Lead-Soil Contamination of Residential Properties Adjacent to Municipal Water Towers in Rhode Island

Marcella Remer Thompson[1,2], Andrea Burdon[2]

[1] Superfund Research Program, Brown University, Providence, Rhode Island [2] College of Nursing, University of Rhode Island, Kingston, Rhode Island

RESEARCH OBJECTIVES

- Describe the distribution of lead-soil contamination found on adjacent residential properties by soil depth and distance from the center of the water tower.
- Compare these data to current state and federal regulations.
- Evaluate the efficacy of current Rhode Island Department of Health soil sampling procedures to detect lead-soil contamination.

BACKGROUND

- Prior to 1978, the exteriors of Rhode Island's municipal water towers were painted with lead-containing paint. Over time, this lead-containing paint either flaked-off or was mechanically removed. Lead may have deposited on adjacent residential properties.
- Lead adheres to soil particles and remains in the upper layer of soil (ATSDR 2007). Environmental availability varies (49% to 100%) depending upon the source, presence of other soil contaminants, and soil characteristics (Pauget et al. 2012; Smith et al. 2010).
- Deteriorating lead paint, dust and soil are primary sources of elevated blood lead levels in U.S. children. For every 1,000 mg/kg increase, blood lead levels can rise 1 to 5 µg/dL (Levin et al. 2008).
- Lead exposure is known to have neurobehavioral and neurodevelopmental consequences in animal models and human population studies (Wigle et al. 2007).

METHODOLOGY

- **Research Design.** Descriptive Study. Secondary Data Analysis. Practice-Based Evidence.
- **Data Source**. Environmental sampling data were extracted and compiled from illustrated site maps, site investigation reports and remedial closure reports that were free and publicly available through the Rhode Island Department of Environmental Management.
- **Study Data**. Data were available for 515 surface samples taken from 31 residential properties adjacent to six municipal water towers. Only 27% and 41% of these core samples were analyzed at 6- and 12-inch depths, respectively.
- **Review Process**. Interviewed key governmental personnel. Reviewed written accounts of events, including public town meetings with residents. Reviewed current national and state health and environmental policies, regulations and practices.

RESULTS

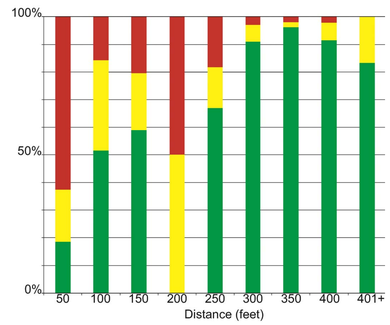

Figure 1. Percentage of Samples and Distribution of Lead Concentrations in Soil at Six-Inch Depth by Distance.

Property Designation Based on Highest Lead-Soil Concentration

Designation Lead-Soil Concentration	No. Properties
"Lead Free"[a] **"Resident Direct Exposure"**[a,b] < 150 mg/kg	8
"Lead Safe"[a] 150 to 400 mg/kg	7
"Lead Hazard"[a,b,c] > 400 mg/kg	8
"Extreme Lead Hazard"[c] > 1,000 mg/kg	8
Total	31

[a]per HEALTH §23-24.6; [b]per DEM-DSR-01-93; [c]per U.S. EPA 40CFR745.227

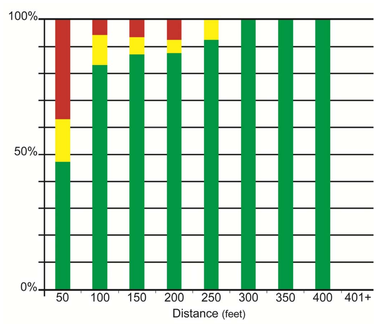

Figure 2. Percentage of Samples and Distribution of Lead Concentrations in Soil at Twelve-Inch Depth by Distance

- Based on these limited data, no residential properties were misclassified with respect to remediation.
- The potential for misclassification based on surface sampling alone was approximately 14%.
- Among those properties initially determined as "lead free", the total number of samples per property was too few to confirm.
- Overall, contamination was inversely related to distance from water towers.
- However, some contamination persisted beyond 200 feet. Most likely, prevailing winds and tower height were contributing factors.
- Five post-remediation lead-soil concentrations suggest the extent of lead contamination may have been deeper than initially determined.

CONCLUSIONS

- Modifications to current soil sampling procedures are needed. Establish *de minimus* sampling guidelines.
- Congruency across state government regulations is recommended. Unify regulatory terms. Avoid using "lead free". Update U.S. EPA IEUBK Model, HEALTH and DEM regulations to reflect lowered CDC exposure guidelines (5.5 µg/dL).
- Additional data would improve the ability to draw more meaningful and generalized conclusions with regard to similar situations.
- Examining practice-based evidence has the ability to confirm or disprove regulatory relevance and efficacy in the context of real world practice.

IEUBK = Integrated Exposure Uptake Biokinetic Model

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