Childhood Lead Poisoning

Nancy K. Van Voorhis, MPH
Healthy Homes Specialist (NEHA) (NCHH)
Director, Lead-Safe Virginia
Data

- A national survey found that lead exposure disproportionately affects children:
  - living in housing built before 1946,
  - from low-income families,
  - and of African-American and Hispanic origin

- In 2011, PHPC health center programs tested 4,453 children for lead.

Resources
Lead Prevention Tips
LeadFreeKids.org
Data

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Objectives

- Lead and its history
- Sources of lead exposure
- Medical diagnosis
- Effects from lead exposure
- Follow up
- Statistics
Physical Properties

• Silvery-gray soft and malleable metal
• Atomic # 82
• Low melting point (327° C/ 621° F)
• Metallic lead is insoluble in water
• In compounds, lead is in valence states of +2 and +4
Physical Properties

• Inorganic lead compounds are used as pigments
• Organic lead compounds also exist: tetramethyl and tetraethyl utilized as gasoline additives
• Insoluble in water, but soluble in solvents
• Lead complexes with ligands containing sulfur, oxygen, or nitrogen as electron donors
Lead Compounds

Lead arsenate $\text{Pb}_3 (\text{AsO}_4)_2$
Insecticide
Lead Compounds

Lead Acetate

\[ \text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \]

Called “sugar of lead” and was used as an artificial sweetener for Roman wine, used today in some hair coloring dyes/imported makeup.
Lead Compounds

Lead azide  \( \text{Pb}(N_3)_2 \)
Cartridge primers, primer cord for explosives
Lead Compounds

Lead chromate $\text{PbCrO}_4$ paint pigment (chrome yellow) and $2\text{PbCO}_3\cdot\text{Pb(OH)}_2$ (lead white)
Lead Compounds

Lead oxide $\text{Pb}_3 \text{O}_4$ paint pigment (red lead) used as primer for rust protection on metal, especially bridges and hulls of ships
Lead Compounds

Lead oxide in wrapper contaminating candy from Mexico
Lead Compounds

Lead silicate PbSiO$_3$
Glazes for china, porcelain, tiles
Lead Compounds

• **Galena** is the natural mineral form lead sulfide, PbS. It is the most important lead ore mineral.
Lead Compounds

Tetraethyl lead Pb(C₂H₅)₄
Antiknock additive to gasoline
History

- 6200 BC – lead artifacts in Turkey
- 2000 BC – lead mines established by Phoenicians in Spain
- 1000 BC - Romans – pipes, cooking, glazes
- 1400s - printing presses
- 1786 - Benjamin Franklin “dry gripes” abdominal colic; “dangles” – wrist drop
- “gripes” – rum distillation
An Excerpt from: (original capitalization and spelling)

**Famous Benjamin Franklin Letter on Lead Poisoning**

**Phila July 31, 1786 (To Benjamin Vaughan)**

**Dear Friend,**

I recollect that when I had the great Pleasure of seeing you at Southampton, now a 12 month since, we had some Conversation on the bad Effects of Lead taken inwardly; and that at your Request I promis'd to send you in writing a particular Account of several Facts I then mention'd to you, of which you thought some good Use might be made. I now sit down to fulfil that Promise.

The first Thing I remember of this kind, was a general discourse in Boston when I was a Boy, of a Complaint from North Carolina against New England Rum, that it poison'd their People, giving them the Dry Bellyach, with a Loss of the Use of their Limbs. The Distilleries being examin'd on the Occasion, it was found that several of them used leaden Still-heads and Worms, and the Physicians were of the Opinion that the Mischief was occasion'd by that Use of Lead. The Legislature of the Massachusetts thereupon pass'd an Act prohibiting under severe Penalties the Use of such Still-heads & Worms thereafter. Inclos'd I send you a Copy of the Act, taken from my printed Law book......

**Yours most affectionately**

B. Franklin
History

Painter’s palsy
“dangles”
History

• 1800s - Lead acetate “sugar of lead” used medicinally to control diarrhea and bleeding
• 1897 – childhood plumbism recognized in Brisbane, Australia due to lead-paint and it was banned in 1914
• 1917 – childhood plumbism recognized in U.S.
• 1943 – Byers & Lord published in *American Journal of Diseases of Children* regarding the effects of lead on mental development
• 1960’s – CDC defined lead poisoning with levels > 60 μg/dl
Lead in Roman Skeleton on a Lead Pipe
Sources of Lead Exposure

Industrial

Domestic
Sources of Lead Exposure

INDUSTRIAL

- Smelters
- Batteries Radiators
- Ship/Bridge Repair
- Welders
- Printers
- Stained Glass
- Jewelers
- Plumbers
- Renovators and Recyclers
Sources of Lead Exposure

DOMESTIC

- House Paint (<1940, 1977)
- Contaminated Soil
- Vinyl Blinds
- Folk Medicine
- Lead-Glazed Pottery,
- Lead Crystal
- Lead Weights and Sinkers
- Buckshot
- Projectiles

- Moonshine
- Parent’s Work Clothing
- Curtain/Fishing Weights
- Solder
- Imported Jewelry, Makeup, Toys
Sources of Lead Exposure

- Imported toys and jewelry, key chains
- Antique toys
Sources of Lead Exposure

- Litargirio: antiperspirant
- Kohl
- Folk remedies
Sources of Lead Exposure

- Dusting, flaking and peeling lead paint is the leading source of lead poisoning in children.
- Lead was used in many paints until it was banned for household use in 1978.
- Homes built before 1978 may contain lead paint.
## Sources of Lead Exposure

- **Age of Housing Matters:**

<table>
<thead>
<tr>
<th>Year House Built</th>
<th>Percent of Houses with Lead-Based Paint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 1940</td>
<td>87%</td>
</tr>
<tr>
<td>1940-1959</td>
<td>69%</td>
</tr>
<tr>
<td>1960-1978</td>
<td>24%</td>
</tr>
<tr>
<td>All US Housing Stock</td>
<td>40%</td>
</tr>
</tbody>
</table>

National Center for Healthy Housing
Sources of Lead Exposure

- Homes built prior to 1978 may have flaking or peeling lead paint. Such homes may also contain *lead dust, which is impossible to see*.
- Lead dust forms as the paint ages and deteriorates, and then settles on the floor and other surfaces all over the house.
- Dust also forms when lead painted surfaces are routinely rubbed and scraped, as in a door or window frame, or during home renovation projects.
- Sanding lead-painted surfaces can produce significant quantities of lead dust.
EPA Home Danger Zone Finder

What to Look for:

If your house or apartment was built before 1978, chances are it contains lead-based paint. The older the building, the more likely it will contain lead-based paint.
Outside

Doors:
Lead based paint was often used in these areas. Check doors and hinges because dust from lead-based paint can be created where painted surfaces rub together when you open and close doors.

Windows:
Check windows, as dust and peeling paint from lead-based paint can be created and build up where painted surfaces rub together, like when you open and close your windows.
Outside

Fences and Porches:
Lead based paint was often used in these areas. Look for chipping or peeling paint that could get into the soil where your children play.

Soil:
When exterior lead-based paint from houses or buildings flakes or peels it can get into the soil around your home. Lead dust can also be tracked into the home from the soil outside. Soil can also be contaminated from lead sources outside the home including lead in gasoline, industrials sites and mining activity. Lead dust can also be tracked into the home from the soil outside. Teach your family to wipe their shoes and keep them by the front door.
Inside

Windows:
Check the windowsills, throughout your home. Dust from lead-based paint can be created and accumulate where painted surfaces rub together, like when you open and close your windows.

Vinyl Mini-Blinds:
Some imported, non-glossy vinyl mini-blinds can be a lead hazard. Sunlight and heat can break down the blinds and may release lead-contaminated dust.
Inside

**Water:**
Water lines and plumbing. Check to see if you have plumbing with lead or lead solder and if your water utility uses lead service lines. Remember, you cannot see, smell or taste lead. Boiling your water will not get rid of lead and can increase the lead concentration in the water.
Diagnosis of Lead Exposure

• At the levels we see today, there usually are no outward symptoms.
• A blood test is the best way to determine lead exposure.
• X-rays are indicated if there is a possibility the child ingested an object.
• Lead stays in the blood after exposure for about 30-45 days (half-life of the red blood cell).
• Children are like sponges and absorb lead very easy. Lead is stored in soft tissues and bones.
• Lead crosses the undeveloped brain barrier to cause neurological damage.
Medical Diagnosis

• Symptoms in children can include:
  – Abdominal pain
  – Nausea and vomiting, leading to noticeable weight loss
  – Irritable with signs of fatigue
  – Headaches
  – Numbness, tingling, weakness or pain in the arms and legs.
Effects of Lead Exposure

- Lead interferes with the normal enzyme reactions within the human body. Lead actually mimics the properties of other metals that are essential to biological functioning.
- However, lead does not work the same way as those metals; the enzymatic reactions that depend on calcium, iron, and zinc are disrupted.
- The most damaging enzymatic reaction that lead affects is the production of hemoglobin, or red blood cell production, which can cause anemia.
Medical Diagnosis

New York State Dept. of Health
Medical Diagnosis

Lead line at gums

Lead particles
Medical Diagnosis

- Swallowed musket ball
- Lead particles from shotgun blast
Medical Diagnosis

Lead Sinker
Effects of Lead Exposure

- Lead is deposited in bones, teeth, and especially in children, the soft tissues.
- It can be removed from the body by excretion through the kidneys and urine, but it is a very slow process.
- Lead can cross the placenta during pregnancy.
Follow up

• Chelation therapy may be used at high levels
  – Must be performed in a hospital setting
  – No long term benefit; however may be needed to reduce immediate risk for coma etc.

• Good nutrition with diet high in iron, calcium, and low in fat
  – Reduces the absorption of lead
Follow up

• Education as tool to prevent continued environmental exposure
  – Remove child from the environment until remediation/abatement is completed with clearance testing
  – Advise family to wash child’s toys, pacifiers, and hands frequently
  – Remove shoes when entering house
  – Wet wipe window sills, floors
  – Use HEPA vacuum to clean, no dry sweeping
## CDC Recommended Follow up

<table>
<thead>
<tr>
<th>If result of capillary test is (µg/dL)</th>
<th>Perform confirmatory test within</th>
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<tbody>
<tr>
<td>Under 10</td>
<td>1-3 months</td>
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<tr>
<td>10 - 44</td>
<td>1 week - 1 month (the higher the screening test, the sooner the confirmatory test shall be performed)</td>
</tr>
<tr>
<td>45 - 59</td>
<td>48 hours</td>
</tr>
<tr>
<td>60 - 69</td>
<td>24 hours</td>
</tr>
<tr>
<td>≥ 70</td>
<td>Immediately as an emergency test</td>
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Follow up

Environmental Investigation

• Venous Confirmed EBLLs ≥ 20 μg/dL
• Persistent or rising venous 15-19 μg/dL
VIRGINIA: Number of Confirmed Elevated Blood Lead Levels ≥ 10 ug/dL, by Age Category (Months), 2011
Lead in children ages 1 to 5 years: Median and 95th percentile concentrations in blood, 1976-2010

Data: Centers for Disease Control and Prevention, National Center for Health Statistics and National Center for Environmental Health, National Health and Nutrition Examination Survey

America’s Children and the Environment, Third Edition
Statistics

Lead in children ages 1 to 5 years: Median concentrations in blood, by race/ethnicity and family income, 2007-2010

Data: Centers for Disease Control and Prevention, National Center for Health Statistics and National Center for Environmental Health, National Health and Nutrition Examination Survey America’s Children and the Environment, Third Edition
Q&A

• If you would like to ask the presenter a question please submit it through the questions box on your control panel.

• If you are dialed in through your telephone and would like to verbally ask the presenter a question, use the “raise hand” icon on your control panel and your line will be unmuted.
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