

Lead Particulate Deposition from Housing Demolition

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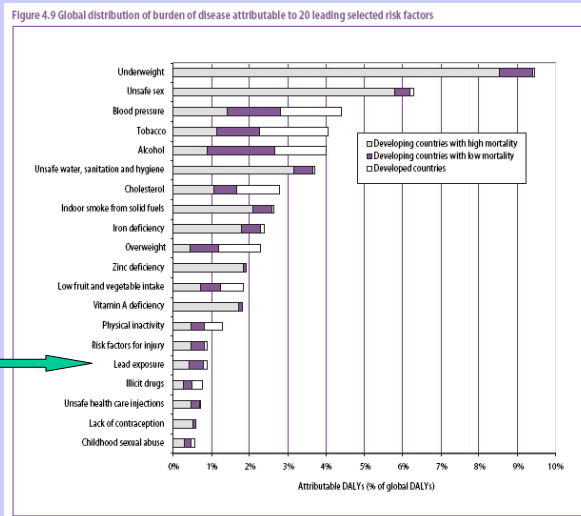
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Introduction

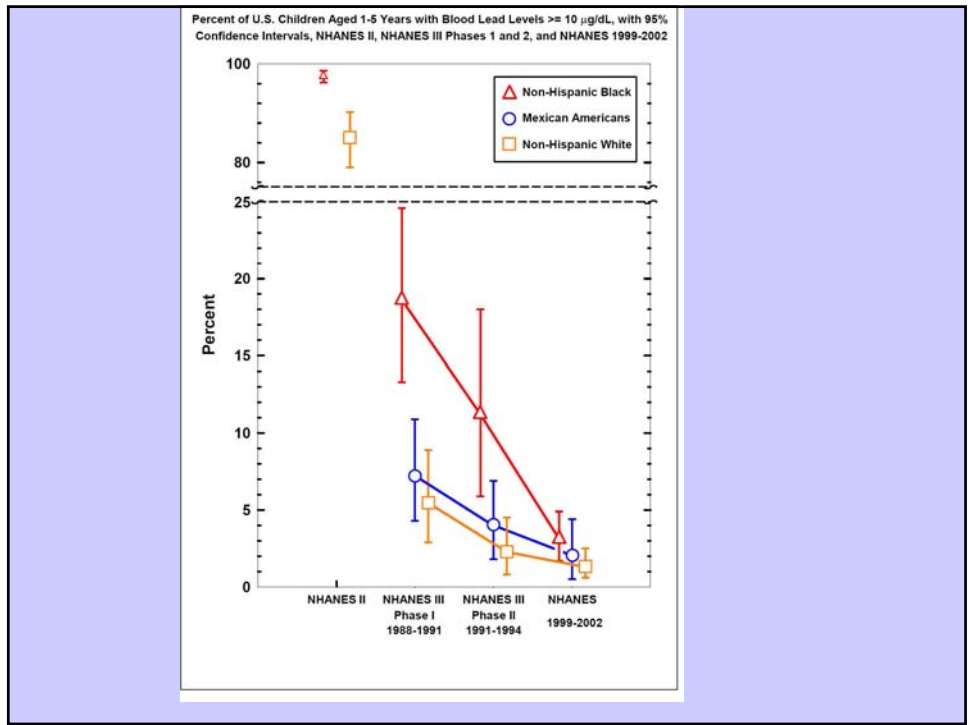
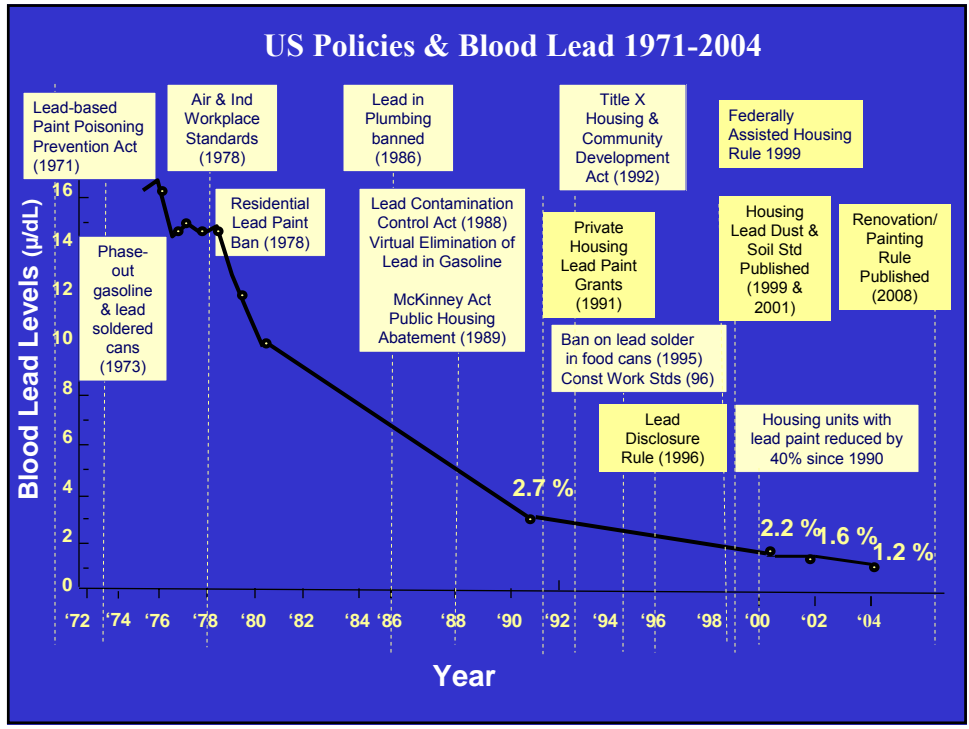
- Magnitude of remaining lead exposure
- Description of demolition studies in Baltimore (MF) and Chicago (SF) and methods
- New dust suppression methods in Baltimore
- Results of lead in air, soil, settled dust and dustfall measurements
- Implications for housing demolition work
- Conclusions

Global Distribution of Burden of Disease Lead = 16th in DALYs (WHO 2002)

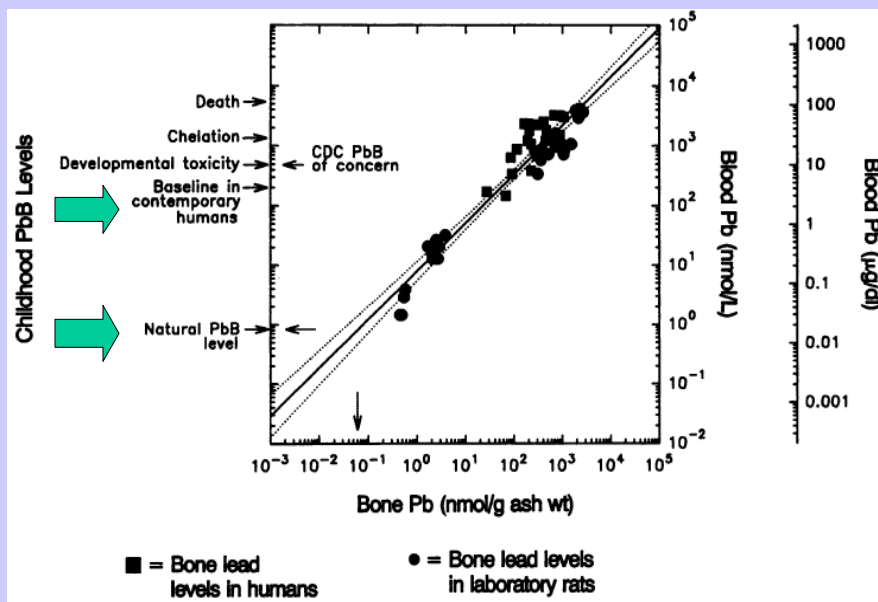


Existing Lead Standards

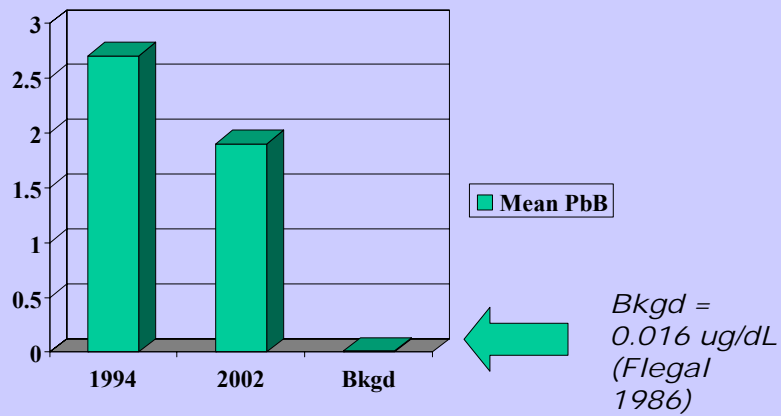
- Paint
- Interior Settled Dust
- Soil
- Water
- Dinnerware
- Exterior Airborne Dust
- None for Exterior Settled Dust or Demolition



Has the Lead Problem Already Been Solved?



US Childhood PbB Compared to “Natural” Background PbB



The Lead Experience

- A Public Health Success Story
- A “Pyrrhic Victory”
- Future Challenges are Large
 - How Large Are They?

Settled Dust Lead & Paint Lead

- Current definition of lead paint = 1 mg/cm²
- Sand a one square foot area into dust
- Spread the dust over a 10 ft x 10 ft room
- Resulting lead dust loading = 9,300 ug/ft²
- Current US Government Limit = 40 ug/ft²

How Much Lead Paint Is Left?

- 7.5 billion square feet interior
- 29.2 billion square feet exterior
- Total = **36.7 billion square feet**

- Implications for demolition and lead dust

Source: HUD National Survey of Lead and Allergens, 2000

Comparison of Baltimore and Chicago Sites

- **Total Structures in Baltimore Site**
 - Over 500 buildings in one area demolished/3 months
 - Typically 3 housing units/bldg
 - Avg age is pre-1910, likely to have lead paint
 - Lead in air, soil, ext. settled dust (wipe) and dustfall
- **Total Structures in Chicago Site**
 - 100 Scattered single family units/one to two days
 - Likely to have lead paint
 - Lead in dustfall, as well as particulate matter, silica, other metals, asbestos)

Summary of Baltimore and Chicago Demolition

	Housing Type	Decon-struction	Water Use	Containment
EBDI	Multiple Row Homes	Some	2-4 fire hoses	Jersey Barrier/ Covered Fencing
Chicago	Single Family Detached	None	None or irregular – 1hose	6 foot fence

Chicago



Chicago



Chicago (no dust suppression or site containment)



Chicago
(limited dust suppression)



Debris Removal Chicago (no dust suppression)



Chicago (note observer)



of demolitions occurring in Chicago

- Between 1996 and 2003, 12,236 demo permits issued: average of 1529/year
- In 2006, 4,500 demo permits issued for single-family homes and duplexes

McMillen, Daniel P., *Teardowns: Costs, Benefits, and Public Policy Land Lines*: July 2006, Volume 18, Number 3.

June 25, 2007 Press release from Urban Habitat Chicago, www.urbanhabitatchicago.org/projects/deconstruction-advocacy/UHC-deconstruction-press-reL.pdf and Delta Institute publication *Gaining Ground*, Vol 4, No 1, March 2009, <http://www.delta-institute.org/enewsletter/volume4/issue1/GainingGround4.1.2.php> accessed 4/24/09

Baltimore 2006 EBDI Site



Operations Protocol

Operations Protocol for Salvage, Deconstruction, Demolition and Site Preparation Activities

EBDI Demolition Protocols (1)

- Roles & Training in Lead Safe Work Practices
- Designation of Full Time Dust Suppression Manager
- Salvage and Deconstruction
- Community Organization Meetings & Notification
- Independent Advisory Panel
- Walk-off mats and HEPA vacuums for nearby residents
- Demolition, Debris Removal, Transport
- Landscaping, greening of lots, street and sidewalk cleaning
- Environmental Monitoring & Reporting

EBDI Demolition Protocols (2)

- Jersey Barriers
- Fencing with Poly
- Sediment control
- Fire Hoses
 - At least 2 hoses during active demolition
 - one above, one below
 - 1 hose used on debris when equipment is moving over it
 - 4 hoses on many occasions to reduce dust
- Deconstruction & salvage if feasible given structural soundness of buildings

EBDI Project Area



Dust Fall Measurement ($\mu\text{g Pb}/\text{m}^2/\text{hr}$) (APHA Method 502)



Study Description (continued)

- Compile weather information
- In subset of 20 sites, we sampled duplicates for particle size distribution, silica, asbestos, 39 metals with ICP-MS.



Jersey Barriers and Fencing Baltimore



Photo 16: Image taken at the 1700 block of E. Eager Street and 1000 block of McDonough Street intersection. View from south to the north.

Typical Chicago Sample locations



Community Involvement

- This study included both environmental data collection and interaction with community residents.
- In Chicago, staff from the Metropolitan Tenants Organization (MTO) interviewed community residents.
- In Baltimore, numerous community meetings to provide results

Lead Dustfall (as modified by Farfel et al.)



Data Collected in Both Cities

Variable	Chicago	Baltimore
Rain in 24 hours prior to demolition	X	X
Relative Humidity	X	X
Temperature	X	X
Pressure	X	X
Wind Speed	X	
Wind Direction	X	X
Use of a Hose	X	X
Presence of a Fence	X	X
Type of Demolition Activity	X	x
Type of Building Material	X	No variability (brick row homes)
Number of Elevations	X	No variability (3 stories)
Number of Dwellings	X	No variability
GPS Positions for Each Sample and for Unit	X	Fixed site locations
Type of Street	X	
Demolition Equipment used	X	x

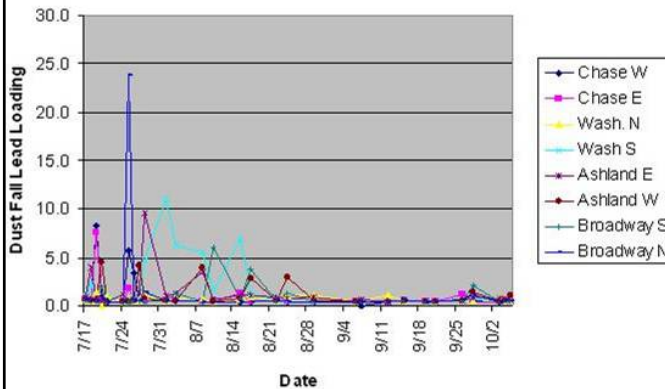
Baltimore Results - 1

Media	No. Samples	Geometric Mean	95% CI	Federal Standard
Airborne Lead During Demolition ($\mu\text{g}/\text{m}^3$)	239	<1.0 (all samples below detection)	--	1.5 (quarterly average)
Soil Lead Before Demolition ($\mu\text{g}/\text{g}$)	16 (matched)	449	(294, 686)	400 (play areas) 1200 (yard)
Soil Lead After Demolition ($\mu\text{g}/\text{g}$)	16 (matched)	166	(102, 269)	400 (play areas) 1200 (yard)

Baltimore Results - 2

Media	n	GM	95% CI	Fed Guidance
Settled PbD Before Demolition	12	74 $\mu\text{g}/\text{ft}^2$	(24, 233)	800 (troughs)
Exterior Settled PbD After Demo & Cleaning	12	44 $\mu\text{g}/\text{ft}^2$	(21, 90)	800 (troughs)
Ambient Dustfall Pb (1 mile away)	36	<5.71 $\mu\text{g}/\text{m}^2/\text{hr}$	---	None
Demolition Dustfall Pb	238	7.64 $\mu\text{g}/\text{m}^2/\text{hr}$	<5, 257	None

Lead in Dust Fall by Date and Sampling Site (Baltimore)



- Peak of 23.85 ug/m²/hr observed at Broadway North during a day when several houses collapsed.

Chicago Results Lead Dustfall

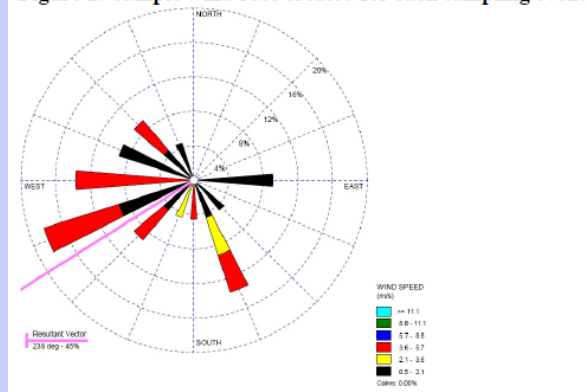
Measure	Type of Sample	N	GM	GSD	Min	Max	% below DL
Lead Dust Fall (µg/ft ² /hr)	Perimeter	261	6.23	8.79	0.0927	2,974.06	5.4
Lead Dust Fall (µg/ft ² /hr)	Non-Perimeter	158	2.13	8.37	0.0924	2,588.92	13.3
Lead Dust Fall (µg/ft ² /hr)	Street-level background at demo	44	0.33	3.12	0.0922	13.92	38.6
Lead Dust Fall (µg/ft ² /hr)	Street-level background non-demo	28	0.18	3.46	0.0231	4.20	21.4
Lead Dust Fall (µg/ft ² /hr)	Rooftop background non-demo	36	0.09	2.43	0.0229	0.67	30.6

Chicago Results (% Lead in Dustfall)

Measure	Type of Sample	N	GM	GSD	Min	Max	% below DL
% Lead in Dust	Perimeter	258	0.28	5.95	0.0004	15.71	5.0
% Lead in Dust	Non-Perimeter	155	0.19	4.82	0.0005	8.00	12.9
% Lead in Dust	Street-level background at demo	43	0.05	8.94	0.0003	4.30	39.5
% Lead in Dust	Street-level background non-demo	28	0.13	3.52	0.0088	4.27	21.4
% Lead in Dust	Rooftop background non-demo	34	0.03	3.26	0.0021	0.19	26.5

Wind in the Windy City

Figure 1: Sample wind rose created for each sampling event



Wind Direction

Table 6: Wind direction and lead dustfall

Type of Sample	Level	# Samples	GM Lead Dust Fall	P-value
(1) Perimeter at demo	0. Downwind <5%	135	4.5279	0.010
	1. Downwind 5-50%	46	10.0284	.
	2. Downwind >50%	80	9.2921	.
(2) Non-Perimeter at demo	0. Downwind <5%	87	1.4872	0.010
	1. Downwind 5-50%	34	3.5457	.
	2. Downwind >50%	37	3.6193	.

Chicago Variables Associated with Lead Dustfall ($p < 0.05$)

- Painted primary exterior surface;
- Presence of a garage to demolish;
- Whether a water hose was present for dust suppression;
- Whether the housing was primarily residential vs mixed commercial and residential; and,
- Whether the samples were downwind of the demolition site

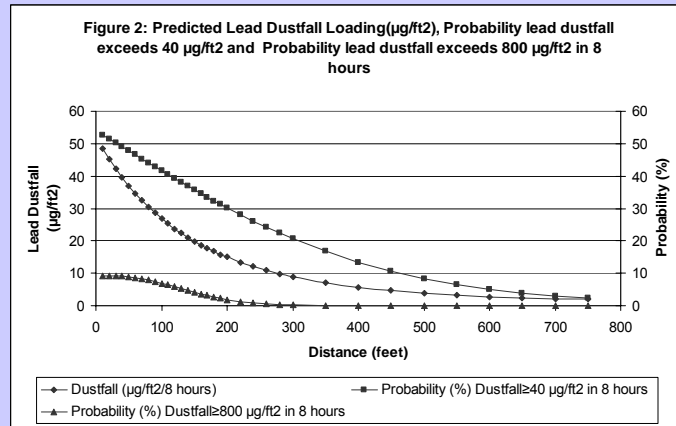
Non-Significant Variables

- Whether the secondary exterior surface was painted;
- Whether the exterior was brick or stone;
- Whether the day's activity consisted primarily of razing the building vs debris removal;
- Whether a fence was present;
- Whether the ground was saturated and whether the demolition was on a main street or a side street.

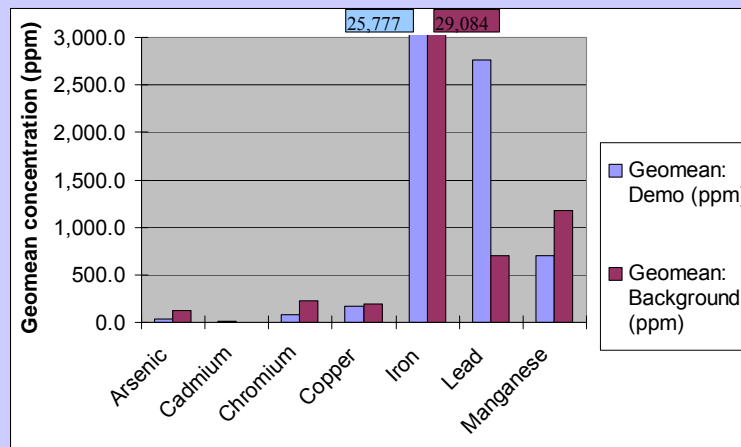
Dustfall Reliability Assessed with Side-By-Side Duplicates

- Reliability is the degree to which a measurement can be replicated
- Values range from 0 (worst) to 1 (best).
- Reliability for lead dust fall = 0.96.
- However, the reliability for total dustfall and percent lead in dust are much lower (0.81 and 0.59, respectively).

Probability of Exceeding Interior Floor PbD (40 $\mu\text{g}/\text{ft}^2$) and Exterior PbD Guidance (800 $\mu\text{g}/\text{ft}^2$) After 8 hrs



Comparison of Lead & Other Metals (Dustfall)



Comparison of Baltimore and Chicago Pb Dustfall & Percent

Measure	Site	N	% Below DL	GM	GSD	25 th percentile	50 th percentile	75 th percentile
Lead Dustfall (µg/ft ² /hr)	Baltimore	238	66%	0.25	3.57	1.28	2.01	4.49
	Chicago	261	5%	6.01	4.47	2.76	9.48	35.98
Percent Lead (%)	Baltimore	226	65%	0.25	3.54	0.23	1.21	2.85
	Chicago	258	5%	5.94	4.49	0.17	0.47	1.41

Baltimore and Chicago Using Max Samples only at Each Site

Table 21: Descriptive Statistics Using Maximum Lead Dustfall Samples (µg/ft²/hr)

<i>Site</i>	<i>N</i>	<i>% Below DL</i>	<i>GM</i>	<i>GSD</i>	<i>25th percentile</i>	<i>50th percentile</i>	<i>75th percentile</i>
Baltimore	30	13%	1.95	3.03	1.65	4.11	6.64
Chicago	87	1%	25.88	4.07	6.75	24.56	82.50

Notes: DL = Detection Limit, GM = Geometric Mean, GSD = Geometric Standard Deviation

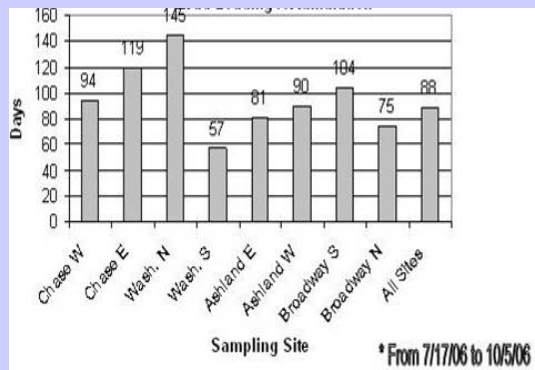
Background Lead Dustfall About Twice as High in Chicago

Site	N	% Below DL	GM	GSD	25 th percentile	50 th percentile	75 th percentile
Baltimore	36	97%	0.34	1.55	-	-	-
Chicago	28	21%	0.15	3.22	0.11	0.31	0.50

Exterior Pb Dustfall Standard?

- Currently does not exist
- Existing exterior dust lead cleanup standard from US Dept of Housing & Urban Development =
800 ug/ft²
- Assume 1 hour = 8,600 ug Pb/m²/hr
- Assume no loss to wind, rain, re-entrainment
- Estimate number of days of demolition that would be required to exceed the HUD guideline

Days of Demolition for Dust Fall Lead Loading to Reach HUD Standard (Baltimore)



- For Chase West it would take 94 days of full time eight hour a day demolition to reach $800 \mu\text{g}/\text{ft}^2$
- For Broadway North it would take 75 days of continuous demolition eight hours per day to exceed $800 \mu\text{g}/\text{ft}^2$

Days of Demolition for Dust Fall Lead Loading to Reach HUD Guidance Level ($800 \mu\text{g}/\text{ft}^2$) in Chicago

- Max dustfall lead = $32,000 \mu\text{g Pb}/\text{m}^2/\text{hr}$
- 1 hour std = $8,600 \mu\text{g Pb}/\text{m}^2/\text{hr}$
- Standard would be exceeded in only **16 minutes** of demolition activity
- Occupied houses in Chicago are within 3-5 meters of demolition



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The lead content of currently available new residential paint in several Asian countries[☆]

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New Lead Paint Production

Table 1
Lead Concentration (ppm) in new household paints by country (analyses by atomic absorption)

Country	Number of paint samples	Median (ppm)	Maximum (ppm)	% (No.) Paints ≥ 600 ppm
China	9	3280	73,400	56 (5)
India	17	16,720	187,200	100 (17)
Malaysia	32	21,300	143,000	72 (23)
China, India, and Malaysia combined	58	17,570	187,200	78 (45)
Singapore	22	9	3500	9 (2)



- **Calling for a Global Ban on Lead Use in Residential Indoor and Outdoor Paints, Children's Products, and All Nonessential Uses in Consumer Products**
- **Policy Date: 11/5/2007**
Policy Number: LB-07-01

Future Challenges

- Non-essential uses of lead continue to proliferate
- Primary Prevention is essential, but reactive approach still dominates
- Recalls are ineffective
- Need to address both legacy sources and emerging exposures

Recommendations

- Notification- Everyone within 400 feet of a single family housing demolition should be notified, not just the immediate neighbors.
- The notification should include expected dates of the demolition and information on lead poisoning and things that residents can do to ameliorate the impact of the lead dust on their families.
- Post a sign on the property starting the day before the demolition. The sign should inform passer-bys of the demolition.
- Special consideration for child-care facilities, parks and schools.
- Increase use of water to suppress the dust
- Standards should be set to ensure that dust suppression with adequate water is being used.
- Following demolition, streets and sidewalks should be cleaned.

Conclusions

- Large amounts of lead-contaminated dust are generated from housing demolition
- It can be controlled using simple dust suppression to protect the public health.
- Dustfall lead loadings were significantly higher in Chicago than Baltimore.
- Although Baltimore was a bigger demolition project, more extensive dust suppression techniques were effective.

Conclusion

- The Lead Experience:
- One of the Best Public Health Success Stories, but
- Primary Prevention Remains a Large Challenge
- Dust from Housing Demolition Requires Control

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