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Dorchester Lead-Safe Yard Project: A Pilot Program to Demonstrate Low-Cost, On-Site Techniques to Reduce Exposure to Lead-Contaminated Soil

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ABSTRACT *Despite a general reduction in blood lead levels in children after lead was banned in gasoline and paint, lead poisoning remains an important health problem in many older urban areas. One factor that increases risk in these places is the high levels of lead in certain residential areas. A major intervention study found that reducing lead levels in urban soils results in a reduction in exposed children's blood lead levels. Removing lead from inner-city soils or reducing exposures to lead-contaminated soils typically is expensive, technologically challenging, or beyond the ability of low-income households to undertake. This project, in conjunction with residents and community-based institutions, developed a series of in situ, low-cost, low-technology measures that worked to reduce the exposure to lead-contaminated soils in one Boston, Massachusetts, neighborhood. The project demonstrated several important results. Government, universities, residents, and community based organizations can work together effectively to reduce exposures to lead in soil. Lead-contaminated soil can be mitigated at a fraction of the cost of conventional methods in ways that increase the ability of residents, community health centers, and others to have a positive impact on their neighborhoods. A lead-safe yard program can be replicated and institutionalized by municipal home de-leading programs and other community organizations.*

KEYWORDS *Children, Community, Lead, Partnerships, Remediation, Urban.*

INTRODUCTION

A highly significant impact of regulating lead out of gasoline in the late 1970s and 1980s has been the dramatic reduction of blood lead levels in children. The ban on lead in gasoline, coupled with legislation banning lead in house paint, plumbing, and lead solder in food cans, has resulted in a rapid decline in the number of children with elevated blood lead levels. The proportion of children under 6 years of age with blood lead levels of 10 μg/dl or more has dropped from 88% in the late 1970s to 6% in the early 1990s.[1]

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Nonetheless, the public health success is shared unequally. Young children living in poverty are approximately 3.5 times more likely to suffer elevated blood lead levels than children who live above the poverty line.[1] Inner-city children who are poor, primarily minority, and live in older, substandard housing are exposed to multiple sources and risks of lead poisoning, namely, deteriorating interior and exterior paint, indoor dust, outdoor soil, and older interior plumbing. Recently, the Centers for Disease Control and Prevention (CDC) estimated that almost 22% of African-American children living in pre-1946 houses have elevated blood lead levels.[2] The Centers for Disease Control and Prevention has stated further that, in the absence of blood lead data, specific community variables, including percentage of houses built before 1950, children receiving some form of public assistance, and children with siblings or playmates who have been poisoned by lead, can be used to identify and target those geographic areas of greatest risk for childhood lead poisoning.[2]

It is held widely that childhood blood lead poisoning is preventable. To this end, primary and secondary prevention efforts generally focus on clinical services and multiple sources of exposure in the home and play environment, particularly interior loose paint and dust and drinking water. Prevention programs may include regular blood lead testing, iron supplements and nutrition counseling, de-leading or covering painted or peeling surfaces of concern, interior dust control, and replacing lead pipes or emptying overnight water in domestic pipes at the kitchen tap.*

The focus of lead poisoning prevention efforts and regulatory action on the indoor environment has been shown to be effective in reducing children's exposure and blood lead levels.[3] However, environmental health researchers acknowledge that urban soil is a significant sink of bioavailable lead that has not been regulated or included in a comprehensive prevention strategy (Dr. T. Spittler, oral communication, June 15, 1997).[4,5] Further, the majority of lead historically released to the ambient urban environment from leaded gasoline emissions and from deteriorated exterior lead paint remains on and near the surface of outdoor soil as an imminent source of exposure to children.[5] Murgueytio and colleagues[6] analyzed the lead content of residential vacuum cleaner bags and determined that soil lead contributed 36% of its lead contents, indicating that lead in soil substantially contaminates interior floors, furniture, walls, and window sills. These findings approximate those of Stanek and Calabrese,[7] who estimate that 30% of interior dust enters airborne through ventilation and is tracked in by humans and animals from outdoor soil. Other studies have found house dust to be comprised of at least 50% soil dust.[8]

LEAD-SAFE YARD PROJECT

The Dorchester Lead-Safe Yard program in Massachusetts was designed as a pilot program to develop on-site soil lead analysis, low-cost remedial landscaping techniques, and educational and instructional materials for reducing children's exposure to lead in soil in a high-risk urban neighborhood. The Lead-Safe Yard program was based on the key finding and conclusion of the Boston Lead-in-Soil Demonstration Project, a prospective environmental intervention study funded in the late 1980s by the US Environmental Protection Agency (EPA). The Boston Lead-in-Soil

*For information on primary and secondary blood lead poisoning prevention, contact the Boston Childhood Lead Poisoning Prevention Program, Public Information Program, 1010 Massachusetts Avenue, Boston, MA 02118.

Demonstration Project found that a reduction of approximately 2,000 ppm lead in soil is associated independently with blood lead level declines ranging from 2.25 to 2.7 μg/dL in young children.[9] The study authors concluded that lead soil abatement, as undertaken in their demonstration program, was too expensive ($9,600 per property on average) for the health benefit achieved and posed too many disposal difficulties to be undertaken as a clinical response. They determined lead soil abatement would be done best as a prevention effort targeted to those most at risk.[9]

At the inception of the Dorchester Lead-Safe Yard project, no program existed in Boston or in most other cities to assist low-income tenants and homeowners in high-risk neighborhoods in reducing children's exposure to lead in residential soil.* The EPA, while not yet regulating lead in yard soil, has issued recommendations and draft guidance that establishes a level of concern at 400 ppm lead in bare residential soil and recommends "response activities" for yards where higher levels of lead contamination are found.[10] Lead in the outdoor environment of the home essentially is left to voluntary corrective action on the part of the community and individual resident. Therefore, inner-city neighborhoods are in need of pilot programs that demonstrate criteria, methods, cost, partnerships, and work specifications for creating low-cost lead-safe yards in contaminated urban communities.

The Dorchester Lead-Safe Yard program was designed both to address the gap between the environmental health knowledge generated by the Boston Lead-in-Soil Demonstration Project and its successful application in low-income neighborhoods with high levels of lead soil contamination and to integrate soil abatement into lead poisoning prevention. The methods, techniques, and materials developed through the pilot have been disseminated to health and housing agencies and neighborhood organizations of the city of Boston for the inclusion, and thus institutionalization, of soil remediation as part of a comprehensive lead poisoning prevention program in high-risk neighborhoods. In summary, the pilot program goal was to design and demonstrate a prevention-oriented soil lead abatement project for high-risk neighborhoods. Added dimensions of the program were less costly soil remediation, structured sharing of data and remedial design decisions with the residents, and institutionalization of a soil remediation program by the city of Boston.

PROJECT DESIGN

The project design was guided by the aims of the EPA EMPACT (Environmental Monitoring for Public Access and Community Tracking) program, through which the Dorchester Lead-Safe Yard program was funded.† EMPACT is an EPA initiative that, since fiscal year 1998, has funded more than 30 projects nationwide to provide citizens with time-relevant environmental data and access to information for the purpose of their informed decision making. The aims of the EMPACT project shaped the two-fold programmatic strategy of the Dorchester project: (1) to generate real-time data of lead concentrations in residential yard soils using an innovative technology, with the data communicated to residents to inform them of the health risks of lead in soil, and (2) to plan with residents and implement affordable and sustainable remedial measures that they would be taught to maintain in their yards.

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*Lead-Safe Cambridge has a voluntary lead-safe yard program as part of their home de-leading program. Contact Lead-Safe Cambridge, 57 Inman Street, Cambridge, MA 02139.

†More information on EMPACT is available on-line at www.epa.gov.

We added additional objectives to the project design. Community partners would be invited to join the project to enhance the success in reaching residents and developing a meaningful and replicable community-based project. Geographic information systems (GIS) would be used to display the project area, property information, and project data when possible. Comprehensive materials on lead poisoning, including brochures on nutrition, blood lead testing, indoor remedial measures, and resources for de-leading houses and home improvements, would be provided to homeowners as part of the outreach education. Costs per yard would be kept as low as possible to create an affordable and sustainable program. Our initial goal was $750 per yard in landscape labor and materials, which would be offered free to homeowners in the pilot area.

Partners

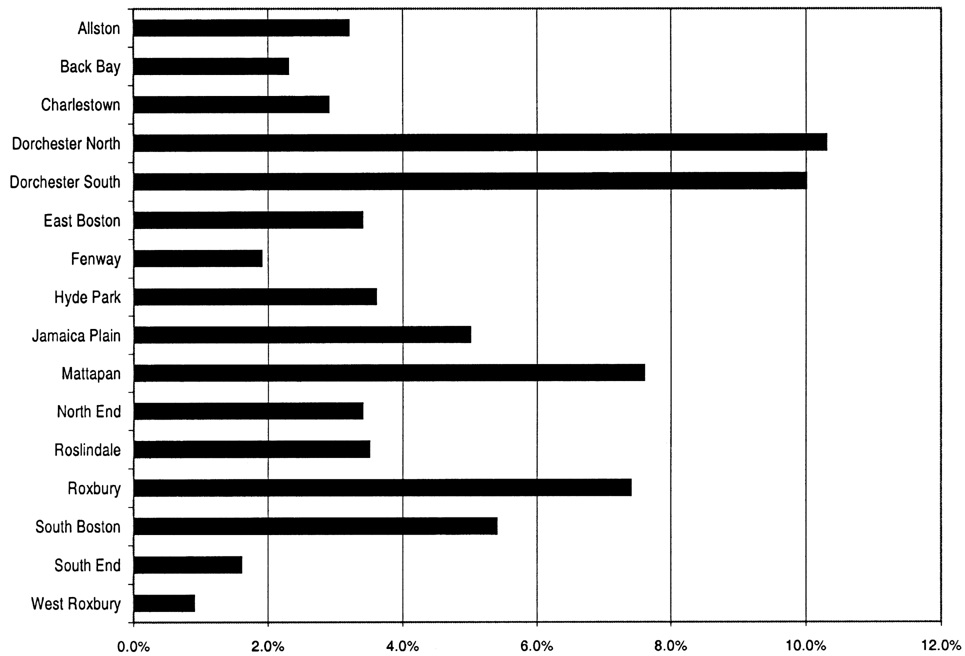
The project partners included the New England Regional Laboratory of EPA Region 1, Boston University School of Public Health, the Bowdoin Street Health Center, and Dorchester Gardenlands and Open Space Preserve. The EPA laboratory provided the project liaison with the national EMPACT program, project management, soil analysis with the assistance of an industrial hygienist from Bowdoin Street Health Center, and GIS mapping. The Boston University School of Public Health provided expertise in urban environmental health, community-based research, remedial measures, and project documentation, and codirected the project with EPA. Outreach to identify interested residents and education about lead poisoning prevention was conducted by the Bowdoin Street Health Center, which has multilingual capacity on staff and a well-respected primary and secondary lead poisoning prevention program. Dorchester Gardenlands, a nonprofit organization, with landscape design staff and a construction crew that build and maintain community gardens and neighborhood parks in the Dorchester neighborhood of Boston, provided all of the project tasks related to remedial design, including planning the landscape measures with the homeowner, undertaking the remedial landscape measures, and completing the maintenance plan. Bowdoin Street Health Center reviewed the maintenance plan with the homeowner.

Site Selection

Four criteria were established to guide the site selection within Dorchester, the largest neighborhood of Boston with extensive minority and poor populations and one in which both community partners work. The pilot area would be in a high-risk area, a neighborhood with a high prevalence rate of blood lead levels greater than 10 μg/dL according to annual data from the Boston Childhood Lead Poisoning Prevention Program. Second, the project, to the extent possible, would work with contiguous homes because children often play in neighboring yards, and soil, dust, and paint chips migrate to nearby yards. The third and fourth criteria were that the project area should be within a neighborhood that has organized around community environmental health issues and that there be other environmental "goods" (such as an environmental schoolyard initiative in our case) that the project could link with and build upon. These last two criteria would help ensure that the outreach effort would succeed.

Using prevalence data on blood lead levels published annually by the Boston Childhood Lead Poisoning Prevention Program, we chose the neighborhood of North Dorchester, which had the highest prevalence rate of any Boston neighborhood in 1998 (Table 1). The Bowdoin Street Health Center, through their environ-

TABLE 1. Prevalence of children, aged 0–6 years, with blood lead levels 10 μg/dL or greater by Boston neighborhood, fiscal year 1998



Source: Boston Childhood Lead Poisoning Prevention Program.

mental health outreach programs, works with civic associations, schools, and community-based organizations in North Dorchester on environmental health issues. Thus, they had links with already active communities and other environmental goods that we sought in siting the project in a neighborhood of need. Applying these criteria to the catchment area of the Bowdoin Street Health Center in North Dorchester, we selected a pilot area within census tract 918.

Site Characteristics

Census data from 1990 indicate that an estimated 22.6% of North Dorchester residents and 35.1% of children under the age of 18 were living at or below the poverty line.[11] An estimated 90% of North Dorchester homes were built before 1978; an estimated 75% are pre-1950 construction, significantly higher than the national rate. Most are three-story multifamily homes constructed of wood that was painted with lead-based paint. Thus, residential soil historically has been a sink for airborne lead and lead that has been leached, peeled, and scraped from painted wood houses. A walk-through of the pilot area revealed a high rate of yard use by children and families, many areas of bare and partially bare soil, and cars parked in yards, side by side with children's play areas, gardens, and picnic or cookout areas. Many wooden houses have been covered with siding, while wooden porches, roof soffits, and exterior window frames often have peeling and flaking paint that drops to the building perimeter. A number of homeowners have purchased side lots, where houses once stood, from the city of Boston and use them for expanded lawn and garden space, children's play areas, and parking lots.

PROJECT ACTIVITIES

Outreach

Outreach to tenants and homeowners was done by staff of the Bowdoin Street Health Center. A flyer explaining the project and translated from English into three languages was distributed to the homes in the project area (Fig. 1). Media coverage

FIGURE 1. Dorchester Lead-Safe Yard project area and yards in program, 1998–1999, North Dorchester, Massachusetts. (From US EPA Region 1.)

on Neighborhood Network News and National Public Radio's *Living on Earth* also provided publicity. Through door-knocking and word of mouth, initially, and the visibility of the project, subsequently, residents signed up to participate in the project, particularly those living near completed yards. Thus, our goal of doing contiguous yards was made easier to achieve. The outreach strategy was designed to be comprehensive, with information and brochures on the sources and harm of childhood lead poisoning, nutrition, and funding opportunities for home de-leading and home improvements distributed at the time of discussion of the lead-safe yard program. Once a homeowner signed a permission form, a team did on-site soil analysis for lead content.

Sampling and Analysis Methods

Soil samples were analyzed in situ according to procedures specified by EPA[12]; the analysis was performed with a portable Niton model 702 field portable X-ray fluorescence (FPXRF) analyzer equipped with a 10-mCi cadmium-109 source and a high-resolution silicon-pin detector. Making contact with the ground surface, the instrument offered data results in 30 to 60 seconds. Replicate samples were taken to the EPA laboratory for testing by a second method, inductional coupled plasma emission spectroscopy, to confirm the FPXRF results.

Four yard areas of concern were evaluated during the on-site soil analysis: the house drip line (3-foot perimeter of a house); areas of unique use, such as children's play areas, picnic and gardening areas; any areas of bare soil and high foot traffic; and "other" areas noted by the sampling team that might present a possible source of lead contamination to the subject property. The initial sample locations depended on the size and shape of the four areas of interest.[13] A line pattern was used when the area was linear (e.g., house drip line). In situ measurements were taken at approximately 5-foot intervals along the line. A large *X* was transcribed to cover other areas of concern, such as children's play areas. In situ measurements were taken at regular intervals along each line of the *X* unless the field technician determined that additional resolution was needed.

Screening data and descriptive information about each site were recorded on a site sheet. Each data point collected during on-site sampling was considered a subsample and averaged with others from their area of interest (e.g., west drip line) to determine the mean value for that area. Results of the XRF soil analysis were transcribed onto a color-coded plot plan of the property for use in the remedial landscape strategy. Color codes were used on the property map to indicate the nature and extent of lead contamination in each area sampled and particular yard uses of concern, such as play and gardening areas. The map then was utilized by the landscaper to discuss yard treatment strategies with the homeowner.

Remedial Measures and Yard Treatments

A member of the landscape crew presented the soil lead results to the homeowner and developed a treatment plan for the yard with the homeowner. A standardized questionnaire was used to document all of the yard uses, demographics, availability of the homeowner, and decisions about treatments of the lead-contaminated areas. A final plot plan was prepared after the interview that combined the lead soil results with treatment recommendations. This became the "blueprint" for work to be done in the yard.

Working with the EPA recommendations for residential lead-contaminated soil,[10] the project developed a suite of treatment options, guided also by our goals of affordability and replicablity by community organizations and homeowners. Removal and disposal of soil off-site was not an option because of disposal difficulties in eastern Massachusetts at the time of the pilot and the cost of disposal. The remedial treatment options according to lead level were as follows:

1. Soil lead levels higher than 5,000 ppm (very high): Semipermanent barriers, including wood-framed drip-edge boxes with a perforated landscape cloth or plastic material underlayment to create a permeable soil cover and filled with gravel or another material, such as mulch.
2. Soil lead levels between 2,000 and 5,000 ppm (high): Not recommended for gardening; relocate vegetable garden. Relocate children's play area, pet area, picnic area, if possible; if not, install framed play and picnic area with perforated landscape cloth or plastic and wood chips 4–6 inches deep. Install path of walking stones for areas of high foot traffic. Seed and fertilize grassy areas or cover with mulch or wood chips if not a suitable site for grass.
3. Soil lead levels between 400 and 2,000 ppm (moderately high): Install raised-bed garden if soil lead is above 400 ppm. Install framed play and picnic area with perforated landscape cloth or plastic and wood chips 4–6 inches deep. Install path of walking stones for areas of high foot traffic. Seed and fertilize grassy areas or cover with mulch or wood chips if not a suitable site for grass.
4. Soil lead levels less than 400 ppm (background): No treatment necessary.

Homeowner Packet

Once treatment work was completed, a packet was presented to the homeowners and reviewed with them for clarity and comprehension. The packet contains a record of lead screening results, a sketch of treatments used, and a maintenance guide. The maintenance guide is keyed to the sketch of treatments and informs the homeowner of maintenance tasks, when and how frequently they are best done, and tools needed. A list of resources, materials, sources of free materials, and typical unit costs of materials is included in the packet.*

RESULTS AND DISCUSSION

From the summer of 1998 through the fall of 1999, the program enrolled participants from 43 owner-occupied homes; many had two and three households in the building, and a small number of homeowners owned adjacent lots. Figure 1, which shows the completed yards within the project area of census tract 918, demonstrates that homeowner interest was particularly strong on two streets, resulting in clustered areas of lead-safe yards.

We completed fewer homes than our target goal of 70 because project costs per yard ran higher than anticipated. The average cost per yard lot was approximately $2,100, with a breakdown of $300 for materials and $1800 for landscape and construction labor. These costs do not include the project management and indirect costs, which add another $900 per yard cost. We were able to obtain some materials free or by donation, including gravel from a local company and wood chips and compost for gardens, which reduced costs. The unit cost per yard was

*Sample packets are available from Lead Program, US EPA Region 1, JFK Building, Boston, MA 02203.

significantly lower than that of the Boston Lead-in-Soil Project (at $9,600), but at the same time, costs were substantially higher than our goal of $750. Because the majority of houses in Dorchester are two- and three-family dwellings, we were able to benefit multiple families for the cost of one lead-safe yard. Of the project homes, 85% were multifamily; of these, approximately two-fifths were duplexes, and three-fifths were three-family units.

Soil Lead Data

With approximately 30 data points per yard and a total of 1,345 sample results, the project yielded a rich amount of data on environmental lead in urban residential soil. Lead in surface soil measured in the North Dorchester project area ranged from less than 54 to 25,000 ppm, with an arithmetic mean of 1,463 ppm, a median of 827 ppm, and a standard deviation of 2,059. Approximately 6% of the measured values fell within the ambient range for lead in soil, 2 to 200 ppm, as cited by Bohn.[14] Of the soil data values, 81% were greater than 400 ppm, the concentration above which EPA recommends remedial response measures for residential bare soil. The high lead content and wide range of variability found in North Dorchester soils were consistent with results reported in other studies of urban soils.[4,15–18]

Figure 2 is a plot of the median and mean values of soil lead in relation to distance from the building. The median is insensitive to extremes and offers a better aggregate measure of the data than the mean due to the influence of small paint chips on the mean value.[15] The results show that, although lead in soil levels fall off after 3 feet from the house foundation, the mean and median soil lead values remain elevated even at distances more than 7 feet in the pilot area. Only 4% of the lots tested did not require any form of soil abatement, having been relandscaped with new fill and soil amendments prior to the pilot program.

The distribution of soil lead with distance from the residential building, as shown in Fig. 2 and Table 2, is consistent with the commonly held assumption that the highest values of lead are associated with lead-based paint chips and are found nearer to the house foundation within the drip line of the building. Table 2 shows frequency distributions of soil lead data collected at 3 feet, 4 to 7 feet, and more than 8 feet from the building foundation. These data have been sorted to eliminate any measurements that would not be an accurate representation of soil lead in

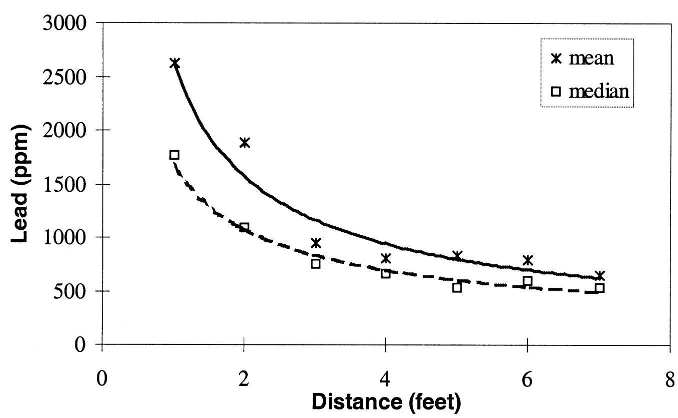


FIGURE 2. Mean and median soil lead concentration with distance from residential foundation Dorchester Lead-Safe Yard project, 1998–1999.

TABLE 2. Frequency distribution of lead in soils at three distances in relationship to building foundation, Dorchester Lead-Safe Yard Program, 1998–1999

	<3 feet		4–7 feet		>8 feet	
Soil lead, ppm	No.	%	No.	%	No.	%
0–200	6	1.6	3	1.6	21	5.4
200–400	15	4.0	15	7.9	66	16.9
400–600	21	5.6	21	11.1	114	29.2
600–800	29	7.8	27	14.2	69	17.7
800–1,000	32	8.6	25	13.2	33	8.5
1,000–1,500	63	16.8	33	17.4	54	13.8
1,500–2,000	38	10.2	30	15.8	16	4.1
2,000–2,500	36	9.6	10	5.3	8	2.1
2,500–3,000	28	7.5	5	2.6	3	0.8
3,000–3,500	18	4.8	6	3.2	1	0.3
3,500–4,000	21	5.6	0	0	2	0.5
4,000–4,500	14	3.7	2	1.1	2	0.5
4,500–5,000	11	2.9	2	1.1	0	0
5,000–10,000	29	7.8	7	3.7	0	0
10,000–20,000	12	3.2	3	1.6	0	0
>20,000	1	0.3	1	0.5	0	0
Total	374		190		381	

relationship to the residential building; thus, sample points near a painted fence, garage, or outbuilding have been eliminated. Over 45% of measured values within 3 feet of the foundation exceeded 2,000 ppm soil lead. Of samples within 4 to 7 feet of the foundation, 19% exceeded 2,000 ppm; 4.5% of soil sampled at distances more than 8 feet from the building foundation exceeded 2,000 ppm.

The highest values of soil lead were found consistently within the drip edge, the 3-foot perimeter around the house; soil lead concentrations tended to decrease (while still high in many cases) with distance from the house. Preliminary discussions with researchers from the National Center for Lead-Safe Housing, who are conducting a nationwide comparative study funded by the US Housing and Urban Development Agency of lead in residential soil, suggest that the house perimeter soil lead values in Dorchester are among the highest in urban areas nationwide (P. McLaine, National Center for Lead-Safe Housing, Columbia, MD, oral communication, June 20, 1999). Comparisons with recent residential soil data from metropolitan New Orleans[15] show that soil lead contamination is significantly greater in Dorchester than in New Orleans.

Some of the contributing factors would be the age and material of houses (75% pre-1950, virtually all of which are wooden construction); the size of houses (many are multifamily with large exterior surfaces and porches); and the poor condition of houses, due in part to racial bias in bank lending and home insurance and to the lower income status of residents. In addition, the density of local and regional traffic, including that of the Southeast Expressway and the nearby feeder roads to downtown Boston, and the older fleet of cars driven by lower-income neighborhood residents would also have contributed to the large concentrations of lead from leaded gasoline in soil.

Dissemination to the Public

Numerous public presentations on the Lead-Safe Yard project have been given, and all of the project materials, including outreach flyers, permission forms, and sketches of remedial treatment measures and maintenance plans, have been provided for those interested. In many cases, a tour of the completed yards was also conducted.

To institutionalize a soil lead program, a primary objective of the project has been to disseminate a template of materials, methods, and techniques to public agencies with a mission to address and prevent childhood lead poisoning. To that end, we have discussed and introduced the project to Lead-Safe Boston, a federally funded citywide program that assists homeowners financially and technically in home de-leading and home improvement.

The work of creating a lead-safe yard is undertaken best once a house has been de-leaded, and exterior sources of lead, such as peeling porches, soffits, and window frames, have been repaired or replaced. Sequencing the lead-safe yard work so that it follows other de-leading work is the best overall strategy for maintaining a lead-safe environment. The Lead-Safe Boston program has expressed strong interest in integrating lead-safe yards into their home de-leading work, an effort that would be financed through future rounds of funding from the US Department of Housing and Urban Development (HUD). To that end, Lead-Safe Boston is undertaking an initial demonstration program of de-leading homes and creating lead-safe yards in the spring of 2000 using the on-site sampling and landscape techniques developed in the Dorchester Lead-Safe Yard pilot program. This effort will help achieve the goal of lowering costs through the process of competitive bids for the lead-safe yard outreach and landscape work.

FURTHER RESEARCH AND FUTURE DIRECTIONS

In taking the Dorchester Lead-Safe Yard project from the pilot phase to integrating it into the city of Boston's HUD-funded lead-safe housing program, the lead-safe yard program has attracted the interest of the National Center for Lead-Safe Housing, also a HUD grantee. The National Center proposed collaboration on an evaluation of the effectiveness of the low-cost soil intervention measures in reducing exposure to lead in soil and dust. The evaluation has four components: pre- and postdust sampling of walk-off mats and entryways in a new round of lead-safe yards; a survey of completed yards to assess the longevity of the interventions and the maintenance practices by the homeowner; a comparative study of the FPXRF with laboratory atomic absorption testing to determine the accuracy of its use in field testing; and a comparative study of surface soil lead and lead concentration with depth in residential soils. Results will be announced in 2001.

Numerous and diverse models for organizing a lead-safe yard program are needed to create an affordable program and particularly to reduce the labor, management, and overhead costs. We are researching community-based alternatives that may reduce current average costs. Examples may include a model based on Habitat for Humanity, in which the homeowner donates a certain number of hours for labor or purchases materials and skilled and semiskilled volunteers contribute labor and management time. Other models may include organizing a block group or civic association to undertake the project in their neighborhood, and, modeled on community gardens, providing a combination of supervision and design support from a local nonprofit organization. Simply stimulating a number of landscape companies to compete for the work, as is being done by Lead-Safe Boston, will bring down the unit costs per yard.

We currently are undertaking a comparative case study of the model developed in this pilot with that of Lead-Safe Cambridge Safer Yard Project. Lead-Safe Cambridge recently developed a residential soil removal program for landfill disposal of soil with lead concentrations greater than 5,000 ppm prior to taking lead-safe landscape measures. While this is desirable from an environmental health perspective, the remedial costs and the complex logistics of handling hazardous waste in residential neighborhoods may limit the number of homes reached by the project (A. Stroobant, Lead-Safe Cambridge, oral communication, October 11, 1999).

An interesting alternative, which has had only limited trial efforts in residential contexts thus far, is phytoremediation—plant uptake of lead from soil.[19] With additional feasibility studies, it may be possible to develop a protocol for use in yards or to construct a central, municipally managed biotreatment site where contaminated residential soil could be deposited for phytoremediation and restored for safe use. The Department of Environmental Health within the Boston Public Health Commission is currently planning a phytoremediation pilot program for residential and vacant lot soil contaminated with lead.

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