
Eliminating Childhood Lead Poisoning:

A Federal Strategy

DRAFT

January 5, 1999



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

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. Work group 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. Although these recommendations are a result of a consensus among the workgroup members, they have not undergone official review and clearance.

Preface

One Family's Story

Example To Be Added

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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 disproportionately 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 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.

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The workgroup acknowledges the contribution of Rick Nevin of ICF Consulting, Inc.

EXECUTIVE SUMMARY

This report describes how lead poisoning harms children, its pervasiveness, and how lead paint hazards in housing (the main cause of lead poisoning) can be eliminated in 10 years

Lead Is Harmful to Children

Lead is highly toxic, especially to young children. It can harm a child's brain, kidneys, bone marrow and other body systems and at high levels can cause coma, convulsions, and death.

The National Academy of Sciences has reported that even comparatively low levels of lead exposure -10 micrograms of lead per deciliter of blood ($\mu\text{g}/\text{dL}$)- are harmful and are associated with decreased intelligence, behavior problems, reduced physical stature and growth, and impaired hearing.¹

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

Table 1

Blood ($\mu\text{g Pb/dl}$)	Effect In Children
10 $\mu\text{g}/\text{dL}$	Reduced IQ, hearing loss, impaired growth, behavioral problems
20 $\mu\text{g}/\text{dL}$	Impaired nerve function
30 $\mu\text{g}/\text{dL}$	Damage to blood forming system

Lead toxicity has been well-established, with of harmful effects in children whose blood lead levels exceed 10 $\mu\text{g}/\text{dL}$.^{2, 3} No single definition of "lead poisoning" suits all purposes. From a public health perspective, the key questions are at what level does preventable adverse impact on health occur and

what is the magnitude. For clarity in this document the term "lead poisoning" is used for elevated blood lead levels of 10 $\mu\text{g}/\text{dL}$ or above.

Too Many Children Are Poisoned

Nearly 1 million children under age 6 have blood lead levels above 10 $\mu\text{g}/\text{dL}$.⁴ A large body of evidence shows that the most common source of lead exposure for children is lead paint in older housing and the contaminated dust and soil it generates.^{4, 5, 6, 7} Poisoning from lead paint has affected millions of children since it was first recognized more than 100 years ago^{8,9} and it persists despite a 1978 ban on lead in new paint.¹⁰ Although all children living in older housing with lead paint are at risk, low-income and minority children are much more likely to face hazards. For example, 16% of low-income children living in older housing that is where lead paint is most prevalent have levels of lead in their blood above the limit recommended by CDC, compared to 4.4% of all children (see Figure 1)⁴ Therefore, eliminating exposure to lead paint hazards in older, low-income housing is essential if childhood lead poisoning is to be eradicated.

Lead Poisoning Can Be Prevented

Lead exposure among young children has been dramatically reduced over the last two decades because of the phaseout of lead from gasoline, food and beverage cans, new house paint, industrial emissions, drinking water, and a variety of consumer goods. As a result, children's blood

lead levels have declined by over 80% since the mid-1970s.¹¹ Table 2 shows that there were about 14.8 million children with blood lead levels above 10 $\mu\text{g/dL}$ in 1978. In the mid-1990's that number declined to 890,000 children.

Figure 1

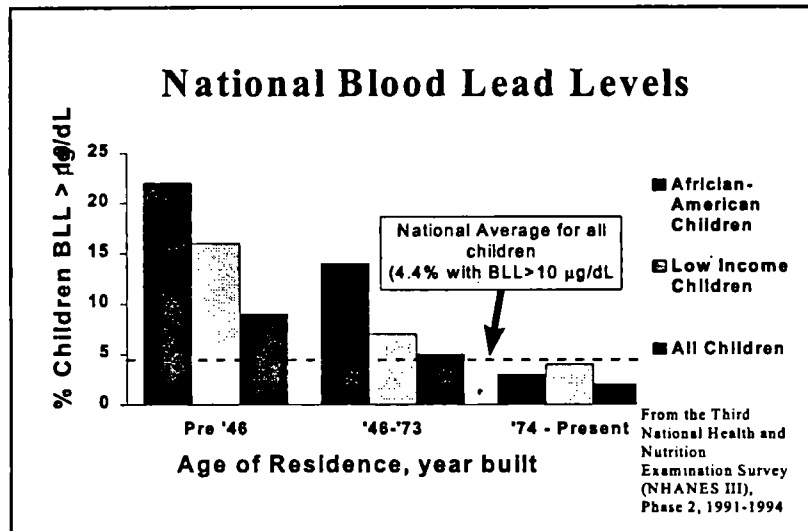


Table 2

<i>Time Period</i>	<i>Number of Children with Lead Poisoning</i>
1976 - 1980	14.8 million
1988-1991	1.7 million
1991-1994	890,000

Source: National Health and Nutrition Examination Surveys 2 and 3

The recommendations in this report, if implemented, will accelerate progress even further so that childhood lead poisoning, most of which is caused by exposure to lead paint hazards in housing, is significantly reduced or eliminated in 10 years. Without new efforts, a large number of young children over the coming decades may be exposed to lead in amounts that could impair their ability to learn and to reach their full potential.

Recent developments described below have brought the ambitious objective of eliminating childhood exposure to lead paint hazards within reach.

Title X

These recent developments are the result of 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). The Act mandated the creation of a system that would correct lead paint

hazards in housing before children are poisoned. Regulations promulgated as a result of Title X created an infrastructure to implement lead hazard control actions in housing across the country. It 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. Controlling these sources and pathways of exposure will eliminate almost all cases of childhood lead poisoning.

That infrastructure now exists and includes:

- Licensing of inspectors and abatement contractors
- Grants to make homes lead-safe
- Training of thousands of workers doing rehab, remodeling, renovation, repainting & maintenance
- Enforcement
- Disclosure of lead paint problems before sale or lease
- Promulgation of federal standards of care
- New, more inexpensive methods to control lead paint hazards
- New evidence that modern hazard control protects children
- Worker protection regulations

A Qualified Workforce Now Exists

Thirty-five states now license lead paint inspectors and abatement contractors. By March 2000 the EPA will be licensing inspectors and contractors in states which do not have Federally approved programs. California alone has trained over 15,000 workers in lead hazard control and the system is in place to train thousands more nationwide. Thousands of remodeling, renovation and painting contractors, together with maintenance personnel, have been trained to use lead-safe work practices in their everyday jobs.

Federal Grants and Private Financing for Lead Hazard Control

The infrastructure also includes HUD grants to finance lead paint hazard control in privately-owned low-income housing. These grants are now operational in over 200 cities. They can be used to leverage private financing, increasingly making it possible for families to locate lead-safe housing without incurring huge additional costs.

Education and Enforcement

Tools to conduct effective public education now exist and are being widely disseminated. Enforcement has made disclosure of lead paint issues during sales and leasing transactions a reality to ensure parents have the information they need to protect their children. Recent enforcement actions have resulted in leveraging over \$1 million in privately-financed abatement in the District of Columbia alone.

Action in Federal Housing & Worker Protection

Virtually all public housing has been inspected for lead paint and will be fully abated in the course of modernization over the next decade. In September 1999, a modern, streamlined standard of care was promulgated through new HUD regulations for lead paint hazard control in Federally-owned and Federally-assisted housing.¹² Regulations to protect construction workers from lead exposure have also been issued and enforced by the Occupational Safety and Health Administration (add 24 CFR 1926.62 to references).

Modern Hazard Control Methods Are More Inexpensive and Reliable

New low-cost methods of identifying housing that has hazards and fixing them are now available. 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 about 25%.¹³ House dust is the most common exposure pathway through which children are exposed to lead paint.¹⁴

Focus of this Strategy

The key elements of this strategy are:

- eliminate and prevent residential lead paint hazards before children are poisoned through targeted grants and leveraging of private and other non-federal funds for hazard control, public education, and enforcement of lead paint laws;
- expand early intervention for children with elevated blood lead levels, through expanded blood lead screening and follow-up services for at risk children, especially Medicaid-eligible children;
- conduct research to drive down costs, promote innovation, and quantify certain ways in which children are exposed to lead; and
- implement surveillance to measure progress and refine lead poisoning prevention strategies.

How Are Children Exposed to Lead Paint?

[insert picture of deteriorated paint]

Children are exposed to lead from paint either directly, by eating paint chips,¹⁵ or indirectly by ingesting lead-contaminated house dust or soil through normal hand-to-mouth contact.^{16, 17} Lead paint contaminates dust or soil when it deteriorates or is disturbed during maintenance, repainting, remodeling, demolition or lead paint removal without proper precautions.^{18,19} In fact, contaminated dust and soil from lead paint are now the main ways in which children are exposed to lead. Residences with exterior lead paint are more than three times as likely to have more lead in soil (exceeding 500 parts per million) than are dwellings without lead in exterior paint (21% versus

6%).^{11,20} If non-intact exterior lead paint is present, soil contamination is 8 times more common (48%) than at residences without exterior lead paint.^{11,20}

Removing, containing or repairing non-intact lead paint resulted in average declines in blood lead levels of between 20 and 30 percent over the following year in children with initial blood lead levels above 25 µg/dL according to an EPA report which reviewed 35 studies.²¹ In one controlled study the decline in blood lead levels for children in treated dwellings was about twice that of children in untreated dwellings.²²

Unsafe Removal Releases Lead Dust that Poisons Children

Extensive removal of lead paint from homes of poisoned children without measures to prevent exposure to contaminated dust and debris have been shown to cause increases in children's blood lead levels.^{23,24,25} Consequently, federal, state and local regulations and guidelines have prohibited certain hazardous paint removal methods and required safe work practices, cleaning, and dust lead ("clearance") testing prior to re-occupancy.²⁶ [insert open-flame burning picture]

Recent long-term studies^{27,28,29} 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. These treatments result in substantial, sustained reductions in interior lead dust and children's blood lead levels.

Housing With Lead Paint

Housing surveys and historical lead consumption data show that between 86-95% of all lead in paint in housing is located in housing built before 1960 (see Tables x in Appendix). Not surprisingly, blood lead data also show that among children living in older dwellings (those built when the use of lead paint was most common), the prevalence of elevated blood lead levels is five times higher than among children living in homes built after 1973, where lead paint is not common.³⁰ Therefore, resources should be targeted to pre-1960 units where most of the lead paint is located.

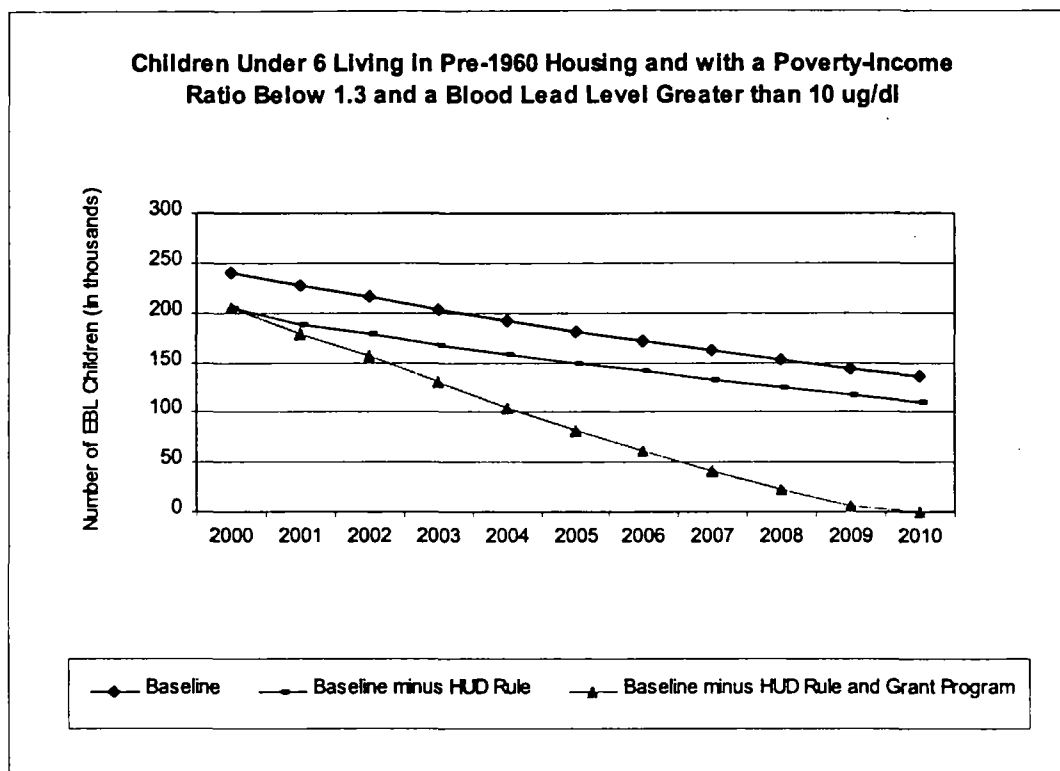
Effect of Demolition, Rehab and Hazard Control

Older housing is continually being demolished, renovated, or abated. Over a very long period of time, these actions will eventually eliminate lead paint hazards in the nation's housing stock. But current projections show that, without an expanded prevention effort, about 135,000 children from low-income families living in pre-1960 housing will still be poisoned annually at the end of the next decade (see Figure 2).

As shown in Table 3, projections based on the American Housing Survey (funded by HUD and conducted by the Bureau of the Census) show that in 1999 there are about 24 million pre-1960 dwelling units that are not zero-bedroom units (where children are unlikely to reside), or have not undergone major renovation. Demolitions and renovations are based on rates experienced

between 1989 and 1997 as reported in the American Housing Survey. The estimated number of units undergoing private hazard control is based on the supplement to the Current Population Survey.

Figure 2



Source: Projections from National Health and Nutrition Examination Survey, HUD Economic Analysis for the Lead Based Paint Regulation in Federally-Assisted Housing, and the Evaluation of the HUD Lead Hazard Control Grant Program (see Appendix)

Table 3
Projections of Pre-1960 Units at Risk of Having Lead paint Hazards in 2010

Housing Stock	# of Housing Units (millions)
Total Units in 1999	24.0
Reduction Due to Demolition, 2000-2010	-1.8
Reduction Due to Substantial Renovation & Private Lead Hazard Control, 2000-2010	-3.8
Subtotal	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 (see Appendix)

Low-income households occupy about 20 percent of the nation's housing. Applying this percentage to the 18.4 million units with lead paint that exist before the HUD rule results in 3.7 million units. HUD estimates that it will produce 1.4 million pre-1960 lead-safe units during the period from 2000 to 2010 as a result of its regulation for federally-owned and federally-assisted housing. Because virtually all these will be occupied by families with low incomes, they can be subtracted, which results in 2.3 million units that need to be assessed and any hazards identified eliminated (Table 3).

For housing occupied by low-income families, direct Federal financial assistance will continue to be needed.³¹ 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.

Protecting All Children

While the risks are greatest for low-income children living in older housing, all children should grow up in lead-safe homes. This report explains how public education, combined with tax or other financial incentives, can be used to protect children not directly served by federal 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 Lead Hazard Control Program Can Leverage Private Resources to Create Lead-Safe Housing

Milwaukee recently received a lead-hazard control grant from HUD for \$1.2 million. The City Council passed a local ordinance requiring all housing units in two high-risk neighborhoods to be made lead-safe. Landlords receive funds to partially defray the cost of complying with the ordinance. About \$400,000 in private funds has been leveraged, in addition to the HUD grant. The result is that about one-fourth of all units in the target neighborhoods have been made lead-safe. When completed, the program will have made nearly 1,000 homes safe for children.

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

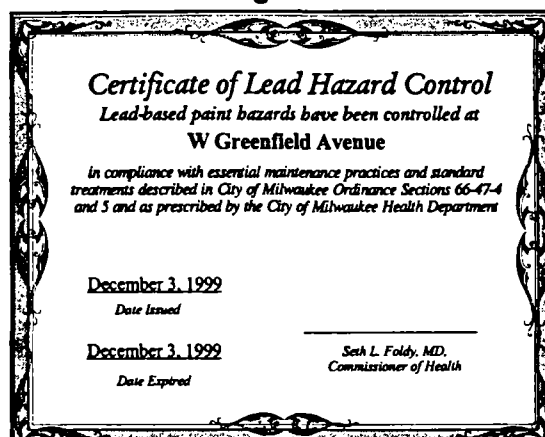
The HUD lead hazard control grant program is not an entitlement for all housing with lead paint hazards, but a limited funding pool. It can be used to not only address lead paint hazards directly, but also leverage private funding and prompt market forces. As more lead-safe housing is created, more landlords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

In addition, landlord motivation can be increased by providing an easily-understood "good housekeeping 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 3). This will promote increased competition, especially in markets where landlords have difficulty attracting tenants. It will also help to increase property value and marketing

appeal. In some areas, it may not be necessary to make all units lead-safe, but to create enough units so that families can find them without incurring significantly greater costs.

However, in some jurisdictions with few vacancies, competitive market forces may not be sufficient to prompt significant private funding of lead hazard control, 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 be the only answer.

Figure 3



Closing the Gap: Costs and Benefits

Table 4 compares the costs of two approaches to controlling lead paint hazards: 1) managing lead paint on an on-going basis to ensure it does not become hazardous (known as interim controls); and 2) permanent abatement. Costs are presented for all housing with lead paint and for low-income housing where risks are greatest.

Table 4
Estimated Average Annual Costs of Options to Address Lead paint
In Pre-1960 Housing, 2001- 2010

	Lead Hazard Screen and Interim Controls (\$1000 per unit)	Inspection/Risk Assessment and Full Abatement of Lead paint (\$9,000 per unit)
All Housing with Lead Paint (1.84 million units/year)	\$1.84 billion	\$16.6 billion
Housing Occupied by Low-Income Families Not Covered by HUD Rule (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)

Table 4 shows that 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. Funding levels are projected to increase further after a suitable "ramp-up" of two years so that most jurisdictions will be able to create a significant pool of lead-safe dwellings for families. Funding in later years will be based in part on the ability to leverage private financing and 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 47)

Comparing the Costs of Short- and Long-Term Hazard Controls

Investments in housing consist of on-going maintenance activities and capital improvements. In the lead paint context, specialized maintenance (interim controls) can eliminate lead paint hazards as long as such maintenance is continued. Lead paint hazards can also be permanently controlled or eliminated through long-term abatement methods. Short term maintenance activities (interim controls) include repair of deteriorated paint, treatment of painted friction and impact surfaces (e.g., windows) that create lead-contaminated dust, and impact surfaces that create paint chips, specialized cleanup, followed by dust testing ("clearance"). 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.

Ideally, lead paint in housing would be permanently abated. However, to leverage private funding to the fullest extent possible and protect the largest number of children as quickly as possible, low-income housing should be made lead-safe using interim controls followed by on-going management until the building is either demolished, renovated or abated.

Of course, if on-going management is not implemented consistently, it is possible that lead hazards will reappear. The challenge today is to eliminate lead paint hazards in as many dwellings as possible. Abatement alone is unlikely to achieve this goal within the foreseeable future, absent significant funding from non-Federal sources. In light of the limited resources available, interim controls followed by either on-going management and/or abatement provides the best opportunity for success and permits 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 between the years 2000 and 2010 will be nearly \$11 billion at a 3% discount rate (\$3.2 billion at a 7% discount rate). 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 monetary benefit of abatement is estimated at \$38.1 billion using a 3% discount rate (\$21.1 billion using a 7% discount rate (see Appendix)).

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 benefits that are more intangible may exist but have not been fully studied and are not included in this total. They include avoided hypertension in later life, improvements in children's height and 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 above may underestimate the actual benefits because of the many unquantifiable benefits associated with eliminating childhood lead paint poisoning.

Public education

Existing public education initiatives are substantial and presented in more detail in the full report. They include locally-driven efforts of parents of lead-poisoned children and community-based organizations, training programs for housing renovation contractors, maintenance workers, inspectors, landlords, abatement contractors and many others, Sesame Street Television videos, mass media, library outreach and more. To accelerate the benefits of lead hazard reduction efforts, an increased focus on outreach to pregnant women and parents of children under one year of age is needed. Children's blood lead levels typically increase after 6 months of age when they become more mobile and peak at about three years of age. Early educational activities for this population, including home visits to assess potential lead paint hazards, will help to connect these families to resources for lead hazard control and thereby prevent poisoning before it happens. One way this can be accomplished is by integrating lead hazard control messages into existing well-baby programs at local health departments. This should be coordinated with national educational campaigns about what parents, caregivers, remodelers and painters and others can do to protect children. Education must always be linked to actual control of lead paint hazards, not viewed as a substitute.

Enforcement

Compliance assistance, compliance monitoring and enforcement are needed if the benefits are to be fully realized. HUD and EPA are responsible for ensuring compliance with the federal lead-based paint disclosure rule, and EPA, HUD and DoJ are responsible for follow-up enforcement when violations are identified. The disclosure law requires that owners and landlords provide information on lead paint, including an educational brochure, warnings, and any reports on testing or hazard control of lead paint before a person is obligated under a sales or lease contract. This helps to ensure that parents are aware of any problems that may exist in dwellings they are about to occupy. Enforcement to date has included properties where children have been lead poisoned, where lead paint hazards are likely to exist, or where tips and complaints have been filed through the Federal Lead Clearinghouse (1-800-424-LEAD). Enforcement actions are underway across the country. DoJ has sent each of its U.S. Attorney offices information on how cases can be investigated and developed. Additional investigation and legal resources are needed by DoJ, HUD and EPA to enforce these new regulations.

In addition, for those states and tribes without authorized programs, EPA is also responsible for compliance assistance, compliance monitoring and enforcement for two other lead rules. Enforcement of these rules helps to ensure the training and certification of lead inspection and abatement professionals and accreditation of training providers, as well as the provision of awareness information to those receiving renovation services so they can be aware of potential hazards created when paint is disturbed and the steps that can be taken to protect children.

The Consumer Product Safety Commission (CPSC) is responsible for enforcing its regulation banning new paint that contains more than 0.06% lead and banning toys or other articles intended for use by children that have lead in paint above that level. In addition, CPSC takes action against products that present a risk of lead poisoning from sources other than paint. In the past, such products have included vinyl miniblinds, crayons and children's jewelry. CPSC also works with the U.S. Customs Service to conduct special dockside surveillance at selected ports-of-entry to look for children's products containing lead that present hazards.

[Insert graphic of miniblinds]

Research

Research has driven down the cost of both inspections and hazard control activities, and increased their quality due to innovative new methods. It has helped to identify exposure pathways so that resources can be targeted better and has shown that modern hazard control methods are effective in greatly reducing children's blood lead levels and contaminated house dust. For example, exposure to contaminated house dust (principally from deteriorated paint and tracked-in soil) has been shown to be the major route of exposure to lead paint hazards for most children.

Additional research is needed to: 1) quantify the contribution of lead-contaminated exterior dust and soil to children's overall exposure; 2) track the longevity of modern hazard control techniques, which have been shown to be effective for at least 3 years (and probably much longer) in both the Evaluation of the HUD Grant Program¹² and in a separate study by Johns Hopkins University;²⁸ 3) assess and improve current lead inspection and hazard control technologies; and 4) further develop portable blood lead and dust lead level analyzers.

Surveillance and monitoring

Surveillance and monitoring activities such as CDC's National Health and Nutrition Examination Survey (NHANES) and the HUD National Survey of Lead Paint Hazards in Housing are essential in revising strategies to better target resources. Development of prevalence data on a state/local level would also assist in determining geographic-specific areas of progress and those needing continuing special attention.

Recommendations

I. Primary Prevention: *Prevent lead exposure in children by correcting lead paint hazards in housing before children are poisoned*

- Increase the availability of lead-safe dwellings so that families can find them without incurring significant additional cost, by increasing federal funding of HUD's lead hazard control grant program and by leveraging private and other non-federal funding. Funding for the grant program should be increased by 50% in FY 2001.
- Increase compliance monitoring and enforcement of lead-based regulations.
- 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 the public has access to assistance programs at both the community and individual levels.
- Conduct a study of lead hazards in child-care centers.
- Coordinate Federal weatherization and lead hazard control programs.
- Explore financial incentives, such as tax credits, for lead paint control for low and moderate income families with young children that are not served by the HUD grants.

II. Secondary Prevention: *Increase early intervention for children with elevated blood lead levels*

- Increase compliance with existing Health Care Financing Administration (HCFA) policies concerning blood lead screening.
- Support community-based programs for outreach, education, and advocacy for lead screening of Medicaid eligible children.
- Clarify HCFA policy concerning Medicaid reimbursement for environmental and case management services and ensure compliance with that policy.
- Encourage and provide technical assistance to State Medicaid Agencies (SMAs) to explore options for coverage of additional environmental services for Medicaid-eligible children with elevated blood lead levels consistent with current law.

III. Research

- Develop & evaluate new cost-effective lead paint hazard control technologies.
- Extend field-based studies on the longevity of housing lead paint hazard controls.
- Develop & evaluate hazard control techniques for urban lead contaminated soil and exterior dust.
- Determine the extent to which certain activities, such as demolition and industrial paint removal on buildings and other structures contribute significantly to urban soil and dust lead levels.
- Support further research and development for improvement of portable blood lead and dust lead level analyzer technology.

IV. Surveillance and Monitoring

- Expand State-based blood lead surveillance systems and capacity to monitor lead screening in Medicaid.
- Repeat the National Survey of Lead Paint Hazards in Housing by 2005.
- Continue blood lead measurements in the National Health and Nutrition Examination Survey (NHANES) on an annual basis.

Table 3
Summary of Federal Agency Roles on Lead Poisoning

Agency	Programs and Duties
Department of Housing and Urban Development (HUD)	Lead Hazard Control Grant Program; Enforcement of Disclosure Rule (with EPA and DoJ), Enforcement of Federally-Assisted Housing Lead Paint Regulations; Public Education; Training of Housing Professionals & others; Technical Assistance; Research; National Survey of Lead Paint in Housing; Lead Hotline (with EPA); Internet listing of lead paint professionals;
Centers for Disease Control and Prevention (CDC)	Blood Lead Screening Grant Program; Public Education to Medical and Public Health Professionals & others; National Health and Nutrition Examination Survey; Quality Control for Laboratories Analyzing Blood Lead Specimens; Research
Environmental Protection Agency (EPA)	Authorize states to license lead paint professionals; environmental laboratory accreditation; Enforcement of Disclosure Rule (with HUD and DOJ); Enforcement of Pre-Renovation Notification Rule; Hazardous Waste Regulation; Public Education to Environmental Professionals & others; Training Curriculum Design; Research; Lead Hotline; Research
Department of Justice	Enforce federal Lead Paint Disclosure Regulation (with HUD and EPA); Defend Federal lead paint regulations
Consumer Product Safety Commission	Ban of Lead in New Paint; Monitor Lead Levels in Consumer Products; Conduct Dockside Inspections for New Products
Occupational Safety and Health Administration	Worker Protection Regulations
Department of the Treasury	Evaluate financial incentives (such as Tax Credits) for lead hazard control
Department of Energy	Conduct weatherization activities in a lead-safe manner

Department of Defense	Administer Lead-Based Paint/Lead Hazard Management Programs in one quarter of one million family housing and child-occupied facilities worldwide; Administer Childhood Lead Poisoning Prevention Programs on installations worldwide; Administer Research and Development Programs to develop new cost effective technologies for lead-based paint management and abatement; Partner with other Federal agencies to develop policies and guidance for lead hazard management on a national level.
Food and Drug Administration	Enforce restrictions on lead in food cans, food, and dinnerware
National Institutes of Health	Basic Research on Lead Toxicity

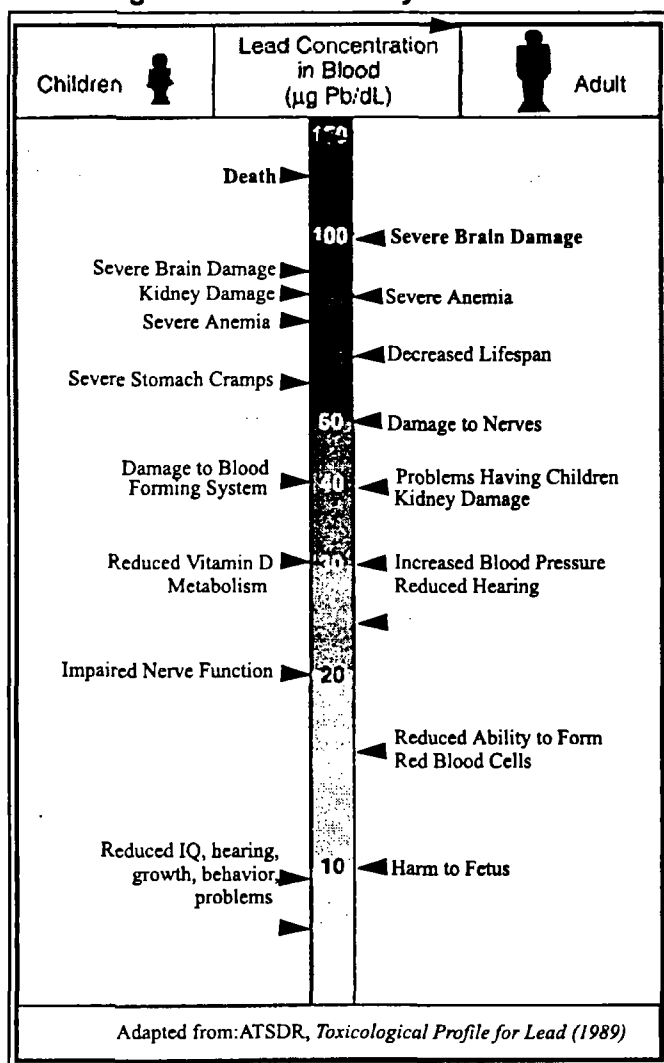
INTRODUCTION

The Lead Poisoning Problem

Lead poisoning is entirely preventable. However, nearly 1 million children living in the United States have lead levels in their blood that are high enough to impair their ability to think, concentrate and learn.⁴ Lead is highly toxic and affects virtually every system of the body. Lead can damage a child's central nervous system, kidneys, and cause anemia and, at very high levels, can cause coma, convulsions, and death. Even low levels -10 micrograms of lead per deciliter of blood ($\mu\text{g/dL}$)- are harmful and are associated with decreased intelligence, behavior problems, reduced physical stature and growth, and impaired hearing.³² (See figure 4) The estimated average effect of an increase in a child's blood lead level is a decrease of 2 IQ points for each 10 $\mu\text{g/dL}$ increase.³ In addition, lead causes reduced attention span and behavioral problems. One study suggests that lead exposure may be associated with juvenile delinquent behavior³³. Lead is most hazardous to

the nation's roughly 24 million children under the age of 6, whose still-developing nervous systems are particularly vulnerable to lead and whose 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 greater mobility during the second and third years of life that make lead hazards more accessible.

Figure 5. Lead Toxicity in Children



Major progress toward reducing 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 developed elevated blood lead levels. These changes were brought about through the efforts and collaborations of many Federal agencies and their State, local, and private sector partners. The result is that, according to the National Health and Nutrition Examination Survey (NHANES) data, the proportion of children age 1-5 years with elevated blood lead levels fell to 4.4% in 1991-

94, a more than 80% decline from 1976-80 (see Fig 2 on page 10).⁴

Despite these accomplishments, nearly one million children in the United States have elevated blood lead levels. The remaining problem is especially acute in certain population groups. For example, among children living in pre-1946 dwellings (those built when the use of lead-containing paint was most common), the prevalence of elevated blood lead levels is five times higher than among children living in homes built after 1973, most of which do not have lead-containing paint. Nationally, children in Medicaid also represent a high-risk group, comprising 80% of children with blood lead levels 15 $\mu\text{g}/\text{dL}$ and above.³⁴ Elevated lead blood levels is the most common environmental disease of young children³⁵ eclipsing all other environmental health hazards found in the residential environment.³⁶

Sources of Lead Poisoning

There are many potential sources of lead exposure in children, although they 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 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 has addressed lead contamination at many Superfund sites. Through action by the Food and Drug Administration (FDA), food processors virtually eliminated the use of lead solder in domestically-canned food. FDA has established strict regulations 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, also benefiting 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 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 for children are lead hazards in their residential environment -- deteriorated lead paint, and house dust and soil contaminated by it. Even though lead paint has been banned since 1978, HUD estimated in 1990 that it still remained in about 64 million dwelling units, where it poses a threat to children in poorly maintained housing and in housing undergoing rehabilitation where paint is disturbed.¹¹ Today, projections indicate that there are approximately 24 million units that may have lead paint hazards, are non-zero bedroom units, and were built before 1960 (see Appendix).

Low income children living in deteriorated older housing, especially in inner-city neighborhoods, shoulder a disproportionate share of lead poisoning cases, although any child is potentially at risk. For example, 16% of low-income children living in housing built prior to 1946 have elevated levels of lead in their blood above the limit recommended by CDC, compared to less than 1% of middle income children living in homes built after 1973.⁴ Lead paint poisoning was first identified over 100 years ago.^{9,10} Left unattended, lead paint hazards will continue to expose a large number of young children to lead over the coming decades.

FEDERAL PROGRAMS AND ACTIVITIES

Lead Paint Hazard Identification and Control

Federal programs in this area involve standards for lead-based 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 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; and evaluation of lead paint detection and abatement methods and development of new technologies. Virtually all these activities were authorized under Title X of the 1992 Housing and Community Development Act (The Residential Lead Hazard Reduction Act).

Infrastructure for lead-based paint inspections, risk assessments, and abatement

EPA regulations have set up a national infrastructure to assess and address lead paint concerns. These regulations cover training, certification (licensing) of lead paint professionals and accreditation of training providers, inspectors, risk assessors, abatement contractors and workers by State and Tribal governments. They were published in 1996, and 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. The demand for services has been stimulated by HUD's Lead Hazard Control Grant Program, which has required that only certified workers be used in its grant program for low-income privately-owned dwelling unit (see below). Today, 36 States, plus the District of Columbia, Puerto Rico and two Indian Tribes have lead paint certification laws on the books. In those states that do not have such laws, EPA will implement certification programs under the authority of Title X in March 2000. There are now tens of thousands of trained and certified inspectors, risk assessors, abatement contractors, workers, and others across the country 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 Internet (www.leadlisting.org) and a toll-free automated telephone system (1-888-LEADLIST) to help the public locate qualified people to address lead paint.

Two additional lead regulations are aimed at providing information to tenants and homeowners. First, the lead paint disclosure rule, published by EPA and HUD in 1996, requires that sellers, landlords and agents provide lead hazard information and disclose information about the presence of known lead paint and lead paint hazards to prospective homeowners and tenants in pre-1978 housing so they will be informed prior to making housing purchase or rental decisions and gives buyers the opportunity to conduct an inspection for lead paint hazards. Attorney General Janet Reno joined HUD Secretary Andrew Cuomo and EPA Administrator Carol Browner, DC 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 the rule.

Second, the lead paint pre-renovation education rule, which became effective June 1, 1999, requires persons conducting renovation for compensation to distribute awareness information to enable those receiving renovation services to be aware of the potential hazards created when paint is disturbed. These regulations are an important component of public education activities, which are described more fully below.

Federal Housing

HUD has issued hazard control requirements for housing receiving Federal assistance and federally owned housing that is being sold. This new regulation was published on September 15, 1999 and 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 where lead paint may be disturbed.

Grants for hazard control activities

HUD operates the Lead-Based Paint Hazard Control Grant Program. Its purpose is to control lead-based paint hazards in privately owned housing occupied by low-income families and to build local 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 are now active in over 200 cities and are awarded competitively each year to ensure that those communities with the greatest need and capacity are served first. The grants stimulate the effective collaboration of local health, housing and community development agencies and local community-based organizations. They also stimulate leveraging of additional private-sector funding.

The Department of Health and Human Services (DHHS) through CDC provides grants to support childhood lead poisoning prevention programs in virtually all state and local health departments, mainly to support secondary prevention efforts. The focus of these programs is 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 the conduct of investigations 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, a significant challenge to these programs is identifying public and private resources to finance such work in low-income housing.

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 of health agency childhood lead poisoning prevention programs with housing entities in their jurisdiction conducting HUD-funded lead hazard control projects. Under these arrangements local health agencies typically conduct functions such as baseline and follow-up blood lead testing, collection of other health data, and, in some cases, identification of high-risk dwellings.

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

Enforcement and compliance with lead regulations

Enforcing lead regulations is an important component of programs to reduce exposure to lead hazards. Many of the new rules mandated by Title X have already been successfully promulgated. Compliance assistance, compliance monitoring and enforcement of these new rules is critical if their benefits are to be fully realized. The Department of Justice (DOJ), HUD and EPA are responsible for enforcing the new requirements. The enforcement strategy has targeted properties with a history of lead-poisoned children, where lead-based paint hazards may exist, instances of substantial non-compliance, or where tips and complaints have been filed through the Federal Lead Clearinghouse (1-800-424-LEAD). Enforcement actions are underway across the country, and to promote additional enforcement, DoJ has provided each of its United States Attorneys' Office guidance on how cases can be investigated, developed, and resolved.

In addition to enforcement efforts, EPA and HUD undertake compliance assistance activities, which help the regulated community comply with lead regulations through efforts such as targeted and mass mailings, seminars/workshops, collaboration with trade associations, on-site assistance, and other activities. Effective March 2000 EPA will initiate enforcement of its accreditation, certification, and work practice requirements in states which do not have EPA-approved programs.

The Consumer Product Safety Commission has banned residential paint that contains more than 0.06% lead, and toys and other articles intended for use by children that bear lead-containing paint in excess of 0.06%. 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 identified a number of disparate products, some intended for use by children and others simply used in or around the household or in recreation, that presented a risk of lead poisoning from sources other than paint. These products have included: vinyl miniblinds, crayons, and children's jewelry. The determination that a product presents a risk of lead poisoning may result in a recall or replacement of the products with substitutes. 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 also extends to collaborating with the U.S. Customs Service to conduct surveillance and interception of 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 lead poisoning risks to children. Title X specifically mandates public education and information efforts. It requires several federal agencies to develop and provide information on lead paint hazards.

Current Federal activities include the bilingual lead Hotline (1-800-424-LEAD), the Lead Clearinghouse, the Campaign for a Lead-Safe America, 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 outreach through advertising campaigns using local bus and subway systems, movie theaters, and mass media. In addition, in FY 2000 EPA initiated a new grant program for education and outreach in Indian Country.

Federal grants have been awarded to both national and local entities to implement the Campaign for a Lead-Safe America. The campaign helps to coordinate the various outreach activities of Federal agencies, grantees and other public and private-sector organizations. Public education grants have been provided to organizations of parents of poisoned children, the National Safety Council, the Consumer Federation of America, the Alliance to End Childhood Lead Poisoning, the National Association of the Remodeling Industry, and many community-based organizations. National partners in the Campaign include Bank of America, Duron Paints and Wallcoverings, Kiwanis International, Painting and Decorating Contractors of America, the National Center for Lead-Safe Housing and dozens of other organizations. The Campaign employs ad campaigns on TV, radio, and print media through HUD's FHA Healthy Homes advertising effort (1-800-HUDS-FHA).

CPSC, working with EPA and HUD, develops information for the public on lead hazards. CPSC uses a variety of techniques to communicate vital information on lead to the public, including a hotline, website, and dissemination of health and safety information through the Commission's State Partners Program, a cooperative program with state and local governments.

In addition to 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 which include developing educational materials for health care providers, managed care organizations, and parents about the importance of lead screening in the Medicaid population. Other DHHS agencies, such as the Health Resources and Services Administration (HRSA) and the Administration for Children and Families (ACF), which have programs serving at risk populations, also conduct childhood lead poisoning prevention outreach and education efforts. For example, HRSA's Maternal and Child Health Branch, in conjunction with CDC, supports the National Lead Training and Resource Center in Louisville, KY.

Lead Screening in Children

The programs described above are oriented to identifying and controlling hazards in housing before they poison children. However, a response is also needed for children who have already have elevated blood lead levels. Screening is necessary to identify such children so that the source of their lead exposure can be identified and corrected, preventing further increases in blood lead. In addition, medical treatment, nutritional interventions, and early intervention for developmental delay may be required.

Through the Childhood Lead Poisoning Prevention Program, CDC provides grants to state health and local health departments to promote screening of at-risk children and to ensure appropriate medical and environmental management for children identified with elevated blood lead levels. In addition, CDC provides management and technical assistance to grantees.

Under the Medicaid program, lead screening has been a required element of an Early and Periodic Screening, Diagnostic and Treatment (EPSDT) general health screening since April 1990. In November 1997, CDC released new screening guidance, "Screening Young Children for Lead

Poisoning: Guidance for State and Local Health Officials".³⁷ This guidance 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.

According to the General Accounting Office (GAO) the Medicaid population accounts for a high proportion of lead poisoned children.³⁸ The Health Care Financing Administration (HCFA), the Centers for Disease Control and Prevention (CDC), the Health Resources and Services Administration (HRSA) and other DHHS agencies have been working together to increase lead screening of Medicaid and other vulnerable children and to improve access to, and the provision of, needed follow-up services for children who are found to be lead poisoned. 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 if appropriate; 3) Develop a process for evaluating requests, based on state-specific data showing a low risk of lead poisoning among children in Medicaid, for waiving universal blood lead screening for Medicaid children; 4) Develop a strategy for educating providers and the public about lead poisoning; and 5) 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 re-issue a Lead Policy Information Notice to all CHCs in the near future.

Head Start programs, which serve approximately 800,000 low income children ages 3-5 across the country, represent an important opportunity for ensuring screening of low-income children for whom screening was not performed at ages 1 and 2. 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 Appropriations Bill, tasked DoD to organize a LBP Task Force, to coordinate activities with other Federal agencies, and to follow guidance established by the Centers for Disease Control (CDC) regarding LBP activities and childhood lead poisoning prevention. Since that time, policies and guidance for lead hazard management and childhood lead poisoning prevention programs have been coordinated jointly by DoD, as well as within the individual services, on an ongoing basis.

As required by DoD policy, installations have proactive lead hazard management programs that include health risk assessment of facilities, health screening of children and workers, and lead hazard control. The blood lead screening results are one measure of the effectiveness of these programs, and indicate that these programs are working. Department of Defense Office of Health Affairs data from 1992 to present show that elevated blood lead levels (EBL)s are not a significant problem among military dependents. DOD blood lead levels are consistently below that of the general population (<2% EBLs vs. 4.4%).

In addition to active programs, the low incidence of elevated blood lead levels among DoD children are associated with the fact that this population is well educated, military housing is well maintained, standards for good housekeeping are in place, and good nutrition and hygiene are practiced.

Research

Understanding the full extent and various pathways of lead exposure is necessary to properly target remedial measures to where they will have the greatest impact. For example, the sources and fate of exterior lead-contaminated dust to children's blood lead levels and methods to control it are poorly understood. Efforts are needed to decrease and eliminate those sources, including the development and evaluation of technologies to identify and control lead hazards. 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 form on bioavailability; 3) *In vitro* and *in vivo* measures of lead bioavailability; and 4) conversions of lead minerals in soil systems. Although this research has been focused on soils at Superfund sites the findings may also be applicable to residential settings.

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 testing. CDC also provides the Blood Lead Laboratory Reference System (BLLRS) to over 275 laboratories worldwide which use these specimens to assess and improve the quality of their own measurements.

CDC is conducting and supporting applied research in lead poisoning prevention. 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.

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

In addition, HUD is conducting the nation's largest study of the effectiveness of modern hazard control methods used by its grantees. The study involves nearly 3,000 dwelling units, hundreds of which have now been followed for at least 3 years. The chief outcome measures are children's blood lead level 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. Briefly, the preliminary raw 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 an average of about 60% (see Table 9 on p. 36). These sustained declines have been replicated in a smaller study at Johns Hopkins University.²⁸

EPA evaluates detection and abatement methods, including encapsulants, test kits, and X-ray Fluorescence (XRF) lead paint analyzers (with HUD). In addition, EPA plans to assess existing impediments and barriers to new technologies and the need for new methods to promote development of new lead detection and abatement technologies. As regulations are completed that

establish standards for dust, paint and soil and address hazards during renovation and remodeling and during deleading on buildings and superstructures, EPA will evaluate products used for detection, abatement and deleading under the authority of Title X.

The Department of Defense (DoD) has developed many new technologies in the areas of encapsulation and abatement, training, and soil remediation. The Army is currently conducting demonstrations and validations of these technologies developed from 1993-1998. These products were jointly developed in collaboration with DOE, EPA, and industry partners. 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 Navy funded the development of a real time lead dust monitor to analyze airborne lead during construction and abatement activities for lead exposure assessment. The Army is working on developing environmentally friendly paint strippers and innovative technologies for the abatement of lead in soil, such as chemical stabilization, and phytoextraction.

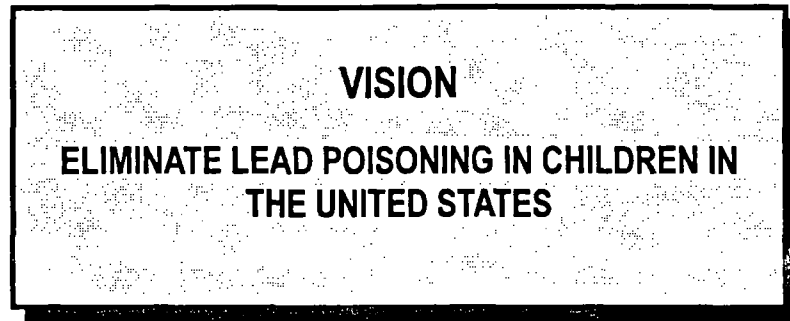
The Army has also developed many policy and guidance documents, to implement lead hazard management programs, including standard statements of work, engineering design guides, and the Hazardous Asbestos and Lead Optimal Management Program.

Surveillance and Monitoring

CDC provides funding and technical assistance to help states develop laboratory-based surveillance systems for blood lead levels among children and analyze and disseminate lead surveillance data. Linkage of data from these state systems to State Medicaid Agency data will be important in monitoring SMA compliance with HCFA policy. CDC uses data submitted by state systems to form a national surveillance database.

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, providing valuable data on the population distribution of this important source of exposure. This effort is being funded by HUD and was designed collaboratively by CDC and HUD.

STRATEGY



Increased efforts to control lead paint hazards in older housing are needed to control the most important remaining source of exposure. Hazards should be controlled before children are poisoned. Because lead hazards are especially common in deteriorated low-income housing, this is an area where the need for additional resources is greatest. Other ongoing efforts will continue to control exposure from other sources. This Strategy also focuses on expanding efforts to provide early intervention for children at highest risk.

As shown above, 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 covering all federally-assisted housing, published on September 15, 1999. Disclosure of known lead paint hazards at the time of sale or lease is now required for 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 paint poisoning.

This document identifies additional resources needed to eliminate lead paint hazards in housing with young children by 2010, and it suggests how to target these resources most efficiently. The analysis incorporates recent data from the third National Health and Nutrition Examination Survey (Phase 2), the 1997 American Housing Survey, the 1999 Economic Analysis accompanying the HUD regulation covering federally-associated 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 Appendix A).

Number of Housing Units

Any house with lead paint could eventually pose a hazard to young children. However, most houses containing lead paint do not contain immediate lead hazards. While 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 ug/dL, the CDC level of concern.

Most residential lead paint is contained in housing built before 1960. Between 86-97% of all lead in paint in housing is located in pre-1960 housing. Therefore, resources to address residential lead paint hazards should be targeted to pre-1960 units first.

Table 5
Paint Lead Consumption by Decade of Housing Construction

	Lead Consumption (tons 000)		Decade- End Occupied Units (MM)	White Lead Pounds per Unit	1991 AHS Units (MM)	1991 White Lead Tons (000)		Percent of All Lead
	White Lead	Red Lead & 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%

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

Table 6
HUD National Lead Paint Survey Data (1990)

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

Source: HUD National Survey of Lead paint in Housing

Based on data from the American Housing Survey, there are about 24 million pre-1960 dwelling units that are not zero-bedroom units (where children are unlikely to reside), have not undergone major renovation (e.g. total window replacement), or have not had lead paint hazards controlled for some other reason (including regulatory compliance). The term "lead paint hazards" is used here as defined in the Residential Lead paint Hazard Reduction Act of 1992. Based on scientific research conducted in the 1980's, Congress defined a lead paint hazard to include deteriorated lead paint and lead-contaminated dust and bare soil. Controlling these sources and pathways of exposure will virtually eliminate childhood lead poisoning associated with lead paint.

The number of demolitions and renovations in Table 7 are based on rates experienced between 1989 and 1997 as reported in the American Housing Survey. The estimated number of units undergoing private hazard control is based on the HUD-funded supplement to the Current Population Survey, which indicates that approximately 1 percent of the respondents' housing units were reported to be "abated" during 1997. Fifty-five percent of such abatements are assumed to be pre-1960 units (the same percentage as in the total occupied stock). As public awareness increases and enforcement of regulations is strengthened, it is likely that the number of privately-funded hazard controls will increase. Nevertheless, we conservatively assume a constant privately-funded abatement rate of 1% for planning purposes here.

In addition to demolition, renovation, and private hazard control, additional units will undergo hazard control as a result of HUD's regulation for federally-associated 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 2010.³⁷

Table 7
Projection of Pre-1960 Units at Risk of Having Lead paint Hazards in 2010

Housing Stock	Number of Housing Units (millions)
Total Units in 1999	24.0
Reduction Due to Demolition	-1.8
Reduction Due to Substantial Renovation & Private Hazard Control	-3.8
Subtotal	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.

Table 7 shows that over the next 10 years, these activities will affect a total of about 5.6 million units, assuming current trends continue. In short, this means that by the year 2010, 18.4 million pre-1960 units will remain with lead paint that could one day pose a threat to children if nothing more is done.

Many of these remaining units may not pose any hazard 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 a hazard. But for low-income families, direct Federal financial assistance and leveraged

private funding will continue to be needed because no other effective option exists.³¹ The HUD lead hazard control grant program has shown that the programmatic expertise exists in local jurisdictions across the country to target federal resources to housing occupied by at-risk, low-income families.

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

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, the type of building components coated with lead paint, and the type of hazard control method employed. Economies of scale also exist for multifamily housing.

There are two broad categories of methods employed to control lead paint hazards: short-term and long-term (interim controls and abatement, respectively, using the definitions 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, but for different time periods. Interim controls which repair deteriorated paint require continuing evaluation and management to ensure that the lead paint remains in an intact, non-hazardous condition. Abatement involves a more "permanent" solution and can involve removal of painted building components, durable enclosure or covering, and paint removal.

Estimated average annual costs of addressing residential lead paint in pre-1960 housing over the next 10 years are shown in Table 8. Costs are estimated for two alternative approaches: (1) interim control of lead paint hazards identified with a lead hazard screen, and (2) abatement of lead paint identified with a complete lead paint inspection/risk assessment (to identify all lead paint as well as all lead paint hazards). Average costs are based on the HUD Economic Analysis³⁸ for the regulation on Federally-associated housing and the Evaluation of the HUD Lead Hazard Control Grant Program,¹² 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 the lead hazard screen; and an average hazard control cost of \$2,500 per unit (to cover paint stabilization and window work, cleanup and clearance). These costs are applied to 35% of the units to be addressed, because that is the frequency with which the Economic Analysis showed hazards to be present, to arrive at an overall average cost. Thus, per unit interim control costs are $\$120 + (35\% \times \$2500) = \$995$ (or about \$1,000)

The \$2500 estimate for the interim control approach includes \$1,000 for exterior paint stabilization, \$500 for interior paint stabilization, \$300 for window work (to correct friction surfaces that produce lead-contaminated dust), \$350 for cleanup, \$150 for clearance testing, and \$200 for relocation,

administrative and other costs.

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; and an average abatement cost of \$8,500 per unit (including cleanup and clearance) is also applied to all of the units because all units have some lead paint. Thus, per unit abatement costs are $\$8,500 + \$500 = \$9,000$.

Table 8
Estimated Average Annual Costs of Options to Address Lead paint
In Pre-1960 Housing, 2001- 2010

	Lead Hazard Screen and Interim Controls (\$1000 per unit)	Inspection/Risk Assessment and Full Abatement of Lead paint (\$9,000 per unit)
All Housing with Lead Paint (1.84 million units/year)	\$1.84 billion	\$16.6 billion
Housing Occupied by Families with $PIR \leq 1.3$, Not Covered by HUD Rule (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)

For housing occupied by low-income families, direct Federal financial assistance will continue to be needed.³⁹ 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.

Protecting All Children

While the risks are greatest for low-income children living in older housing, all children should grow up in lead-safe homes. This report explains how public education, combined with tax or other financial incentives, can be used to protect children not directly served by federal and other 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 hazard control grant program is not an entitlement for all housing with lead paint hazards, but a limited funding pool. It can be used to not only address lead paint hazards directly, but also leverage private funding and prompt market forces. As more lead-safe housing is created, more landlords and homeowners will be motivated to address lead paint hazards in their units, because they will want to realize the increased property value associated with lead hazard control in a competitive market. In addition, landlord motivation can be increased by providing an easily-understood "good housekeeping 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. [insert example of certificate] This will promote increased competition, especially in markets where landlords have difficulty attracting tenants. It will also help to increase property value and marketing appeal. In some areas, it may not be necessary to make all units lead-safe, but to create enough units so that families can find them without incurring significantly greater costs.

However, in some jurisdictions with few low-income vacancies, competitive market forces may not be sufficient to prompt significant private funding of lead hazard control, 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 be the only answer.

Closing the Gap: Costs and Benefits

Table 8 compares the costs of two approaches to reducing lead paint hazards: 1) managing lead paint on an on-going basis to ensure it does not become hazardous; and 2) permanent abatement. Costs are presented for all housing with lead paint and for low-income housing where risks are greatest.

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 will be based in part on the ability to leverage private financing and 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 47)

Comparing the Costs of Short- and Long-Term Hazard Controls

Investments in housing consist of on-going maintenance activities and capital improvements. In the lead paint context, specialized 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.

Ideally, all housing with lead paint would be permanently abated. In order 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 on-going management until the building is either demolished or abated.

Of course, if on-going management is not implemented consistently, it is possible that lead hazards will reappear. The challenge today is to eliminate lead paint hazards in as many dwellings as possible. Abatement alone is unlikely to achieve this goal within the foreseeable future, absent significant funding from non-Federal sources. In light of the limited resources available, interim controls followed by either on-going management and/or abatement provides the best opportunity for success and permits local entities to implement a strategy consistent with local needs.

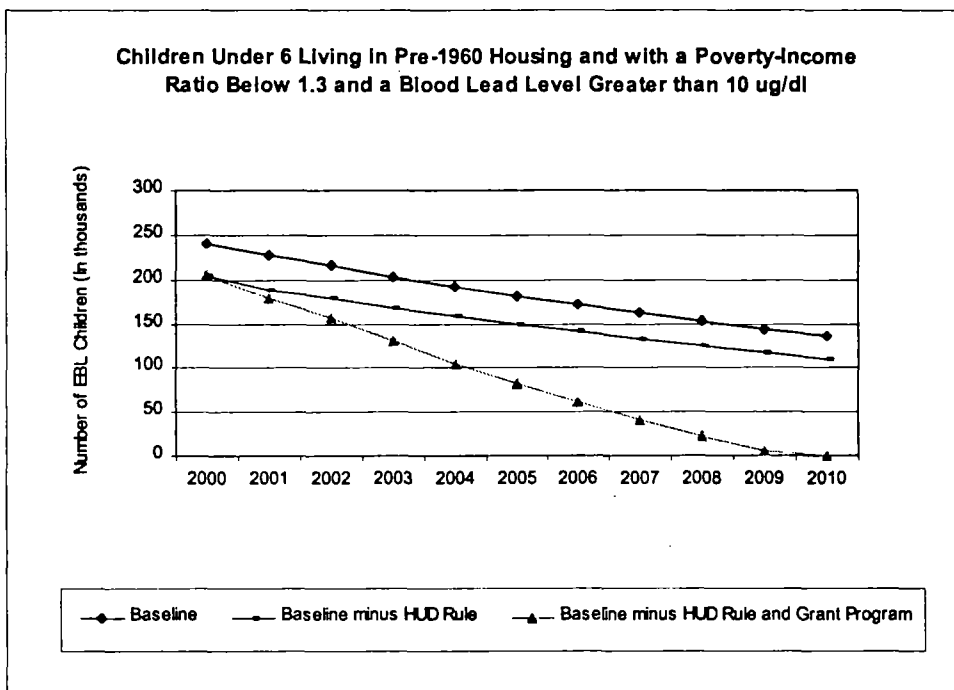
Benefits of Eliminating Childhood Lead Poisoning

Using conservative assumptions, the quantified monetary benefit (which does not include all potential benefits) of eliminating lead paint hazards through interim controls in the nation's pre-1960 low-income housing stock between the years 2000 and 2010 will be nearly \$ 10.9 billion (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 monetary benefit of abatement is estimated at \$25.2 billion (see Appendix).

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. We believe that other benefits may exist that have not been fully studied that have not been included in this total. They include avoided hypertension in later life, improvements in children's height and 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 above may underestimate the actual benefits because of the many unquantifiable benefits associated with eliminating childhood lead paint poisoning.

Figure 5 shows that childhood lead paint poisoning can be virtually eradicated 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.

Figure 5



Evaluation of the HUD Lead Hazard Control Grant Program

Table 9 shows preliminary data from the evaluation of the HUD lead paint grant program, using blood lead levels in resident children and lead levels in housedust as outcome measures. Despite their preliminary nature, the data show that the modern hazard control techniques employed by the

cities and states receiving HUD grants are effective in drastically reducing both blood lead and dust lead levels in resident children. A final report is expected in 2001.

**Table 9. Outcome Data For HUD Lead paint Hazard Control Grant Program Evaluation
(Vacant and Occupied Dwelling Units Combined)**

		Decline in Median PbB (% of baseline)	Blood (n=481 children)		Dust					
			% of children with increases greater than 3 μ g/dL compared to baseline	% of children with decreases greater than 3 μ g/dL compared to baseline	Median % of PbD decline comparing baseline PbD and clearance (n=2,455 dwelling units)			Median % of PbD decline comparing baseline PbD and 2 years (n=593 units)		
	Strategy		all measured at 12 months		Floors	Sills	Troughs	Floors	Sills	Troughs
	02	27%	6%	34%	8%	67%	97%	37%	75%	56%
	03	29%	8%	50%	18%	65%	88%	54%	66%	87%
Interior	04	25%	7%	49%	62%	91%	99%	68%	86%	93%
	05	19%	7%	30%	69%	94%	99%	65%	92%	95%
	06	**	**	**	95%	96%	95%	**	**	**
	02	25%	7%	45%	74%	94%	99%	65%	90%	93%
Exterior	03	17%	5%	35%	44%	91%	100%	85%	91%	98%
	04	43%	3%	49%	55%	90%	99%	62%	82%	95%
	01	**	**	**	55%	92%	100%	75%	81%	88%
	02	**	**	**	68%	94%	99%	81%	87%	93%
Site	03	**	**	**	68%	90%	99%	86%	80%	**

** Less than 15 results

Median baseline blood lead level = 1 μ g/dl

Median baseline dust lead level. Floors=78 μ g/sq.ft., Sills=565 μ g/sq.ft., Troughs=7,000 μ g/sq.ft

Blood data from February 1999 dataset

Dust data from September 1998 dataset

RECOMMENDATIONS

Each agency has performance goals and measures for their programs and activities that accompany their budget proposals. Longer-term progress toward the vision of the Strategy - *to eliminate lead poisoning in children in the United States* - and the goals of the strategy, will be measured through the National Survey of Lead Paint Hazards in Housing and the National Health and Nutrition Examination Survey (NHANES).

1. 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 for the identification & 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 to virtually eliminate childhood lead paint poisoning by the year 2010. 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 children residing in this housing sector. Each year for the past 4 years, an average of only one in four applicants has been able to be funded.

Active grant programs now exist in 200 cities across the country. These 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 capacity now exists, the grants can be restructured. Specifically, the three-year grant period can be reduced to two 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-based regulations. New federal regulatory responsibilities demand a new emphasis on enforcement if the goal of virtually eliminating childhood lead paint poisoning by the year 2010 is to be achieved. In addition to authorizing federal grants to owners of low-income privately-owned housing to correct lead-based

paint hazards, Title X also provides for streamlined and more effective federal regulations that collectively provide a comprehensive framework for eliminating lead-based paint hazards. Many of the new regulations mandated by Title X have now been issued in final form. Together, compliance with these regulations:

- ensures that parents get 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 children in federally-assisted housing from lead-based paint hazards; and
- ensures safe management and disposal of lead paint debris.

The disclosure rule requires that sellers, landlords and agents provide lead hazard information and disclose information about known lead paint and lead paint hazards to prospective homeowners and tenants in pre-1978 housing prior to making rental or purchase decisions on pre-1978 housing and provides buyers the opportunity to conduct an inspection for lead-based paint hazards. A 1998 HUD-funded survey on compliance with this rule was conducted through the Bureau of the Census and showed that compliance was poor. 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 cannot be delegated to the States, so enforcement rests with EPA, HUD and DOJ, and can take the form of administrative actions by EPA or HUD, and civil or criminal referrals to DOJ.

Enforcement efforts for 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, housing with physical or management problems that indicates the likely presence of lead-based paint hazards, and tips and complaints received from the public. An increase in targeted inspections, along with these enforcement efforts, should be facilitated by working closely with local health departments in identifying landlords with lead-poisoned children, and with local law enforcement authorities responsible for enforcing local lead-based paint ordinances.

EPA will have responsibility for enforcing four other lead-based 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 an expanded number of locations, and management and disposal of lead-based paint debris. The Agency should encourage states, tribes and territories to adopt approved programs given the critical role which 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. Experience has shown that these techniques have been effective in addressing environmental and compliance problems in other program areas. These integrated initiatives will complement the more traditional enforcement efforts, which will be increased to ensure compliance with three new lead rules (one of which was recently issued, and two of which should be final by 2002).

These national and regional integrated initiatives should be tailored to the particular lead rule involved and include, as appropriate, a 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, and receive penalty waivers or reductions in accordance with EPA's audit 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 which children or pregnant women will inhabit; and
- Targeted enforcement actions.

Enforcement will also be needed for the new regulation for federally-assisted housing, which takes effect in September, 2000. In 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, organizations using HUD-funded housing rehabilitation, maintenance and finance operations and many others.

Enforcement will help to ensure that: parents receive the information they need to protect their children before signing a new sales or lease agreement; workers conducting lead-based paint inspections, risk assessments and abatements are properly trained; contractors are certified; training programs are accredited; and workers use safe and reliable work practices. The increased compliance monitoring will also ensure that families at risk from renovations that may generate lead-based paint hazards receive the required educational pamphlet and are informed about minimizing the risk, and that management and disposal of lead-based paint debris is handled properly.

Without this increased enforcement, the full benefits of lead paint regulations will not be realized. Increased enforcement will increase awareness of the precautions that can be taken to protect children from lead poisoning, and 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 the public has 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. The Senate recently passed a resolution establishing the last week in October as National Childhood Lead Poisoning Prevention Week and the President issued a message in support.

Individualized education through public health agencies

Even with a substantial expansion of resources for residential lead hazard control, among dwellings that could house families with young children, a substantial number will remain with lead hazards for several years. 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.

Federally-supported state and local childhood lead poisoning prevention programs currently focus their limited resources to ensuring 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 before children develop elevated blood lead levels. Such efforts should be coordinated with existing programs serving at risk families, such as WIC and Healthy Start. Families identified would receive education about lead poisoning prevention, would be offered assessment of their home environment for lead hazards, and, if appropriate, be assisted in obtaining resources (such as HUD lead hazard control grants) for remediation of identified lead hazards. Programs would also provide social services and other assistance to families for which relocation to lead-safe housing is the best alternative. Measures to assess and address neighborhood level exposure sources, where appropriate, would be carried out in collaboration with state and local environmental agencies and community organizations.

Conduct a study of lead hazards in child-care centers. HUD and CPSC should consider conducting a study of both home-based and institutional child care centers to determine if children in the centers 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.

Coordinate Federal weatherization and lead hazard control programs. The Department of Energy provides funds to more than 970 local governments and non-profit organizations to annually weatherize and reduce energy consumption in approximately 67,000 low-income housing units. DHHS' low income energy assistance program also funds weatherization projects. Some communities are already leveraging funds from both HUD's lead abatement and these weatherization programs to successfully reduce both energy use and lead paint hazards in a cost-effective manner. 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:

- 1) DOE and HHS, in partnership with HUD and EPA, should ensure all federally-funded weatherization activities are conducted consistent with modern, lead-hazard control techniques. This includes providing lead-hazard control education and training opportunities for all weatherization workers.
- 2) DOE, HHS, and HUD should consider conducting a study of the cost and health benefits of conducting weatherization and lead-hazard control activities simultaneously. This will include an assessment of the types of weatherization activities that provide the greatest benefit for energy savings and lead-hazard reduction, e.g. window replacement.
- 3) 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.
- 4) HUD and EPA should include in their relevant educational programs and materials the energy savings associated with lead-hazard reduction activities.

Explore financial incentives for lead paint control for low and moderate income families with young children that are not served by the 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- and moderate-income families with children, additional financial incentives may be warranted. This recommendation suggests 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.

Current Tax Treatment of Hazard Control Costs

In general, the costs of deleading an owner occupied residence cannot be deducted, but may be added to basis 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 based 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 its tax return for the year the expenditure was paid or incurred. Replacing all the windows in the 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 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.

II. Secondary Prevention: *Increase early intervention for children with elevated blood lead levels.*

Goal

By 2003 70% of the Children on Medicaid (excluding those residing in States that have been granted a waiver by HCFA of universal screening requirements*) will be screened for elevated blood lead levels.

*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 based on data provided by SMA's on the prevalence of elevated blood lead levels in their Medicaid-eligible population.

Increase compliance with existing HCFA policies concerning blood lead screening. Current CDC recommendations are that state and local jurisdictions develop screening guidelines to target children at high risk for lead poisoning based on community and individual risk factors. Data from phase II of the third National Health and Nutrition Examination Survey (NHANES III, 1991-1994) shows that, nationally, children in Medicaid represent a high-risk group, comprising 80% of children with blood lead levels 15 micrograms per deciliter 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. No data reflecting this 1998 policy are available yet on lead screening in the Medicaid population since this policy was released. However, a General Accounting Office study, based on claims data from 1994 and 1995, prior to the new policy, in 15 states, showed that less than 20 percent 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 percent in all cases.¹³

Therefore, a number of additional measures are recommended. GAO found that about half of written policies on lead screening were inconsistent with HCFA policy. In light of the GAO report, HCFA is in the process of releasing 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 on bringing their policies compliance. Second, routine monitoring of lead screening in the Medicaid population is needed to track compliance with HCFA and SMA policies. Systems to routinely monitor screening penetration and the prevalence of elevated blood lead levels in the Medicaid population do not exist in most states. A revision of the HCFA form-416 used by SMAs to report services provided under EPSDT should promote the development of data systems for identifying Medicaid children who have received a screening blood lead test in States. CDC and HCFA should continue and expand ongoing efforts to support and assist State health departments and SMAs to link blood lead surveillance data to Medicaid data in order to improve the quality of data needed to monitor lead screening penetration and prevalence. {Other recommendations for surveillance of elevated blood lead levels and lead screening are found under IV. Surveillance and Monitoring.} 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 where performance goals are not met. Third, 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 of the substantial variation in the risk of EBLs among geographic areas and demographic groups, it is expected that the risk will vary substantially among Medicaid populations in different states. 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. Pending the review of such waiver requests, the task force is proposing an interim goal for lead screening among Medicaid children in States not granted a waiver. The goal is that 70% of such children be screened by 2003.

Support community-based outreach, education, and advocacy for lead screening of Medicaid eligible children. In addition to health care provider interventions, educating and empowering consumers of health care to seek out preventive care is an important part of efforts to increase the utilization of clinical preventive services more generally. Efforts should be expanded to inform Medicaid-eligible families with young children of the need for lead screening and the requirements for providers to provide it. CDC should encourage State and local health department lead poisoning prevention programs 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 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 children with elevated blood lead levels. 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 that typically need to be addressed. GAO found that most SMAs did not reimburse for environmental and case management services, perhaps due to current HCFA policy indicating that these *may* be covered services. Therefore, it is recommended that HCFA actively encourage SMA's not currently covering environmental and case management services to provide this benefit and that CDC and HCFA provide technical assistance to SMA's concerning the implementation of such a benefit.

Encourage and provide technical assistance to SMAs to explore options where applicable for coverage of additional environmental treatment services for children with elevated blood lead levels consistent with current law. Other environmental services needed to identify and control lead exposure in the environment of EBL children may not be routinely covered under current HCFA policy. For example, HCFA policy does 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 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 an 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. While 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 the major source of contamination from their

homes. HCFA has committed under the HHS lead initiative to provide technical assistance to SMAs developing such waiver applications.

III. Research

Develop & evaluate new cost-effective lead paint hazard control technologies. New hazard identification and control technologies are continually being developed to make lead paint hazard 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, eliminating the need for laboratory analysis, which can lengthen the period of time families must be relocated from their homes. New durable coating products may render lead paint inaccessible for long periods of time and may reduce the amount of dust generated. Finally, further research 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 studies on the longevity of housing lead paint hazard controls. Each year for the past several years, HUD has sent a report to Congress measuring the costs and effectiveness of the grant program. The chief outcome measures are blood lead levels in resident children and levels of lead in house dust. Current plans are to follow the trends in these houses for a three year period, with a final report due in 2001. Preliminary data indicate that large reductions in house dust levels have been achieved and maintained for the initial three year period. A separate study conducted by Johns Hopkins University has confirmed these findings.

To evaluate the full longevity 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 critical in understanding the durability of interim control methods.

Develop & evaluate hazard control techniques for urban lead contaminated soil and exterior dust. Research has shown that exterior dust and soil contaminated by deteriorated leaded paint and past fallout from leaded gasoline is an important contributor to lead exposure among children, especially in urban areas. In some urban communities, levels of lead in dust and soil are comparable to those found in areas contaminated by smelting and other industrial activities and designated for cleanup under the Superfund program. Past research in reducing exposure to such contamination is limited in two ways. First, much of it has been carried out in non-urban settings and the feasibility, cost, and effectiveness of some proposed remediation techniques have not been assessed in urban environments. Second, research on remediation in urban settings has focused on costly soil removal. Therefore, research efforts should be expanded to translate findings from non-urban settings to the urban environment and to evaluate lower cost hazard reduction methods, such as covering of contaminated soil and methods of controlling exposure from bare soil through use of methods that reduce the "bioavailability" of lead in the soil.

Determine the extent to which activities, such as building demolition, aging paint & industrial paint removal on buildings & structures contribute significantly to urban soil and dust loadings. Additional efforts are needed to more fully understand the complex problem of the release and movement of lead in the environment, with particular attention to sources of exterior contamination and how they contribute to soil and dust exposures and resulting exposure to children.

Significant effort has been made to understand residential environments and exposure pathways related to lead paint and lead-contaminated interior dust. However, not much effort, has been devoted to understanding the external environment and how exterior lead paint may contribute to lead poisoning in children.

It is clear that fallout from past leaded gasoline emissions and deterioration of paint on building exteriors has contributed to the existing reservoir of contamination in urban soil and dust. For lead contamination already in place, the critical public health question concerns best methods for remediation, rather than a precise apportionment of the amount of contamination from various past uses. However, limited data indicates that building demolition and deterioration or removal of leaded paint from buildings and other large structures such as bridges may contribute to ongoing contamination. Efforts to reduce exposure to existing contamination may be ineffective if neighborhoods are recontaminated by uncontrolled emissions from paint deterioration, removal or demolition. Thus, additional research is needed concerning the amount of contamination associated with these activities and effective controls.

Support further research and development for improvement of portable blood lead analyzer technology. The development of the LeadCare (tm) hand-held blood lead analyzer makes possible virtually immediate determination of a blood lead level in a clinic or field setting and initiation of retesting and follow-up as appropriate. While this development has the potential to increase the penetration of lead screening, two technical problems need to be addressed for such instruments to achieve wider use and utility. First, the only commercially available device is classified as "moderately complex" and so requires CLIAA certification of providers that employ it. A simpler "CLIAA-waived" device would make portable blood lead instruments more attractive to clinical providers. Second, to ensure that lead screening results from physicians offices can be easily reported to health authorities for monitoring and follow-up purposes, technology for easy and secure electronic transmission of demographic and blood lead data from such instruments should be further developed.

IV. Surveillance and Monitoring

Support state-based blood lead surveillance systems and capacity to monitor lead screening in Medicaid through data linkage. The goals of CDC's childhood blood lead surveillance activity are to: 1) assist states in developing laboratory-based surveillance systems for 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 4 state projects to estimate the prevalence of elevated blood lead levels and screening penetration in the Medicaid population. CDC will continue to support such efforts.

Repeat the National Survey of Lead Paint Hazards in Housing by 2005. HUD has conducted surveys of the prevalence of lead paint in the nation's housing stock in 1991 and again in 1999. 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 June, 2000. The survey should be repeated in 2005 to assess progress toward the 2010 goal.

Continue blood lead measurements in NHANES beyond NHANES IV. The National Health and

Nutrition Examination Survey (NHANES) is administered by CDC and 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 continuous survey, providing data from a representative sample of the U.S. population every year. As this strategy is implemented and blood lead levels continue to fall, it is crucial that blood lead measurements remain a part of the NHANES to track the success of the overall preventive effort at the national level.

Budget Table not included for
interagency review - to be
added to final document.

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Lead Poisoning Prevention Strategy

Appendix

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

Appendix

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

This document explains how the number of children under age 6 with elevated blood lead levels (EBLs), can be projected for future years, and how federal intervention strategies can substantially reduce the EBL prevalence for poor children, who are disproportionately at risk of lead poisoning. The childhood EBL projections, before and after federal intervention, combine data from the following sources:

- ◆ NHANES III Phase 2
- ◆ The American Housing Survey (AHS)
- ◆ The Residential Energy Consumption Survey (RECS)
- ◆ The National Survey of Lead-Based Paint in Housing

The EBL projections show that ongoing demolition and rehabilitation of older housing units, which account for most of the lead based paint (LBP) in housing, should result in a steady decline in the number of EBL children over the next decade. In the absence of federal intervention, however, this analysis estimates that there would still be 355,000 EBL children under six in the year 2010, and households with a poverty income ratio (PIR) of less than 1.3 would account for 73 percent of these EBL children. (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 EBL children, and the benefits of federal intervention, are explained below in seven sections:

1. NHANES III Phase 2 data and limitations
2. Combining AHS and NHANES data to estimate number of EBL children in 1993 and 1997
3. Using AHS, RECS, and National Survey data to forecast number of housing units with "high" and "low" risk of LBP hazards
4. Calculating prevalence of children with EBLs for high and low risk housing
5. Forecasting EBL prevalence by PIR and age of housing based on percentage of housing stock with high risk of LBP hazards.
6. Projecting number of EBL children in low and high risk units, before and after adjustment for HUD rule for federally assisted housing
7. Adjusting projections for EBL children to reflect impact of expanded grant program for lead hazard reduction

1. NHANES Phase 2 Data and Limitations

Tables 1 and 2 show NHANES III Phase 2 data on the prevalence of children under age 6 with EBLs above 10 and 15 µg/dL, within year of home construction, poverty income ratio (PIR), and 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 elevated blood lead in the "don't know" category is similar to the prevalence in older units.

MMWR 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 MMWR. 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 have elevated blood lead levels. 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 > 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 BLL ≥ 10 µg/dL, by PIR, MSA size, and year house built (% of children within each cell).

Characteristic	Year House Built:			
	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 M	5.77	3.06	2.51	2.17
MSA population ≥ 1 M	11.49	5.80	0.81	7.89
PIR ≤ 1.3 and MSA pop < 1 M	10.62	3.82	6.48	2.92
PIR ≤ 1.3 and MSA pop ≥ 1 M	22.27	9.09	2.65	8.39
PIR > 1.3 and MSA pop < 1 M	3.03	2.38	0.22	0.52
PIR > 1.3 and MSA pop ≥ 1 M	3.35	2.10	0.21	4.22

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

Table 2. Prevalence of children under age 6 with BLL $\geq$ 15 μ g/dL, by PIR, MSA size, and year house built (% of children within each cell).

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

Source: U.S., 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 EBL 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 μ g/dL and only three were above 15 μ g/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 EBL children in post-73 housing multiplied by the large number of children in post-73 housing still results in a significant number of EBL children. With the growth in post-73 housing between 1993 and 1997, the estimated number of EBL children in post-73 housing will grow accordingly. This estimate would be reasonable only if the prevalence of children in post-73 housing with EBLs were entirely due to lead hazards unrelated to housing (and if no progress in reducing such hazards were anticipated). However, AHS 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 EBL children in post-73 housing were exposed to LBP 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 LBP hazards from older buildings in their immediate neighborhood. For all of these reasons, a reduction in older units with LBP hazards is also likely to reduce the prevalence of children with EBLs in post-73 housing.

Table 3. NHANES Phase 2 blood lead data for children under age 6 (raw numbers)

	Year House Built:												Total
	Pre- 1946			1946-1973			Post 1973			Don't Know			
	Total	³ 10	³ 15	Total	³ 10	³ 15	Total	³ 10	³ 15	Total	³ 10	³ 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 M	159	14	4	339	16	5	388	9	2	145	4	1	1031
Children in MSA ³ 1 M	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 M	74	10	2	179	9	4	152	6	0	94	3	0	499
PIR £ 1.3 & MSA ³ 1 M	118	25	11	332	36	6	142	5	1	136	14	10	728
PIR >1.3 & MSA < 1 M	73	3	2	145	5	0	221	1	1	37	1	1	476
PIR >1.3 & MSA ³ 1 M	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

2. Combining AHS and NHANES data to estimate number of EBL 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 AHS data. Table 5 combines the NHANES data from Table 1 with the AHS data from Table 4 to estimate the number children under 6 with BLL above 10 µg/dL in 1993. AHS 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 BLL 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). Table 6 applies the same approach to combine NHANES data in Table 2 with AHS data in Table 4 to estimate the number of children under 6 with BLL 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 BLLs above 15 µg/dL.

Table 7 shows the total number of children under 6 by year of home construction, PIR, and MSA size, based on 1997 AHS data, and Table 8 shows the percentage change in each household category (cell) between the 1993 and 1997 AHS data. The AHS 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 EBL 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.

The net effect of these trends on the estimated number of EBL 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 BLL above 10 µg/dL for that housing category in Table 1 multiplied by the total 1997 AHS 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 AHS data in Table 7 to estimate the number children under 6 with BLL 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 11 summarizes housing stock changes from 1993 through 1997 that are reflected in the declining estimated number of EBL 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 4. Number of Children (in millions) under age 6 by PIR and MSA (1993 AHS)

	Year House Built:		
	Pre-1940	1940-1974	Post 1974
Children with PIR $\leq$ 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 $\leq$ 1.3, MSA pop < 1M	1.02	1.83	1.33
Children with PIR $\leq$ 1.3, MSA pop > 1M	0.96	1.7	0.56
Children with PIR > 1.3, MSA pop < 1M	1.58	2.94	4.34
Children with PIR > 1.3, MSA pop > 1M	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 BLL $\geq$ 10 μ g/dL by PIR and MSA size (1993 AHS children times NHANES Phase 2 Prevalence)

	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 < 1M	109	(12%)	70	(8%)	86	(10%)	265	(30%)
With PIR £ 1.3, MSA pop > 1M	213	(24%)	155	(17%)	15	(2%)	383	(43%)
With PIR > 1.3, MSA pop < 1M	48	(5%)	70	(8%)	9	(1%)	127	(14%)
With PIR > 1.3, MSA pop > 1M	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 BLL ≥ 15 $\mu\text{g/dL}$ by PIR and MSA size (1993 AHS children times NHANES Phase 2 Prevalence)

	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. Number of children (in millions) under age 6 by PIR and MSA (1997 AHS)

	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 $< 1\text{M}$	.68	1.36	1.40
Children with PIR ≤ 1.3 , MSA pop $> 1\text{M}$	.69	1.69	.62
Children with PIR > 1.3 , MSA pop $< 1\text{M}$	1.51	2.90	4.89
Children with PIR > 1.3 , MSA pop $> 1\text{M}$	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 1993."

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 $\leq$ 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 $\leq$ 1.3, MSA pop < 1M	-33%	-26%	+5%
Children with PIR $\leq$ 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 1993." And U.S., Third National Health and Nutrition Examination Survey—Phase 2, 1991-1994

Table 9. Total number of children (in thousands) under age 6 with BLL $\geq$ 10 μ g/dL, by PIR and MSA size, 1997

	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 $\leq$ 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 $\leq$ 1.3, MSA < 1M	72	(9%)	52	(7%)	91	(12%)	215	(28%)
With PIR $\leq$ 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 1993." And U.S., Third National Health and Nutrition Examination Survey—Phase 2, 1991-1994

Table 10. Total number of children (in thousands) under age 6 with BLL ≥ 15 μ g/dl, by PIR, and MSA size, 1997

	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 1993." And U.S., Third National Health and Nutrition Examination Survey—Phase 2, 1991-1994

Table 11. Changes in Housing Stock Reflected in Estimated Change in number of EBL Children under age 6 from 1993 to 1997

Year of home construction	1993 Occupied Units (MM)	1997 Occupied Units (MM)	Percent Change per year	Kids<6 per 1993 unit	Kids<6 per 1997 unit	1993 % of Kids<6 with PIR<1.3	1997 % of Kids<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%

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 and 1997.

3. Using AHS, RECS, and National Survey data to project number of housing units with "high" and "low" risk of LBP hazards

The estimated number of EBL children in 1997 derived in Section 2 does not account for housing rehabilitation between 1993 and 1997, which could further reduce the number of EBL 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 dust lead. In the long run, however, substantial rehabilitation will generally reduce LBP hazards by removing housing components with LBP. This may be especially true when LBP is removed

from friction and impact surfaces as a result of window and door replacement. In fact, the HUD Evaluation data show that the LBP hazard intervention strategies selected most often by Grantees were window work and/or window replacement, paint stabilization, and cleanup.

Table 12 shows RECS and AHS data on the percent of units that have replaced all of their windows prior to 1990, and from 1990 through 1997. The 1993 RECS 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 AHS 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 AHS 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 AHS and RECS 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 (RECS) and AHS data on Window Replacement

Age of Housing	1993 RECS All Windows Replaced			AHS > \$2K		1990-97 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 LBP hazards, and certainly does not abate all LBP in the unit, it may serve as a good indicator for substantial rehabilitation and for housing in good condition. The Cincinnati progressive 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 LBP 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 LBP hazards, similar to the rehabilitated and satisfactory housing in the Cincinnati study. The extent of LBP 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 LBP 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 for "satisfactory" condition.

Table 13 shows AHS 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.

Table 13
Percent of Units with Window versus Siding Replacement > \$2K, by PIR
(AHS 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 AHS data for owner-occupied units only, RECS 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 AHS 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 affect both owner-occupied and rental units over time.

Table 14
1985-97 Changes in Tenure Status (Across 7 AHS Samples)

	1989 AHS Percent Rented	Percent Ever Rented in 1985-97 AHS	Percent Always Rented in 1985-97 AHS
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 National Survey data on the percent of units without interior LBP, to forecast the change in high-risk and low-risk units from 1989 through 1997. The second column of Table 15 shows National Survey data on the percent of units without interior LBP, by year built (post-74 units are assumed to have virtually no interior LBP). 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.

Low-risk units in 1989 can be defined as units without interior LBP. Lead paint was used so extensively prior to 1940 that it might be reasonable to assume that most pre-40 units without interior LBP have already undergone substantial rehabilitation (removing interior LBP). The percent of units with all windows replaced prior to 1990 (13.1% from Table 12) is very similar to the percent without interior LBP in 1990 (17%), which also suggest that most pre-40 units without interior LBP 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 ($.83 \times .95 + .17 \times 0.4 = .86$).

National survey data show that 31% of 1940-59 units had no interior LBP in 1990, and 51% of 1960-78 units had no interior LBP. Within either housing category, older units are more likely to have interior LBP and are also likely to be demolished at a higher rate than newer units without LBP. Also, the percent of 1940-59 units with all windows replaced before 1990 (about 10.6%) suggests that many pre-60 units without LBP 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 ($.69 \times .80 + .31 \times 0.4 = 0.68$). 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 ($.49 \times .60 + .51 \times 0.4 = 0.50$).

Table 15
Units with No LBP, and Demolition and Rehab Rates, by Year Built

Year Built	1990: No Interior LBP	Occupied Units (MM)		1989-97 Demolition or growth rate per year			Window Replacement (Rehab) rate per year		
		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

The last three columns of Table 15 show the annual window replacement rate by year built, and how rates might 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 LBP 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 ($.83 \times 1.85 + .17 \times 0.4 = 1.6$). 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 ($.69 \times 1.85 + .31 \times 1.05 = 1.6$). 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 ($.49 \times 1.5 + .51 \times 1.0 = 1.6$).

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 LBP, 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.

3. Calculating EBL prevalence for children in high and low risk housing

NHANES data can be combined with the data in Section 4 to estimate the EBL prevalence for children in high versus low risk housing, by PIR and age of housing. As a first step, this analysis assumes that the EBL prevalence in older low-risk units is approximately equal to the prevalence in post-1974 units. This assumption may understate the EBL prevalence in older low-risk units because our definition of "low-risk" includes units with LBP, and older units are more likely to be in older neighborhoods with dust and soil hazards created by deteriorating exterior LBP from other buildings. Even in post-74 housing, however, the prevalence of EBL children is much higher among households with a PIR below 1.3, suggesting that neighborhood LBP risks may also be reflected to some extent in the post-74 prevalence data.

If we assume that the prevalence of EBL children in low-risk older housing is approximately the same as the prevalence in post-74 housing, then we can estimate the prevalence of EBL 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 (23.8 million out of 45.6 million units)

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

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

- ◆ X6 = EBL 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:

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

Housing Type	1989 Units	Annual Rate of Change	1990 Units	1991 Units	1992 Units	1993	1994	1995	1996	1997	1998	1999
High Risk												
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
Rehab												
pre-40		-1.85%	0.32	0.31	0.30	0.29	0.29	0.28	0.27	0.26	0.25	0.25
1940-59		-1.85%	0.27	0.26	0.25	0.25	0.24	0.23	0.23	0.22	0.22	0.21
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
1940-59		-0.80%	0.12	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.09	0.09
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												
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	44.19		43.1	42.0	40.9	39.9	38.8	37.8	36.9	35.9	35.0	34.1
Low Risk	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%

- ◆ $.25 \cdot 4.33 + .75 \cdot X3 = 16.37$
 $X3 = (16.37 - (.25 \cdot 4.33)) / 0.75 = 20.38\%$
- ◆ $.25 \cdot .22 + .75 \cdot X4 = 3.19$
 $X4 = (3.19 - (.25 \cdot .22)) / 0.75 = 4.18\%$
- ◆ $.47 \cdot 4.33 + .53 \cdot X5 = 7.25$
 $X5 = (7.25 - (.47 \cdot 4.33)) / 0.53 = 9.84\%$
- ◆ $.47 \cdot .22 + .53 \cdot X6 = 2.24$
 $X6 = (2.24 - (.47 \cdot .22)) / 0.53 = 4.00\%$

These calculations indicate an EBL 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 EBL prevalence for children with PIR above 1.3 in low-risk housing is only 0.22%. The EBL 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.

4. Forecasting EBL prevalence by PIR and age of housing based on percentage of housing stock with high risk of LBP hazards

The forecast decline in high risk units (Table 16) combined with the higher EBL prevalence estimates for high risk units (derived in Section 4) indicates that the overall EBL prevalence should decline with the decline in high risk units. Furthermore, data presented in this section suggest that EBL 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 kids <6) by PIR and age of housing, based on 1993 AHS data. EBL 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 Kids <6 and Percent EBL, by PIR, Housing Unit Risk, and Year Built

Year Built	% of Kids <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%	N.A.	N.A.	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 AHS 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.

Table 18
Post-74 Units with Kids<6, by PIR and Year Built
with Percent Moved in 1993 and Percent near Older Units

	Post-74 Units with Kids<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 EBL prevalence for low PIR children in post-74 housing may be largely attributable to LBP hazards in a previous residence and/or from nearby residences with exterior LBP hazards. With respect to neighborhood LBP 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 LBP. Almost all of the post-74 units in the AHS that do not describe nearby buildings as "older" or "very mixed" describe the nearby buildings as "about the same" age as the AHS 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 LBP.

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 EBL prevalence in Post-74 housing reflects LBP hazards in a previous residence. The 1993 AHS 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 EBL prevalence for these children reflects the EBL prevalence for their previous housing category, then the EBL 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 EBL prevalence for children with PIR under 1.3 in Post-74 housing
- ◆ 16.37% is the EBL prevalence for children with PIR under 1.3 in Pre-40 housing
- ◆ 7.25% is the EBL 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 EBL 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 EBL prevalence for low PIR children in post-74 housing may actually reflect their exposure to LBP in previous residences built before 1974. The neighborhood LBP hazards discussed above would explain some additional portion of the EBL 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 LBP hazards in their own unit, because LBP 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 EBL prevalence for low PIR children living in low-risk units.

5. Projecting number of EBL 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 EBL 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 EBL 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 17 assumes that the EBL 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 EBL children each year is calculated by multiplying the EBL prevalence for each housing and PIR category by the number of housing units and the number of children per unit.

The projection in Table 19 implicitly assumes that eliminating all high-risk housing would also eliminate all childhood EBLs. Of course, this assumption is not entirely realistic because LBP hazards are not the only cause of lead poisoning. However, the analyses presented above suggest that eliminating LBP hazards could very nearly eliminate childhood lead poisoning, or at least reduce the overall EBL 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 EBL 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 HUD Regulatory Impact Analysis (RIA). 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 EBL prevalence.

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 AHS and RECS data on window replacement used to project the decline in high-risk units should include federally assisted rehabilitation. The HUD RIA shows that about 40% of assisted rehabilitation units report window and door replacement as part of their rehabilitation work in the 1995 AHS, and other assisted units may have replaced windows in earlier years.

Table 19
Projected Number of High Risk Units and Associated Change in EBL 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%
EBL 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 kids under 6 (000) with BLL above 10 ug/dl with PIR > 1.3										
Housing Category	Kids<6/unit	%PIR>1.3	1993	1994	1995	1996	1997	1998	1999	2000
High-Risk pre-40	0.214	67.0%	93	87	82	77	72	68	64	60
1940-59	0.216	66.0%	73	69	65	61	57	54	51	48
1960-74	0.199	67.3%	61	58	55	52	49	46	44	41
Low Risk pre-40	0.214	67.0%	1	2	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%	13	13	13	13	13	13	13	13
Projected Number of kids under 6 (000) with BLL above 10 ug/dl with PIR < 1.3										
High-Risk pre-40	0.214	33.0%	222	209	196	184	173	162	152	143
1940-59	0.216	34.0%	94	88	83	78	73	69	65	61
1960-74	0.199	32.7%	73	69	66	62	59	56	53	50
Low Risk pre-40	0.214	33.0%	14	15	15	15	15	15	15	15
1940-59	0.216	34.0%	24	23	23	23	23	22	22	22
1960-74	0.199	32.7%	38	37	36	35	34	33	32	31
Post-74	0.249	22.3%	74	74	74	74	74	75	75	75
All Kids<6 with BLL > 10 ug/dl			787	750	716	683	651	621	593	565

Table 20
Projected Number of Children with Avoided EBLs 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%
<i>Projected Number of kids (000) with avoided BLL > 10 ug/dL due to HUD rule for government owned and assisted units</i>														
TBR	Units (000)		Kids<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

Table 21
Projected Number of EBL Children under Six (000) Before and After HUD Rule and Expanded Grant Program

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Baseline EBL Projection for Children with PIR<1.3 (000)											
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 Protect by HUD Rule (Non-Rehab) (000)											
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 Grant Program Units (000)											
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 EBL Children Due to Grant Program (000)											
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
EBL Projection for Children with PIR<1.3 (000)											
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 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 Grant Program	205	179	156	131	105	82	61	41	23	6	-9
Benefits of Additional Grant Program											
Hazard Reduction Units		33	50	67	83	83	83	87	90	93	97
Benefits at 3% (\$ MM)		\$251	\$377	\$503	\$629	\$629	\$629	\$654	\$679	\$704	\$729
Cumulative (\$ MM)		\$251	\$629	\$1,131	\$1,760	\$2,389	\$3,017	\$3,671	\$4,350	\$5,054	\$5,783

7. Adjusting projections for EBL children to reflect impact of expanded grant program for lead hazard reduction

Table 21 shows the additional number of low PIR children protected from lead poisoning by an expanded 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 number of children protected is equal to the number of units in each category multiplied by one child per unit and the corresponding EBL prevalence (the weighted average prevalence for low PIR children). To average one child per unit would require some combination of restrictions placed on grantees and coordination with public health officials to direct pregnant women and low-income families with young children to units addressed by this program. The combination of the HUD rule and this expanded grant program could eliminate low-PIR EBL children in pre-60 housing, and virtually eliminate low-PIR EBL children in pre-1974 housing, by 2010. The analysis in Section 5 also suggests that this action would also substantially eliminate low-PIR EBL 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 HUD Grant Program. The HUD criteria for the Grant Program are actually stated in terms of households with income between 50% and 80% of area income. Table 2 shows AHS data indicating that households with PIR below 1.3 will almost always meet the Grant Program criteria, and between 56.6% and 81.8% of households that meet the Grant Program criteria will also have PIR below 1.3.

Table 22
Comparison of Low PIR and Percent of Area Income (X%) Criteria for 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%

The expanded grant program units in Table 21 are all pre-60 units because data from the HUD National Survey and the US Geological Survey both indicate that lead in residential paint is disproportionately concentrated in pre-60 units. The HUD RIA also found that the unit benefits of lead dust removal in 1960-78 housing are only about 60% of the unit 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 National Survey data on the total surface area of LBP, the average lead concentration in LBP, and total tons of LBP 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
National Survey Data on Square Feet of Surface Area with LBP, Average Lead per Unit of Surface Area, and Total and Percent of Lead, by Year of Home Construction

	Pre-40	1940-1959	1960-1978	Total
LBP Surface Area (million sq. feet)				
Interior	15,912	8,247	5,279	29,438
Exterior	25,969	12,635	10,502	49,106
Average LBP Concentration (mg/sq.c)				
Interior	5.7	2.5	2.0	
Exterior	6.1	4.2	3.2	
Total Lead in LBP (1000 tons)	255	75	45	376
Interior	93	21	11	125
Exterior	162	54	34	251
Percent of Total Lead in LBP	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 1920s consumption because 1914 is the earliest year of available data. A small percentage of white lead was consumed in ceramics, chemicals, greases, 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.

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. These data indicate that the amount of paint lead per unit began to decline at least as far back as the 1920s. The white lead per unit is then multiplied by

the number of occupied units that remained in the housing stock in the 1991 AHS, 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.

Table 24
Estimated Average Paint Lead by Decade of Construction

	Lead Consumption (tons 000)		Decade- End Occupied Units (MM)	White Lead Pounds per Unit	1991 AHS Units (MM)	1991 White Lead Tons (000)		Percent of All White Lead
	White Lead	Red Lead & 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 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 much 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 definition of LBP, 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 National 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.

The last part of Table 21 shows the monetized health benefits associated with the expanded grant program. These benefit estimates assume that two-thirds of the grant units pass a hazard screen and hazard reduction activities are performed in one-third of the units. Benefits

are realized only for units where hazard reduction work is performed, and the benefit per unit is based on the HUD RIA estimates for lead dust removal and paint stabilization benefits lasting five years, assuming that one child under six resides in each of these units on average. In the case of the grant program, however, public health officials can also direct families with young children to units that pass the hazard screen, and this will yield health benefits to the extent that those families might have otherwise lived in units with LBP hazards. Also, grant program units have not actually shown any increase lead dust hazards in the two to three years of post-intervention data available, indicating that benefits may last far longer than five years after hazard intervention. Therefore, applying the RIA methodology to the Grant program will understate its total benefits to some extent. Even with these conservative assumptions, however, the expanded grant program would produce monetized benefits of \$5.8 billion using a three percent discount rate for lifetime earnings.

Children Under 6 Living in Pre-1975 Housing and with a Poverty-Income Ratio Below 1.3 and a Blood Lead Level Greater than 10 ug/dl

