

## REDUCTION OF URBAN RESIDENTIAL LEAD EXPOSURE: BALTIMORE'S EXPERIENCE, USA

FARFEL Mark R., BROPHY Merrill, ORLOVA Anna O., CHISOLM J. Julian Jr.

Kennedy Krieger Research Institute, 707 N. Broadway, Baltimore, Maryland 21205, USA,  
E-mail: mfarfel@jhmi.edu

### 1. Introduction

Lead poisoning is a worldwide environmental problem. In the U.S., lead-containing paint and dust remain the major lead sources of exposure. The U.S. did not sign the 1923 international treaty to ban the manufacture, sale, and use of residential white-lead paint (>2% lead). Only after 1978 did the U.S. limit the lead content of residential paints to 0.06%. Consequently, 83% (75 million) of occupied residential units built before 1980 contain lead-based paint. Nearly 6 million U.S. children 1 to 2 years old live in lead-painted houses. At highest risk are poor children living in older (pre-1946) urban houses; 16.4% of such children aged 1 to 5 years have blood lead concentrations (PbB) >10 µg/dL. As a scientific basis for prevention, field studies in Baltimore summarized below have documented the short and long-term effectiveness and costs of alternative methods of controlling residential lead-based paint and dust hazards. In the past, untrained workers commonly burned and sanded lead-based paint in an effort to reduce lead hazards in the home. This work, often done without safety precautions to protect occupants, greatly increased the amount of lead in house dust which in turn caused children to be lead poisoned or to have worse lead poisoning, FARFEL and CHISOLM (1990). In the early 1990s, we found that major residential lead-based paint abatement by trained workers using safety precautions greatly reduced the amount of lead in dust, FARFEL (1994). Unfortunately, the major renovations cost more than many families and property owners could afford. For this reason, in two more recent studies we tried to find ways to repair and maintain older houses that could reduce lead in dust and paint and also be affordable to more families and owners.

The ongoing „Lead-Based Paint Abatement and Repair and Maintenance (R&M) Study“ sponsored by U.S. EPA and U.S. HUD is an investigation of the short- and long-term (up to 5 years) effectiveness of three types of repair interventions (n=75 houses) designed to reduce children's exposure to lead in paint and settled dust (Table 1), FARFEL (1997). The ongoing „Treatment of Lead-Exposed Children (TLC) - Clinical Trial“ sponsored by NIEHS implemented the R&M types of lead hazard control interventions, as well as professional cleaning interventions without repairs, in the homes of more than 220 children prior to the start of their clinical treatment, TLC (1998). Both studies provide data on changes in dust lead before and after intervention.

### 2. Materials and Methods

Cyclone dust samples (R&M Study) and wipe dust samples (TLC Trial) were collected from floors, window surfaces, and entryways before intervention and periodically post intervention. The cyclone provided estimates of dust lead loadings (µg Pb/m<sup>2</sup>) and lead concentrations (µg Pb/g). Wipes provided estimates of lead loadings. Cyclone dust was decomposed using a closed vessel microwave nitric acid digestion method (modified US EPA SW 846 Methods 3015 and 3051) and analyzed by ICP-AES (SW 846 Method 6010). Wipes were prepared using a modified US EPA Method 3050 for hotplate acid digestion and analyzed by Flame-AAS. In the R&M Study, children's venous blood was periodically tested for lead using Graphite Furnace AAS. Longitudinal data analysis was used to assess changes in lead in dust and children's blood.

Table 1: R&amp;M Study Interventions

ELEMENT	LEVEL I	LEVEL II	LEVEL III
Cost (\$)	1,650	3,500	6,000
Time (days)	within 1	within 3	within 7
Safe Practices	✓	✓	✓
Paint Stabilization	✓	✓	✓
Windows	well caps	sash guides + well caps	new windows + ext. trim cover
Floors & Stairs	not treated	sealed	sealed/covered
Entryway Mat	✓	✓	✓
Professional Clean-up	✓	✓	✓

### 3. Results and Discussion

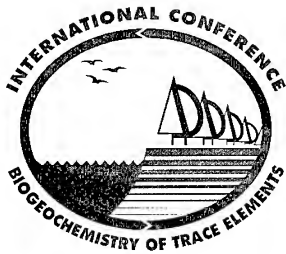
On average, all three R&M interventions reduced dust lead loadings on window surfaces by 90% and on floors by 70% or more immediately post-intervention. The average dust lead level during the first two years after all three R&M interventions remained lower than the amount of lead in dust before the repairs. R&M III was associated with the lowest dust lead levels over time compared to R&M I and R&M II. The TLC Trial documented reductions in dust lead loadings after repairs and after professional cleaning interventions. Houses built after lead was banned from house paint had the lowest dust lead levels. Also important was the finding that children's PbBs did not get worse after the R&M study repairs. The greatest reductions in PbB (35%) during two years of follow-up were in children with PbB > 15 µg/dL at the start. Lastly, houses in neighborhoods without lead in paint were associated with the lowest PbB in children (< 10 µg/dL).

### 4. Conclusions

Both studies show that significant reductions in dust lead levels and children's blood lead concentrations can be achieved and sustained over a period of years in older lead-painted houses through the implementation of various risk reduction interventions by trained workers. Such interventions are an important elements of lead poisoning control and prevention efforts.

### 5. References

- FARFEL, M. and CHISOLM, J Jr. (1990): Health and environmental outcomes of traditional and modified practices for abating residential lead-based paint. *Am J of Public Health* 80:1240-1245.
- FARFEL, M. et. al. (1994): The longer-term effectiveness of residential lead paint abatement. *Environmental Research*, 66:217-221.
- FARFEL, M. et. al. (1997): Lead paint abatement and repair & maintenance study: findings based on two years of follow-up. U.S. EPA, Washington, D.C., EPA 747-R97-005, December 1997.
- TLC TRIAL GROUP (1998): The treatment of lead-exposed children (TLC) trial: design and recruitment for a study of the effect of oral chelation on growth and development in toddlers. *Pediatric and Perinatal Epidemiology* 12:313-333.



DISTRIBUTION STATEMENT A  
Approved for Public Release  
Distribution Unlimited

100% QUALITY INSPECTED

20000616 026

W.W. Wenzel, D. S. Galloway, B. Allen, J. H. E. De Vries,  
C. Keller, N.W. Lepp, M. Wench, R. Narayan, G.M. Pierzynski  
(Editors)

100% QUALITY INSPECTED

**PROCEEDINGS OF EXTENDED ABSTRACTS**

**5<sup>th</sup> ICOBTE '99**

**5<sup>th</sup> International Conference  
on the  
Biogeochemistry of Trace Elements**

**July 11-15, 1999  
Vienna, Austria**



**Volume 2**

**Biogeochemistry, Distribution and  
Fractionation Of Trace Elements**  
(Technical Session 6)