.5% with the highest blood lead levels.

This document refers to a blood lead level of 10 µg/dL as the CDC level of concern for adverse health outcomes in children. This terminology has changed, and readers are referred to the ACCLPP recommendations of 2012.

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Lead poisoning is a completely preventable disease. Residential lead paint hazards in homes of children can be virtually eliminated in 10 years. Every child deserves to grow up in a home free of lead paint hazards.

Eliminating Childhood Lead Poisoning:

A Federal Strategy Targeting Lead Paint Hazards

President's Task Force on Environmental Health Risks and Safety Risks to Children

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February 2000

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Preface

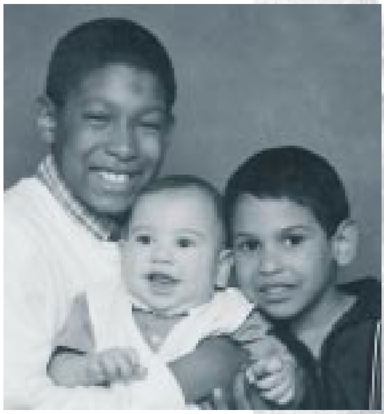
The following story is true. Lead poisoning can be prevented by identifying whether lead hazards in a home are present and by learning how to safely address them.

One Family's Story

Like any other parent, the most important priority in my life is to provide my three children, Damien, Samuel, and Nathan, with a happy and healthy home—a place where they can grow, learn, and develop into productive adults. What I didn't know was that our home would threaten my children's health.

In April of 1996, my family and I managed to save enough to buy our own home. Within four months of moving in, our pride and joy evaporated when Samuel, then 10 months old, was diagnosed with a blood lead level of 32 micrograms per deciliter (μg/dL). I soon learned that my son's blood lead level was three times above the limit thought to cause future learning problems. A greater shock was that the lead paint, dust and soil in and around our treasured home was the culprit.

Worse yet, a month later, Samuel's lead level had risen to 50 μg/dL. He was hospitalized that same afternoon and for three long, agonizing days he stayed in the hospital and began treatment. During Samuel's hospitalization, my husband and I spent many hours attempting to make our home lead safe, all the while keeping vigil over Sam. For nearly 4 years, Sam had his blood tested every two months. We continued to improve our home through repair loans to make it safe. Today, our house has new windows, and lead abatement has been completed on the interior and exterior of our home. Samuel's blood lead level has dropped below 10 μg/dL. To see Samuel, now 4 years old, you would never know what this happy, beautiful little boy has had to endure. Our son's lead poisoning could have been prevented if we had known to check for lead and how to keep our home lead safe. Today, families receive this information when they buy or rent an older home. It is critical that parents receive this information so that they can take the necessary steps to protect their family. I share my story with the hope that other families and their children will learn about the dangers of lead, and that one day soon, lead poisoning will be a disease of the past.



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About the President's Task Force on Environmental Health Risks and Safety Risks to Children

In recognition of the growing body of scientific information demonstrating that America's children suffer more than adults from environmental health risks and safety risks, President William Jefferson Clinton issued Executive Order 13045 on April 21, 1997, directing each federal agency to make it a high priority to identify, assess, and address those risks. In issuing this order, the President also created the Task Force on Environmental Health Risks and Safety Risks to Children, co-chaired by Donna E. Shalala, Secretary of the U.S. Department of Health and Human Services, and Carol M. Browner, Administrator of the U.S. Environmental Protection Agency. The Task Force was charged with recommending strategies for protecting children's environmental health and safety.

This Strategy has been developed by an interagency work group of the President's Task Force on Environmental Health Risks and Safety Risks to Children. Workgroup representatives are listed on page five.

The goal of the workgroup was to develop a set of recommendations to eliminate childhood lead poisoning in the United States as a major public health problem by the year 2010. This report focuses primarily on expanding efforts to correct lead paint hazards (especially in low-income housing), a major source of lead exposure for children.

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Graphics developed and provided by Dorothy Allen, Matt Ammon, Dana Bres, and Harry Hudson.

Executive Summary

This report, for the first time, presents a coordinated federal program to eliminate childhood lead poisoning in the United States. It describes how lead poisoning harms children, how pervasive lead poisoning is, and how lead paint hazards in housing can be eliminated in 10 years. To achieve the goal of making children safe from lead hazards, the President's FY2001 budget increases federal funding for several agencies, including the Environmental Protection Agency (EPA) and the Department of Justice (DoJ), and provides for a 50% increase in lead hazard control grants issued by the U.S. Department of Housing and Urban Development (HUD). The budget also maintains the current level of funding for lead programs at the Department of Health and Human Services (DHHS). In this report, we are proposing 10-year plan that will create 2.3 million lead-safe homes for low-income families with children, thereby resulting in net benefits of $8.9 billion, as estimated by HUD.

- Lead poisoning is a completely preventable disease.
- Residential lead paint hazards in homes of children can be virtually eliminated in 10 years.
- Every child deserves to grow up in a home free of lead paint hazards.

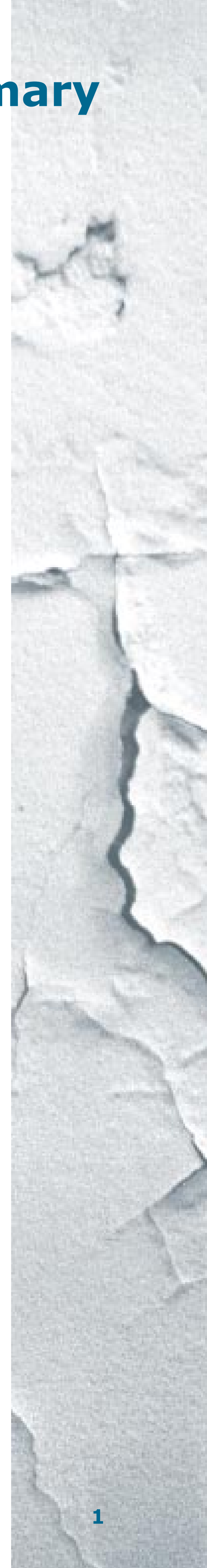
Recommendations: The following recommendations are key to a successful lead hazard control strategy:

- **Act before children are poisoned:** Target federal grants for low-income housing and leverage private and other non-federal funds to control lead paint hazards; promote education for universal lead-safe painting, renovation, and maintenance work practices; and ensure compliance and enforcement of lead paint laws.
- **Identify and care for lead-poisoned children:** Improve early intervention by expanding blood lead screening and follow-up services for at-risk children, especially Medicaid-eligible children.
- **Conduct research:** Improve prevention strategies, promote innovative ways to drive down lead hazard control costs and quantify the ways in which children are exposed to lead.
- **Measure progress and refine lead poisoning prevention strategies:** Implement monitoring and surveillance programs.

(See page 29 for the full list of recommendations.)

The Lead Problem

Lead is highly toxic, especially to young children. It can harm a child's brain, kidneys, bone marrow, and other body systems. At high levels, lead can cause coma, convulsions, and death. The National Academy of Sciences has reported that comparatively low levels of lead exposure are harmful. Levels as low as 10 micrograms of lead per deciliter of blood (μg/dL) in infants, children, and pregnant women are associated with impaired cognitive function, behavior difficulties, fetal organ development, and other problems.[1] In addition, low levels of lead in children's blood can cause reduced intelligence, impaired hearing and reduced stature.[2] Lead toxicity has been well-established, with evidence of harmful effects found in children whose blood lead levels exceed 10 μg/dL.[3,4]



No single definition of "lead poisoning" suits all purposes. From a public health perspective, the key questions are: 1) At what level does lead poisoning have a preventable adverse impact on health? and 2) What is the magnitude of the health problem? In this report, the term "lead poisoning" is used to describe blood lead levels of 10 μg/dL or above in children under six.

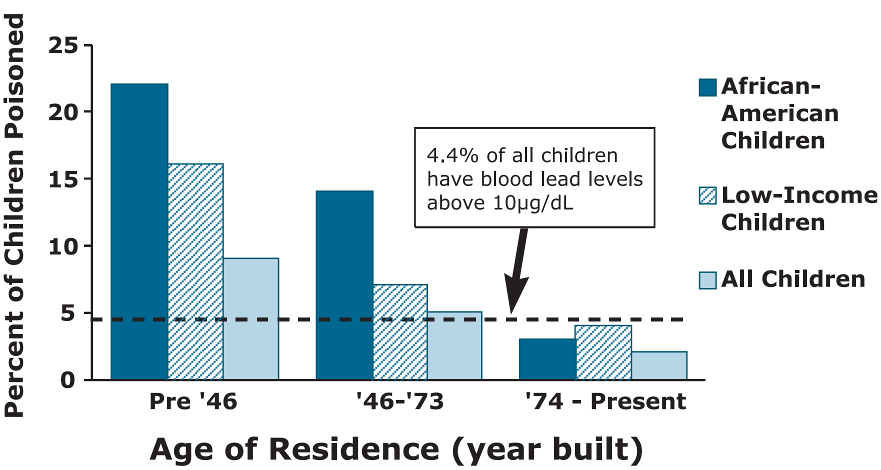
Lead Paint In Housing - Particularly Low-Income Housing

The most current national survey shows that nearly 1 million children are lead poisoned.[5] A large body of evidence shows that the most common source of lead exposure for children today is lead paint in older housing and the contaminated dust and soil it generates.[6-14] Poisoning from lead paint has affected millions of children since this problem was first recognized more than 100 years ago[15, 16] and it persists today despite a 1978 ban on the use of lead in new paint.[17] Although all children living in older housing (where lead paint is most prevalent) are at risk, low-income and minority children are much more likely to be exposed to lead hazards. For example, 16% of low-income children living in older housing are poisoned, compared to 4.4% of all children (see Figure 1).[5] Therefore, eliminating lead paint hazards in older low-income housing is essential if childhood lead poisoning is to be eradicated.

Other Sources Of Childhood Lead Poisoning

Lead exposure among young children has been dramatically reduced over the last two decades because of the phase-out of lead from gasoline, food and beverage cans, and new house paint, and because of reductions of lead in industrial emissions, drinking water, consumer goods, hazardous waste sites, and other sources. As a result of these past and on-going efforts, children's blood lead levels have declined over 80% since the mid-1970s.[5] In 1978 there were about 14.8 million poisoned children in the United States. By the early 1990s, that number had declined to 890,000 children. The long-term vision of this strategy is to eliminate childhood lead poisoning in the United States.

Figure 1
National Blood Lead Levels



From the Third National Health and Nutrition Examination Survey (NHANES III), *Phase* 2, 1991-1994

Vision:

Eliminate childhood lead poisoning in the United States

Further Efforts Needed To Eliminate Lead Poisoning In Children

Despite progress, lead poisoning remains one of the top childhood environmental health problems today.[14] Without further action, over the coming decades large numbers of young children may be exposed to lead in amounts that could impair their ability to learn and to reach their full potential. To help accelerate the progress in eliminating this disease, this report has been compiled to examine what needs to be done to make children's housing lead-safe and to provide early intervention for children at highest risk. Specifically, it examines what actions need to be taken *before* children are poisoned. This report shows that the number of poisoned children can be greatly reduced over the next decade as a result of demolition, renovation, regulation, and increased federal subsidy and leveraged private funding (Figure 2). Additional efforts will continue to address exposures from other sources, such as lead in exterior soil and dust, drinking water, and air emissions.

Goals: This Strategy advances two goals:

1. By 2010, eliminate lead paint hazards in housing where children under six live. This goal can be accomplished through the following:

- federal grants and leveraged private funding to identify and eliminate lead paint hazards in order to produce an adequate supply of lead-safe housing for low-income families with children;
- outreach and public education to increase awareness of lead hazards and how to address them; and
- enforcement of lead safety laws and regulations.

2. By 2010, elevated blood lead levels in children will be eliminated through:

- increased compliance with existing policies concerning blood lead screening; and
- increased coordination across federal, state and local agencies responsible for outreach, education, technical assistance, and data collection related to lead screening and abatement.

Infrastructure Now Exists

Title X of the 1992 Housing and Community Development Act, otherwise known as the Residential Lead-Based Paint Hazard Reduction Act (Public Law 102-550), mandated the creation of an infrastructure that would correct lead paint hazards in housing. Title X also redefined "lead paint hazards" and how they can be controlled. Based on scientific research in the 1980's, Congress defined a "hazard" to include deteriorated lead paint and the lead-contaminated dust and soil it generates. The infrastructure has been developed and includes the following:

- Grant programs to make homes lead safe, now active in over 200 cities
- Training of thousands of workers doing housing rehabilitation, remodeling, renovation, repainting, and maintenance to help them do their work in a lead-safe way
- Licensing of inspectors and abatement contractors
- Compliance with and enforcement of lead safety laws and regulations
- Disclosure of lead paint problems before sale or lease
- National and local education and outreach programs

- Promulgation of federal standards of care
- Worker protection regulations

Modern Lead-Safe Methods

New low-cost methods are now available to identify and fix hazardous housing. Field studies have shown that modern lead hazard control methods have been effective in reducing levels of lead-contaminated house dust by an average of 60%, with an average decline in blood lead levels of about 25%.[19] House dust is the most common exposure pathway through which children are exposed to lead paint. Older housing is continually being demolished, renovated, or abated. Current projections show that, without this further action, several million children would be poisoned over the next several decades. Figure 2 depicts the potential impacts of various actions on the number of lead poisoned children.

HUD indicates that 2.3 million housing units will be at risk of lead paint hazards in 2010, if current trends continue (Table 1). Direct federal financial assistance for housing occupied by low-income families will continue to be needed.[14] These funds can be used to leverage private resources to create lead-safe housing. In some jurisdictions, it may be possible to create enough lead-safe housing for families, yet not necessarily address all housing units with lead paint. In other jurisdictions, virtually all housing will need to be made lead-safe to protect children.

Economic Costs And Benefits Of Making Homes Lead Safe

Ideally, lead paint in housing would be permanently abated. However, the challenge today is to quickly eliminate lead paint hazards in as many dwellings as possible.

Figure 2
Potential Impacts of Various Actions on the Number of Low-Income Lead Poisoned Children

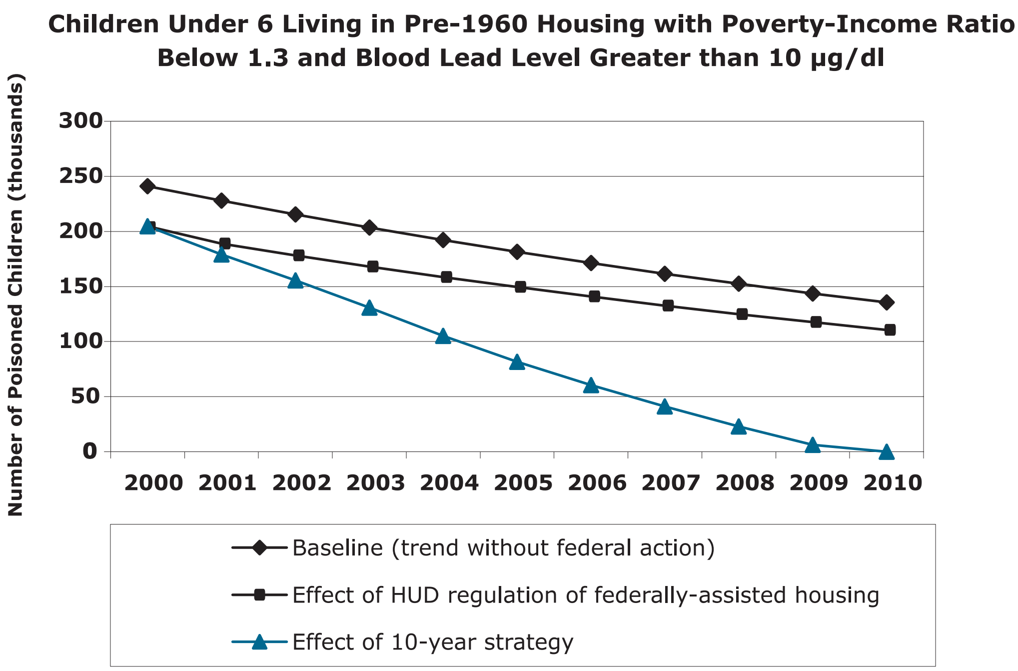


Table 1
Pre-1960 Units at Risk of Having Lead Paint Hazards in 2010

Housing Stock	Number of Housing Units (millions)
Total Units at Risk of Lead Paint Hazards in 1999	24.0
Reduction Due to Demolition, 2000-2010	-1.8
Reduction Due to Substantial Renovation, 2000-2010	-3.8
Subtotal *(Total Units at Risk of Lead Paint Hazards in 2010)*	18.4
20% of Subtotal Occupied by Low-Income Families	3.7
Reduction Due to HUD Regulation of Federally-Assisted Housing, 2000-2010	-1.4
Total Low-Income Units in 2010 At Risk of Lead Paint Hazards	2.3

Source: *American Housing Survey, Current Population Survey, Residential Energy Consumption Survey* (Appendix)

Abatement alone is unlikely to achieve this goal, absent significant funding from non-federal sources. Interim controls (specialized maintenance and safe repainting and renovation work practices) followed by ongoing management provide the best opportunity for success to leverage private funding to the fullest extent possible and thereby protect the largest number of children in the near term. If ongoing management is not implemented consistently, lead hazards could reappear. Lead paint must be safely managed until the building is demolished, renovated, or abated.

HUD compared the costs of two approaches to controlling lead paint hazards: 1) managing lead paint on an ongoing basis

Table 2
Estimated Average Annual Costs of Options to Address Lead Paint Hazards in Pre-1960 Housing, 2001–2010

Pre-1960 Housing Stock	Lead Hazard Screening and Interim Controls ($1,000 per unit)	Inspection/Risk Assessment and Full Abatement of Lead Paint ($9,000 per unit)
All Pre-1960 Housing at Risk of Lead Paint Hazards (1.84 million units/year)	$1.84 billion	$16.6 billion
Pre-1960 Housing Occupied by Low-Income Families Not Covered by HUD Regulation (230,000 units/year)	$230 million	$2.1 billion

Source: *Evaluation of the* HUD *Lead Hazard Control Grant Program; The Economic Analysis for the* HUD *Lead Paint Regulation for Federally Assisted Housing* (see Appendix) to ensure it does not become hazardous (interim controls); and 2) permanent abatement for all pre-1960 housing with lead paint and for low-income housing where risks are greatest (Table 2). The Department determined that the benefits of eliminating lead hazards greatly exceed the costs for all cases.

Based on conservative assumptions, the quantifiable monetary benefit (which does not include all benefits) of eliminating lead paint hazards through interim controls in the nation's pre-1960 low-income housing stock over the next 10 years will be $11.2 billion at a 3% discount rate ($3.5 billion at a 7% discount rate). The *net* benefits of interim controls are $8.9 billion at a 3% discount rate and $1.2 billion at a 7% discount rate. The monetary benefit of *abatement* of low-income housing is estimated at $37.7 billion at a 3% discount rate [$20.8 billion at a 7% discount rate (see Appendix)]. The benefit of permanently abating lead paint is considerably greater because more children would benefit over a considerably longer time span. The quantified monetary benefits may underestimate the actual benefits because of the many unquantifiable benefits associated with eliminating childhood lead paint poisoning.

Other Key Federal Activities

Table 3 presents a summary of federal agency programs and duties for dealing with lead poisoning.

In addition to expanding the HUD lead hazard control grant program, this strategy recognizes other important federal activities that need to be continued or increased to confront childhood lead poisoning.

Enforcing lead regulations is important to reduce exposure to lead hazards. This strategy recommends increasing enforcement of the Lead Paint Disclosure Rule, concentrating on housing with a history of lead-poisoned children, or that has physical or management problems indicating the likely presence of lead paint hazards. Other lead paint rules addressing certification and training, pre-renovation education, use of safe and reliable work practices, and management and disposal of lead-based paint debris also need to be implemented using integrated strategies that combine compliance assistance, incentives, monitoring and enforcement.

Even with a substantial expansion of resources for residential lead hazard control, a significant number of dwellings that could house families with young children will remain with lead hazards. The public health benefits of hazard control activities should be increased by outreach programs to identify at-risk families—especially those with pregnant women or young infants who live in homes with lead hazards—and link them to existing lead safe housing and resources for hazard control.

Improving early intervention by expanding blood lead screening and follow-up services for at-risk children is a key component of this strategy. Recommendations include ensuring that targeted case management for lead poisoned Medicaid children includes coordination of medical treatment services with environmental, housing, and social interventions to identify and eliminate sources of lead exposure.

Research to develop new cost-effective lead hazard control technologies, evaluate hazard control techniques for urban lead contaminated soil and exterior dust, and improve portable blood lead analyzer technology is also advocated. In addition, monitoring programs to measure progress and refine lead poisoning prevention strategies are needed.

Table 3
Federal Agency Roles on Lead Poisoning Prevention

Agency	Programs and Duties
Department of Housing and Urban Development	Lead Hazard Control Grant Program, enforcement of Disclosure Rule (with EPA and DoJ) and Federally-Assisted Housing Lead Paint Regulations, National Survey of Lead Paint in Housing, Lead Hotline (with EPA), Internet listing of lead paint professionals, public education and training of housing professionals and providers and others, technical assistance, research.
Department of Health and Human Services:	
Centers for Disease Control and Prevention (CDC)	Blood Lead Screening Grant Program, public education to medical and public health professionals and others, National Health and Nutrition Examination Survey, quality control for laboratories analyzing blood lead specimens, research.
Health Care Financing Administration (HCFA)	Covers and reimburses for lead screening and diagnosis, lead poisoning treatment, and follow-up services for Medicaid-eligible children.
National Institute of Child Health and Human Development (NICHHD)	Conducts and supports laboratory, clinical, and epidemiological research on the reproductive, neurobiologic, developmental, and behavioral processes including lead poisoning related research.
Health Resources and Services Administration (HRSA)	Directs national health programs to assure quality health care to under-served, vulnerable, and special need populations including children with lead poisoning.
The Agency for Toxic Substances and Disease Registry (ATSDR)	Undertakes the study of blood lead in populations near Superfund sites and funds State health agencies to undertake this type of work.
Food and Drug Administration	Enforces standards for lead in ceramic dinnerware; monitors lead in food.
National Institutes of Health	Basic research on lead toxicity.

Table continues on next page

Table 3 (continued)
Federal Agency Roles on Lead Poisoning Prevention

Agency	Programs and Duties
Environmental Protection Agency (EPA)	Authorizes States to license lead paint professionals; environmental laboratory accreditation; enforcement of disclosure Rule (with HUD and DOJ) and Pre-Renovation Notification Rule; Hazardous Waste Regulation; public education to parents, environmental professionals, and others; training curriculum design; Lead Hotline (with HUD); research; addresses lead contamination at industrial waste sites including drinking water and industrial air emissions.
Department of Justice	Enforces Federal Lead Paint Disclosure Rule (with HUD and EPA), defends Federal lead paint regulations, enforces pollution statutes including hazardous waste laws.
Consumer Product Safety Commission	Enforces ban of lead paint; investigates and prevents the use of lead paint in consumer products; initiates recalls of products containing lead that present a hazard; conducts dockside surveillance and intercepts imported products that present a risk of lead poisoning; recommends elimination of lead from consumer products through Guidance Policy on lead.
Occupational Safety and Health Administration	Worker protection regulations.
Department of the Treasury	Evaluates financial incentives (such as tax credits) for lead hazard control.
Department of Energy	Conducts weatherization activities in a lead-safe manner.
Department of Defense	Administers lead-based paint/lead hazard management programs in 250,000 family housing and child-occupied facilities worldwide, administers childhood lead poisoning prevention programs on installations worldwide, administers research and development programs to develop new cost-effective technologies for lead paint management and abatement, partner with other Federal agencies to develop policies and guidance for lead hazard management on a national level.

Budget Summary

President's Task Force on Environmental Health Risks and Safety Risks to Children Lead Poisoning Prevention Strategy Budget Summary

FY99 Enacted		FY2000 Enacted Budget		FY2001 President s Budget	
Area/Activity	**$**	**Area/Activity**	**$**	**Area/Activity**	**$**
Environmental Protection Agency					
■ Inspection, Enforcement and Compliance	$1M	■ Inspection, Enforcement and Compliance	$1M	■ Inspection, Enforcement and Compliance	$3M
■ Education and Outreach	$2M	■ Education and Outreach	$2M	■ Education and Outreach	$2M
■ Decrease Toxic Waste	$1M	■ Decrease Toxic Waste	$1M	■ Decrease Toxic Waste	$1M
	$4M		$4M		$6M
Department of Housing and Urban Development					
■ Hazard Control Grants in Private Low-Income Housing	$60M	■ Hazard Control Grants in Private Low-Income Housing	$60M	■ Hazard Control Grants in Private Low-Income Housing	$90M
■ Public Education, Technical Assistance, Research	$10M	■ Public Education, Technical Assistance, Research	$10M	■ Public Education, Technical Assistance, Research	$10M
■ Healthy Homes Initiative	$10M	■ Healthy Homes Initiative	$10M	■ Healthy Homes Initiative	$10M
■ (Enforcement)	(not a separate line item)	■ (Enforcement)	(not a separate line item)	■ Enforcement	$10M
	$80M		$80M		$120M
Department of Health and Human Services (CDC only)					
■ Screening, Medical and Env. Management, Outreach and Education	$38M	■ Screening, Medical and Env. Management, Outreach and Education	$38M	■ Screening, Medical and Env. Management, Outreach and Education	$38M
Department of Justice					
■ Enforcement	$0.1M	■ Enforcement	$0.1M	■ Enforcement	$0.3M
Consumer Product Safety Commission					
■ Inspection, Enforcement and Compliance	$0.1M	■ Inspection, Enforcement and Compliance	$0.1M	■ Inspection, Enforcement and Compliance	$0.1M
■ Education and Outreach	$0.1M	■ Education and Outreach	$0.1M	■ Education and Outreach	$0.1M
	$0.2M		$0.2M		$0.2M
Department of Defense					
Not Available					
Total	**$122.3M**		**$122.3M**		**$164.5M**

The Lead Poisoning Problem

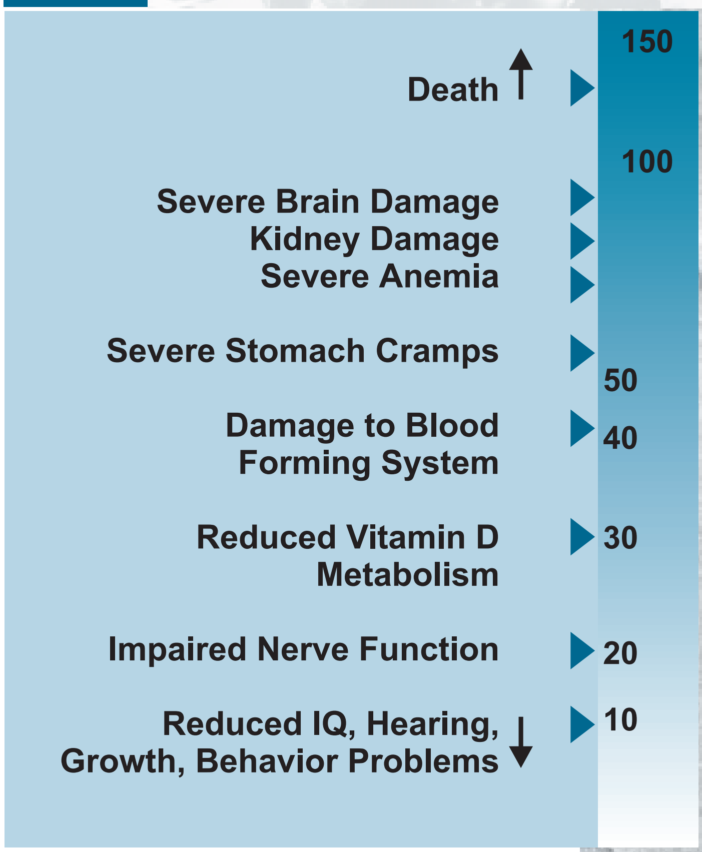
Lead poisoning is entirely preventable. However, nearly 1 million children living in the United States have blood lead levels high enough to impair their ability to think, concentrate, and learn.[5] Lead is highly toxic and affects virtually every system of the body. It can damage a child's kidneys and central nervous system and cause anemia. At very high levels, lead can cause coma, convulsions, and death. Even low levels of lead are harmful. Levels as low as 10 micrograms of lead per deciliter of blood (μg/dL) are associated with decreased intelligence, behavior problems, reduced physical stature and growth, and impaired hearing (see Figure 3).[1,2] A child is estimated to lose 2 IQ points for each 10 μg/dL increase in blood lead level.[4] One study suggests that lead exposure may be associated with juvenile delinquent behavior.[20] Lead toxicity has been well-established, with evidence of harmful effects found in children whose blood lead levels exceed 10 μg/dL.[3,4,21]

No single definition of "lead poisoning" suits all purposes. From a public health perspective, the key questions are: 1) At what level does a preventable adverse impact on health occur? and 2) What is the magnitude of this health problem? In this report, the term "lead poisoning" is used to describe blood lead levels of 10 μg/dL or above in children under six.

Lead is most hazardous to the nation's roughly 24 million children under the age of 6. Their still-developing nervous systems are particularly vulnerable to lead, and their normal play activities expose them to lead paint hazards and lead-contaminated dust and soil. Children between ages one and three are at greatest risk because of normal hand-to-mouth activity and the increase in mobility during their second and third years which make lead hazards more accessible to them.

Major progress on lead poisoning has been achieved through a combination of primary prevention measures that have eliminated major sources of lead exposure and through secondary prevention programs that ensure screening and interventions for children who have already been poisoned. These changes were brought about through the efforts and collaborations of many federal agencies (see Table 3) and their State, local, and private-sector partners. As reported in the National Health and Nutrition Examination Survey (NHANES), the proportion of children age 1-6 with lead poisoning fell to 4.4% in 1991-94. This was a more than 80% decline from 1976-80.[5]

Figure 3
Toxicity of Blood Lead Concentration in Blood (μg Pb/dL) in Children



Adapted from ATSDR, *Toxicological Profile for Lead*

Despite these accomplishments, nearly 1 million children in the United States have lead poisoning. This remaining problem is especially acute in certain population groups. For example, among children living in pre-1946 dwellings (when the use of lead in paint was most common), the prevalence of lead poisoning is five times higher than among children living in homes built after 1973 (most of which do not have lead paint)[5] Nationally, children in Medicaid also represent a high-risk group, comprising 80% of children with blood lead levels 15 µg/dL and above.[22]

Although any child is potentially at risk, low-income children living in deteriorated older housing (especially in inner-city neighborhoods) shoulder a disproportionately larger share of lead-poisoning cases. For example, 16% of low-income children living in housing built prior to 1946 are lead poisoned.[5] Without new prevention and control efforts, a large number of young children may continue to be exposed to lead paint hazards over the coming decades.

Sources of Lead Poisoning

Potential sources of lead exposure in children vary greatly in magnitude. Many of these sources have already been addressed and have directly contributed to the dramatic decline in blood lead levels to date. The U.S. Environmental Protection Agency (EPA) has virtually eliminated lead in gasoline, and has placed strict limits on the amount of lead in drinking water and on lead emitted from industrial facilities. EPA has also phased out lead in pesticides and, with the Department of Justice (DoJ), has addressed lead contamination at many Superfund sites. In cooperation with the Food and Drug Administration (FDA), food processors virtually eliminated the use of lead solder in domestically-canned food and beverages. FDA also has established strict standards concerning the amount of lead that can leach from ceramicware into beverages and foods. The Occupational Safety and Health Administration (OSHA) has regulated lead exposure for workers, which also benefits the children of those workers who may have been placed at risk via take-home exposures (such as lead dust on work clothing). Lead in residential paint was phased out and completely banned by the Consumer Product Safety Commission (CPSC) in 1978. In addition, CPSC has addressed lead contamination in children's toys, miniblinds, playground equipment, and other sources, and continues to conduct special dockside inspections to look for imported children's products containing lead that present hazards. Public education efforts have been launched to publicize the dangers of lead in folk remedies, pottery glazing, art supplies, cosmetics, fishing sinkers, and other products.

A large body of evidence indicates that the most important remaining exposure sources for children are lead hazards in their residential environment—deteriorated lead paint, house dust, and lead-contaminated soil.[6-14] Lead paint poisoning was first identified over 100 years ago.[15, 16] Even though lead paint has been banned in the United States since 1978, the Department of Housing and Urban Development (HUD) estimated in 1990 that it still remains in about 64 million dwelling units.[17,23] Exposure to this paint poses a threat to children, especially as the paint deteriorates or is disturbed during renovation activities.

Children are exposed to lead from paint either directly by eating paint chips[10] or indirectly by ingesting lead-contaminated house dust or soil through normal hand-to-mouth contact.[11, 12] Unless proper precautions are followed, lead paint can contaminate dust or soil when it deteriorates or is disturbed during maintenance, repainting, remodeling, demolition, or lead paint removal.[13, 14] In fact, dust and soil contaminated from lead paint are now the main sources of lead exposure for children. Residences with exterior lead paint are more than three times as likely to have higher levels of lead in the surrounding soil (exceeding 500 parts per million) than are dwellings without exterior lead paint (21% versus 6%).[17, 23] For buildings with deteriorating exterior lead paint, soil contamination is eight times more common (48%) than at residences without exterior lead paint.[17,23]

Without measures to prevent children's exposure to contaminated dust and debris, extensive removal of lead paint from homes of poisoned children has been shown to cause increases in children's blood lead levels.[24,25,26] Consequently, federal, state, and local regulations and guidelines have prohibited certain hazardous paint removal methods and required safe-work practices, cleaning, and lead dust testing ("clearance") prior to re-occupancy.[27]

Recent long-term studies[19,28,29] of lead hazard controls have evaluated strategies that combined measures to repair deteriorated lead paint with other measures to reduce and prevent re-accumulation of lead dust. The studies showed that these treatments resulted in substantial, sustained reductions in interior lead dust and children's blood lead levels.

Federal Resources and Leveraged Private Resources to Create Lead-Safe Housing

After receiving a $3 million lead hazard control grant from HUD, The City Council of Milwaukee passed a local ordinance requiring all housing units in two high-risk neighborhoods to be made lead-safe. HUD funds and approximately $400,000 in leveraged private funds are being used to partially defray landlords' costs of complying with the ordinance. So far, about one-fourth of all units in the targeted neighborhoods have been made lead-safe. When completed, the program will make nearly 1,000 homes safe for children.

Boston has leveraged $3.7 million in non-federal funds with $7.7 million in HUD lead-hazard control grants.

Protecting All Children

Although the risks are greatest for low-income children living in older housing, *all* children should grow up in lead-safe homes. Targeted education and training of painters, renovators, remodelers, maintenance workers, landlords, parents, and others, combined with tax or other financial incentives, can be used to protect children not directly served by federal grants and leveraged private financial assistance. Promoting universal lead-safe remodeling and repainting work practices, occupant protection, and cleanup and dust testing can ensure that no child need be exposed to lead paint hazards.

The HUD lead paint hazard control grant program is not an entitlement for all housing with lead paint hazards, but rather a limited funding pool. The program can be used to not only address lead paint hazards directly, but also to leverage private funding and prompt market forces. As more lead-safe housing is created, more landlords and homeowners may be motivated to address lead paint hazards in their units in order to realize increased property values associated with lead hazard control in a competitive market.

In addition, landlord motivation can be increased by providing an easily-understood "seal of approval" showing which units are lead-safe (and conversely, which are not). Rhode Island, Milwaukee, and a few other jurisdictions already provide such certificates (see Figure 4 for the certificate used in Milwaukee). Such measures will promote increased competition, especially in markets where landlords have difficulty attracting tenants, and will help to increase property values and marketing appeal. In some areas, it may not be necessary to make all units lead-safe, but rather to create enough units so that families can find them without incurring significantly greater costs.

In other jurisdictions, however, competitive market forces may not be sufficient to prompt significant private funding of lead-hazard controls, because landlords and low- and middle-income homeowners are unlikely to be able to take on additional debt. In such circumstances, direct federal subsidies and/or tax incentives may need to be considered.

Figure 4
Certificate of Lead Hazard Control

Certificate of Lead Hazard Control

Lead paint hazards have been controlled at

____

(address)

In compliance with essential maintenance practices and standard treatments described in the City of Milwaukee Ordinance Sections 66-47-4 and 5 as prescribed by the City of Milwaukee Health Department

____
Date Issued

____
Date Expired

____
Commissioner of Health

Current and Ongoing Federal Programs and Activities

Lead Paint Hazard Identification And Control

Federal programs addressing lead poisoning involve standards and regulations for lead paint inspections, risk assessments, and abatement; enforcement and compliance with lead regulations; grants to States, cities, and counties to control lead paint hazards in low-income privately-owned housing; grants to States, territories, and Indian tribes to run EPA-approved programs for accreditation of training providers and certification of lead paint professionals; inspections for lead paint hazards in high-risk residential units; evaluation of lead paint detection and abatement methods; development of new technologies; and laboratory accreditation. Virtually all of these activities were authorized under Title X of the 1992 Housing and Community Development Act (The Residential Lead Hazard Reduction Act).

Lead Paint Regulations

EPA regulations cover training, certification (licensing) of lead paint professionals (inspectors, risk assessors, abatement contractors, and workers), and accreditation of training providers by State and Tribal governments (or by EPA in the absence of a State/Tribal program). Published in 1996, these regulations include requirements to ensure that lead inspection and abatement professionals are capable of and required to use work practices that are safe, reliable, and effective. HUD's Lead Paint Hazard Control Grant Program requires that certified workers be used in its grant program for low-income privately-owned dwelling units. Today 36 States, plus the District of Columbia, Puerto Rico, and two Indian tribes have enacted lead paint certification laws. In those States that do not have such laws, EPA will implement certification programs in March 2000 under the authority of Title X. Tens of thousands of inspectors; risk assessors; abatement contractors; painting, renovation, and maintenance workers; and others across the country have been trained or certified, and the system is in place to train many more. HUD provides a grant to maintain a nationwide listing (by State) of certified firms via the Internet (www.leadlisting.org) and a toll-free automated telephone system (1-888-LEADLIST) to help the public locate qualified firms to address lead paint concerns. The Federal Lead Paint Hotline (1-800-424-LEAD) also provides important information.

The Disclosure Rule and Pre-Renovation Education Rule are aimed at providing information to tenants and homeowners. Published jointly by EPA and HUD in 1996, the lead paint Disclosure Rule requires sellers, landlords, and agents to provide lead hazard information and to disclose information about the presence of known lead paint and/or lead paint hazards to prospective homeowners and tenants in pre-1978 housing prior to their housing purchase or rental decision. This rule also gives buyers the opportunity to have the homes tested for lead prior to purchase. Attorney General Janet Reno joined HUD Secretary Andrew Cuomo, EPA Administrator Carol Browner, District of Columbia Mayor Anthony Williams, and local enforcement personnel at a press conference on July 15, 1999, to announce the first judicial actions and nationwide enforcement actions against landlords who had violated this rule.

The lead paint Pre-Renovation Education Rule, which became effective June 1, 1999, requires persons conducting renovations for compensation to distribute awareness information to those receiving renovation services concerning potential hazards created when paint is disturbed. These regulations are an important component of public education activities.

Federally-Assisted Housing

HUD has issued hazard control requirements for housing receiving federal assistance and for federally-owned housing that is being sold. This new regulation, published on September 15, 1999, will take effect one year after publication. For the first time, modern lead paint hazard control will become an integral part of most federally-assisted housing programs. For example, clearance examinations, which ensure that a property is safe for children following repair or hazard control work, will now be required for all housing rehabilitation and maintenance programs receiving federal assistance whenever lead paint may be disturbed.

Grants

HUD operates the Lead Paint Hazard Control Grant Program to control lead paint hazards in privately-owned housing occupied by low-income families and to build local lead abatement and inspection capacity. Additional eligible activities include relocation during hazard control work (to ensure that children are not inadvertently exposed to lead in the course of the work), public education, job training and job creation programs to enable low-income residents to become employed in the lead abatement and associated construction trades, and blood lead testing (if not reimbursable from another source).

These grants, which are now active in over 200 cities, are awarded competitively each year to ensure that communities with the greatest need and capacity are served first. The grants stimulate the effective collaboration of local health, housing, and community development agencies as well as local community-based organizations. They also stimulate leveraging of additional private-sector funding.

The Department of Health and Human Services (DHHS), through the Centers for Disease Control and Prevention (CDC), provides grants to support childhood lead poisoning prevention programs. These grants, mainly to support secondary prevention efforts, are provided to State and local health departments.

In some jurisdictions, HUD grant funds are being used to remediate lead hazards in dwellings where poisoned children have been identified. In addition, CDC works with HUD to promote collaboration with local health agencies that administer lead-poisoning prevention programs.

EPA provides grants to States, territories, tribes, and the District of Columbia to develop and implement programs to accredit training providers, certify lead paint workers and firms, and enforce work-practice standards to ensure that risk assessments, inspections, and abatement of lead-based paint hazards are properly performed by a well-trained and experienced workforce.

Compliance Assurance And Enforcement Of Lead Regulations

Enforcing lead regulations is an important component of programs established to reduce exposure to lead hazards. Most of the new rules mandated by Title X have now been successfully promulgated. Compliance assistance, compliance monitoring, and enforcement of these new rules are critical to producing the full benefits of these regulations. DoJ, HUD, and EPA are responsible for enforcing the new requirements. The strategy for enforcing the Disclosure Rule targets properties with a history of lead-poisoned children, buildings where lead paint hazards may exist, instances of substantial non-compliance, or places for which tips and complaints have been filed through the National Lead Information Clearinghouse (1-800-424-LEAD). To promote enforcement actions that are already underway across the country, DoJ has provided each of its U.S. Attorneys' Offices with guidance on how cases can be investigated, developed, and resolved.

To help regulated communities comply with lead regulations, EPA and HUD undertake compliance assistance activities such as targeted and mass mailings, seminars/ workshops, collaboration with trade associations, and on-site assistance. In March 1999, EPA began enforcing the accreditation requirements for training providers. Beginning in March 2000, EPA will enforce certification work practice requirements in States that do not have an authorized program.

CPSC has banned residential paint that contains more than 0.06% lead as well as toys and other articles intended for use by children that bear lead-containing paint in excess of 0.06% by weight. CPSC continues to investigate and prevent the use of lead-containing paint in consumer products. For example, the Commission has provided guidance to State health officials and others about identifying and controlling lead paint on public playground equipment. CPSC has also identified a number of disparate products that present a risk of lead poisoning from sources other than paint. These products, which include vinyl miniblinds, crayons, and children's jewelry, are intended for use by children or are simply used in or around the household or in recreation. The determination that a product presents a risk of lead poisoning may result in a recall or replacement with a substitute. In addition, the Commission has issued an official guidance policy that urges manufacturers to eliminate lead in consumer products (16 CFR s 1500.230).

CPSC's contribution to protecting children from lead poisoning involves a collaboration with the U.S. Customs Service to conduct surveillance as products enter the United States and to intercept imported children's products that may present a risk of lead poisoning.

Education And Outreach

Educating the public on the dangers of exposure to lead is an important component of reducing childhood lead poisoning. Title X specifically mandates federal agencies to conduct public education and outreach efforts.

Current federal activities include the bilingual Lead Hotline (1-800-424-LEAD); the National Lead Information Clearinghouse; numerous publications and pamphlets (many in both Spanish and English) targeted to parents, homeowners, and building managers; a major Hispanic outreach program (including Spanish public service announcements, specially designed materials, etc.); and advertising campaigns using local bus and subway systems, movie theaters, and mass media. In addition, in FY 2000 EPA is initiating a new grant program for education and outreach in Indian Country.

HUD has provided grants to train painters, renovators, remodelers, maintenance workers, landlords, and others to recognize and control lead hazards. Working with EPA and HUD, CPSC communicates vital information on lead to the public through its hotline, website, and health and safety information disseminated through the Commission's State Partners Program (a cooperative program with State and local governments).

In addition to encouraging screening and follow-up of lead-poisoned children, CDC's Childhood Lead Poisoning Prevention grants support education and outreach efforts. Local grantees use a variety of individual and community-level strategies. Educational materials are developed for health-care providers, managed-care organizations, and parents to communicate the importance of lead screening in high-risk children, especially Medicaid-eligible children. Other DHHS agencies, such as the Health Resources and Services Administration (HRSA) and the Administration for Children and Families (ACF), also conduct childhood lead-poisoning prevention outreach and education efforts for at-risk populations. For example, HRSA's Maternal and Child Health Branch, in conjunction with CDC, supports the National Lead Training and Resource Center in Louisville, KY. This Center provides education and training to health-care professionals (at federal, state, and local levels) who work in the field of childhood lead-poisoning prevention.

Identification And Early Intervention For Children With Lead Poisoning

The programs just described are oriented toward identifying and controlling hazards in housing before they poison children. An immediate response is also needed, however, to help children who have already been poisoned. These children must be screened to identify and correct the source of their lead exposure and thereby prevent further increases in blood lead levels. Medical treatment, nutritional interventions, and early intervention to address developmental consequences of lead poisoning may also be required.

CDC, through its National Childhood Lead Poisoning Prevention Grant Program, provides grants to State and local health departments to promote screening of at-risk children and to ensure appropriate medical and environmental case management is provided for lead poisoned children. In addition, CDC provides management and technical assistance to grantees to build their program and surveillance capacity. All these programs focus on identifying and screening high-risk children (through blood lead testing) and ensuring the provision of case management services. An important part of case management is to ensure that investigations are conducted to identify sources of lead exposure and to ensure their remediation. Because CDC grants may not be used to pay for lead hazard remediation work, these programs face a significant challenge to identify public and private resources to finance such work in low-income housing.

In November 1997, CDC released new screening guidance, "Screening Young Children for Lead Poisoning: Guidance for State and Local Health Officials,"[30] that specifically addresses the issue of reaching high-risk children, including children enrolled in Medicaid. CDC requires all State-level lead poisoning prevention grantees to develop screening plans consistent with CDC guidance. CDC's prevention efforts are supported by the Health Care Financing Administration's (HCFA) Medicaid program, which has required lead screening as part of the Early and Periodic Screening, Diagnostic and Treatment (EPSDT) general health screening guidelines since April 1990.

According to the General Accounting Office (GAO), the Medicaid population accounts for a high proportion of lead poisoned children.[22] HCFA, CDC, HRSA, and other DHHS agencies have been working together to increase lead screening of enrolled Medicaid and other vulnerable children and to improve access to, and the provision of, needed follow-up services for lead-poisoned children. Key elements of the ongoing interagency work are to: 1) ensure compliance with federal lead-screening policies, 2) develop better State-specific data on lead screening and blood lead levels in children, 3) develop a strategy for educating providers and the public about lead poisoning; and 4) promote working relationships with federally-funded programs involved in childhood lead poisoning issues and other activities. For example, federally-subsidized Community Health Centers (CHCs) are an important source of care for Medicaid children and other high-risk populations. HRSA plans to update and reissue a Lead Policy Information Notice to all CHCs in the near future.

Head Start programs, which serve approximately 800,000 low-income children 3-5 years of age across the country, represent an important opportunity to ensure screening of low-income children who were not previously screened at ages 1 and 2. The Administration for Children and Families (ACF) works to ensure that grantees implement Head Start Performance Standards concerning lead screening.

In June 1991, the Report of the House Committee on Appropriations, which accompanied H.R. 2521 to the 1992 Department of Defense (DOD) Appropriations Bill, tasked DOD to organize a Lead Paint Task Force, to coordinate activities with other federal agencies, and to follow guidance established by CDC regarding lead paint activities and childhood lead poisoning prevention. Since that time, policies and guidance for lead hazard management and childhood lead poisoning prevention programs for military personnel have been coordinated by DOD, as well as within the individual services, on an ongoing basis.

DOD has administered childhood blood lead screening programs since 1992. As required by DOD policy, military installations have proactive lead hazard management programs that include health risk assessments of facilities, health screening of children and workers, and lead hazard controls. The blood lead screening results, one measure of the effectiveness of these programs, indicate that these programs are working. According to DOD Office of Health Affairs data from 1992 to the present, blood lead levels above 10 μg/dL of military dependents are consistently below 2%, well under the general population (4.4%).

Research

HUD is conducting the nation's largest study of the effectiveness of modern lead-hazard control methods used by its grantees.[19] The study involves nearly 3,000 dwelling units, hundreds of which have been followed for at least 3 years. The main outcome measures are children's blood lead levels and levels of lead in house dust. HUD has sent several interim reports on the evaluation to Congress, with a major report expected in 2001. Preliminary data show that children's blood lead levels declined by an average of about 25% and dust lead levels on floors, window sills, and window troughs declined by an average of about 60% (see Table 8 on p. 27). These sustained declines have been replicated in a smaller study at Johns Hopkins University.[28,29]

HUD is also conducting research on lead paint hazard evaluation and control methods. This research includes: 1) improving, in conjunction with EPA, on-site inspection methods such as spot test kits and x-ray fluorescence (XRF) instruments; 2) improving laboratory methods used for risk assessments, such as collection and analysis of dust wipe and soil samples; 3) assessing the hazards of lead soil and lead dust in carpets, upholstery, air ducts, and other places where lead can accumulate; 4) improving risk assessments in single-family and multifamily housing; 5) assessing the lead risks to residents from construction, repair, and maintenance projects; 6) using surveys of lead hazard control projects and programs to assess and improve lead hazard control methods, and using laboratory and field testing to evaluate likely candidates for improvements in specific control techniques; and 7) assessing public awareness and understanding of lead paint hazard issues, and identifying approaches for increasing this understanding.

EPA has conducted research that focuses on lead remediation in soils in four areas: 1) identification of mineral forms of lead in soil, 2) effects of mineral forms on bioavailability, 3) *in vitro* and *in vivo* measures of lead bioavailability, and 4) conversions of lead minerals in soil systems. EPA has been evaluating chemical reactions of metals in soil to allow appropriate exposure assessments and to develop environmentally non-intrusive amendments to soil that reduce bioavalability and mobility. In 1999, EPA researchers discovered a method to render lead-contaminated soil safe for humans by immobilizing lead, potentially reducing its bioavailability. This method could potentially decrease the number of children suffering from lead poisoning.

EPA also evaluates (in conjunction with HUD) detection and abatement methods including encapsulants, test kits, and x-ray fluorescence (XRF) lead paint analyzers. In addition, EPA plans to assess existing impediments and barriers to developing new technologies and the need for new methods to promote development of new lead detection and abatement technologies. As regulations are developed that establish standards for renovation, remodeling, and deleading on buildings and superstructures, EPA will use its authority under Title X to evaluate products used for detection, abatement, and deleading.

CDC is conducting and supporting applied research in preventing lead poisoning. Examples of current projects include three randomized trials of primary prevention strategies to avoid increases in blood lead levels. In each study, interventions begin prenatally in order to reduce exposure before infants become mobile and begin ingesting contaminated dust and soil.

CDC is undertaking research to improve the quality of blood lead measurements and to develop new technology to provide immediate results with portable, low-cost blood lead analyzers. Under the Blood Lead Laboratory Reference System (BLLRS), CDC sends blood lead specimens for quarterly analysis to over 275 laboratories worldwide. The results are then compared to known reference values. Participating laboratories are advised of their performance, and consultation is offered to improve performance.

In collaboration with DOE, EPA, and industry partners, DoD has developed many new technologies in the areas of encapsulation and abatement, training, and soil remediation. The U.S. Army is currently conducting demonstrations and validations of these technologies. The thermal spray vitrification (TSV) process was developed by the Army to remove hazardous lead paint from steel structures. Because of the environmental stability of the waste, vitrification has been designated the Best Demonstrated Available Technology (BDAT) by the EPA. The U.S. Navy funded the development of a real-time lead-dust monitor to analyze airborne lead exposure during construction and abatement activities. The Army is working on developing environmentally-friendly paint strippers and innovative technologies, such as chemical stabilization and phytoextraction, for the abatement of lead in soil.

Surveillance And Monitoring

The National Health and Nutrition Examination Survey (NHANES), which is administered by CDC, is the only source of periodic nationally-representative data on blood lead levels in the U.S. population. Data from the NHANES are used to track trends in blood lead levels, identify high-risk populations, and support regulatory and policy decisions. The next NHANES survey will, for the first time, include a measurement of lead in house dust that will provide valuable data on the population distribution of this important source of exposure. This effort is funded by HUD and was designed collaboratively by CDC and HUD.

CDC provides funding and technical assistance for States to develop laboratory-based surveillance systems to determine blood lead levels in children. Data from these State systems can be linked to data from the State Medicaid Agency (SMA) to monitor SMA compliance with HCFA policy. CDC uses data submitted by State systems to form a national surveillance database.

The Agency for Toxic Substances and Disease Registry (ATSDR) is the public health arm of the Superfund Program. ATSDR undertakes the study of blood lead in populations near Superfund sites and funds State health agencies to undertake this type of work. ATSDR's work in this area has helped to guide development of policies covering the cleanup of sites contaminated with lead.

Vision:

Eliminate childhood lead poisoning in the United States

Increased efforts to control lead paint hazards in older housing are needed to eradicate childhood lead poisoning. Lead hazards should be controlled before children are poisoned. The need for additional resources is greatest in deteriorated low-income housing, where lead hazards are especially common. Other ongoing efforts will continue to control exposure from other lead sources and to focus attention on expanding efforts to provide early intervention for children at highest risk.

The foundation for solving this problem has been established over the past decade. A qualified, licensed pool of inspection and hazard control contractors now exists, and the system for training and certifying more people is in place. Hazard control techniques have been implemented and shown to be effective in over 200 cities through HUD's grant program for privately-owned low-income housing. A standard of care has been established through HUD's new regulation published on September 15, 1999 covering all federally-assisted housing. Known lead paint hazards now must be disclosed at the time of sale or lease of most pre-1978 residential properties where children may reside. Despite these and other advances, more must be done if the nation is to achieve the vision of eradicating childhood lead poisoning.

This document estimates the additional resources needed over the next 10 years to eliminate lead paint hazards in housing with young children. Projections are based on the third National Health and Nutrition Examination Survey (NHANES)—Phase 2, the 1997 American Housing Survey, the 1999 Economic Analysis accompanying the HUD regulation covering federally-assisted housing, the Residential Energy Consumption Survey, U.S. Geological Survey data on the historical use of lead in paint, and the 1990 HUD National Survey of Lead paint in Housing (see the Appendix to this report for a detailed description of the methodology used to make these projections).

Number Of Housing Units With Lead Paint Hazards That Need To Be Addressed

Any house with lead paint could eventually pose a hazard to young children. Most such houses, however, do not contain immediate lead hazards. Although about 60% of the nation's housing stock contains lead paint, only 4.4% of all children under 6 have blood lead levels above 10 μg/dL.[5,17]

Between 86-95% of all lead in paint is contained in housing built before 1960 (see Tables 4 and 5). Therefore, resources to address residential lead paint hazards

- Lead poisoning is a completely preventable disease.
- Residential lead paint hazards in homes of children can be virtually eliminated in 10 years.
- Every child deserves to grow up in a home free of lead paint hazards.

Table 4
Lead Consumption in Housing per Decade

	Lead Consumption (thousands of tons)	Decade-End Occupied Units (millions)	White Lead per Unit (pounds)	1991 AHS Units (millions)	Lead Paint In Housing (thousand tons)		Percent of All Lead Paint
					Before Rehab	After Rehab	
1914-23*	1340	24.35	110	9.02	496	413	49.1%
1920-29	1663	29.91	87	5.06	221	184	21.9%
1930-39	1158	34.86	42	5.98	126	104	12.4%
1940-49	1665	42.83	22	7.67	84	72	8.6%
1950-59	1012	53.02	7	12.51	44	37	4.5%
1960-69	863	63.45	3	14.52	22	20	2.4%
1970-79	654	80.39	1	21	11	10	1.2%
					1,004	841	100%

Source: U.S. Geological Survey, American Housing Survey (see Appendix)

* *White lead data from 1914-1923 is used to estimate consumption between 1910 and 1920 because 1914 is the earliest year of available data.*

Table 5
HUD National Lead Paint Survey Data (1990)

		Pre-40	1940-1959	1960-1978	Total
Lead Paint Surface Area (million sq. feet)					
	Interior	15,912	8,247	5,279	29,438
	Exterior	25,969	12,635	10,502	49,106
Average Lead Paint Concentration (mg/sq.cm)					
	Interior	5.7	2.5	2.0	
	Exterior	6.1	4.2	3.2	
Total Lead in Lead Paint (1000 tons)		255	75	45	376
	Interior	93	21	11	125
	Exterior	162	54	34	251
Percent of Total Lead in Paint		68%	20%	12%	100%
	Interior	74%	17%	9%	100%
	Exterior	65%	22%	14%	100%

Source: *HUD National Survey of Lead Paint in Housing*[17]

should be targeted to pre-1960 units, with the oldest or most-deteriorated houses being treated first.

Analysis of American Housing Survey data (see Appendix) indicates that there are about 24 million pre-1960 dwelling units in 1999 at risk of having lead paint hazards. These are units with interior lead paint that have not undergone major renovation (e.g., total window replacement). The number of demolitions and renovations through 2010 in Table 6 is based on rates experienced between 1989 and 1997 as reported in the American Housing Survey conducted by the Bureau of the Census.

In addition to demolition and renovation (including private hazard control), additional units will undergo hazard control as a result of HUD's regulation for federally-assisted housing. Based on the Economic Analysis for the rule, HUD estimates that it will produce 1.4 million pre-1960 lead-safe units during the 10 years from 2000 to 2010.

Table 6 shows that about 5.6 million units will undergo demolition and renovation over

Table 6
Pre-1960 Units at Risk of Having Lead Paint Hazards in 2010

Housing Stock	Number of Housing Units (millions)
Total Units at Risk of Lead Paint Hazards in 1999	24.0
Reduction Due to Demolition, 2000-2010	-1.8
Reduction Due to Substantial Renovation, 2000-2010	-3.8
Subtotal (Total Units at Risk of Lead Paint Hazards in 2010)	18.4
20% of Subtotal Occupied By Low-Income Families	3.7
Reduction Due to HUD Regulation of Federally-Assisted Housing	-1.4
Total Low-Income Units in 2010 Requiring Federal Assistance	2.3

See Appendix for methods and data sources used to derive these estimates.

the next 10 years, assuming current trends continue. In short, this means that by the year 2010, 18.4 million pre-1960 units will remain at risk of having lead paint that could one day pose a threat to children if nothing more is done.

Households with incomes less than 1.3 times the poverty level [Poverty Income Ratio (PIR) <1.3] occupy about 20% of all units. A PIR<1.3 was used here because it was the definition of low-income used in NHANES and because it is a good approximation of the low-income eligibility criterion used in the HUD grant program (see Appendix). Applying this percentage to the 18.4 million units with lead paint that exist prior to the implementation of the HUD rule results in 3.7 million units occupied by families with incomes less than 1.3 times the poverty level. Subtracting the 1.4 million units affected by the HUD rule (because virtually all these will be occupied by families with incomes of PIR<1.3) yields a remainder of 2.3 million units. Thus, over a 10-year period, an average of 230,000 units would need to be evaluated and any identified lead paint hazards controlled each year.

Many of these remaining 2.3 million units may not pose any problem if they are maintained in such a way that the lead paint does not become hazardous. Tax credits, market forces, public education, and other incentives can encourage moderate- and upper-income owners to address lead paint before it becomes hazardous. For low-income families, however, direct federal financial assistance and leveraged private funding will continue to be needed because no other effective option exists.[18]

Cost Of Controlling Children's Exposure To Lead Paint In Housing

The cost of controlling lead paint hazards in any given house depends on the unit's condition, extent of lead hazards, type of building components coated with lead paint, and type of hazard control method employed. Economies of scale also exist for multifamily housing.

Housing is kept viable through both capital improvements and ongoing maintenance. Similarly, short-term (interim controls) and long-term (abatement) methods are employed to control lead paint hazards. Definitions for these methods can be found in Title X of the 1992 Housing and Community Development Act. Both methods have been shown to be effective in controlling childhood exposures to lead. Interim controls involve the repair of deteriorated paint and require continuing evaluation and management to ensure that the lead paint remains intact and non-hazardous. Abatement, a more permanent solution, involves the removal of painted building components, construction of a durable enclosure or covering, and/or paint removal.

Table 7 presents the estimated average annual costs of addressing residential lead paint in pre-1960 housing over the next 10 years. Costs are estimated for two approaches: 1) interim control of lead paint hazards identified through lead hazard screening (a low-cost way to identify the likelihood of lead hazards), and 2) abatement of lead paint identified through a complete inspection/risk assessment of all lead paint and all lead paint hazards). Average costs are based on the HUD Economic Analysis[31] presented in the regulation on federally-assisted housing and the evaluation of the HUD Lead Paint Hazard Control Grant Program,[19] which are currently the most complete sources of cost data for this field. The cost estimates are from actual cost data obtained from HUD grantees and from interviews with lead hazard control contractors.

For the interim controls approach, these data show an average cost of $120/unit for lead hazard screening and an average hazard control cost of $2,500 per unit (to cover paint stabilization, window work, cleanup, and clearance). To arrive at an overall average cost, these costs are applied to one-third of the units to be addressed because the Economic Analysis of the HUD rule indicates that about one-third of pre-60 units with lead paint will have lead paint hazards (see Appendix). Thus, per-unit interim control costs are $120 + (32% x $2500) = $920 (or about $1,000).

The $2,500 estimate for the interim controls approach includes $1,000 for exterior paint stabilization, $500 for interior paint stabilization, $300 for window work (to repair friction surfaces that produce lead-contaminated dust), $350 for cleanup, $150 for clearance testing, and $200 for relocation, administrative, and other costs. These

Table 7
Estimated Average Direct Annual Costs of Options to Address Lead Paint in Pre-1960 Housing, 2001-2010

Pre-1960 Housing Stock	Lead Hazard Screening and Interim Controls ($1,000 per unit)	Inspection/Risk Assessment and Full Abatement of Lead Paint ($9,000 per unit)
All Pre-1960 Housing with Lead Paint (1.84 million units/year)	$1.84 billion	$16.6 billion
Pre-1960 Housing Occupied by Families with PIR<1.3, Not Covered by HUD Regulation (230,000 units/year)	$230 million	$2.1 billion

Source: Evaluation of the HUD *Lead-Hazard Control Grant Program; The Economic Analysis for the* HUD *Lead Paint Regulation for Federally Assisted Housing (see Appendix)* costs do not include any other housing rehabilitation costs that may also be incurred at the time of hazard control.

For the more-permanent abatement approach, an average cost of $500/unit for the lead paint inspection and risk assessment is applied to all units to be addressed, as well as an average abatement cost of $8,500 per unit (including cleanup and clearance), because virtually all units have some lead paint. Thus, per-unit abatement costs are $8,500 + $500 = $9,000.

Comparing The Costs Of Short- And Long-Term Hazard Controls

Investments in housing consist of ongoing maintenance activities and capital improvements. Specialized short-term maintenance (interim controls) can eliminate lead paint hazards as long as such maintenance is continued. Lead paint hazards can also be permanently controlled through long-term abatement methods. Short-term maintenance activities include repair of deteriorated paint and cleanup, treatment of painted friction surfaces (e.g., windows) that create lead-contaminated dust, followed by dust testing. Long-term methods include removal of building components coated with lead paint (e.g., window replacement), enclosure (e.g., new siding), and other methods. Both interim controls and abatement have been shown to produce lead-safe dwellings.

To leverage private funding to the fullest extent possible, this report recommends that low-income housing be made lead-safe using interim controls followed by ongoing management until the building is either demolished or abated. If ongoing management is not implemented consistently, however, lead hazards may reappear. The challenge today is to eliminate lead paint hazards in as many dwellings as possible. Ideally, all housing with lead paint would be permanently abated. Abatement alone, however, is unlikely to achieve this goal within the foreseeable future, unless significant funding is provided from non-federal sources. Because resources are limited, interim controls followed by either ongoing management and/or abatement provide the best opportunity for success and permit local entities to implement a strategy consistent with local needs.

Benefits Of Eliminating Childhood Lead Poisoning

Using conservative assumptions, the quantifiable monetary benefit (which does not include all benefits) of eliminating lead paint hazards through interim controls in the nation's pre-1960 low-income housing stock over the next 10 years will be $11.2 billion at a 3% discount rate ($3.5 billion at a 7% discount rate). The net benefit is therefore approximately $8.9 billion at a 3% discount rate (or $1.2 billion at a 7% discount rate). The monetary benefit of abatement of low-income housing is estimated at $37.7 billion using a 3% discount rate [$20.8 billion using a 7% discount rate (see Appendix)]. The benefit of permanently abating lead paint in all housing is considerably greater because more children would benefit over a considerably longer time span.

The quantified monetary benefits include savings associated with avoided medical care, avoided special education, increased lifetime earnings due to increased cognition, and market benefits due to improvements in housing. Other more intangible benefits may exist, but they have not been fully studied and are not included in this total. These benefits may include avoided hypertension in later life; improvements in children's height, physical stature, hearing, and vitamin D metabolism; and expenses and emotional costs involved in caring for poisoned children. In short, the quantified monetary benefits cited may underestimate the actual benefits because of the many unquantifiable benefits associated with eliminating childhood lead paint poisoning.

The overall benefit of this 10-year strategy is displayed in Figure 5, which shows that childhood lead paint poisoning can be drastically reduced by 2010 through expanded prevention efforts. Without such efforts, about 135,000 children from low-income families living in pre-1960 housing will continue to be poisoned annually at the end of the next decade.

Federal Funding

Federal funds can be used to leverage private resources to create lead-safe housing. In some jurisdictions, it may be possible to create enough lead-safe housing for families, yet not necessarily address all housing units with lead paint. In other jurisdictions, virtually all housing will need to be made lead-safe to protect children.

Public and private funding should be increased substantially to help control lead paint hazards in housing. The HUD Lead-Hazard Control Grant program is currently funded at $60 million/year. Beginning in FY 2001, the Administration will request an increase of 50%, to $90 million. Funding in later years needs to be increased further based in part on the ability to leverage private financing and on updated surveys of children's blood lead levels and lead paint hazards in housing. The FY 2001 President's Budget also funds lead programs in other federal agencies including EPA, DHHS, DoJ, and DoD. (See budget summary on page 9)

Evaluation Of The HUD Lead Hazard Control Grant Program

Table 8 shows preliminary data on blood lead levels in resident children and lead levels in house dust. The preliminary data compiled in the evaluation of the HUD lead paint grant program show that modern hazard control techniques employed by cities and States receiving HUD grants are effective in drastically reducing both blood lead and dust lead levels. A major report on these findings will be completed in 2001.

Figure 5
Potential Impacts of Various Actions on the Number of Low-Income Lead Poisoned Children

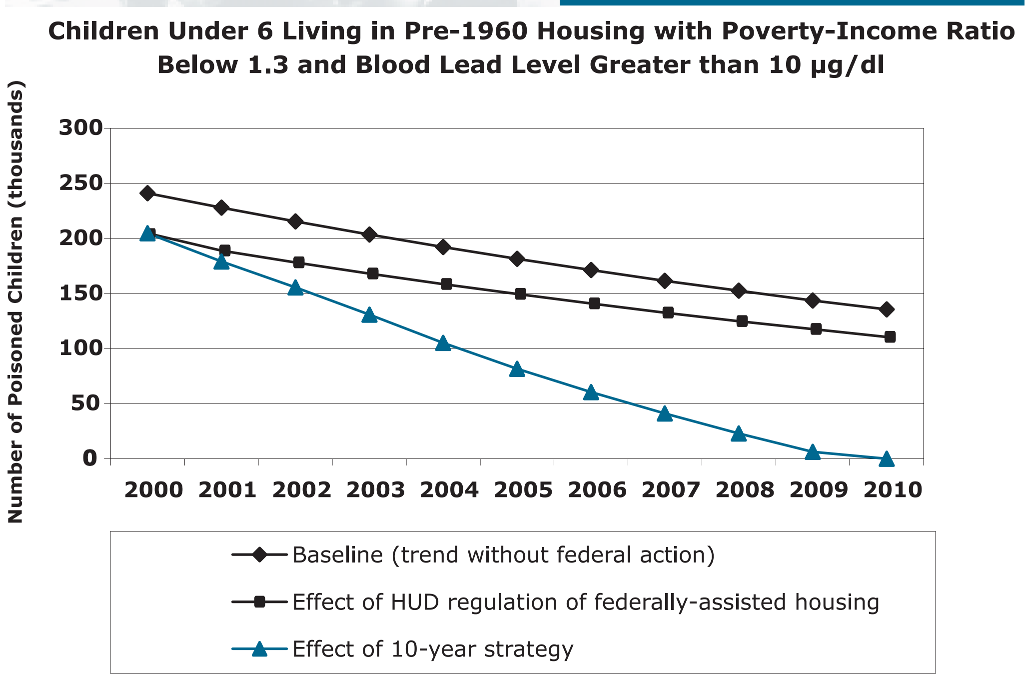


Table 8 Preliminary Outcome Data for HUD Lead Paint Hazard Control Grant Program Evaluation (Vacant and Occupied Dwelling Units Combined)

		Blood (n=485 children)			Dust					
		Decline in Median Blood lead Level (% of baseline)	% of Children With Increases Greater Than 3 µg/dL Compared to Baseline	% of Children With Decreases Greater Than 3 µg/dL Compared to Baseline	Median % of Lead Dust Decline Comparing Baseline and Clearance (n=1,943 dwelling units)			Median % of Lead Dust Decline Comparing Baseline and 2 Years After Control (n=568 units)		
	Strategy*		All measured at 12 months		Floors	Sills	Troughs	Floors	Sills	Troughs
Interior	02	25%	9%	43%	14%	80%	98%	43%	64%	57%
	03	31%	10%	58%	10%	68%	91%	57%	68%	88%
	04	26%	6%	59%	33%	92%	100%	73%	79%	96%
	05	17%	7%	38%	68%	97%	100%	66%	92%	96%
	06	**	**	**	93%	95%	97%	**	**	**
Exterior	02	28%	8%	55%	67%	94%	100%	69%	88%	94%
	03	17%	6%	42%	35%	96%	100%	79%	92%	99%
	04	24%	3%	55%	49%	94%	100%	58%	81%	95%
Site	01	**	**	**	38%	91%	100%	85%	89%	88%
	02	**	**	**	62%	95%	100%	92%	92%	93%
	03	**	**	**	46%	92%	99%	86%	76%	**

** Strategy codes refer to increased intensity of hazard control*
***Less than 15 results*
Median baseline blood lead level = 10 µg/dl
Median baseline dust lead level. Floors=22 µg/sq.ft., Sills=316 µg/sq.ft., Troughs=5,665 µg/sq.ft
Blood and dust data from February 1999 dataset

Recommendations

The budget proposals of federal agencies are accompanied by performance goals and measures for their programs and activities. These annual performance goals and measures will be used to assess progress toward the goals presented here. Longer-term progress toward the vision of the Strategy - to eliminate lead poisoning in children in the United States - will be measured through the National Survey of Lead Paint Hazards in Housing and the National Health and Nutrition Examination Survey (NHANES).

I. Primary Prevention Recommendations: Prevent Lead Exposure In Children

Goal

By 2010, lead paint hazards in housing where children under six live will be eliminated through:

- Federal grants and leveraged private funding to be used for the identification and elimination of lead paint hazards to produce an adequate supply of lead-safe housing for low-income families with children
- Outreach and public education
- Enforcement and compliance assistance and monitoring

Increase the availability of lead-safe dwellings by increasing federal funding of HUD's lead hazard control grant program and by leveraging private and other non-federal funding.

The HUD grant program should be expanded to enable local governments and others involved to accelerate the production of lead-safe housing units. The program should continue to emphasize control of lead paint hazards in pre-1960 low-income privately-owned housing units where young children are expected to reside.

Over the past decade, HUD grants have been provided to local and State governments to enable them to eliminate lead paint hazards in low-income privately-owned dwellings. In most cases, these are the only financial resources available to make such dwellings safe for resident children in this housing. Each year for the past 4 years, HUD funds were available to make an award to an average of only one in four applicants.

Active HUD lead paint hazard control grant programs now exist in 200 cities across the country. These programs have helped create a large trained workforce, local lead-poisoning prevention ordinances, job creation and job training programs for low-income residents, new collaboration between local housing and health departments, and locally-driven public education and outreach campaigns. Because the capacity now exists, the future grants can be restructured in several ways. Specifically, the 3-year-grant period can be reduced to 2 years because most future grantees will not need the planning period to organize the work. Grants should continue to be awarded competitively to target the funds to jurisdictions with the greatest need and capacity. Grants should also be used to leverage private and non-federal resources.

Increase compliance monitoring and enforcement of lead paint regulations.

New federal regulatory responsibilities demand a new emphasis on enforcement. In addition to authorizing federal grants to owners of low-income privately-owned housing to correct lead paint hazards, Title X also provides for streamlined and more effective federal regulations that collectively provide a comprehensive framework for eliminating lead paint hazards. Most of the new regulations mandated by Title X have now been issued in final form. Together, compliance with these regulations:

- ensures that parents receive the information they need to protect their children before they are obligated under a new sales or lease contract or before renovation work is begun in their residence;
- provides a skilled, trained, and licensed workforce to implement safe work practices that will prevent renovation and hazard control activities from inadvertently poisoning children;
- creates new standards of care to protect resident children from lead paint hazards; and
- ensures safe management and disposal of lead paint debris.

The disclosure rule requires sellers, landlords, and agents to provide lead hazard information and to disclose information about known lead paint and lead paint hazards to prospective homeowners and tenants in pre-1978 housing prior to their rental or purchase decisions. This rule also gives buyers the opportunity to conduct an inspection for lead paint hazards. A 1998 HUD-funded survey conducted through the Bureau of the Census showed poor compliance with this rule. At least 36% of survey respondents were certain that they did not receive the required information when they bought or rented pre-1978 housing, and another 52% were uncertain. Enforcement of the disclosure rule, which cannot be delegated to the States, rests with EPA, HUD, and DoJ. Enforcement can take the form of administrative actions by EPA or HUD, and civil or criminal referrals to DoJ.

Efforts to enforce the disclosure rule need to be increased to prompt improved compliance. Enforcement actions should continue to be concentrated in housing with a history of lead poisoned children, in housing with physical or management problems that indicate the likely presence of lead paint hazards, and in places for which tips and complaints are received from the public. Targeted inspections and enforcement efforts should be increased through close federal cooperation with local health departments to identify landlords of housing with lead-poisoned children as well as through cooperation with local law enforcement authorities responsible for enforcing local lead paint ordinances.

EPA will have responsibility for enforcing four other lead paint rules in those States and on tribal lands without authorized programs. These rules will address certification and training, pre-renovation education, use of safe and reliable work practices at expanded locations, and management and disposal of lead paint debris. The Agency should encourage States, tribes, and territories to adopt approved programs, given the critical role they play in protecting children from lead poisoning.

The Federal Government should expand its use of integrated strategies that combine compliance assistance, incentives, monitoring, and enforcement. These techniques, which have been effective in addressing environmental and compliance problems in other program areas, will complement the more traditional enforcement efforts.

These national and regional integrated initiatives should be tailored to the pertinent lead rule involved and include an appropriate mix of the following:

- **Compliance assistance,** which includes targeted and mass mailings, seminars/workshops, collaboration with trade associations and local groups, on-site assistance, and publicizing the toll-free phone number (800-424-LEAD) to report tips and complaints;

- **Compliance incentives,** such as a window of opportunity to audit, disclose, and correct violations as well as to receive penalty waivers or reductions in accordance with EPA's auditing and small-business policies;

- **Compliance monitoring,** including coverage of urban and low-income neighborhoods and follow-up to tips and complaints, with a priority focus on sites inhabited by children or pregnant women; and

- **Targeted enforcement actions.**

The new regulation for federally-assisted housing, which takes effect September 2000, will also require enforcement. During the year-long phase-in period, HUD will conduct a wide variety of training and educational activities for HUD constituents such as non-profit housing providers, public housing authorities, landlords enrolled in rental subsidy and other programs, and organizations using HUD-funded housing rehabilitation, maintenance, and finance programs.

Without this increased enforcement, the full benefits of lead paint regulations will not be realized. Increased enforcement will raise awareness of the precautions that can be taken to protect children from lead poisoning and to reduce both lead paint hazards and children's exposure to lead.

Conduct education and environmental intervention for families with children at high risk for future lead poisoning and provide a link between education and public health programs so that families have access to assistance programs.

Community-Level

National campaigns to educate parents, landlords, renovation and remodeling workers, housing inspectors, public health professionals, and others about lead poisoning should be expanded. In 1999 the Senate passed a resolution establishing the last week in October as National Childhood Lead Poisoning Prevention Week and the President issued a message of support.

Individualized Education Through Public Health Agencies

Even with a substantial expansion of resources to control residential lead hazards, a significant number of dwellings that could house families with young children will remain with lead hazards for several years. Outreach programs on the public health benefits of hazard control activities should be extended to identify at-risk families, especially those with pregnant women or young infants who live in homes with lead hazards. These outreach programs should be linked to existing lead-safe housing programs and resources for hazard control.

Federally-supported State and local childhood lead poisoning prevention programs currently focus their limited resources to ensure screening and follow-up of children with elevated blood lead levels. With additional federal support and leadership, such programs should expand their efforts to identify at-risk families and provide services to them before children are poisoned. To best serve at-risk families, such efforts should be coordinated with existing programs such as Women and Infant Care (WIC) and Healthy Start. Families identified should receive education about lead poisoning prevention, be offered lead hazard assessments of their homes, and be assisted in obtaining appropriate services (such as HUD lead hazard control grants) to remediate identified lead hazards. Programs should also provide social services and other assistance to families for which relocation to lead-safe housing is the best alternative. Neighborhood lead exposure sources should be assessed and addressed in collaboration with State and local environmental agencies and community organizations.

Conduct a study of lead hazards in child-care centers.

CPSC, in collaboration with HUD and EPA, should consider conducting a study of children in both home-based and institutional child-care centers to determine if they are being exposed to lead hazards. If children in the centers are at risk, child-care centers should be included in the strategy to prevent lead poisoning in children while they are at the centers.

Coordinate federal weatherization and lead-hazard control programs.

DOE provides funds to more than 970 local governments and non-profit organizations annually to weatherize and reduce energy consumption in approximately 67,000 low-income housing units. The DHHS low-income energy-assistance program also funds weatherization projects. Some communities are already leveraging funds from both HUD's lead hazard control program and these weatherization programs to cost-effectively reduce the use of energy and control lead paint hazards simultaneously. As a part of this strategy, HUD, DOE, HHS, and EPA have begun to identify and implement additional actions to ensure weatherization activities are consistent with modern lead hazard control techniques, and increase the collaboration between these successful programs to yield additional health benefits and cost savings. This collaboration should actively continue. Specifically:

- DOE and HHS, in partnership with HUD and EPA, should ensure all federally-funded weatherization activities are conducted in a manner consistent with modern lead hazard control techniques. This includes providing lead hazard control education and training opportunities for all weatherization workers.

- DOE, HHS, and HUD should consider conducting a study of the cost and health benefits of simultaneously conducting weatherization and lead hazard control activities, including an assessment of the types of weatherization activities that provide the greatest energy savings and lead hazard reduction (e.g., window replacement).

- DOE, HHS, and HUD should emphasize collaboration between their respective weatherization and lead hazard control grant programs to ensure their grantees combine these two activities in a cost-effective and safe manner.

- HUD and EPA should include information about the energy savings associated with lead hazard reduction activities in their relevant educational programs and materials.

Explore the use of financial incentives (such as tax credits or deductions) or federal grants to control lead paint hazards in housing occupied by low- and moderate-income families with young children not served by HUD grants.

The HUD grant program targets assistance to residences with lead paint hazards that are occupied by low-income families with children under the age of six. Since public funds may not be available for some low-

Current Tax Treatment of Hazard Control Costs

The costs of deleading an owner-occupied residence cannot be deducted, but may be added to the basis of the property if the deleading costs are capital expenditures. Deleading costs incurred by landlords of residential and non-residential property are either currently deducted, or must be capitalized and recovered over the useful life of the property. Whether deleading costs are deductible or must be capitalized depends on the facts and circumstances of the situation.

In general, removing lead paint and replacing it with non-lead paint is considered a repair and is currently deductible by landlords. The paint can be either inside or outside the building. If a $10,000 expense can be currently deducted (expensed), then the taxpayer can include $10,000 as a deduction on the tax return for the year the expenditure was paid or incurred. Replacing all the windows in a building generally would be a capital expenditure. Thus, if the property is initially purchased for $200,000 and $10,000 is incurred to replace all the windows, then the basis in the property is $210,000 ($200,000 + $10,000). This $210,000 basis may be recovered through depreciation over the useful life of the building or upon its sale. Replacing some windows may be a repair and currently deductible or it may be a capital expenditure, depending upon whether the replacements are determined to have materially added to the value or prolonged the useful life of the building. For a family with a young child who suffers or had suffered from lead poisoning, the cost of removing or covering lead paint in areas of the dwelling in poor repair and readily accessible to the child may be a deductible medical expense. Medical expenses are deductible to the extent that they exceed 7.5 percent of annual income. Expenses that would otherwise be considered capital expenditures may be deducted in the current year to the extent that the cost exceeds the resulting increase in the value of the property. In other cases, the costs of deleading an owner-occupied residence cannot be deducted, but may be added to the basis if the deleading costs are capital expenditures.

and moderate-income families with children, additional financial incentives may be warranted. This recommendation calls for further work to determine the specific federal grants or tax incentives that would most efficiently encourage proper control of hazards in homes occupied by low- and moderate-income families.

Given federal resource constraints and the financial capacity of higher-income families to pay for proper hazard control, the financial incentives should be targeted to low- and moderate-income families or to owners of residential rental property serving these families. Further exploration on the specifics of the financial incentives would enable a careful weighing of the advantages and disadvantages of each proposal.

II. Secondary Prevention Recommendations: Increase Early Intervention For Lead-Poisoned Children

Goal

By 2010, eliminate elevated blood lead levels in children through:

- increased compliance with existing policies concerning blood lead screening; and
- increased coordination across federal, state and local agencies responsible for outreach, education, technical assistance, and data collection related to lead screening and lead hazard control*

**Note: HCFA, CDC, and CDC's Advisory Committee on Childhood Lead Poisoning Prevention will be developing criteria to evaluate requests from State Medicaid Agencies (SMAs) to waive the current Medicaid requirement to screen all Medicaid-eligible children. These waiver requests are based on data provided by SMAs on the prevalence of elevated blood lead levels in their Medicaid-eligible population.*

Increase compliance with existing HCFA policies concerning blood lead screening.

CDC recommends that State and local jurisdictions develop screening guidelines to target children at high risk of lead poisoning based on community and individual risk factors. Data from phase II of the third National Health and Nutrition Examination Survey (NHANES II, 1991-1994) show that children in Medicaid represent a high-risk group comprising 83% of all children with blood lead levels of 20 μg/dl and above. As of October 1998, HCFA policy requires that all children enrolled in Medicaid receive a screening blood lead test at age 12 and 24 months. Data reflecting this 1998 policy on lead screening in the Medicaid population are not yet available. A GAO study, based on claim data from 1994 and 1995, was conducted in 15 States prior to the new policy. This study showed that less than 20% of Medicaid children had been screened nationally (based on NHANES data) and that screening rates varied widely from State to State but were less than 50% in all cases.[22]

The following discussion recommends a number of additional measures. After GAO issued a report indicating that about half of the written policies on lead screening were inconsistent with HCFA policy, HCFA released a letter to State Medicaid Directors (SMDs) reiterating the HCFA policy on lead screening and the importance of such screening. In addition, HCFA plans to individually contact States not currently in compliance with HCFA policy and work with their SMDs to bring policies into compliance.

Lead screening in the Medicaid population should be routinely monitored to track compliance with HCFA and SMA policies. Most States, however, do not have systems to routinely monitor screening penetration and the prevalence of elevated blood lead levels in the Medicaid population. HCFA Form-416 used by SMAs to report services provided under EPSDT should be revised to promote the development of data systems for identifying Medicaid children who have received blood lead screening. CDC and HCFA should continue and expand upon ongoing efforts to support and assist State health departments and SMAs to link blood lead surveillance data to Medicaid data. Such efforts will improve the quality of data needed to monitor the penetration and prevalence of lead screening. HCFA should require SMAs to monitor and report on lead screening penetration. In cooperation with CDC, HCFA should develop specific performance goals for lead screening and require

SMAs to develop plans for improvement when performance goals are not met.

HCFA and CDC should continue to provide guidance and technical assistance to SMAs to ensure that lead screening requirements are incorporated into Medicaid-managed care contracts and that adherence to such requirements is monitored.

Because the risk of lead poisoning varies substantially among geographic areas and demographic groups, the risk among Medicaid populations in different states also will likely vary substantially. It is further expected that some SMAs will request waivers from HCFA's lead screening policy. HCFA is currently working with CDC and CDC's Advisory Committee on Childhood Lead Poisoning Prevention to develop criteria for reviewing such waivers based upon actual data on blood lead levels in a State's Medicaid-eligible population.

Support community-based outreach, education, and advocacy efforts for lead screening of Medicaid-eligible children.

In addition to the intervention through health-care-providers, an important part of the efforts to increase the use of clinical preventive services involves the education and empowerment of consumers of health care to enable them to seek out preventive care. Efforts should be expanded to inform Medicaid-eligible families with young children of the need for lead screening. CDC should encourage the lead poisoning prevention programs of State and local health departments to partner with community-based organizations (CBOs) in such outreach and education efforts. Logical partners in this effort would include CBOs currently involved in outreach and education activities to increase immunization coverage and those working to increase enrollment of eligible families in the Medicaid program and related health insurance entitlements. SMAs may fund the latter as an administrative expense under HCFA rules.

Ensure compliance with Medicaid policy on case-management services and one-time on-site identification of the source of lead among Medicaid-eligible children with lead poisoning.

The most important part of the treatment of childhood lead poisoning is the identification and elimination of the sources of lead exposure. In addition, case management services are needed to coordinate interventions related to environmental, housing, medical, and social factors. GAO found that most SMAs did not reimburse for environmental and case-management services, perhaps because current HCFA policy indicates that these may be covered services. The October 22, 1999, letter from HCFA to SMAs clarified HCFA policies regarding the coverage of investigations to determine the source of lead and case-management services. It is recommended that HCFA actively encourage SMAs not currently covering environmental and case-management services to provide this benefit and that CDC and HCFA provide technical assistance to SMAs for implementing such a benefit.

Encourage and provide technical assistance to SMAs to explore options for covering additional environmental treatment services for children with lead poisoning.

Essential environmental services needed to identify and control lead exposure in the environment of children with elevated blood lead levels may not be routinely covered under current HCFA policy. For example, HCFA regulations do not permit reimbursement for laboratory analysis of environmental samples such as dust, paint, soil, or water. Although visual inspection of paint and on-site x-ray fluorescence (XRF) analysis to measure lead in paint may be covered services, research and current guidelines developed by HUD (together with CDC) indicate that laboratory measurements, especially of lead in house dust, bare soil, and drinking water, are necessary to identify sources of exposure. One possible option for coverage of additional environmental services for Medicaid-eligible children with elevated blood lead levels is through a 1115 demonstration waiver, whereby Medicaid savings can be applied to the provision of additional benefits. For example, Rhode Island was approved to expand its Statewide 1115 Medicaid demonstration waiver to cover the cost of replacing windows in the homes of children diagnosed with lead poisoning. Although replacing windows is not a covered item under the "regular" Medicaid program, Rhode Island was able to obtain HCFA approval for this because it financed the program with Medicaid savings created through other aspects of its 1115 waiver. This innovative program is expected to improve the health of lead poisoned children by removing a major source of contamination from their homes. Under the HHS lead initiative, HCFA has committed to provide technical assistance to SMAs developing such waiver applications.

III. Research

Develop and evaluate new cost-effective lead paint hazard control technologies.

New technologies are continually being developed to make lead paint hazard identification and control services more affordable. Research is needed to help develop, evaluate, and market new products. For example, x-ray fluorescence technologies may be able to provide rapid on-site analysis of lead levels in house dust. Use of this technology would eliminate the need for laboratory analysis. New durable coating products may render lead paint inaccessible for long periods of time and may reduce the amount of dust generated.

Further research also is needed to develop methods of removing lead paint in ways that do not generate dust, thus reducing occupational exposures and the need for extensive cleanup following lead hazard control work.

Extend field-based housing studies on the longevity of lead paint hazard controls.

For the past several years, HUD has sent an annual report to Congress measuring the cost-effectiveness of the grant program. The main outcome measures in this report are blood lead levels in resident children and levels of lead in house dust. Current plans are to follow the trends in the houses studied over a 3-year period, with a major report due in 2001. Preliminary data indicate that large reductions in house-dust lead levels have been achieved and maintained (see Table 8)

To evaluate the full longevity potential of the modern hazard control techniques employed by HUD's grantees, the study should be extended for another 7 years to fully measure the relative cost-effectiveness of different hazard control methods. These data will also be crucial to understanding the long-term durability of interim control methods.

Develop hazard control techniques for evaluating exterior urban lead-contaminated soil and dust.

Research has shown that soil and dust from a number of sources of lead, including fallout from leaded gasoline, paint, and hazardous waste sites are important contributors to childrens' exposure. Even though lead in gasoline was banned in the late 1970s, the soil in urban settings (especially near roadways) that have not been disturbed for long periods may still contain elevated levels of lead.

Although not tested for their effectiveness, specific actions might reduce exposure to lead in some situations. For example, soil with a thin layer of contaminated lead may be tilled to reduce lead concentration to acceptable levels. These and other methods require further study.

Determine the extent to which activities such as building demolition, aging paint deterioration, and industrial paint removal from buildings and structures contribute to urban soil contamination and dust loadings.

Additional efforts are needed to more fully understand the complex problem stemming from the release and movement of lead in the environment. Particular attention needs to be paid to sources of exterior contamination, how they contribute to soil and dust exposures, and the resulting exposure to children.

Although significant efforts have been made to gain an understanding of residential environments and exposure pathways related to lead paint and lead-contaminated interior dust, more research is needed to understand the external environment.

For lead contamination already in place, the critical public health question concerns the best methods for remediation. Limited data indicate that building demolition and deterioration or removal of leaded paint from buildings and other large structures such as bridges may also contribute to ongoing contamination. Additionally, efforts to reduce exposure to existing contamination may be ineffective if neighborhoods are recontaminated by uncontrolled emissions from paint deterioration, paint removal, or demolition of buildings and structures. Thus, additional research is needed to determine the amount of contamination associated with these activities and to achieve effective controls.

Support further research and development to improve portable blood lead analyzer technology.

The LeadCare™ hand-held blood lead analyzer can almost immediately determine a blood lead level in a clinic or field setting, thereby allowing faster retesting and follow-up as appropriate. Although this development has the potential to increase the penetration of lead screening, two technical problems need to be addressed prior to the wider use and utility of this instrument. First, because the only commercially available device is classified as "moderately complex," clinical providers must acquire Clinical Laboratory Improvement Act (CLIA) certification. A simpler "CLIA-waived" device would make portable blood lead instruments more attractive to clinical providers. Second, to ensure that lead screening results from physician offices can be easily reported to health authorities for monitoring and follow-up purposes, technology should be further developed to allow these instruments to provide easy and secure electronic transmissions of demographic and blood lead data.

IV. Surveillance And Monitoring

Support State-based blood lead surveillance systems and the capacity to use data linkage to monitor lead screening in the Medicaid population.

The goals of CDC's childhood blood lead surveillance activity are to: 1) assist States in developing laboratory-based systems for surveying blood lead levels among children, 2) help States in the analysis and dissemination of lead surveillance data, and 3) use data from State systems to form a national surveillance database. To achieve these goals, CDC provides technical assistance, develops and provides computer software, provides funding through grants, and compiles surveillance data submitted by State programs. To support efforts to monitor and increase screening in high-risk groups, especially among Medicaid children, CDC currently funds four State projects to estimate the prevalence of elevated blood lead levels and screening penetration in the Medicaid population. CDC should continue to support such efforts.

Repeat the National Survey of Lead Paint Hazards in Housing by 2005.

HUD conducted surveys of the prevalence of lead paint in the nation's housing stock in 1991 and again in 1999-2000. Results of the most recent survey, which includes data from 830 homes chosen to represent the entire U.S. housing stock, are expected to be available by late 2000. The survey should be repeated in 2005 to assess progress toward the 2010 goal.

Continue blood lead measurements in future NHANES.

The National Health and Nutrition Examination Survey (NHANES) administered by CDC represents the only source of periodic, nationally representative data on blood lead levels in the U.S. population. Data from the NHANES have been invaluable in tracking trends in blood lead levels, identifying high-risk populations, and supporting regulatory and policy decisions. The last available NHANES covered the period 1991-1994. NHANES is now being implemented as a continual survey that will provide data from a representative sample of the U.S. population every year. As this strategy is implemented, it is crucial that blood lead measurements remain a part of the NHANES in order to track the success of the overall prevention effort at the national level.

Resources

Hotlines

The National Lead Information Center
1-800-424-LEAD (5323)
(EPA, HUD, CDC)

EPA's Safe Drinking Water Hotline
1-800-426-4791

HUD's Healthy Homes Hotline
1-800-HUDS-FHA

Web sites

Environmental Protection Agency:
www.epa.gov/lead

US Department Housing & Urban Development: **www.hud.gov/lea**

Listing of Lead Service Providers:
www.leadlisting.org (or 1-888-LEADLIST)

Centers for Disease Control
(888-232-6789):
www.cdc.gov/nceh/ncehhome.htm

Consumer Product Safety Commission
(800-638-2772): **www.cpsc.gov**

Key Publications

Protect Your Family From Lead in Your Home (EPA, CPSC, HUD), EPA 747-K-99-001, April 1999 (disclosure pamphlet) **Available in Spanish**

Lead in Your Home: A Parent's Reference Guide (EPA), EPA 747-B-99-003, May 1999 (70-page comprehensive guide)

Lead Poisoning and Your Children (EPA), EPA 800-B-92-002, February 1995 (trifold with foldout poster of tips) **Available in Spanish**

Runs Better Unleaded – How to Protect Your Children From Lead Poisoning (EPA), EPA 747-F-99-005A, August 1999 (trifold brochure for parents, caregivers)

Lead Paint Safety: A Field Guide for Painting, Home Maintenance, and Renovation Work, HUD, EPA, CDC, HUD Office of Lead Hazard Control, HUD-1779-LHC, June 1999

Guidelines for the Evaluation and Control Of Lead-Based Paint Hazards in Housing, HUD-1539-LBP, July 1995; updated Chapter 7, 1997, 700 pages

How to Check For Lead Hazards In Your Home, HUD, EPA, Consumer Federation of America, HUD Office of Lead Hazard Control

Moving Toward A Lead-Safe America: A Report to the Congress of the United States, HUD Office of Lead Hazard Control, Feb. 1997

Putting the Pieces Together: Controlling Lead Hazards in the Nation's Housing, Lead-Based Paint Hazard Reduction and Financing Task Force, HUD-1542-LBP, June 1995

Lead-Based Paint Training Curriculum for Maintenance and Renovation Workers (from www.hud.gov/lea)

Endnotes

1. National Academy of Sciences, *Measuring Lead Exposure in Infants, Children, and Other Sensitive Populations*, Committee on Measuring Lead in Critical Populations, Board on Environmental Studies and Toxicology, Commission on Life Sciences, National Academy of Sciences, National Academy Press, Washington, DC, 1993.

2. Case Studies in Environmental Medicine, *Lead Toxicity*, Agency for Toxic Substances and Disease Registry (ATSDR), Revised September 1992, U.S. Department of Health and Human Services.

3. Centers for Disease Control, *Preventing Lead Poisoning in Young Children: A Statement by the Centers for Disease Control*, Report No. 99-2230, Atlanta, Ga.: CDC, U.S. Department of Health and Human Services, 1991; and neurotoxicity review in U.S. Environmental Protection Agency, *Air Quality Criteria for Lead: Supplement to the 1986 Addendum*, Research Triangle Park NC, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, EPA Report No. EPA/600-8-89-049F, 1990

4. Schwartz, J., "Low-Lead Level Exposure and Children's IQ: A Meta-analysis and Search for a Threshold," *Environ. Res.* 65:42-55, 1994.

5. Centers for Disease Control and Prevention, "Update: Blood Lead Levels–United States 1991-1994," *Morbidity and Mortality Weekly Report*, U.S. Department of Health and Human Services/Public Health Service, Vol 46, No.7, Feb 21, 1997, p. 141-146 and erratum in vol 46, No. 26, p. 607, July 4, 1997.

6. Lanphear B.P. Emond M, Jacobs D.E., Weitzman M, Tanner M., Winter N., Yakir B., Eberly S, "A Side by Side Comparison of Dust collection Methods for Sampling Lead-Contaminated House Dust," *Env. Res.* 68:114-123, 1995.

7. Clark, C.S., R. Bornschein, P. Succop, S. Roda, and B. Peace, "Urban Lead Exposures of Children in Cincinnati, Ohio," *Journal of Chemical Speciation and Bioavailability*, 3(3/4):163-171, 1991.

8. Jacobs D.E., "Lead paint as a Major Source of Childhood Lead Poisoning: A Review of the Evidence," in *Lead in Paint, Soil and Dust: Health Risks, Exposure Studies, Control Measures and Quality Assurance*, ASTM STP 1226, Michael E. Beard and S.D. Allen Iske, eds, American Society for Testing and Materials, Philadelphia, 1995.

9. Lanphear B.P., Matte T.D., Rogers J., Clickner R.P., Dietz B., Bornschein R.L., Succop., Mahaffey K.R., Dixon S., Galke W., Rabinowitz M., Farfel M., Rohde C., Schwartz J. Ashley P., Jacobs D.E., "The Contribution of Lead-Contaminated House Dust and Residential Soil to Children's Blood lead Levels: A Pooled Analysis of 12 Epidemiological Studies," *Environmental Research*, 79:51-68, 1998.

10. McElvaine MD, DeUngria EG, Matte TD, Copley CG, Binder S. Prevalence of radiographic evidence of paint chip ingestion among children with moderate to severe lead poisoning, St. Louis, Missouri, 1989-90, *Pediatrics* 1992; 89:740-742.

11. Bornschein RL, Succop P, Kraft KM, Clark CS, Peace B, Hammond PB. "Exterior surface dust lead, interior house dust lead and childhood lead exposure in an urban environment." In Hemphill DD (ed). *Trace Substances in Environmental Health*, 20. Proceedings of University of Missouri's 20th Annual Conference, June 1986. University of Missouri, Columbia, Missouri, 1987.

12. Lanphear BP, Roghmann KJ. "Pathways of lead exposure in urban children." Environ Res., 1997;74(1):67-73.

13. Rabinowitz M, Leviton A, Bellinger D. "Home refinishing: Lead paint and infant blood lead levels," *Am. J. Public Health* 75: 403-404, 1985.

14. Shannon, M.W., and J.W. Graef, "Lead Intoxication in Infancy," *Pediatrics* 89(1):87-90, 1992.

15. Turner J.A., "Lead Poisoning Among Queensland Children," *Australasian Medical Gazette*, Vol 16, p. 475-479, 1897.

16. Gibson, J. L., "A Plea for Painted Railings and Painted Walls of Rooms as the Source of Lead Poisoning Amongst Queensland

Children," *Australasian Medical Gazette*, Vol. 23, 1904, pp. 149-153.

17. U.S. Department of Housing & Urban Development, *Moving Toward a Lead-Safe America: A Report to the Congress of the United States*, Washington, DC, February 1997 and *Comprehensive and Workable Plan for the Abatement of Lead paint in Privately Owned Housing: Report to Congress*, Washington, D.C., 1990.

18. *Putting the Pieces Together: Controlling Lead Hazards in the Nation's Housing, Report of the Lead paint Hazard Reduction and Financing Task Force*, HUD-1547-LBP, Washington DC, July 1995.

19. Evaluation of the HUD Lead Paint Hazard Control Grant Program, National Center for Lead-Safe Housing and the University of Cincinnati Department of Environmental Health, Fifth Interim Report, March 1998 with update from Feb 1999 dataset, Columbia, MD.

20. Needleman HL, Riess JA, Tobin MJ, Biesecker GE, Greenhouse JB, "Bone lead levels and Delinquent Behavior," *J Am Med Assoc* 275:363-369, Feb 7, 1996.

21. Centers for Disease Control, *Preventing Lead Poisoning in Young Children: A Statement by the Centers for Disease Control*, Report No. 99-2230, Atlanta, Ga.: CDC, U.S. Department of Health and Human Services, 1991.

22. U.S. General Accounting Office, *Lead Poisoning: Federal Health Care Programs Are Not Effectively Reaching At-Risk Children*, GAO/HEHS-99-18, Washington DC, January 1999.

23. Environmental Protection Agency, *Report on the HUD National Survey of Lead paint in Housing (Base Report)*, EPA 747-R95-003, April 1995.

24. Farfel MR, Chisolm JJ. "Health and environmental outcomes of traditional and modified practices for abatement of residential lead paint," *Am J Public Health*, 1990;80:1240-45.

25. Amitai Y, Graef JW, Brown MJ, et al. "Hazards of 'deleading' homes of children with lead poisoning," *Am J Dis Child* 1987;141:758-760.

26. Swindell SL, Charney E, Brown MJ, Delaney J. "Home abatement and blood lead changes in children with class III lead poisoning," *Clinical Pediatrics* 1994;33:536-541.

27. U.S. Department of Housing and Urban Development, Office of Lead Paint Abatement and Poisoning Prevention (Office of Lead Hazard Control), *Guidelines for the Evaluation and Control of Lead paint Hazards in Housing* HUD-1539-LBP, Washington, D.C. 1995.

28. Farfel MR, Chisholm JJ, Rohde CA. "The longer-term effectiveness of residential lead paint abatement," *Environ Res* 1994;66:217-221.

29. Environmental Protection Agency. *Lead Paint Abatement And Repair And Maintenance Study In Baltimore: Findings Based On Two Years Of Follow-Up*. EPA No. 747-R-97-005. Washington: EPA, 1997.

30. Centers for Disease Control and Prevention, *Screening Young Children for Lead Poisoning*, Atlanta, GA, November 1997.

31. *Economic Analysis of the Final Rule on Lead paint: Requirements for Notification, Evaluation and Reduction of Lead paint Hazards in Federally-Owned Residential Property and Housing Receiving Federal Assistance*, HUD Office of Lead Hazard Control, Washington, DC, September 7, 1999.

Other References

Amitai 1987. Amitai, Y., Graef, J.W., Brown, M.J., Gerstle, R.S., Kahn, N., and Cochrane, R.E., "Hazards of Deleading Homes of Children with Lead Poisoning, *American Journal of the Disabled Child*, 141, 1987, p. 758-760.

Amitai 1991. Amitai, Y., M.J. Brown, J.W. Graef, and E. Cosgrove. "Residential Deleading: Effects on the Blood Lead Levels of Lead-Poisoned Children," *Pediatrics* 88(5):893-897.

Annest 1984. Annest, J. L., and Mahaffey, K., "Blood Lead Levels for Persons Aged 6 Months to 74 Years, United States 1976-80," *Vital and Health Statistics*, Series 11, 1984, No. 233, DHHS Publ. No. (PHS) 84-1683, Washington, D.C.

Aschengrau 1994. Aschengrau A., Beiser A., Bellinger A., et al. "The Impact of Soil Lead Abatement on Urban Children's Blood Lead Levels; Phase II Results from the Boston Lead-In-soil Demonstration Project," *Environmental Research* 1994: 67:125-148.

Aschengrau 1997. Aschengrau A. Beiser A, Bellinger D, Copenhafer D, Weitzman M. "Residential lead paint hazard remediation and soil lead abatement: their impact among children with mildly elevated blood lead levels," *Am J. Public Health* 1997; 87:1698-1702.

ATSDR 1988a. ATSDR (Agency for Toxic Substances and Disease Registry). 1988. *The Nature and Extent of Lead Poisoning in Children in the United States: A Report to Congress*. Atlanta, GA.: U.S. Department of Health and Human Services.

Bellinger 1987. Bellinger, D., A. Leviton, C. Waternaux, H. Needleman, and M. Rabinowitz. 1987. "Longitudinal analyses of prenatal and postnatal lead exposure and early cognitive development," *N. Engl. J. Med.* 316:1037 1043.

Bellinger 1992. Bellinger D.C., Stiles, K.M, Needleman HL, "Low-level Lead Exposure, Intelligence and Academic Achievement: A long-term Follow-up Study," *Pediatrics* (6):855-861.

Bornschein 1987. Bornschein, R.L., Succop, P.A., Krafft, K.M., Clark, C.S., Peace, B., Hammond, P.B., "Exterior Surface Dust Lead, Interior House Dust Lead and Childhood Lead Exposure in an Urban Environment," *Trace Substances in Environmental Health*, 20, 1987, p. 322-332.

Brody 1994. Brody, D.J., J.L. Pirkle, R.A. Kramer, K.M. Flegal, T.D. Matte', E.W. Gunter, D.C. Paschall, "Blood Lead Levels in the US Population." *Journal of the American Medical Association* 272(4):277-283.

CDC 1991a. CDC (Centers for Disease Control). 1991. *Preventing Lead Poisoning in Young Children: A Statement by the Centers for Disease Control, Report No.* 99-2230, Atlanta, Ga.: CDC, U.S. Department of Health and Human Services.

CDC 1991b. *Strategic Plan for the Elimination of Childhood lead Poisoning*, Centers for Disease Control and Prevention, Public Health Service, Department of Health and Human Services, Atlanta, GA.

CDC 1997a. "Update: Blood Lead Levels—United States 1991-1994," *Morbidity and Mortality Weekly Report*, U.S. Department of Health and Human Services/Public Health Service, Vol 46, No. 7, Feb 21, 1997, p. 141-146.

CDC 1997b. *Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials*, Centers for Disease Control and Prevention, National Center for Environmental Health, Atlanta, GA, November 1997.

Charney 1983. Charney, E., Kessler, B., Farfel, M., and Jackson, D., "A Controlled Trial of the Effect of Dust-Control Measures on Blood Lead Levels," *New England Journal of Medicine*, Vol. 309, No. 18, 1983, pp. 1089-1093.

Chisolm 1985. Chisolm, J. J., Mellits, E. D., and Quaskey, S. A., "The Relationship between the Level of Lead Absorption in Children and the Age, Type and Condition of Housing," *Environmental Research*, Vol. 38, 1985, pp. 31-45.

Clark 1985. Clark, S., Bornschein, R. L., Succop, P., Que Hee, S. S., Hammond, P. B., and Peace, B., "Condition and Type of Housing as an Indicator of Potential Environmental Lead Exposure and Pediatric Blood Lead Levels", *Environmental Research*, Vol. 38, 1985, pp. 46-53.

Clark 1991. Clark, C.S., R. Bornschein, P. Succop, S. Roda, and B. Peace, "Urban Lead Exposures of Children in Cincinnati, Ohio," *Journal of Chemical Speciation and Bioavailability*, 3(3/4):163-171.

Duggan 1985. Duggan, M.J. and Inskip M.J. "Childhood Exposure to Lead in Surface Dust and Soil: A Community Health Problem," *Public Health Review* 13:1 54, 1985.

EPA 1995b. Environmental Protection Agency, *Review of Studies Addressing Lead Abatement Effectiveness*, Battelle Institute, EPA 747-R-95-006.

Environmental Protection Agency, *Report on the National Survey of Lead paint in Housing* (*Base Report*), EPA 747-R95-003, April 1995.

Shannon, 1992. Shannon, M.W., and J.W. Graef, "Lead Intoxication in Infancy," *Pediatrics* 89(1):87-90.Shannon, 1992. Shannon, M.W., and J.W. Graef, "Lead Intoxication in Infancy," *Pediatrics* 89(1):87-90.

EPA 1996. Environmental Protection Agency, Final Rule, Requirements for Lead paint Activities, *Federal Register*, Washington DC, August 29, 1996, p. 45777-45829.

Farfel 1990. Farfel, M. R., and Chisolm, J. J., "Health and Environmental Outcomes of Traditional and Modified Practices for Abatement of Residential Lead paint," *American Journal of Public Health*, Vol. 80, No. 10, 1990, pp. 1240-1245.

Farfel 1991. Farfel, M., and J.J. Chisolm, Jr., "An Evaluation of Experimental Practices for Abatement of Residential Lead paint: Report on a Pilot Project." *Eighth International Conference on Heavy Metals in the Environment* (*Volume* I), ed. J.G. Farmer, Edinburgh, United Kingdom, September 1991, pp. 119-122.

Farfel 1994. Farfel M.R., Chisolm J.J., Rohde C.A., "The Longer-term Effectiveness of Residential Lead Paint Abatement," *Env. Res.* 66:217-221.

Feldman, R.G. (1978). "Urban lead mining: lead intoxication among deleaders," N. *Engl. J. Med.* 298:1143-1145.

Fishbein 1981. Fischbein, A., K.E. Anderson, S. Shigeru, R. Lilis, S. Kon, L. Sarkoi, and A. Kappas, "Lead Poisoning From Do-It - Yourself Heat Guns for Removing Lead paint: Report of Two Cases," *Environmental Research* 24:425-431.

Fulton 1987. Fulton, M., G. Raab, G. Thomson, D. Laxen, R. Hunter, and W. Hepburn. 1987. "Influence of blood lead on the ability and attainment of children in Edinburgh," *Lancet* 1:1221 1226.

Gibson 1904. Gibson, J. L., "A Plea for Painted Railings and Painted Walls of Rooms as the Source of Lead Poisoning Amongst Queensland Children," *Australasian Medical Gazette*, Vol. 23, 1904, pp. 149-153.

Gibson 1908. Gibson, J. L., "Plumbic Ocular Neuritis in Queensland Children," *British Medical Journal*, Vol. 2, 1908, pp. 1488-1490.

Gibson 1911. Gibson, J. L., "The Importance of Lumbar Puncture in the Plumbar Ocular Neuritis of Children," *Transactions of the Australasian Medical Congress*, Vol. 2, 1911, p. 750.

Gibson 1917. Gibson, J. L., "The Diagnosis, Prophylaxis and Treatment of Plumbic Ocular Neuritis," *Medical Journal of Australia*, Vol. 2, 1917, pp. 201-204.

HUD 1990a. U.S. Department of Housing & Urban Development, *Comprehensive and Workable Plan for the Abatement of Lead paint in Privately Owned Housing*: *Report to Congress*. Washington, D.C.

U.S. Department of Housing and Urban Development, Office of Lead paint Abatement and Poisoning Preventio HUD 1995b. n, *Guidelines for the Evaluation and Control of Lead paint Hazards in Housing* HUD-1539-LBP, Washington, D.C. 1995.

Putting the Pieces Together: *Controlling Lead Hazards in the Nation's Housing*, Report of the Lead paint Hazard Reduction and Financing Task Force, HUD-1547-LBP, Washington DC, July 1995.

HUD 1999. U.S. Department of Housing and Urban Development, Office of Lead Hazard Control, *Economic Analysis of the Final Rule on Lead paint*: *Requirements for Notification, Evaluation and Reduction of Lead paint Hazards in Federally-Owned Residential Property and Housing Receiving Federal Assistance*, ICF Consulting, Washington DC, September 7, 1999.

Jacobs 1995. "Lead paint as a Major source of Childhood Lead Poisoning: A Review of the Evidence," in *Lead in Paint*, *Soil and Dust*: *Health Risks*, *Exposure Studies*, *Control Measures* *and Quality Assurance*, ASTM STP 1226, Michael E. Beard and S.D. Allen Iske, eds, American Society for Testing and Materials, Philadelphia, 1995.

Lanphear 1995. Lanphear B.P. Emond M, Jacobs D.E., Weitzman M, Tanner M., Winter N., Yakir B., Eberly S, "A Side by Side Comparison of Dust collection Methods for Sampling Lead-Contaminated House Dust," *Env. Res*. 68:114-123.

Marino 1990. Marino, P.E., Landrigan, P.J., Graef, J., Nussbaum, A., Bayan, G., Boch, K., and Boch, S. "A case report of lead paint poisoning during renovation of a victorian farmhouse," *Am. J. Pub. Health* 80(10):1183-1185.

McMichael 1988. McMichael AP, Baghurst N, Wigg G, Vimpani E, Robertson E and Roberts R, "The Port Pirie cohort study: Environmental exposure to lead and children's abilities at the age of four years," *N. Engl. J. Med*. 319:468 475.

National Academy of Sciences 1993. *Measuring Lead Exposure in Infants, Children, and Other Sensitive Populations*, Committee on Measuring Lead in Critical Populations, Board on Environmental Studies and Toxicology, Commission on Life Sciences, National Academy Press, Washington, DC, 1993.

Needleman 1979. Needleman HL, Gunnoe C, Leviton A, Reed R, Pereise H, Maher C, Barrett P, "Deficits in psychologic and classroom performance of children with elevated dentine lead levels," N *Engl J Med* 300:689-695.

Needleman 1990. Needleman HL, Schell A, Bellinger D, Leviton A, Allred AL, "The long-term effects of childhood exposure to low doses of lead: An 11-year followup report," N *Engl J Med* 322:83-88.

Needleman 1996. Needleman HL, Riess JA, Tobin MJ, Biesecker GE, Greenhouse JB, "Bone lead levels and Delinquent Behavior," *J Am Med Assoc* 275:363-369, Feb 7, 1996.

Rabin 1989. Rabin R., "Warnings Unheeded: A History of Child Lead Poisoning American," *J. Pub Health* 79(12):1668-1674.

Rabinowitz 1985a. Rabinowitz, M., Leviton, A., Needleman, H., Bellinger, D., and Waternaux, C., "Environmental Correlates of Infant Blood Lead Levels in Boston," *Environmental Research*, Vol. 38, 1985, pp. 96-107.

Rabinowitz 1985b. Rabinowitz M, Leviton A, Bellinger D. "Home refinishing: Lead paint and infant blood lead levels," *Am. J. Public Health* 75:403 404.

Schwar 1988. Schwa, M.J. and Alexander, D.J., "Redecoration of External Leaded Paint Work and Lead-In-Dust Concentrations in School Playgrounds," *Science of the Total Environment*, 68, 1988, p. 45-59.

Schwartz 1991a. Schwartz, J., and Levin, R., "The Risk of Lead Toxicity in Homes with Lead Paint Hazard," *Environ. Research*, Vol. 54, 1991, pp. 1-7.

Schwartz 1991b. Schwartz J, "Lead, blood pressure and cardiovascular disease in men and women," *Env Health Perspect*., 91:71-65.

Schwartz 1994a. "Low-Lead Level Exposure and Children's IQ: A Meta-analysis and Search for a Threshold," *Environ. Res*. 65:42-55.

Schwartz 1994b. Schwartz J, "Societal Benefits of Reducing Lead Exposure," *Env. Res*. 66,105-124.

Shannon, 1992. Shannon, M.W., and J.W. Graef, "Lead Intoxication in Infancy," *Pediatrics* 89(1):87-90.

Silbergeld 1991. Silbergeld, E.K., Landrigan, P.J., Froines, J.R. and Pfeffer, R.M. (1991). "The occupational lead standard: A goal unachieved, a process in need of repair," *New Solutions* 4:20 - 30, Spring 1991.

Lanphear B.P, Matte T.D., Rogers J, Clickner R.P., Dietz B., Bornschein R.L., Succop P., Mahaffey K.R., Dixon S.,Galke W.,Rabinowitz M.,Farfel M.,Rohde C.,Schwartz J.,Ashley P.,Jacobs D.E., "The Contribution of Lead-Contaminated House Dust and Residential Soil to Children's Blood Lead Levels: A Pooled Analysis of 12 Epidemiological Studies," *Environmental Research*, 79:51-68, 1998.

Staes 1995a. Staes C., and Rinehart R., "Does Residential Lead paint Hazard Control Work? A Review of the Scientific Evidence." National Center for Lead-Safe Housing, Columbia, Maryland, 79 pages.

Staes 1995b. Staes C, Matte T, Staeling N, Rosenblum L, Binder S, "Lead Poisoning

Deaths in the United States, 1979 through 1988," J. *American Medical Assoc* 273: 847-848.

Swindell 1994. Swindell S, Charney E, Brown M.J. Delaney J., "Home Abatement and Blood Lead Changes in Children with Class III Lead Poisoning," *Clinical Pediatrics* 536-541, Sept. 1994.

Thomson 1989. Thomson GOB, Raab GM, Hepburn WS, Hunter R, Fulton M, Laxen DPH, "Blood lead levels and children's behavior: results from the Edinburgh lead study," J *Child Psychol Psychiatry* 30:515-528.

Turner 1897. Turner J.A., "Lead Poisoning Among Queeensland Children, *Australasian Medical Gazette*, Vol 16, p. 475-479.

Evaluation of the HUD Lead paint Hazard Control Grant Program, National Center for Lead-Safe Housing and the University of Cincinnati Department of Environmental Health, Fifth Interim Report, March 1998 with update from Feb 1999 dataset, Columbia, MD.

Weitzman 1993. Weitzman, M., Aschengrau, A., Bellinger, D., Jones, R., Hamlin, J. S., and Beiser, A., "Lead-Contaminated Soil Abatement and Urban Children's Blood Lead Levels," *Journal of the American Medical Association*, Vol. 269, No. 13, 1993, pp. 1647-1654.

Lead poisoning is a completely preventable disease. Residential lead paint hazards in homes of children can be virtually eliminated in 10 years. Every child deserves to grow up in a home free of lead paint hazards.

Appendix

Methodology Used to Project Numbers of Lead Poisoned Children and Trends in the American Housing Stock, 2000-2010

Eliminating Childhood Lead Poisoning:

A Federal Strategy Targeting Lead Paint Hazards

President's Task Force on Environmental Health Risks and Safety Risks to Children

ELIMINATING CHILDHOOD LEAD POISONING:
A FEDERAL STRATEGY TARGETING LEAD PAINT HAZARDS

Appendix

Methodology Used to Project Numbers of Lead Poisoned Children and Trends in the American Housing Stock, 2000-2010

February, 2000

Prepared by
ICF Consulting

President's Task Force on
Environmental Health Risks and Safety Risks to Children

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Methodology Used to Project Numbers of Lead Poisoned Children and Trends in the American Housing Stock, 2000-2010

This document explains how the number of children under age 6 with lead poisoning can be projected for future years. The projections, before and after Federal intervention, combine data from the following sources:

- The Third National Health And Nutrition Examination Survey (NHANES III) Phase 2
- The American Housing Survey
- The Residential Energy Consumption Survey
- The HUD National Lead Paint Survey

The lead poisoning projections show that ongoing demolition and rehabilitation of older housing units, which account for most of the lead paint in housing, should result in a steady decline in the number of lead poisoned children over the next decade. In the absence of Federal intervention, however, this analysis estimates that there would still be 185,000 lead poisoned children under age six living in pre-1975 housing in the year 2010, in households with a poverty income ratio (PIR) of less than 1.3. (PIR is equal to household income divided by the poverty income level, so households with PIR below 1.3 are under 130 percent of the official poverty level).

The methodology used to project the number of lead poisoned children, and the benefits of Federal intervention, are explained below in eight sections:

1. NHANES III Phase 2 data and limitations.
2. Combining American Housing Survey and NHANES data to estimate the number of lead poisoned children in 1993 and 1997.
3. Using American Housing Survey, Residential Energy Consumption Survey, and HUD National Lead Paint Survey data to forecast number of housing units with “high” and “low” risk of lead paint hazards.
4. Calculating the prevalence of children with lead poisoning for high and low risk housing.
5. Forecasting lead poisoning prevalence by PIR and age of housing based on the percentage of the housing stock with a high risk of lead paint hazards.
6. Projecting the number of lead poisoned children in low and high risk units, before and after adjustment for the HUD rule for Federally assisted housing.
7. Adjusting projections for lead poisoned children to reflect the impact of an expanded HUD Lead Hazard Control Grant Program.
8. Estimating the benefits and net benefits of an expanded Lead Hazard Control Grant Program.

In this document, the term "lead poisoned children" refers to children with blood lead levels above 10 µg/dL. CDC guidelines have established this level as a threshold for public health response and one at which the evidence for harm to children's health is well established. However, considerable evidence also links blood lead levels below 10 µg/dL in young children to cognitive losses (lower IQ) that reduce the average lifetime earnings of such children. Lead paint hazard control activities provide the greatest benefit to children who avoid lead poisoning, but these same activities also benefit other children by reducing the average blood lead for children below 10 µg/dL. The Economic Analysis for the HUD Lead Paint Regulation for Federally Assisted Housing estimates the combined monetized health benefit per housing unit where lead hazards are controlled. This "unit benefit" includes the benefit to children who avoid lead poisoning, plus the benefit of lower blood lead levels for other children (below 10 µg/dL). Although the first seven sections of this document focus on the projected number of the lead poisoned children, the analysis of benefits in Section 8 includes the total benefit of lead hazard reduction, including the benefit of lower blood lead levels for children below 10 µg/dL.

1. NHANES III Phase 2 Data and Limitations

Tables 1 and 2 show NHANES III Phase 2 data on the prevalence of children under age 6 with blood lead levels above 10 and 15 µg/dL, within year of home construction, poverty income ratio (PIR), and Metropolitan Statistical Area (MSA) population categories. The "don't know" category refers to NHANES respondents who didn't know the age of their housing unit. People in older housing units may be less likely to know the age of their unit, which suggests that most of the "don't know" units are older units. This would also explain why the prevalence of children with lead poisoning in the "don't know" category is similar to the prevalence in older units.

NHANES III Phase 2 reported the prevalence of children above 10 µg/dL by age of housing, MSA population, and three PIR categories. These data were recreated for Table 1 to ensure that this analysis reflects the same population weights and statistical methods reflected in the NHANES data reported in Morbidity and Mortality Weekly Report (February 21, 1997). For the remainder of this analysis, however, only two PIR categories were used - above and below 1.3 (families above and below 130% of the poverty income level, where poverty income is adjusted for family size and inflation but not for geographic variations in income). This was done because the small amount of NHANES sample data for higher income children was inadequate to support projections with any reasonable degree of confidence.

Tables 1 and 2 both indicate that lower income children and children in older housing are more likely to be lead poisoned. Table 1 shows a surprisingly high prevalence of low-income children in post-73 housing with blood lead > 10 µg/dL, but Table 2 shows that almost none of these low-income children in post-73 housing have blood lead > 15 µg/dL. In fact, the prevalence of children above 15 µg/dL is also extremely low in 1946-73 housing. The prevalence of children with blood lead levels above 15 µg/dL is especially high for children with PIR less than 1.3, in pre-46 housing in MSAs with population greater than one million.

Table 1. Prevalence of Children Under Age 6 With Blood Lead Levels ≥10 µg/dL, by PIR, MSA Size, and Year House Built (% of children within each cell)

	Year House Built:			
Characteristic	Pre-1946 %	1946-1973 %	Post-1973 %	Don't know %
PIR ≤ 1.3 (low)	16.37	7.25	4.33	6.02
1.3 < PIR ≤ 3.5 (Medium)	4.09	2.01	0.38	2.95
3.5 < PIR < 8.5 (High)	0.87	2.65	0	0
PIR > 1.3	3.19	2.24	.22	2.81
MSA population< 1 million	5.77	3.06	2.51	2.17
MSA population ≥ 1 million	11.49	5.80	0.81	7.89
PIR ≤ 1.3 and MSA pop < 1 million	10.62	3.82	6.48	2.92
PIR ≤ 1.3 and MSA pop ≥ 1 million	22.27	9.09	2.65	8.39
PIR >1.3 and MSA pop < 1 million	3.03	2.38	0.22	0.52
PIR >1.3 and MSA pop ≥ 1 million	3.35	2.10	0.21	4.22

Source: Third National Health and Nutrition Examination Survey—Phase 2, 1991-1994 (MMWR, February 21, 1997).

Table 2. Prevalence of Children Under Age 6 With Blood Lead Levels ≥ 15 µg/dL, by PIR, MSA Size, and Year House Built (% of children within each cell)

	Year House Built:			
Characteristic	Pre-1946 %	1946-1973 %	Post-1973 %	Don't know %
PIR ≤ 1.3 (low)	6.75	1.19	0.12	3.60
1.3 < PIR ≤ 3.5 (Medium)	1.77	0.16	0.38	0.21
3.5 < PIR ≤ 8.5 (High)	0	0	0	0
PIR > 1.3	1.27	0.10	0.22	0.20
MSA population < 1 million	1.44	0.63	0.67	0.13
MSA population ≥ 1 million	5.71	0.70	0.21	4.66
PIR ≤ 1.3 and MSA pop < 1 million	1.35	1.30	0	0
PIR ≤ 1.3 and MSA pop ≥ 1 million	12.30	1.13	0.21	6.35
PIR >1.3 and MSA pop < 1 million	1.67	0	0.22	0.52
PIR >1.3 and MSA pop ≥ 1 million	0.88	0.20	0.21	0

Source: Third National Health and Nutrition Examination Survey—Phase 2, 1991-1994

Table 3 shows the sample size limitations of the NHANES data, which could distort the projected number of lead poisoned children in post-73 housing. The total NHANES sample of children under 6 with blood lead, MSA, and PIR data is 2214, but only 13 children living in post-73 housing were above 10 µg/dL and only three were above 15 µg/dL. The limitations of the NHANES sample result in large 95% confidence intervals around the prevalence estimates in Tables 1 and 2. For example, the prevalence estimate of 16.37% for children with PIR less than 1.3 in pre-46 housing has a 95% confidence interval of 9.9% to 27.2%. For children with PIR less than 1.3 in post-73 housing, the prevalence estimate of 4.33% has a 95% confidence interval of 2.1% to 9.1%.

The small prevalence of lead poisoned children in post-73 housing multiplied by the large number of children in post-73 housing still results in a significant number of lead poisoned children. With the growth in post-73 housing between 1993 and 1997, the estimated number of lead poisoned children in post-73 housing will grow accordingly. This estimate would be reasonable only if the lead poisoning prevalence for children in post-73 housing were entirely due to lead hazards unrelated to housing (and if no progress in reducing such hazards were anticipated). However, American Housing Survey data indicate that over one-third of all families with children under 6 in 1993 moved into their then current residence within the previous two years, and almost half moved within the previous three years. Therefore, it is likely that many lead poisoned children in post-73 housing were exposed to lead paint hazards at an older previous residence. Others may have been exposed at a friend or relative's residence, and still others may have been exposed to lead paint hazards from older buildings in their immediate neighborhood. For all of these reasons, a reduction in older units with lead paint hazards is also likely to reduce the lead poisoning prevalence for children in post-73 housing.

2. Combining American Housing Survey and NHANES Data to Estimate the Number of Lead Poisoned Children in 1993 and 1997

Table 4 shows the total number of children under 6 by year of home construction, PIR, and MSA size, based on 1993 American Housing Survey data. Table 5 combines the NHANES data from Table 1 with the American Housing Survey data from Table 4 to estimate the number of children under 6 with blood lead levels above 10 µg/dL in 1993. American Housing Survey data are reported in slightly different time intervals than NHANES data, so pre-40 housing is associated with pre-46 prevalence estimates (most housing built in the 1940s was built after 1945) and post-74 housing is associated with post-73 prevalence estimates. Each cell or household category in Table 5 reflects the prevalence of children under 6 with blood lead levels above 10 µg/dL for that housing category in Table 1 multiplied by the total number of children under 6 in that household category from Table 4. (The NHANES data relating to the "don't know" age of housing category were not used in this analysis). These calculations yield estimates of 887,000 to 993,000 for the total number of children above 10 µg/dL, versus 930,000 reported by MMWR (based on population census weights). (MMWR revised this estimate to 890,000 in an erratum published July 4, 1997). Table 6 applies the same approach to combine NHANES data in Table 2 with American Housing Survey data in Table 4 to estimate the number of children under 6 with blood lead levels above 15 µg/dL in 1993. Of particular interest in Table 6 is the fact that children under 6 with PIR less than 1.3, in pre-46 housing, and in MSAs with population greater than one million account for more than half of all children under 6 with blood lead levels above 15 µg/dL.

Table 3. NHANES Phase 2 Blood Lead Data for Children Under Age 6 (raw numbers)

	Year House Built: Pre- 1946			1946-1973			Post 1973			Don't Know			Total
	Total	**≥ 10**	**≥ 15**	*Total*	**≥ 10**	**≥ 15**	*Total*	**≥ 10**	**≥ 15**	*Total*	**≥ 10**	**≥ 15**	
Children with PIR < 1.3	192	35	13	511	45	10	294	11	1	230	17	10	1227
Children with PIR > 1.3	147	9	5	341	10	1	412	2	2	87	4	1	987
Total	*339*	*44*	*18*	*852*	*55*	*11*	*706*	*13*	*3*	*317*	*21*	*11*	***2214***
Children in MSA < 1 million	159	14	4	339	16	5	388	9	2	145	4	1	1031
Children in MSA ≥ 1 million	209	35	16	550	41	7	356	6	2	206	21	12	1321
Total	*368*	*49*	*20*	*889*	*57*	*11*	*744*	*15*	*4*	*351*	*25*	*13*	***2352***
PIR ≤ 1.3 & MSA < 1 million	74	10	2	179	9	4	152	6	0	94	3	0	499
PIR ≤ 1.3 & MSA ≥ 1 million	118	25	11	332	36	6	142	5	1	136	14	10	728
PIR >1.3 & MSA < 1 million	73	3	2	145	5	0	221	1	1	37	1	1	476
PIR >1.3 & MSA ≥ 1 million	74	6	3	196	5	1	191	1	1	50	3	0	511
Total	*339*	*44*	*18*	*852*	*55*	*11*	*706*	*13*	*3*	*317*	*21*	*11*	***2214***

Source: U.S., Third National Health and Nutrition Examination Survey—Phase 2, 1992-1994

Table 4. 1993 Number of Children (in millions) Under Age 6 by PIR and MSA

	Year House Built: Pre-1940	1940-1974	Post 1974
Children with PIR ≤ 1.3	1.98	3.53	1.89
Children with PIR > 1.3	2.75	6.18	6.50
Total	*4.73*	*9.71*	*8.39*
Children in MSA population area < 1 million	2.60	4.76	5.68
Children in MSA population area > 1 million	2.13	4.95	2.71
Total	*4.73*	*9.71*	*8.39*
Children with PIR ≤ 1.3, MSA pop < 1million	1.02	1.83	1.33
Children with PIR ≤ 1.3, MSA pop > 1 million	0.96	1.7	0.56
Children with PIR > 1.3, MSA pop < 1 million	1.58	2.94	4.34
Children with PIR > 1.3, MSA pop > 1 million	1.17	3.24	2.16
Total	*4.73*	*9.71*	*8.39*

Source: U.S. Bureau of the Census and U.S. Department of Housing and Urban Development, "American Housing Survey for the United States in 1993."

Table 5: 1993 Number of Children (in thousands) Under Age 6 With Blood Lead Levels ≥10 µg/dL, by PIR and MSA Size (1993 American Housing Survey Children Times NHANES Phase 2 Prevalence ≥10 µg/dL)

	Year House Built: Pre-1940		1940-74		Post-74		Total	
	Number	% of total	Number	% of total	Number	% of total	Number	% of total
Children with PIR ≤ 1.3	324	(36%)	256	(28%)	82	(9%)	662	(73%)
Children with PIR > 1.3	88	(10%)	138	(15%)	13	(2%)	239	(27%)
Total (all PIR)	412	(46%)	394	(43%)	95	(11%)	**901**	
Children in MSA < 1 million	150	(15%)	147	(15%)	142	(14%)	439	(44%)
Children in MSA > 1 million	245	(25%)	287	(29%)	22	(2%)	554	(56%)
Total (all MSA)	395	(40%)	434	(44%)	164	(16%)	**993**	
With PIR ≤ 1.3, MSA pop < 1 million	109	(12%)	70	(8%)	86	(10%)	265	(30%)
With PIR ≤ 1.3, MSA pop > 1 million	213	(24%)	155	(17%)	15	(2%)	383	(43%)
With PIR > 1.3, MSA pop < 1 million	48	(5%)	70	(8%)	9	(1%)	127	(14%)
With PIR > 1.3, MSA pop > 1 million	39	(4%)	68	(8%)	5	(1%)	112	(13%)
Total (all MSA and PIR)	409	(45%)	363	(41%)	115	(14%)	**887**	

Sources: U.S. Bureau of the Census and U.S. Department of Housing and Urban Development, "American Housing Survey for the United States in 1993." And U.S., Third National Health and Nutrition Examination Survey—Phase 2, 1992-1994

Table 6. 1993 Number of Children (in thousands) Under Age 6 With Blood Lead Levels ≥15 µg/dL, by PIR and MSA Size (1993 American Housing Survey Children Times NHANES Phase 2 Prevalence ≥15 µg/dL)

	Year House Built:							
	Pre-1940		**1940-74**		**Post-74**		**Total**	
	Number	% of total	Number	% of total	Number	% of total	Number	% of total
Children with PIR ≤ 1.3	134	(57%)	42	(18%)	3	(1%)	179	(76%)
Children with PIR > 1.3	36	(15%)	6	(3%)	14	(6%)	56	(24%)
Total (all PIR)	170	(72%)	48	(21%)	17	(7%)	**235**	
Children in MSA < 1 Million	37	(14%)	30	(12%)	38	(14%)	105	(40%)
Children in MSA > 1 Million	117	(45%)	35	(13%)	6	(2%)	158	(60%)
Total (all MSA)	154	(59%)	65	(25%)	44	(16%)	**263**	
With PIR ≤ 1.3, MSA pop < 1M	14	(6%)	24	(10%)	0	(0%)	38	(16%)
With PIR ≤ 1.3, MSA pop > 1M	118	(51%)	19	(8%)	1	(1%)	138	(60%)
With PIR > 1.3, MSA pop < 1M	26	(11%)	0	(0%)	10	(4%)	36	(16%)
With PIR > 1.3, MSA pop > 1M	10	(4%)	6	(2%)	5	(2%)	21	(8%)
Total (all MSA and PIR)	168	(72%)	49	(21%)	16	(7%)	**233**	

Sources: U.S. Bureau of the Census and U.S. Department of Housing and Urban Development, "American Housing Survey for the United States in 1993." And U.S., Third National Health and Nutrition Examination Survey—Phase 2, 1992-1994

Table 7 shows the total number of children under 6 by year of home construction, PIR, and MSA size, based on 1997 American Housing Survey data, and Table 8 shows the percentage change in each household category (cell) between the 1993 and 1997 American Housing Survey data. The American Housing Survey data in Tables 4 and 7 indicate that the total number of children under 6 declined from 22.8 million in 1993 to 22.2 million in 1997 (the Census Bureau also projects virtually no growth in the number of children under 6 through about 2008). Two other trends over these four years would also reduce the number of lead poisoned children. First, the population of children under 6 with PIR less than 1.3 actually fell by about one million, while children with PIR greater than 1.3 grew by 0.4 million. Second, the decline in children with PIR below 1.3 was entirely in pre-73 housing, and disproportionately in pre-46 housing. The shift of low PIR children to newer housing appears to reflect two trends with the older housing stock. First, many older units in poor condition are demolished each year. Second, substantial rehabilitation and gentrification of older neighborhoods reduces the number of older units that serve low PIR families with young children.

Table 7. 1997 Number of Children (in millions) Under Age 6 by PIR and MSA

	Year House Built:		
	Pre-1940	**1940-1974**	**Post 1974**
Children with PIR ≤ 1.3	1.37	3.05	1.98
Children with PIR > 1.3	2.79	6.11	6.91
Total	*4.16*	*9.16*	*8.89*
Children in MSA population area < 1 Million	2.19	4.26	6.29
Children in MSA population area > 1 Million	1.97	4.90	2.60
Total	*4.16*	*9.16*	*8.89*
Children with PIR ≤ 1.3, MSA pop < 1M	.68	1.36	1.40
Children with PIR ≤ 1.3, MSA pop > 1M	.69	1.69	.62
Children with PIR > 1.3, MSA pop < 1M	1.51	2.90	4.89
Children with PIR > 1.3, MSA pop > 1M	1.28	3.21	1.98
Total	*4.16*	*9.16*	*8.89*

Source: U.S. Bureau of the Census and U.S. Department of Housing and Urban Development, "American Housing Survey for the United States in 1997."

Table 8. Percentage Change in Numbers of Children Under Age 6 from 1993 to 1997

	Year House Built:		
	Pre-1940	**1940-1974**	**Post-1974**
	% Change since 1993		
Children with PIR ≤ 1.3	-31%	-14%	+5%
Children with PIR > 1.3	+1%	-1%	+6%
Total (all PIR)	-12%	-6%	+6%
Children in MSA population area < 1 Million	-16%	-11%	+11%
Children in MSA population area > 1 Million	-8%	-1%	-4%
Total (all MSA)	-12%	-6%	+6%
Children with PIR ≤ 1.3, MSA pop < 1M	-33%	-26%	+5%
Children with PIR ≤ 1.3, MSA pop > 1M	-28%	-1%	+11%
Children with PIR > 1.3, MSA pop < 1M	-4%	-1%	+13%
Children with PIR > 1.3, MSA pop > 1M	+9%	-1%	-8%
Total (all MSA and PIR)	-12%	-6%	+6%

Sources: U.S. Bureau of the Census and U.S. Department of Housing and Urban Development, "American Housing Survey for the United States in 199," and "American Housing Survey for the United States in 1997."

The net effect of these trends on the estimated number of lead poisoned children in 1997 is shown in Tables 9 and 10. Each household category in Table 9 reflects the NHANES prevalence of children under 6 with blood lead levels above 10 µg/dL for that housing category in Table 1 multiplied by the total 1997 American Housing Survey number of children under 6 in that household category from Table 7. The calculations that reflect PIR yield estimates of about 775,000 children above 10 µg/dL in 1997 versus estimates of about 900,000 in 1993. Table 10 applies the same approach to combine NHANES data in Table 2 with American Housing Survey data in Table 7 to estimate the number of children under 6 with blood lead levels greater than 15 µg/dL in 1997. The calculations in Table 10 that reflect PIR yield estimates of about 190,000 children above 15 µg/dL in 1997 versus estimates of about 230,000 in 1993.

Table 9. 1997 Number of Children (in thousands) Under Age 6 With Blood Lead Levels ≥10 µg/dL, by PIR and MSA size (1997 American Housing Survey Children Times NHANES Phase 2 Prevalence ≥10 µg/dL)

	Year House Built:							
	Pre-1940		**1940-74**		**Post-74**		**Total**	
	Number	% of total	Number	% of total	Number	% of total	Number	% of total
Children with PIR ≤ 1.3	224	(29%)	221	(29%)	86	(11%)	531	(69%)
Children with PIR > 1.3	89	(12%)	136	(18%)	15	(2%)	241	(31%)
Total (all PIR)	*313*	*(41%)*	*357*	*(46%)*	*101*	*(13%)*	***771***	
Children in MSA < 1 Million	126	(13%)	131	(14%)	158	(17%)	415	(44%)
Children in MSA > 1 Million	227	(24%)	284	(30%)	21	(2%)	532	(56%)
Total (all MSA)	*353*	*(37%)*	*415*	*(44%)*	*179*	*(19%)*	***948***	
With PIR ≤ 1.3, MSA < 1M	72	(9%)	52	(7%)	91	(12%)	215	(28%)
With PIR ≤ 1.3, MSA > 1M	154	(20%)	154	(20%)	16	(2%)	323	(41%)
With PIR > 1.3, MSA < 1M	46	(6%)	69	(9%)	11	(1%)	126	(16%)
With PIR > 1.3, MSA > 1M	43	(6%)	67	(9%)	4	(1%)	114	(15%)
Total (all MSA and PIR)	*315*	*(40%)*	*342*	*(44%)*	*122*	*(16%)*	***779***	

Sources: U.S. Bureau of the Census and U.S. Department of Housing and Urban Development, "American Housing Survey for the United States in 1997." And Third National Health and Nutrition Examination Survey—Phase 2, 1991-1994

Table 10: 1997 Number of Children (in thousands) Under Age 6 With Blood Lead Levels ≥15 µg/dL, by PIR and MSA Size (1997 American Housing Survey Children Times NHANES Phase 2 Prevalence ≥15 µg/dL)

	Year House Built:							
	Pre-1940		**1940-74**		**Post 74**		**Total**	
	Number	% of total	Number	% of total	Number	% of total	Number	% of total
Children with PIR ≤ 1.3	93	(49%)	36	(19%)	2	(1%)	132	(70%)
Children with PIR > 1.3	35	(19%)	6	(3%)	15	(8%)	57	(30%)
Total (all PIR)	129	(68%)	42	(22%)	17	(9%)	**189**	
Children in MSA < 1 Million	31	(12%)	27	(11%)	42	(17%)	100	(40%)
Children in MSA > 1 Million	108	(43%)	34	(14%)	5	(2%)	148	(59%)
Total (all MSA)	140	(56%)	61	(24%)	48	(19%)	**249**	
With PIR ≤ 1.3, MSA < 1M	9	(5%)	18	(9%)	-	(0%)	27	(14%)
With PIR ≤ 1.3, MSA > 1M	85	(45%)	19	(10%)	1	(1%)	105	(55%)
With PIR > 1.3, MSA < 1M	25	(13%)	-	(0%)	11	(6%)	36	(19%)
With PIR > 1.3, MSA > 1M	11	(6%)	6	(3%)	4	(2%)	22	(12%)
Total (all MSA and PIR)	131	(69%)	43	(23%)	16	(8%)	**190**	

Sources: U.S. Bureau of the Census and U.S. Department of Housing and Urban Development, "American Housing Survey for the United States in 1997." And U.S., Third National Health and Nutrition Examination Survey—Phase 2, 1991-1994

Table 11 summarizes housing stock changes from 1993 through 1997 that are reflected in the declining estimated number of lead poisoned children. First, pre-46 units account for most housing demolition. Second, the average number of children per housing unit declined slightly. Third, the percentage of children with PIR below 1.3 declined sharply in pre-46 housing.

Table 11. Changes in Housing Stock Reflected in Estimated Change in Number of Lead Poisoned Children Under Age 6 from 1993 to 1997 (occupied units in millions)

Year of home construction	1993 Occupied Units	1997 Occupied Units	Percent Change per year	Children < 6 per 1993 unit	Children < 6 per 1997 unit	1993 percent of children < 6 with PIR < 1.3	1997 percent of children < 6 with PIR < 1.3
pre-40	19.9	19.4	-0.57%	0.24	0.21	42%	33%
1940-74	44.4	44.3	-0.07%	0.22	0.21	36%	33%
Post-74	30.4	35.8	4.07%	0.28	0.25	23%	22%

Sources: U.S. Bureau of the Census and U.S. Department of Housing and Urban Development, "American Housing Survey for the United States in 1993" and "American Housing Survey for the United States in 1997."

3. Using American Housing Survey, Residential Energy Consumption Survey, and National Lead Paint Survey Data to Project the Number of Housing Units With "High" and "Low" Risk of Lead Paint Hazards

The estimated number of lead poisoned children in 1997 derived in Section 2 does not account for housing rehabilitation between 1993 and 1997, which could further reduce the number of lead poisoned children in 1997. In the short run, remodeling and rehabilitation work without safe practices and adequate cleanup can increase the blood lead levels of resident children exposed to lead dust. In the long run, however, substantial rehabilitation will generally reduce lead paint hazards by removing housing components with lead paint. This may be especially true when lead paint is removed from friction and impact surfaces as a result of window and door replacement. In fact, the HUD Evaluation data show that the lead paint hazard intervention strategies selected most often by Grantees were window work and/or window replacement, paint stabilization, and cleanup.

Table 12 shows Residential Energy Consumption Survey and American Housing Survey data on the percent of units that have replaced all of their windows prior to 1990, and from 1990 through 1997. The 1993 Residential Energy Consumption Survey data asks respondents if they have replaced all of their windows in the last two years (1992-93), in the last three to four years (1990-91) or earlier (pre-1990). The 1995 and 1997 American Housing Survey data report the number of units that replaced windows and doors and the amount that each unit spent on this housing upgrade. Table 12 shows the percent of American Housing Survey units spending more than $2000 on window and door replacement in each two-year survey period, as a rough estimate of the percent of units replacing all of their windows. Since 1990, the American Housing Survey and Residential Energy Consumption Survey data show that about 1.6% per year of all pre-1970 units have replaced all of their windows.

Table 12. Residential Energy Consumption Survey and American Housing Survey data on Window Replacement

Age of Housing	1993 Residential Energy Consumption Survey: All Windows Replaced			American Housing Survey: > $2K		1990-1997 Average/Year
	Pre-90	1990-91	1992–93	1994–95	1996-97	
Pre-40	13.1%	3.7%	3.3%	2.5%	2.4%	1.5%
1940-49	11.0%	3.5%	3.8%	3.0%	2.6%	1.6%
1950-59	10.3%	4.1%	4.4%	3.4%	2.3%	1.8%
1960-69	4.7%	2.8%	3.6%	2.9%	2.9%	1.5%
1970-79	1.1%	1.4%	2.0%	2.1%	2.2%	1.0%

Although replacing all the windows in a housing unit is not equivalent to abating lead paint hazards, and certainly does not abate all lead paint in the unit, it may serve as a good indicator for substantial rehabilitation and for housing in good condition. The Cincinnati longitudinal study found that children living in deteriorated older housing had mean blood lead levels that were almost twice the mean blood lead of children living in rehabilitated housing and pre-WWII housing in satisfactory condition. Dust lead levels in deteriorated housing were also substantially higher than dust lead levels in rehabilitated housing and pre WWII housing in satisfactory condition. Housing condition was assessed as "satisfactory" if the house appeared to be well maintained and had no peeling paint visible from the street. Deteriorated housing was lacking one of both of these features. Rehabilitated units were extensively rehabilitated about 10 to 20 years prior to this study, with interiors that were frequently gutted and exteriors that were often sandblasted or chemically cleaned. These three categories of housing in the Cincinnati study were all in the same general location, so the variation in blood lead and dust lead levels should be primarily attributable to the extent of lead paint hazards in each unit.

Replacing all of the windows in an older house demonstrates a level of housing reinvestment that probably results in a relatively low risk of future lead paint hazards, similar to the rehabilitated and satisfactory housing in the Cincinnati study. The extent of lead paint removal in units that replace all of their windows is not as great as in the extensively rehabilitated housing in Cincinnati, but window replacement does remove lead paint from an important friction and impact surface that could have contributed to future lead dust levels. Furthermore, the level of housing investment from window replacement is a strong indication that other upgrades and repairs will be made to the same housing unit over time. At a minimum, housing units where all of the windows have been replaced are also likely to satisfy the Cincinnati criteria Analysis for “satisfactory” condition.

Table 13 shows American Housing Survey data on window and siding replacements costing more than $2000, for owner-occupied units, by PIR. The units that reported window replacement costing more than $2000 in 1994-95 and in 1996-97 were not generally the same units that reported siding replacement costing more than $2000 during the same four year period, but the siding and window replacement data do show a similar pattern by PIR. Households with PIR above 1.3 are more likely to make either type of investment in their homes. It is reasonable to assume that units with all the windows replaced are also likely to have siding replaced over time, and to have other upgrade and upkeep investments made to maintain or enhance home value. Therefore, it is reasonable to use window replacement rates as a proxy for rehabilitation affecting lead paint hazards.

Table 13. Percent of Units With Window Versus Siding Replacement > $2K, by PIR (American Housing Survey 1994-97, Owner Occupied Units)

Window and Door Replacements	PIR<1.3	1.3<PIR<3.5	3.5>PIR
Pre-20	2.7%	4.5%	6.0%
1920-39	1.7%	4.7%	6.1%
1940-49	3.9%	4.6%	7.8%
Siding Additions and Replacements	**PIR<1.3**	**1.3<PIR<3.5**	**3.5>PIR**
Pre-20	0.9%	2.5%	4.1%
1920-39	0.4%	2.3%	2.6%
1940-49	0.5%	1.9%	2.7%

Although Table 13 reflects American Housing Survey data for owner-occupied units only, Residential Energy Consumption Survey data show that the percent of rental units that report all windows replaced in recent years is the same or slightly higher than the percent of owner occupied units that report all windows replaced. Furthermore, Table 14 shows that the tenure status of older housing units changed substantially between 1985 and 1997. About 37% of all pre-1940 housing units were rental units in 1989, but 55% were rental units during at least one of the 7 American Housing Surveys from 1985 through 1997, and only about 23% were rental units throughout this period. Therefore, window and siding replacement rates for owner-occupied housing will be reflected in both owner-occupied and rental units over time.

Table 14. 1985-1997 Changes in Tenure Status (Across 7 American Housing Survey Samples)

	1989 American Housing Survey Percent Rented	Percent Ever Rented in 1985–97 American Housing Survey	Percent Always Rented in 1985–97 American Housing Survey
Pre-20	36%	54%	22%
1920-39	37%	55%	24%
1940-49	32%	50%	19%

Tables 15 and 16 combine data on demolition rates, window replacement rates, and HUD National Lead Paint Survey data on the percent of units without interior lead paint, to forecast the change in high-risk and low-risk units from 1989 through 1997. The second column of Table 15 shows HUD National Lead Paint Survey data on the percent of units without interior lead paint, by year built (post-74 units are assumed to have virtually no interior lead paint). The third and fourth columns show the number of occupied units, by year built, in 1989 and in 1997. The fifth column of Table 15 shows the annual percentage change in number of units, by year built, and the next two columns show how demolition rates might differ for low and high-risk pre-75 housing.

Table 15. Units With No Lead Paint, and Demolition and Rehab Rates, by Year Built

Year Built	No interior lead paint	Occupied Units (millions)		1989-97 Demolition rate per year			Window Replacement (Rehab) rate per year		
	1990	1989	1997	All	High Risk	Low Risk	All	High Risk	Low Risk
Pre-40	17%	20.82	19.44	0.86%	0.95%	0.40%	1.60%	1.85%	0.40%
1940-59	31%	20.90	19.80	0.68%	0.80%	0.40%	1.60%	1.85%	1.05%
1960-74	51%	25.49	24.49	0.50%	0.60%	0.40%	1.25%	1.50%	1.00%
Post-74	100%	26.48	35.76	NA	NA	NA	NA	NA	NA

Low-risk units in 1989 can be defined as units without interior lead paint. Lead paint was used so extensively prior to 1940 that it might be reasonable to assume that most pre-40 units without interior lead paint have already undergone substantial rehabilitation (removing interior lead paint). The percent of units with all windows replaced prior to 1990 (13.1% from Table 12) is very similar to the percent without interior lead paint in 1990 (17%), which also suggest that most pre-40 units without interior lead paint have had substantial rehabilitation. This suggests that low-risk units are less likely to be demolished because rehabilitated units are less likely to be demolished. Therefore, the annual demolition rate of .86% for pre-40 housing is assumed to reflect a weighted average of .95% for high-risk housing and 0.4% for low-risk housing (.83x.95 + .17x0.4 = .86).

HUD National Lead Paint Survey data show that 31% of 1940-59 units had no interior lead paint in 1990, and 51% of 1960-78 units had no interior lead paint. Within either housing category, older units are more likely to have interior lead paint and are also likely to be demolished at a higher rate than newer units without lead paint. Also, the percent of 1940-59 units with all windows replaced before 1990 (about 10.6%) suggests that many pre-60 units without lead paint may have undergone substantial rehabilitation. Therefore, the annual demolition rate of 0.68% for 1940-59 housing is assumed to reflect a weighted average of .80% for high-risk housing and 0.4% for low-risk housing (.69x.80 + .31x0.4 = 0.68). Similarly, the annual demolition rate of 0.50% for 1960-74 housing is assumed to reflect a weighted average of .60% for high-risk housing and 0.4% for low-risk housing (.49x.60 + .51x0.4 = 0.50).

The last three columns of Table 15 show the annual window replacement rate by year built, and how rates differ for low and high-risk pre-75 housing. Table 12 shows that about 1.6% of all pre-70 units replace all of their windows each year, but only about one percent of units built in the 1970s replace all their windows each year. Most pre-40 units and many 1940-59 units without lead paint in 1990 are likely to have undergone rehabilitation (window replacement) prior to 1990, and it is unlikely that these units would replace all of their windows again for many years. Therefore, the annual rehab rate of 1.6% for pre-40 housing is assumed to reflect a weighted average of 1.85% for high-risk housing and 0.40% for low-risk housing (.83x1.85 + .17x0.4 = 1.6). Also, the annual rehab rate of 1.6% for 1940-59 housing is assumed to reflect a weighted average of 1.85% for high-risk housing and 1.05% for low-risk housing (.69x1.85 + .31x1.05 = 1.6). The annual rehab rate of 1.25% for 1960-74 housing is assumed to reflect a weighted average of 1.5% for high-risk housing and 1.0% for low-risk housing (.49x1.5 + .51x1.0 = 1.6).

Table 16 shows how the data in Table 15 are used to forecast changes in the high and low-risk housing stock. The number of high-risk units in 1989 reflects the total number of occupied units in 1989 multiplied by the percent of units with interior lead paint, by year built. Pre-40 high-risk units are expected to decline by 2.8% per year (1.85% rehabilitated plus .95% demolished), 1940-59 high risk units decline by 2.65% per year (1.85% rehabilitated plus 0.8% demolished), and 1960-74 high risk units decline by 2.1% per year (1.5% rehabilitated and 0.6% demolished). Post-74 low-risk units increase by 3.73% per year with new construction. Low-risk pre-75 units experience a 0.4% demolition rate, but this decline is more than offset by the rehab rate for pre-75 high-risk units (rehabilitation of high-risk units moves these units to the low-risk category). Based on the assumptions detailed above, Table 16 shows the high-risk housing stock would decline from 44.2 million units in 1989 to 34.1 million units in 1999, while the low-risk housing stock would rise from 49.5 million units in 1989 to 67.1 million units in 1999.

The HUD National Lead Paint Survey indicated that lead in residential paint and associated lead dust hazards are both disproportionately concentrated in pre-60 units. Table 16 shows that 24 million high-risk pre-60 units remained in the housing stock in 1999 (13 million pre-40 units and 11 million 1940-59 units). The last column of Table 16 shows that 3.8 million of these high-risk pre-60 units will be rehabilitated by 2010 (2.1 million pre-40 units and 1.1 million 1940-59 units) and another 1.8 million units will be demolished (1.1 million pre-40 units and 0.7 million 1940-59 units). In the absence of Federal action, this would still leave 18.4 million high-risk pre-1960 units in 2010.

Table 16. Forecast Change in High and Low Risk Units Resulting from 1989-97 Demolition and Rehab (Window Replacement) Rates (housing units in millions)

Housing Type	1989 Units	Annual Rate of Change	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000-2010
High Risk Units													
pre-40	17.28	-2.80%	16.80	16.3	15.9	15.4	15.0	14.6	14.2	13.8	13.4	13.0	
1940-59	14.42	-2.65%	14.04	13.7	13.3	13.0	12.6	12.3	11.9	11.6	11.3	11.0	
1960-74	12.49	-2.10%	12.23	12.0	11.7	11.5	11.2	11.0	10.8	10.5	10.3	10.1	
pre-40		-1.85%	0.32	0.31	0.30	0.29	0.29	0.28	0.27	0.26	0.25	0.25	2.1
Rehab 1940-59		-1.85%	0.27	0.26	0.25	0.25	0.24	0.23	0.23	0.22	0.22	0.21	1.7
1960-74		-1.50%	0.19	0.18	0.18	0.18	0.17	0.17	0.16	0.16	0.16	0.15	
Demolition													
pre-40		-0.95%	0.16	0.16	0.16	0.15	0.15	0.14	0.14	0.13	0.13	0.13	1.1
1940-59		-0.80%	0.12	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.09	0.09	0.7
1960-74		-0.60%	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	
Low Risk Units													
pre-40	3.54	-0.4%+HR rehab*	3.8	4.1	4.4	4.7	5.0	5.2	5.5	5.7	5.9	6.2	
1940-59	6.48	-0.4%+HR rehab*	6.7	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	
1960-74	13.00	-0.4%+HR rehab*	13.1	13.3	13.4	13.5	13.6	13.7	13.9	14.0	14.1	14.2	
Post-74	26.48	+3.73%	27.5	28.5	29.6	30.7	31.8	33.0	34.2	35.5	36.8	38.2	
High Risk Units	44.19		43.1	42.0	40.9	39.9	38.8	37.8	36.9	35.9	35.0	34.1	
Low Risk Units	49.50		51.2	52.9	54.5	56.3	58.0	59.8	61.5	63.4	65.2	67.1	
Percent High Risk	47.2%		45.7%	44.3%	42.8%	41.5%	40.1%	38.8%	37.5%	36.2%	34.9%	33.7%	
Change in High Risk %			-3.1%	-3.2%	-3.2%	-3.2%	-3.3%	-3.3%	-3.4%	-3.4%	-3.4%	-3.5%	

* High risk (HR) units that become low risk units due to rehabilitation (window replacement).

4. Calculating Lead Poisoning Prevalence for Children in High and Low Risk Housing

NHANES data can be combined with the data in Section 3 to estimate the lead poisoning prevalence for children in high versus low risk housing, by PIR and age of housing. As a first step, this analysis assumes that the lead poisoning prevalence in older low-risk units is approximately equal to the prevalence in post-1974 units. This assumption may understate the lead poisoning prevalence in older low-risk units because our definition of "low-risk" includes units with lead paint, and older units are more likely to be in older neighborhoods with dust and soil hazards created by deteriorating exterior lead paint from other buildings. Even in post-74 housing, however, the prevalence of lead poisoned children is much higher among households with a PIR below 1.3, suggesting that neighborhood lead paint risks may also be reflected to some extent in the post-74 prevalence data.

If we assume that the prevalence of lead poisoned children in low-risk older housing is approximately the same as the prevalence in post-74 housing, than we can estimate the prevalence of lead poisoned children in high-risk older housing based on the percent of older housing that is high risk. Table 16 shows the following distribution for older housing in 1994, at the end of NHANES III Phase 2:

- Pre-40: 75% high risk (15 million out of 20 million units)
- 1940-74: 53% high risk (24 million out of 45 million units)

These weighting factors can be used to estimate the following prevalence data:

- X1 = lead poisoning prevalence for children with PIR under 1.3 in low-risk housing = 4.33%
- X2 = lead poisoning prevalence for children with PIR above 1.3 in low-risk housing = 0.22%
- X3 = lead poisoning prevalence for children with PIR under 1.3 in high risk pre-40 housing
- X4 = lead poisoning prevalence for children with PIR above 1.3 in high risk pre-40 housing
- X5 = lead poisoning prevalence for children with PIR under 1.3 in high risk 1940-74 housing
- X6 = lead poisoning prevalence for children with PIR above 1.3 in high risk 1940-74 housing

The values for X1 (4.33%) and X2 (0.22%) are assumed to equal the NHANES III Phase 2 prevalence values for post-73 housing. The values for the other four categories can then be derived from the weighted-average NHANES prevalence values for pre-46 and 1946-73 housing, as follows:

- $.25*4.33 + .75*X3 = 16.37$
  $X3 = (16.37 – (.25*4.33))/0.75 = 20.38\%$

- $.25*.22 + .75*X4 = 3.19$
  $X4 = (3.19 – (.25*.22))/0.75 = 4.18\%$

- $.47*4.33 + .53*X5 = 7.25$
  $X5 = (7.25 – (.47*4.33))/0.53 = 9.84\%$

- $.47*.22 + .53*X6 = 2.24$
  $X6 = (2.24 – (.47*.22))/0.53 = 4.00\%$

These calculations indicate a lead poisoning prevalence of about 4% for children with PIR below 1.3 in low-risk housing (X1) and for children with PIR above 1.3 in high-risk housing (X4 and X6). The lead poisoning prevalence for children with PIR above 1.3 in low-risk housing is only 0.22%. The lead poisoning prevalence is much higher for children with PIR below 1.3 in high-risk housing: 20.38% for children in pre-40 housing and 9.84% for children in 1940-74 housing during the NHANES III Phase 2 sampling period (1992-1994).

5. Forecasting Lead Poisoning Prevalence by PIR and Age of Housing Based on Percentage of Housing Stock With High Risk of Lead Paint Hazards

The forecast decline in high risk units (Table 16) combined with the higher lead poisoning prevalence estimates for high risk units (derived in Section 4) indicates that the overall lead poisoning prevalence should decline with the decline in high risk units. Furthermore, data presented in this section suggest that lead poisoning prevalence estimates for children in low risk housing should also decline with the decline in the high-risk housing stock.

Table 17 shows the distribution of children (% of children<6) by PIR and age of housing, based on 1993 American Housing Survey data. Lead poisoning prevalence estimates are also shown for high and low risk housing, by PIR and age of housing category. Only 25.5% of children below a PIR of 1.3 lived in post-74 housing in 1993, whereas 42.2% of children above a PIR of 1.3 lived in post-74 housing.

Table 17. Distribution of Children<6 and Percent Above 10 μg/dL by PIR, Housing Unit Risk, and Year Built

Year Built	Percent of Children<6		High Risk Unit (% EBL)		Low Risk Unit (% EBL)	
	PIR<1.3	PIR >1.3	PIR<1.3	PIR >1.3	PIR<1.3	PIR >1.3
Pre-40	26.8%	17.8%	20.38%	4.19%	4.33%	0.22%
1940-59	21.9%	17.8%	9.84%	3.96%	4.33%	0.22%
1960-74	25.8%	22.2%	9.84%	3.96%	4.33%	0.22%
Post-74	25.5%	42.2%	NA	NA	4.33%	0.22%
All	100.0%	100.0%				

Table 18 provides additional detail on the distribution of children in post-74 housing, whether they moved into their post-74 unit during 1993, and whether other residential buildings within 300 feet are described in the 1993 American Housing Survey as "older" or "very mixed." These data show that children below a PIR of 1.3 in post-74 housing are more likely to live in 1975-79 housing, more likely to have moved to this unit in 1993, and more likely to live near older residential buildings than are children with PIR above 1.3.

Table 18. Post-74 Units with Children<6, by PIR and Year Built With Percent Moved in 1993 and Percent Near Older Units

	Post-74 Units with Children<6	Percent of Row:	
		Moved in 1993	Near Older Units
PIR <1.3, 1975-79	40.6%	40.3%	21.0%
1980-84	26.6%	27.6%	19.3%
Post-84	32.8%	33.5%	38.7%
Post-74	100.0%	34.7%	26.6%
PIR >1.3, 1975-79	26.8%	29.4%	18.6%
80-84	21.6%	27.7%	20.3%
Post-84	51.6%	24.4%	23.1%
Post-74	100.0%	26.4%	21.3%

The data in Table 18 suggest that the higher lead poisoning prevalence for low PIR children in post-74 housing may be largely attributable to lead paint hazards in a previous residence and/or from nearby residences with exterior lead paint hazards. With respect to neighborhood lead paint hazards, 26.6% of low PIR children in post-74 housing and 38.7% of those in post-84 housing live near older buildings that could have deteriorating lead paint. Almost all of the post-74 units in the American Housing Survey that do not describe nearby buildings as “older” or “very mixed” describe the nearby buildings as “about the same” age as the American Housing Survey unit. About two thirds of low PIR children in post-74 housing are in 1975-84 housing units, where nearby buildings “about the same” age (based on a visual evaluation) could also include many pre-74 buildings with deteriorating lead paint.

The percent of low PIR children in Post-74 housing who moved in 1993, and the percent of low PIR children by age of housing, can be combined to estimate the extent to which the low PIR lead poisoning prevalence in Post-74 housing reflects lead paint hazards in a previous residence. The 1993 American Housing Survey was completed in October, so children who moved into the unit in 1993 could not have been there more than 10 months. To the extent that families with children are more likely to move during summer, those who moved in during 1993 had probably only been in their new home for a few months, on average. If we assume that the lead poisoning prevalence for these children reflects the lead poisoning prevalence for their previous housing category, then the lead poisoning prevalence for low PIR children in post-74 housing can be described as a weighted-average that incorporates the following values:

- 4.33% is the lead poisoning prevalence for children with PIR under 1.3 in Post-74 housing
- 16.37% is the lead poisoning prevalence for children with PIR under 1.3 in Pre-40 housing
- 7.25% is the lead poisoning prevalence for children with PIR under 1.3 in 1940-74 housing
- 34.7% of children with PIR below 1.3 in post-74 housing moved in 1993
- 26.8% of all children with PIR<1.3 live in Pre-40 housing
- 47.7% of all children with PIR<1.3 live in 1940-74 housing

If the low PIR children who moved to post-74 units in the past year reflect the distribution of all low PIR children by age of housing, then lead poisoning prevalence for low PIR children in post-74 units who haven’t moved recently (Y) can be estimated as follows:

$$4.33\% = .347 * (.268*16.37\% + .477*7.25\%) + .653*Y = 2.72\% + .653*Y$$

$$Y = (4.33\% - 2.72\%)/0.653 = 2.47\%$$

This calculation indicates that almost half of the lead poisoning prevalence for low PIR children in post-74 housing may actually reflect their exposure to lead paint in previous residences built before 1974. The neighborhood lead paint hazards discussed above would explain some additional portion of the lead poisoning prevalence for low PIR children in post-74 housing. Finally, with 40.6 percent of low PIR children in post-74 housing living in 1974-79 housing, many of these children are also exposed to lead paint hazards in their own unit, because lead paint for residential use was not banned until 1978. For all of these reasons, it is reasonable to expect that the decline in high-risk units over time will also reduce the lead poisoning prevalence for low PIR children living in low-risk units.

6. Projecting the Number of Lead Poisoned Children in Low and High Risk Units, Before and After Adjustment for HUD Rule for Federally Assisted Housing

Table 19 shows how the projected decline in high-risk housing is likely to reduce the lead poisoning prevalence for children under age six in two ways. First, the projected decline in high-risk units will reduce the percent of children living in high-risk units. Second, the prevalence of lead poisoned children in low-risk units should also decline as the declining number of high-risk units reduces both the risk of neighborhood lead hazards and the percent of children poisoned in a previous residence. In particular, Table 19 assumes that the lead poisoning prevalence for each category of housing (derived in Section 4 for 1993) will decline each year at a rate equal to the rate of decline in the high-risk housing percentage of the total housing stock. Based on these assumptions, the number of lead poisoned children each year is calculated by multiplying the lead poisoning prevalence for each housing and PIR category by the number of housing units and the number of children per unit.

The decline in the number of lead poisoned children from 1993 to 1997 reflects both changes in the housing stock and changes in the percent of older units with poor children between 1993 and 1997, as discussed in Section 2. The projections beyond 1997 are all based on the 1997 American Housing Survey data on the average number of children per unit, and the percent of units with PIR below 1.3. The change in these two variables between 1993 and 1997 is why the number of lead poisoned children is estimated to have declined more rapidly between 1993 and 1997. Continued declines in the baseline number of lead poisoned children after 1997 reflect only the projected rate of demolition and housing rehabilitation (window replacement) which reduce the number of high-risk units.

The projection in Table 19 implicitly assumes that eliminating all high-risk housing would also eliminate all childhood lead poisoning. Of course, this assumption is not entirely realistic because lead paint hazards are not the only cause of lead poisoning. However, the analyses presented above suggests that eliminating lead paint hazards could very nearly eliminate childhood lead poisoning, or at least reduce the overall lead poisoning prevalence to the very low 0.22% prevalence already achieved for children in post-74 housing with PIR above 1.3.

Table 20 shows the number of low PIR children protected from lead poisoning by the HUD rule for Federally assisted housing. The lead poisoning prevalence estimates for this projection reflect a weighted-average of the prevalence for low and high risk housing, by age of construction. The number of units in 2000 reflects the number of units covered by the first year of the HUD rule, as reported in the Economic Analysis for the HUD rule for Federally Assisted Housing. The number of units in 2001 reflects the phase-in of additional public housing and project-based assistance units covered by the rule. The number of children protected is equal to the number of units in each category multiplied by the number of children per unit and the corresponding lead poisoning prevalence.

Table 19. Projected Number of High Risk Units and Associated Change in Lead Poisoning Prevalence

High Risk Housing Units			**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Percent High Risk			41.5%	40.1%	38.8%	37.5%	36.2%	34.9%	33.7%	32.5%
Change in High Risk Percent			-3.2%	-3.3%	-3.3%	-3.4%	-3.4%	-3.4%	-3.5%	-3.5%
Lead Poisoning Prevalence										
High Risk, PIR>1.3pre-40			4.19%	4.1%	3.9%	3.8%	3.7%	3.5%	3.4%	3.3%
High Risk, PIR>1.31940-74			3.96%	3.8%	3.7%	3.6%	3.5%	3.3%	3.2%	3.1%
Low Risk, PIR>1.3			0.22%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
High Risk, PIR<1.3pre-40			20.38%	19.7%	19.1%	18.4%	17.8%	17.2%	16.6%	16.0%
High Risk, PIR<1.31940-74			9.84%	9.5%	9.2%	8.9%	8.6%	8.3%	8.0%	7.7%
Low Risk, PIR<1.3			4.33%	4.2%	4.0%	3.9%	3.8%	3.6%	3.5%	3.4%
Pre-40, PIR<1.3			16.6%	15.8%	15.1%	14.4%	13.7%	13.0%	12.4%	11.8%
1940-74, PIR<1.3			7.3%	7.0%	6.7%	6.5%	6.2%	5.9%	5.7%	5.4%
Projected Number of children under 6 (in thousands) with blood lead levels above 10 µg/dl with PIR > 1.3										
Housing Category	**Children<6/unit**	**%PIR>1.3**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
High-Risk pre-40	0.214	67.0%	89	85	81	77	72	68	64	60
1940-59	0.216	66.0%	71	68	64	61	57	54	51	48
1960-74	0.199	67.3%	64	60	56	53	49	46	44	41
Low Risk pre-40	0.214	67.0%	1	1	2	2	2	2	2	2
1940-59	0.216	66.0%	2	2	2	2	2	2	2	2
1960-74	0.199	67.3%	4	4	4	4	4	3	3	3
Post-74	0.249	77.7%	14	14	14	13	13	13	13	13
Projected Number of children under 6 (in thousands) with blood lead levels above 10 µg/dl with PIR < 1.3										
High-Risk pre-40	0.214	33.0%	313	278	243	208	173	162	152	143
1940-59	0.216	34.0%	104	96	89	81	73	69	65	61
1960-74	0.199	32.7%	88	81	73	66	59	56	53	50
Low Risk pre-40	0.214	33.0%	20	19	18	17	15	15	15	15
1940-59	0.216	34.0%	26	25	24	24	23	22	22	22
1960-74	0.199	32.7%	45	43	40	37	34	33	32	31
Post-74	0.249	22.3%	82	80	78	76	74	75	75	75
All Children<6 with blood lead levels > 10 µg/dl			**925**	**857**	**788**	**720**	**651**	**621**	**593**	**565**

Table 20. Projected Number of Children with Avoided Lead Poisoning Due to HUD Rule for Assisted Units

EBL Prevalence				**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Pre-40, PIR<1.3				11.8%	11.2%	10.6%	10.1%	9.6%	9.1%	8.6%	8.2%	7.7%	7.3%	6.9%
1940-74, PIR<1.3				5.4%	5.2%	5.0%	4.8%	4.6%	4.4%	4.2%	4.0%	3.8%	3.6%	3.5%
Projected Number of children (in thousands) with avoided blood lead levels > 10 μg/dL due to HUD rule for Federally assisted units														
TBR	Units (thousands)		Children<6 per unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	2000	2001												
pre-40	80	80	1.76	16.5	15.7	14.9	14.2	13.5	12.8	12.1	11.5	10.9	10.3	9.7
1940-59	99	99	1.76	9.4	9.0	8.7	8.3	7.9	7.6	7.2	6.9	6.6	6.3	6.0
1960-74	163	163	1.76	15.6	15.0	14.3	13.7	13.1	12.5	12.0	11.4	10.9	10.4	9.9
Public Housing														
pre-40	16	33	0.70	1.4	2.6	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.6
1940-59	66	131	0.70	2.5	4.8	4.6	4.4	4.2	4.0	3.8	3.7	3.5	3.3	3.2
1960-74	82	164	0.70	3.1	6.0	5.7	5.5	5.2	5.0	4.8	4.6	4.4	4.2	4.0
Project-based														
pre-40	97	109	0.34	3.9	4.1	3.9	3.7	3.5	3.4	3.2	3.0	2.9	2.7	2.6
1940-59	97	109	0.34	1.8	1.9	1.8	1.8	1.7	1.6	1.5	1.5	1.4	1.3	1.3
1960-74	385	468	0.34	7.1	8.3	7.9	7.6	7.3	6.9	6.6	6.3	6.1	5.8	5.5
Other non-rehab														
pre-40	14	14	0.34	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3
1940-59	11	11	0.34	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
1960-74	27	27	0.34	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3
Total Non-Rehab														
pre-40	207	236		22.3	23.0	21.8	20.7	19.7	18.7	17.7	16.8	15.9	15.0	14.2
1940-59	272	349		13.9	16.0	15.3	14.6	14.0	13.4	12.8	12.2	11.6	11.1	10.6
1960-74	657	822		26.4	29.7	28.4	27.2	26.0	24.9	23.8	22.7	21.7	20.7	19.8
Pre-75	**1,136**	**1,407**		**63**	**69**	**66**	**63**	**60**	**57**	**54**	**52**	**49**	**47**	**45**
Cumulative Non-Rehab				**63**	**131**	**197**	**259**	**319**	**376**	**430**	**482**	**531**	**578**	**623**

Rehabilitation covered by the HUD rule is not reflected in Table 20 to avoid any double counting of the overall reduction in high-risk units resulting from rehabilitation. The American Housing Survey and Residential Energy Consumption Survey data on window replacement used to project the decline in high-risk units should include Federally assisted rehabilitation. The Economic Analysis for the HUD rule shows that about 40% of assisted rehabilitation units report window and door replacement as part of their rehabilitation work in the 1995 American Housing Survey, and other assisted units may have replaced windows in earlier years.

7. Adjusting Projections for Lead Poisoned Children to Reflect Impact of Expanded HUD Lead Hazard Control Grant Program

Table 21 shows the additional number of low PIR children protected from lead poisoning by an expanded HUD Lead Hazard Control Grant Program. The number of units addressed each year reflects a phase-in strategy that emphasizes pre-40 units first, and shifts to more 1940-59 units in later years. The estimated number of children protected reflects the average number of children per unit multiplied by the lead poisoning prevalence for low PIR children by age of housing. Table 21 assumes that the number of young children per unit is similar to the Tenant-Based Rental units subject to the HUD rule for Federally assisted housing. The HUD rule applies to Tenant-Based Rental units with children under age six, and American Housing Survey data indicate that about half of these units have children ages one or two. In the case of the expanded Lead Hazard Control Grant Program, the concentration of young children in these units assumes that public health officials can direct families with young children (and those expecting a child) to units that have undergone hazard reduction or passed the hazard screen. The combination of the HUD rule and this expanded HUD Lead Hazard Control Grant Program could eliminate low-PIR lead poisoned children in pre-60 housing, and virtually eliminate low-PIR lead poisoned children in pre-1974 housing, by 2010. The analysis in Section 5 also suggests that this action would also substantially eliminate low-PIR lead poisoned children in post-74 housing, by eliminating the risk from previous residences and reducing neighborhood risks.

The projections in Table 21 assume that households with PIR less than 1.3 will realize all the benefits from the expanded Lead Hazard Control Grant Program. The eligibility criteria for the HUD Lead Hazard Control Grant Program are actually stated in terms of households with income between 50% and 80% of area income. Table 22 shows American Housing Survey data indicating that households with PIR below 1.3 will almost always meet the HUD criteria, and 56.6% to 81.8% of households that meet the HUD criteria will also have PIR below 1.3.

Table 22. Comparison of Low PIR and Percent of Area Income (X%) Criteria for HUD Lead Hazard Control Grant Program

	X=80%	X=70%	X=60%	X=50%
PIR< 1.3 & income < X% of area median	28.9%	28.8%	28.6%	26.9%
Only PIR < 1.3	0.3%	0.4%	0.7%	2.3%
Only income < X% of area median	22.2%	17.2%	11.5%	6.0%
Neither	48.6%	53.6%	59.2%	64.8%
Total	100%	100%	100%	100%
PIR < 1.3 as Percent of Less than X%	56.6%	62.6%	71.3%	81.8%

Table 21. Projected Number of Lead Poisoned Children under Six (in thousands) Before and After HUD Rule and Expanded HUD Lead Hazard Control Grant Program

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Baseline Projection for Lead Poisoned Children with PIR<1.3 (thousands)											
Pre-40	158	149	141	133	125	118	111	104	98	92	87
1940-59	83	79	75	71	67	64	61	57	54	52	49
1960-74	81	77	74	70	67	64	61	58	55	52	50
Pre-1975	322	305	289	274	259	245	232	220	208	196	185
Children Protected by HUD Rule (Non-Rehab) (thousands)											
Pre-40	22	23	22	21	20	19	18	17	16	15	14
1940-59	14	16	15	15	14	13	13	12	12	11	11
1960-74	26	30	28	27	26	25	24	23	22	21	20
Pre-1975	63	69	66	63	60	57	54	52	49	47	45
Additional Children Protected by Expanded HUD Lead Hazard Control Grant Program Units (thousands)											
Pre-40		80	100	120	130	130	120	120	120	120	120
Pre-40 Cumulative		80	180	300	430	560	680	800	920	1,040	1,160
1940-59		20	50	80	120	120	130	140	150	160	170
1940-59 Cumulative		20	70	150	270	390	520	660	810	970	1,140
Avoided Number of Lead Poisoned Children Due to HUD Lead Hazard Control Grant Program (thousands)											
Pre-40	0	9	19	30	41	51	59	65	71	76	80
1940-59	0	1	3	7	12	17	22	26	31	35	40
Pre-60	0	10	23	37	53	68	80	92	102	111	120
Summary Projection for Lead Poisoned Children with PIR<1.3 (thousands)											
Baseline Projection	322	305	289	274	259	245	232	220	208	196	185
After HUD Rule	259	237	224	211	200	188	178	168	158	149	141
After Expanded Grant Program	259	227	201	174	146	121	98	76	56	38	21
Pre-60 Baseline Projection	241	228	215	203	192	181	171	162	152	144	135
After HUD Rule	205	189	178	168	159	149	141	133	125	118	111
After Expanded Grant Program	205	179	156	131	105	82	61	41	23	6	0

The expanded Lead Hazard Control Grant Program units in Table 21 are all pre-60 units because data from the HUD National Lead Paint Survey and the US Geological Survey both indicate that lead in residential paint is disproportionately concentrated in pre-60 units. The Economic Analysis of the HUD rule also found that health benefits of lead dust removal in 1960-78 housing are only about 60% of the benefits for lead dust removal in pre-60 units (because pre-60 units are more likely to exceed the dust hazard standard by a substantial amount).

Table 23 shows HUD National Lead Paint Survey data on the total surface area with lead paint, the average lead concentration in lead paint, and total tons of lead in paint by age of housing. These data indicate that post-60 housing accounts for only 9% of all lead in interior paint, and only about 14% of all lead in exterior paint.

Table 23. HUD National Lead Paint Survey Data on Surface Area with Lead Paint, Average Lead per Unit of Surface Area, and Percent of Lead by Year of Construction

	Pre-40	**1940-1959**	**1960-1978**	**Total**
Lead paint Surface Area (million sq. feet)				
Interior	15,912	8,247	5,279	29,438
Exterior	25,969	12,635	10,502	49,106
Average lead paint Concentration (mg/sq.c)				
Interior	5.7	2.5	2.0	
Exterior	6.1	4.2	3.2	
Total Lead in lead paint (1000 tons)	255	75	45	376
Interior	93	21	11	125
Exterior	162	54	34	251
Percent of Total Lead in lead paint	68%	20%	12%	100%
Interior	74%	17%	9%	100%
Exterior	65%	22%	14%	100%

Table 24 shows data on white lead consumption, by decade, from 1914-78 (US Geological Survey). White lead data for 1914-23 in Table 24 are used to estimate consumption from 1910 to 1920 because 1914 is the earliest year of available data. A small percentage of white lead was consumed in ceramics, greases, chemicals, plasterizers and stabilizers but the majority of white lead was used in paint. In fact, the paint industry accounted for about 95 percent of total white lead pigment consumption during the 1930s.

For comparison with white lead, Table 24 also shows consumption of red lead and litharge from 1920-78 (US Geological Survey). Litharge is primarily used in storage batteries. Red lead was used mostly for ceramics, lubricants, petroleum, rubber, glass, and other industrial applications, and was used very little in the paint industry as varnishes, enamels and glazes. The limited application of red lead by the paint industry was often as a rust-inhibiting primer coat for exterior metals, including bridges and automobiles, which were covered by a finish coat of different composition. The industrial uses of red lead are especially apparent in the data for the 1940s when there was a sharp increase in red lead and litharge consumption during World War II, while housing starts were sharply lower during the same period. The increase in red lead consumption in 1941 was specifically associated with efforts by the automobile industry to produce a record number of vehicles before converting to war production. Industrial lead consumption can result in paraoccupational lead exposure for young children (lead brought home from work exposure, usually on work clothes) but white lead used in house paint would have the far more pervasive effect on children's blood lead levels. Therefore, the white lead data for each decade in Table 24 are used to estimate the amount of lead in residential paint in housing built before 1978.

Table 24. Estimated Average Paint Lead by Decade of Construction (housing units in millions)

	Lead Consumption (thousand tons)		Decade-End Occupied Units	White Lead pounds per Unit	1991 Housing Units	1991 White Lead (thousand tons)		Percent of All White Lead
	White Lead	Red Lead and Litharge				Before Rehab	After Rehab	
1914-23	1,340	0	24.35	110	9.02	496	413	49.1%
1920-29	1,307	356	29.91	87	5.06	221	184	21.9%
1930-39	737	421	34.86	42	5.98	126	104	12.4%
1940-49	476	1,189	42.83	22	7.67	84	72	8.6%
1950-59	196	816	53.02	7	12.51	44	37	4.5%
1960-69	82	781	63.45	3	14.52	22	20	2.4%
1970-79	29	625	80.39	1	21	11	10	1.2%
	4,111	4,187				1,004	841	100%

The white lead data for each decade in Table 24 are divided by total occupied units at the end of each decade (United States Census Bureau) to estimate the tons of lead consumed per occupied unit during each decade. The white lead per unit is then multiplied by the number of occupied units that remained in the housing stock in the 1991 American Housing Survey, before subtracting the paint lead removed by rehab. Finally, the lead tons remaining in each age of housing category is reduced by the percentage of units with all windows replaced prior to 1991, as an estimate of substantial rehabilitation.

The calculations in Table 24 yield an estimate 841,000 tons of lead in paint remaining in pre-80 housing in 1991. This estimate is higher than the estimate of 376,000 tons in Table 23 for three reasons. First, the data in Table 24 are adjusted for housing rehabilitation but not for all the paint lead removed from older units by decades of paint peeling and scraping. Second, the estimates in Table 24 assume that all paint lead is used in residential units, but commercial buildings actually account for some of the paint lead consumed. Finally, the data in Table 23 reflect only the surface area of paint above the one mg per square centimeter federal definition of lead paint, whereas some of the paint lead in Table 24 was used in paint with a lead concentration below this threshold. In spite of these differences in methodology, the overall distribution of paint lead in Table 24 confirms the HUD National Lead Paint Survey data showing that post-60 housing accounts for a very small percentage of total paint lead in housing. The data in Table 24 also suggest that pre-20 units may account for a surprisingly high percentage of paint lead in housing.

8. Estimating the Benefits and Net Benefits of an Expanded Lead Hazard Control Grant Program

Lead paint hazard control activities provide the greatest benefit to children who avoid lead poisoning, but these same activities also benefit other children by reducing the average blood lead for children below 10 µg/dL. The Economic Analysis for the HUD Lead Paint Regulation for Federally Assisted Housing estimates the combined monetized health benefit per housing unit where lead hazards are reduced. This "unit benefit" includes the benefit to children who avoid lead poisoning, plus the benefit of lower blood lead levels for children below 10 μg/dL.

The Economic Analysis for the HUD rule showed that almost all of the monetized benefit of reducing lead paint hazards results from the present value of increased lifetime earnings associated with higher IQ levels due to avoided childhood lead exposure. Cognitive ability is reduced, on average, by about one-quarter IQ point for every one μg/dL increase in childhood blood lead. A reduction of one IQ point reduces lifetime earnings, on average, by about $9,600 at a 3 percent discount rate, and by about $2,200 at a 7 percent discount rate. Therefore, a one μg/dL increase in childhood blood lead reduces average lifetime earnings by about $2,400 at a 3 percent discount rate, and by about $550 at a 7 percent discount rate. The Economic Analysis for the HUD rule also cites research indicating the average avoided increase in blood lead due to hazard reduction activities, and the average number of children per housing unit, to estimate the average monetized benefit of lead hazard reduction per housing unit.

Table 25 shows the health and market benefits associated with the expanded HUD Lead Hazard Control Grant Program, assuming that lead paint hazards will be found in approximately one-third of all units inspected. Only units that are treated (units where lead paint hazards are found) incur the costs and realize the associated market benefits of lead hazard reduction. The Economic Analysis of the HUD rule shows that pre-40 units account for about 53 percent of all pre-60 units with lead paint, and 1940-59 units account for the other 47 percent. The Economic Analysis also shows that 44 percent of pre-40 units and 18 percent of the 1940-59 units have deteriorated lead paint. Therefore, about one-third (32 percent) of all pre-60 units are expected to have lead paint hazards (.44 * 53% + .18 * 47% = 32%).

The health benefit estimates in Table 25 also assume that the number of young children per unit is similar to the Tenant-Based Rental units subject to the HUD rule for Federally assisted housing. (The Economic Analysis for the HUD rule estimates that 75-80% of health benefits are realized by children ages one and two). Table 25 further assumes that one-third of the children in units inspected and/or treated by the HUD Lead Hazard Control Grant Program will realize the benefits of hazard reduction, because about one-third of the children living in these units would otherwise have lived in units with lead paint hazards. The Economic Analysis benefit estimates for interim controls assume 5 years of avoided paint chip ingestion (paint stabilization) and 5 years of avoided lead dust hazards. Abatement, by definition, protects against lead paint hazards for at least 20 years.

In addition to monetized health benefits, the Economic Analysis for the HUD rule shows that interim controls and lead hazard abatement also provide maintenance and rehabilitation market benefits. A large part of the cost of interim controls is paint stabilization, but more than 90 percent of this cost reflects the market value of paint repair, and less than 10 percent reflects the incremental cost of safe practices associated with lead hazards. In the case of abatement, the Economic Analysis estimates that about 80 percent of the total cost is offset by the market benefits of housing rehabilitation (including window replacement) and only 20 percent is an incremental cost of lead hazard reduction. Table 25 shows the following estimated market benefits for the expanded HUD Lead Hazard Control Grant Program:

- $1.058 billion for interim controls
- $15.64 billion for hazard abatement

Table 25. Monetized Health Benefits and Market Benefits (dollars in millions) of Expanded HUD Lead Hazard Control Grant Program

Monetized Health Benefits:	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Interim Control Benefits at 3%										
5-year avoided paint hazards	$27	$48	$60	$75	$75	$75	$78	$81	$84	$87
5-year avoided dust hazards	$370	$657	$822	$1,027	$1,027	$1,027	$1,068	$1,109	$1,150	$1,191
Total	$397	$705	$881	$1,102	$1,102	$1,102	$1,146	$1,190	$1,234	$1,278
Cumulative	$397	$1,102	$1,983	$3,085	$4,186	$5,288	$6,434	$7,624	$8,857	$10,135
Interim Control Benefits at 7%										
5-year avoided paint hazards	$8	$14	$17	$21	$21	$21	$22	$23	$24	$25
5-year avoided dust hazards	$85	$151	$189	$236	$236	$236	$246	$255	$265	$274
Total	$93	$165	$206	$258	$258	$258	$268	$278	$288	$299
Cumulative	$93	$258	$464	$721	$979	$1,236	$1,504	$1,782	$2,070	$2,369
Abatement Benefits at 3%										
20-year avoided paint hazards	$59	$104	$130	$163	$163	$163	$170	$176	$183	$189
20-year avoided dust hazards	$806	$1,433	$1,791	$2,239	$2,239	$2,239	$2,329	$2,418	$2,508	$2,597
Total	$865	$1,537	$1,922	$2,402	$2,402	$2,402	$2,498	$2,594	$2,690	$2,786
Cumulative	$865	$2,402	$4,324	$6,726	$9,128	$11,530	$14,028	$16,622	$19,312	$22,098
Abatement Benefits at 7%										
20-year avoided paint hazards	$17	$30	$37	$47	$47	$47	$48	$50	$52	$54
20-year avoided dust hazards	$185	$330	$412	$515	$515	$515	$536	$556	$577	$597
Total	$202	$359	$449	$562	$562	$562	$584	$607	$629	$651
Cumulative	$202	$562	$1,011	$1,572	$2,134	$2,696	$3,280	$3,886	$4,515	$5,167
Interim Control Market Benefits	**$41**	**$74**	$92	$115	$115	$115	$120	$124	$129	$133
Cumulative	$41	$115	$207	$322	$437	$552	$672	$796	$925	$1,058
Abatement Market Benefits	$612	$1,088	$1,360	$1,700	$1,700	$1,700	$1,768	$1,836	$1,904	$1,972
Cumulative	$612	$1,700	$3,060	$4,760	$6,460	$8,160	$9,928	$11,764	$13,668	$15,640

Table 26 summarizes the total costs, health benefits, market benefits, and net benefits over 10 years of the interim control and hazard abatement options for addressing lead paint hazards in pre-1960 housing occupied by low-income families not covered by the HUD rule. Abatement yields a higher net benefit based on a 3% discount rate for health benefits, but interim controls yield a higher net benefit based on a 7% discount rate for health benefits.

Table 26. Estimated Total Costs, Benefits, and Net Benefits of Options to Address Lead Paint in 2.3 Million Pre-1960 Housing Units Occupied by Low-Income Families Not Covered by HUD Rule, 2001-2010 ($ billion)

	Lead Hazard Screen and Interim Controls ($1000 per unit)	Inspection/Risk Assessment and Full Abatement of Lead paint ($9,000 per unit)
Cost	($2.3)	($20.7)
Health Benefit at 3%	$10.1	$22.1
Market Benefit	$1.1	$15.6
Net Benefit	**$8.9**	**$17.0**
Cost	($2.3)	($20.7)
Health Benefit at 7%	$2.4	$05.2
Market Benefit	$1.1	$15.6
Net Benefit	**$1.2**	**$00.1**

Source: Evaluation of the HUD Lead Hazard Control HUD Lead Hazard Control Grant Program; The Economic Analysis for the HUD Lead Paint Regulation for Federally Assisted Housing.