Lead–Safe Virginia Program

Nancy K Van Voorhis, MPH
Healthy Homes Specialist (NEHA, NHHA)
Objectives

- Distinguish various lead compounds
- Discuss historical perspectives
- Review potential sources of lead exposure
- Discuss epidemiology of lead poisoning in Virginia
- Provide additional resources of information
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 & +4
- 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 Pb₃(AsO₄)₂
Insecticide
Lead Compounds

Lead Acetate
Pb(C$_2$H$_3$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  \( \text{Pb}(\text{N}_3)_2 \)
Cartridge primers, primer cord for explosives
Lead Compounds

Lead chromate PbCrO$_4$ paint pigment (chrome yellow) and 2PbCO$_3$ · Pb(OH)$_2$ (lead white)
Lead Compounds

Lead oxide Pb₃ O₄ 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

The Roman techniques of glazing were most likely discovered sometime in the first century B.C. However, it is important to note that lead glazing holds a long history in the ancient world which spans far before Roman times. After the Roman period, the tradition spread and eventually the process became a practice for mass produced ceramics.
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
- 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
An Excerpt from: (original capitalization and spelling)
The 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”
Sources of Lead Exposure

- Smelters
- Batteries Radiators
- Ship/Bridge Repair
- Welders
- Printers
- Stained Glass
- Jewelers
- Plumbers
- Renovators and Recyclers
- House Paint (<1940, 1977)
- Contaminated Soil
- Vinyl Blinds
- Folk Medicine
- Lead-Glazed Pottery
- Target Shooting
- Moonshine
- Parent’s Work Clothing
- Curtain/Fishing Weights
- Solder

Industrial

Domestic
Sources of Lead Exposure

- Solder (do-it-yourself plumbing, food canning, crafting homemade fishing tackle, and fabricating grain alcohol stills)
- Radiation shields (dental offices)
- Non-residential outdoor paints: cars, highway, bridge, and marine
- Stabilizers in production of plastics, glazes, crystal
- Explosives, ammunition such as lead bullets and buckshot
- Batteries—80% of battery lead is recycled, can contaminate soil
Lead weights/sinkers (i.e. fishing, curtain) are small and smooth and easily swallowed by curious children.

Curious young children will readily swallow projectiles.

Buckshot (small balls of lead used by hunters) may remain in cooked game and be unintentionally eaten.

Also, lead from projectiles that remain lodged in the acidic synovial fluid of joints or in the cerebral spinal fluid (CSF) can be absorbed into the blood.
Sources of Lead Exposure

- Litargirio: antiperspirant

- Folk remedies: products with lead include Azarcon, Alarcon, Coral, Pay-loo-ah, and Greta. The product is likely a capsule, or an orange or yellow powder, which is ingested.

- Kohl usually contains ground galena, a metallic mineral and source of lead. Some cultures also put kohl on the umbilical stump of newborns, or decorate the eyes and faces of children.

- Imported toys and jewelry, key chains
- Antique toys
- Mexican candy: wrapper but also most high-lead candy has one ingredient in common: chili powder. Tests on chili powder intended for Mexican candy production have found very high levels of lead.
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.

Lead paint can also be found on old playground equipment and on old painted toys and furniture.

You cannot tell just from looking whether or not paint contains lead.
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.
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 things like 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 Issues

- Lead stays in the body for a long time once it has been absorbed, inhaled, or ingested.
- Lead is deposited in our 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.
- Chelation therapy may be used at high levels.
Medical Issues

- At the levels we see today, there usually are no outward symptoms.
- A blood test is the best way to determine lead exposure.
- 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 crosses the undeveloped brain barrier to cause neurological damage.
Basophilic stippling are visual particles in stained red blood cells that are actually precipitated ribosomal protein (RNA) and are often seen in lead poisoning and some anemias.
Medical Issues

Lead line at gums
The picture at right demonstrates a child who swallowed a large leaded sinker (below) which became retained in the stomach. His lead level was markedly elevated within 24 hours.
Lead Exposure Follow up

- Venous Confirmed EBLLs \( \geq 20 \) µg/dL or persistent or rising 15–19 µg/dL need:

  1. Nursing assessment to identify other sources of exposure, child’s behavior, and determine age of housing.
  2. Then an environmental investigation or risk assessment will be performed on all addresses where the child spends a significant amount of time.
  3. Risk assessments are performed only on “target housing”, which is defined as built before 1978.
  4. If the house is not target housing or is a trailer, then an environmental investigation is performed which includes water, soil near identified hazards such as old car batteries, vinyl mini-blinds, antique toys, spices, home remedies etc. These samples can also be collected during a risk assessment if the nursing assessment shows risk.
INCIDENCE
VIRGINIA, CHILDREN UNDER 6 YEARS OF AGE, 2010 REPORTED ELEVATED BLOOD LEAD LEVELS

Note: Data are confirmed elevated blood lead levels of >=10 ug/dL. Only children determined to be at risk are required to be tested for lead poisoning.
Blood lead levels ≥10 µg/dL, by age category, by year: Virginia

- < 36 months
- < 72 months
Number of children < 72 months of age with reported confirmed elevated blood lead levels ≥ 10 µg/dL, by age category: Virginia, 2011
<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
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</thead>
<tbody>
<tr>
<td><strong>Number Performed</strong></td>
<td>44</td>
<td>49</td>
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<tr>
<td>Number of “newcomer/refugee” children with EBLL requiring an investigation</td>
<td>1</td>
<td>0</td>
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<tr>
<td>Lead dust hazard on floors</td>
<td>24</td>
<td>19</td>
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<tr>
<td>Lead dust hazard on window sills</td>
<td>25</td>
<td>18</td>
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<tr>
<td>Lead dust hazard on other housing components (porch post, etc.)</td>
<td>10</td>
<td>5</td>
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<tr>
<td>Deteriorated lead based paint on interior surfaces</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>Deteriorated lead based paint on exterior surfaces</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td>Soil lead hazards identified (children’s play area)</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Soil lead hazards identified (non play areas)</td>
<td>4</td>
<td>8</td>
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<tr>
<td>Lead in water above 15 ppb: plumbing or well</td>
<td>1</td>
<td>0</td>
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<tr>
<td>Lead from deteriorated items such as mini blinds, bathtubs, antique furniture</td>
<td>6</td>
<td>2</td>
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<tr>
<td>Other (keys, dishes, pottery, pots, jewelry, batteries, toys, misc.)</td>
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<td>7</td>
</tr>
<tr>
<td>Kohl and/or Surma (eye-liner)</td>
<td>1</td>
<td>0</td>
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<tr>
<td>Home remedies</td>
<td>1</td>
<td>0</td>
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<tr>
<td>Occupational exposure from parent or caregiver</td>
<td>4</td>
<td>2</td>
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