

Environmental Medicine Grand Rounds

# Lead Toxicity



# Lead

## Medical Grand Rounds Seminar

CS109909-3



**ATSDR**  
AGENCY FOR TOXIC SUBSTANCES  
AND DISEASE REGISTRY

# Learning Objectives

- **Explain what lead is**
- **Identify where lead is most commonly found in the United States today**
- **Identify the most important routes of exposure to lead**
- **Identify the populations most heavily exposed to lead**
- **State the CDC's level of concern for lead in children's blood and recommendations for screening**
- **State the OSHA level for intervention for occupational exposure to lead**



# Learning Objectives (cont'd)

- Describe the way lead is taken up, distributed, and stored throughout the body
- Describe at least three major physiologic effects of lead
- Name three symptoms of mild lead toxicity
- Name three symptoms of acute lead toxicity
- Name the most useful test for lead toxicity



# Learning Objectives (cont'd)

- **List three steps that should be take at blood lead levels between 10 and 19 mcg/dL**
- **Describe additional steps that should be take for BLL 20-44 mcg/dL, 45-69 mcg/dL and 70 mcg/dL and above**
- **List steps patients with domestic exposures can take to reduce lead exposure**
- **List steps patients with occupational exposures should take**



# What is Lead?

- **Soft blue-gray metal**
- **Found in the natural environment**
- **Was added to paint and gasoline in past**
- **Still used in consumer products**



*the natural ore galena*



# How Does Lead Get Into the Environment?

- **Deterioration of lead-based paint**
- **Leaded gasoline**
- **Businesses that involve lead**
- **Lead mines or smelters**



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# How Are People Exposed to Lead?

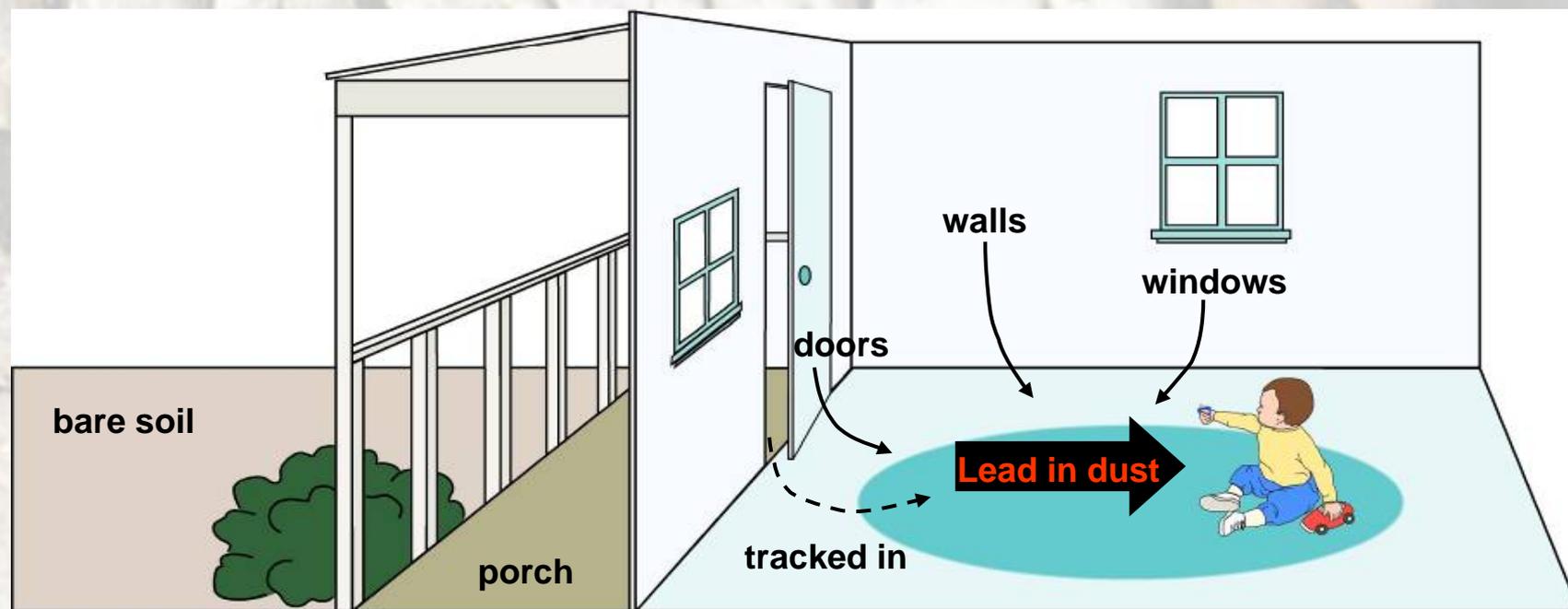
- **Dust, paint, and/or soil**
- **Contaminated food, water, or alcohol**
- **Some imported home remedies and cosmetics**
- **Endogenous exposure**



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# Lead in Home Environments



- Pre-1978 homes with deteriorated leaded paint
- Children at greatest risk
- Most exposure through leaded dust in home
- Lead dust levels have been directly correlated with children's BLL

# How Are People Exposed to Lead in Work Environments?

- **Swallowing lead dust**
- **Breathing contaminated air**
- **Lead contacting skin**
- **Workers can expose their families if they bring lead home on their clothes or skin**

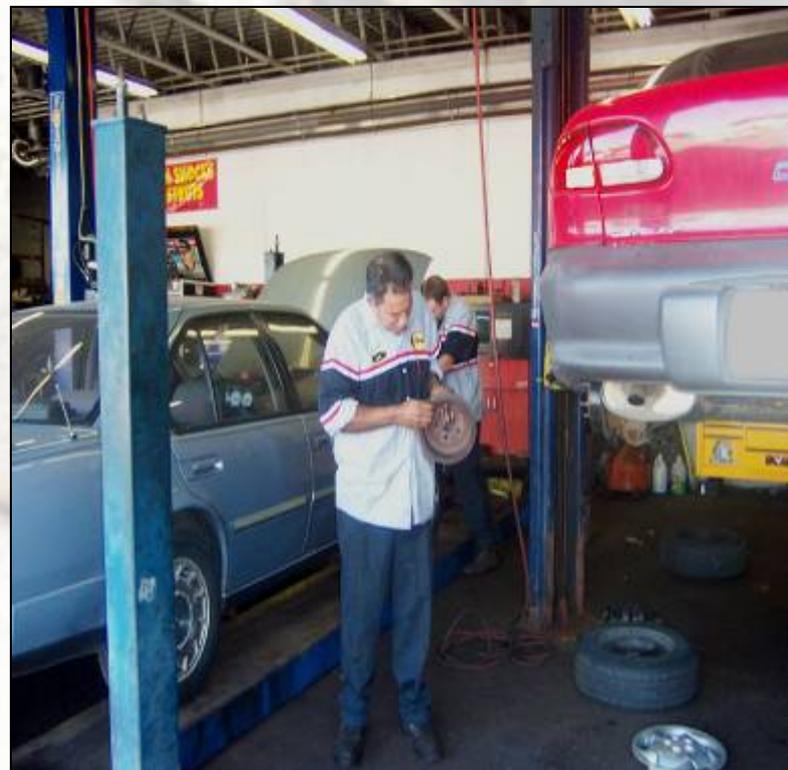


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# What Jobs Involve Lead?

- **Lead smelting or mining**
- **Construction/remodeling**
- **Automobile repair**
- **Plumbing**
- **Police officers/military**
- **Many others**



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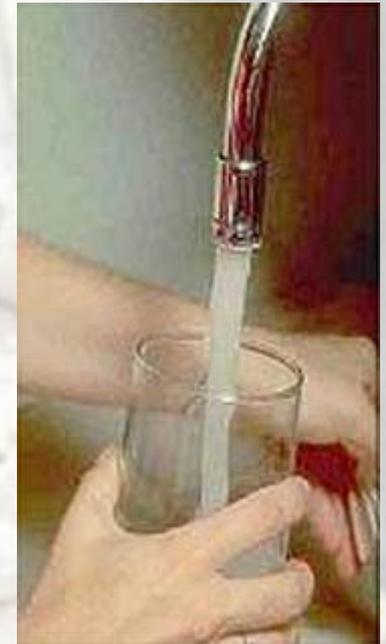
# What Hobbies Involve Lead?

- **Car repair**
- **Artistic painting**
- **Stained glass**
- **Pottery glazing**
- **Soldering**
- **Target shooting**
- **Making bullets, slugs or fishing sinkers**



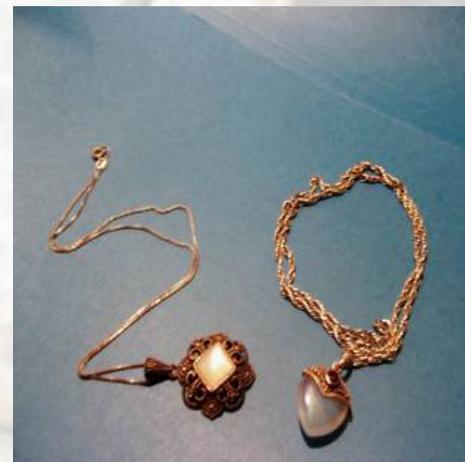
# Lead in Drinking Water

- **Lead can enter water by leaching from**
  - **Lead-containing pipes**
  - **Brass faucets**
  - **Solder**
- **Boiling does not get rid of lead**
- **Running cold water before use may reduce exposure**



# Lead in Commercial Products

- **Lead is still used in products such as:**
  - Bridge paint
  - Computers
  - Solder
  - Pewter
  - Ceramic glazes
  - Jewelry
  - Automotive batteries
- **Imported or older pre-regulation products**



# Lead in Food Products

- **Food or beverages may be contaminated through**
  - **Production**
  - **Packaging**
  - **Storage**



# Lead in Ethnic Products

- **Mexican:** azarcon, greta, liga, Maria Luisa, alarcon, coral, rueda
- **Asian:** chuifong, tokuwan, ghasard, bali goli, kandu, surma, ba-baw-san
- **Middle Eastern:** alkohl, saoott, cebagin
- **For more examples, see Appendix 1 of:**  
<http://www.cdc.gov/nceh/lead/CaseManagement>



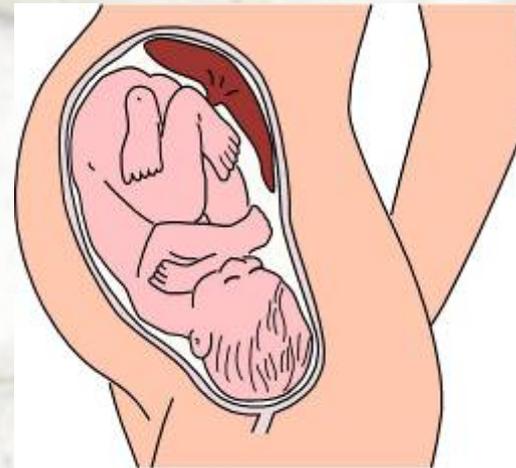
# Lead in the Environment

- **Varies from place to place**
- **Soil near roadways (pre-1976 gasoline)**
- **Elevated in soil, water, or air near lead mining or smelting facilities**
- **Near smaller businesses and industries that involve lead**



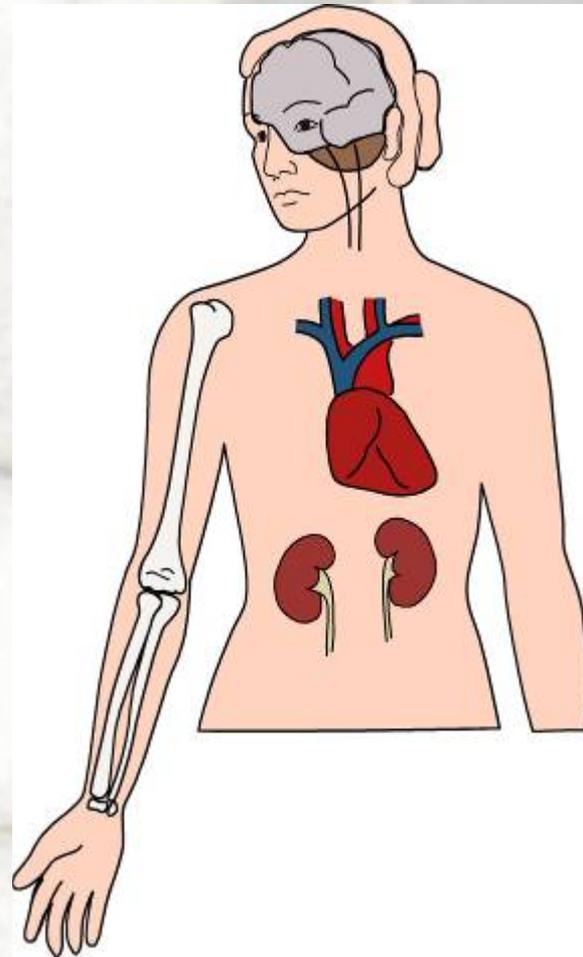
# Who is Most at Risk of Lead Exposure?

- **Children living in older housing**
- **Pregnant women and developing fetus**



# Biologic Fate

- **Most lead is excreted**
- **Children and pregnant women absorb more lead than others**
- **Exchanged between blood, soft tissues, and mineralizing tissues**



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# Physiologic Effects of lead

- **No known threshold for effects of lead**
- **Affects all organ systems**
- **Developmental neurologic effects of greatest concern**



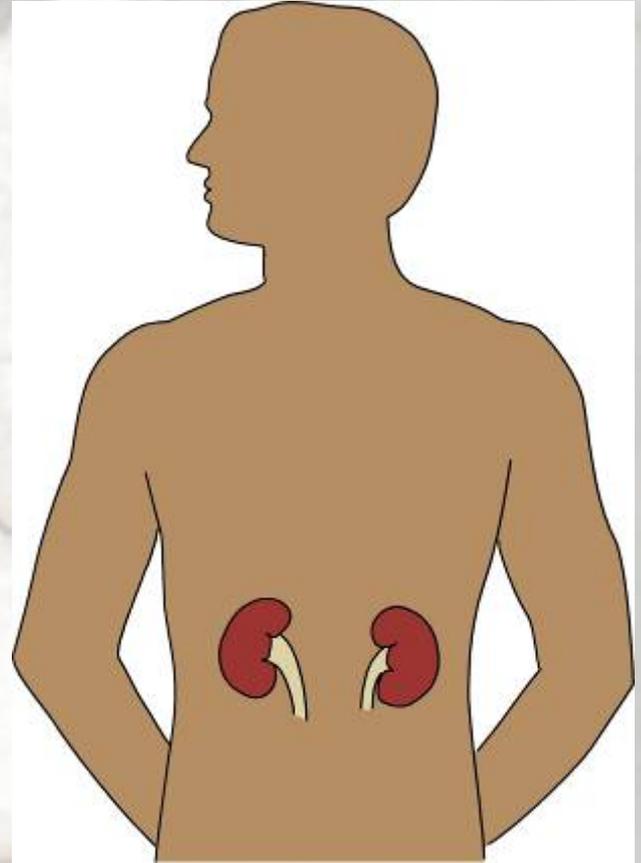
# Neurologic Effects of Lead

- Neurologic effects on children documented at levels below 10 mcg/dL
- Low exposure effects: lowered IQ, attention deficits, and impaired hearing
- High exposure effects: irritability, convulsions, coma, or death
- Similar effects in adults at higher exposure levels



# Renal Effects of Lead

- **Acute exposure:**  
reversible effects
- **Chronic exposure:**  
nephropathy (chronic interstitial nephritis)
- **Childhood exposures** →  
adult renal disease



# Hematologic Effects of Lead

- **Interferes with production of hemoglobin**
- **Can induce two kinds of anemia:**
  - **Acute exposure → hemolytic**
  - **Chronic exposure → synthetic**
- **Threshold for adults: 50 mcg/dL**
- **Threshold for children: 40 mcg/dL**

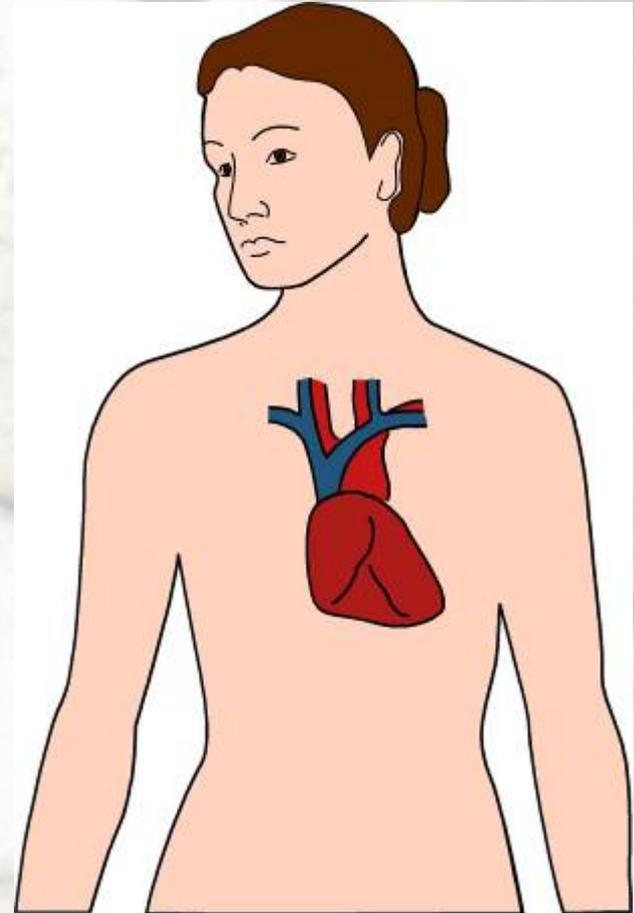


# Endocrine Effects of Lead

- **Inverse correlation between BLLs and vitamin D levels**
- **Chronic exposure may affect thyroid function**

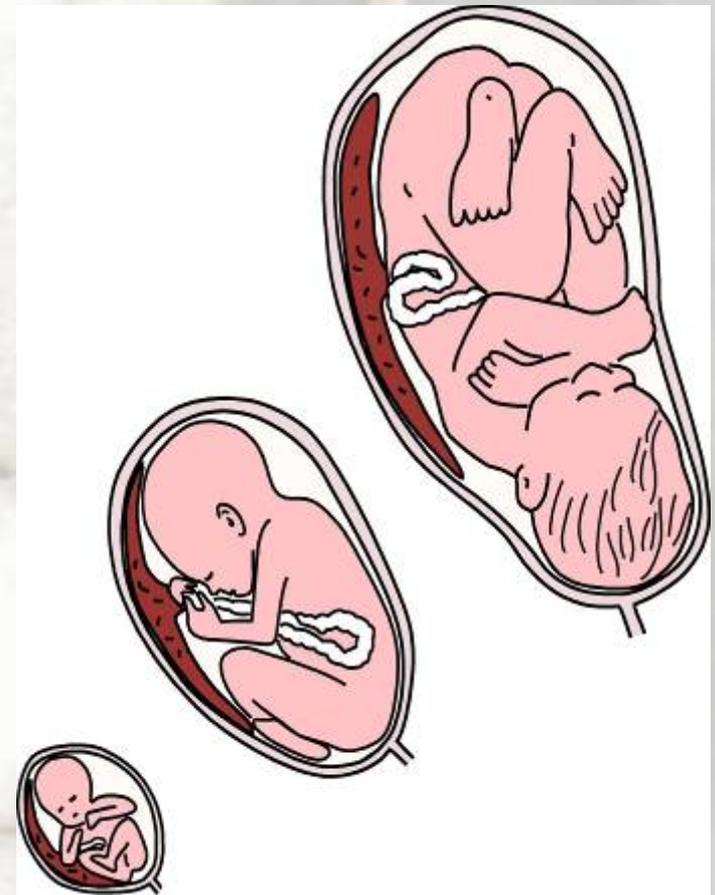
# Cardiovascular Effects of Lead

- **Increases risk of hypertension**



# Developmental Effects of Lead

- **Crosses the placental barrier**
- **Affects fetal viability, and fetal and early childhood development**
- **Maternal lead may affect child's neurologic development**



# Clinical Evaluation

- Preventive screening
- Exposure History
- Physical evaluation
- Signs and symptoms



# Preventive Screening

- **See state or local guidance for blood lead screening**
- **CDC guidelines**
  - **Test children at ages one and two**
  - **Test children annually to age six if high-risk**
- **For adults, see OSHA guidelines**
- **Lead exposure risk questions**



# Environmental Exposure History

- **Age and condition of residences**
- **Home remodeling activities**
- **Occupations and hobbies of family**
- **Family history**
  - **Maternal /exposure**
  - **Unusual medicines or home remedies.**
- **Imported or glazed ceramics or lead crystal**
- **Siblings or playmates with lead poisoning**



# Physical Examination

- **Neurologic**
- **Hematologic**
- **Cardiovascular**
- **Gastrointestinal**
- **Renal**
- **For children: hearing and nutritional status**



# Signs and Symptoms

- **Patient may appear asymptomatic**
- **Impaired abilities may include**
  - **Decreased learning and memory**
  - **Lowered IQ**
  - **Decreased verbal ability**
  - **Impaired speech and hearing functions**
  - **Early signs of hyperactivity or ADHD**
- **Symptoms vary by exposure level**



# Signs and Symptoms: Low Toxicity

- **Myalgia or paresthesia**
- **Mild fatigue**
- **Irritability**
- **Lethargy**
- **Occasional abdominal discomfort**

# Signs and Symptoms: Moderate Toxicity

- **Arthralgia**
- **General fatigue**
- **Difficulty concentrating/Muscular exhaustibility**
- **Tremor**
- **Headache**
- **Diffuse abdominal pain**
- **Vomiting**
- **Weight loss**
- **Constipation**



# Signs and Symptoms: Severe Toxicity

- **Paresis or paralysis**
- **Encephalopathy—may abruptly lead to seizures, changes in consciousness, coma, and death**
- **Lead line (blue-black) on gingival tissue**
- **Colic (intermittent, severe abdominal cramps)**



# Laboratory Tests

- Venous blood sample
- Confirm elevated finger-stick
- Erythrocyte protoporphyrin (EP) is no longer considered useful

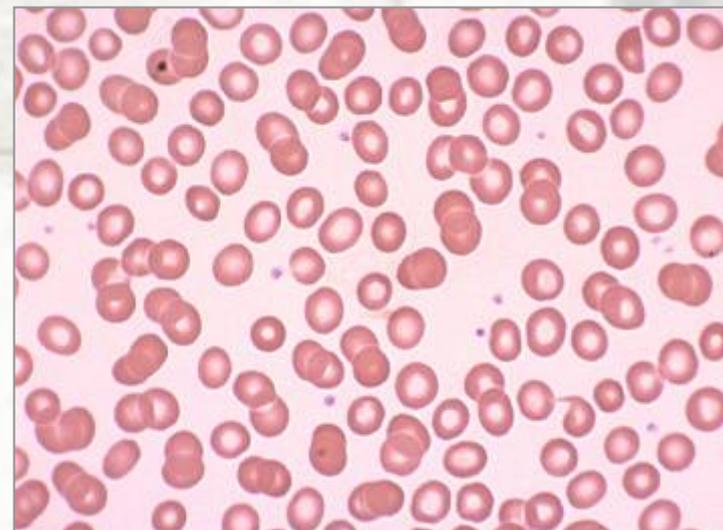


# Complete Blood Count

- May show basophilic stippling\* in patients with extended significant exposure



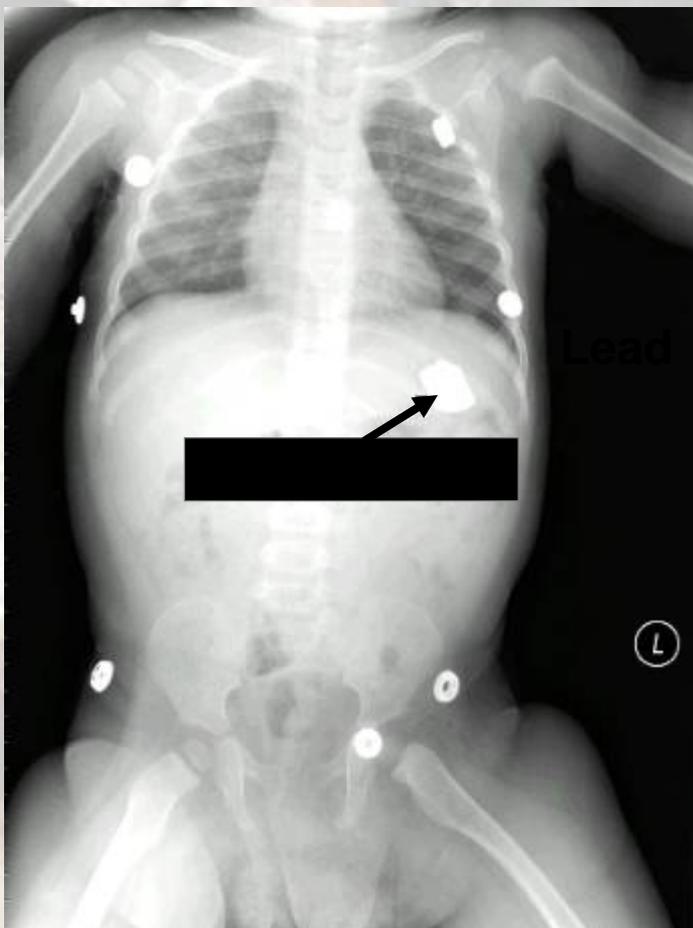
Lead poisoning



Normal red blood cells

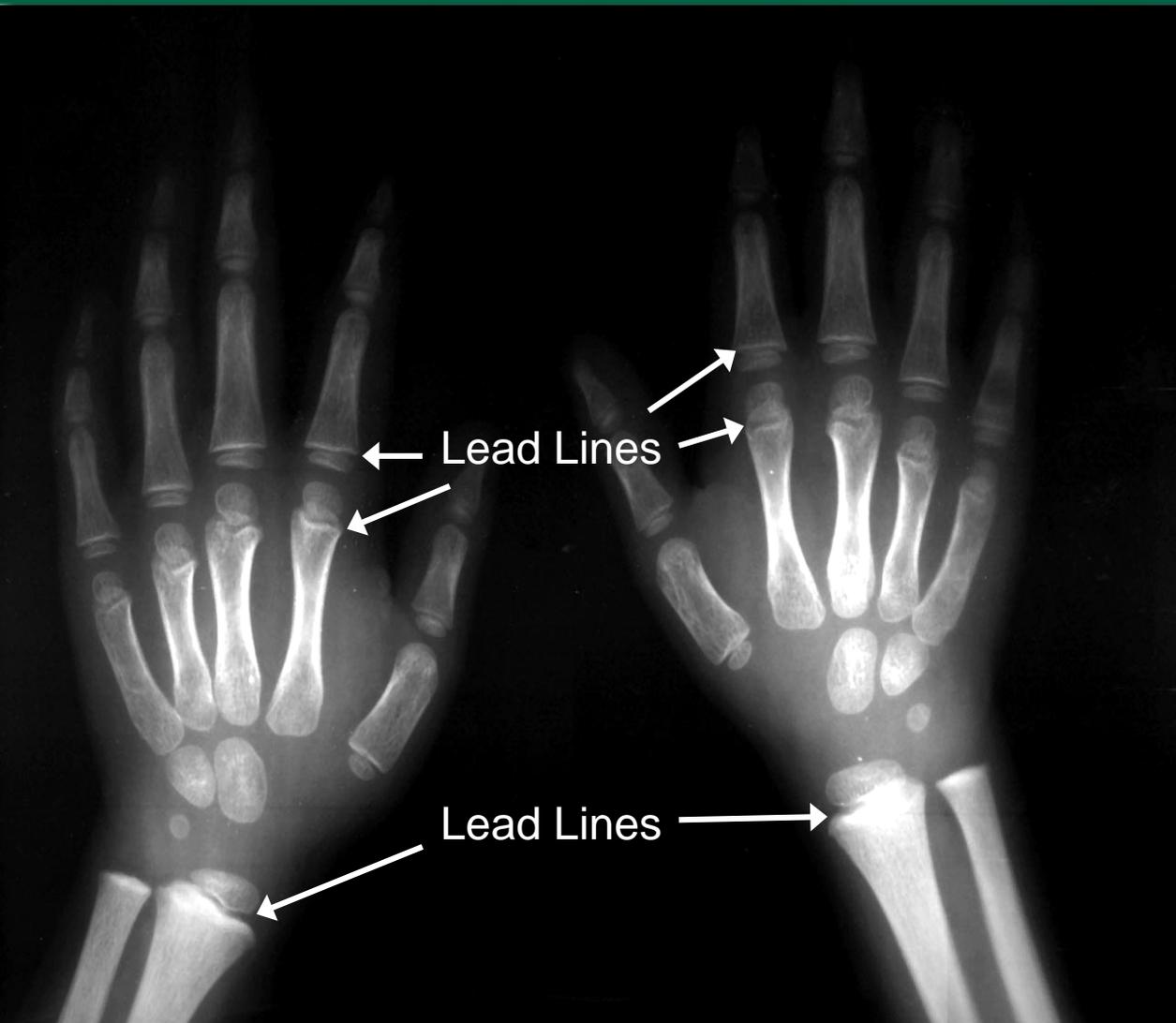
\* Also seen in arsenic poisoning

# Abdominal Radiograph



**Lead charm found in  
child's stomach**

# Longbone radiographs



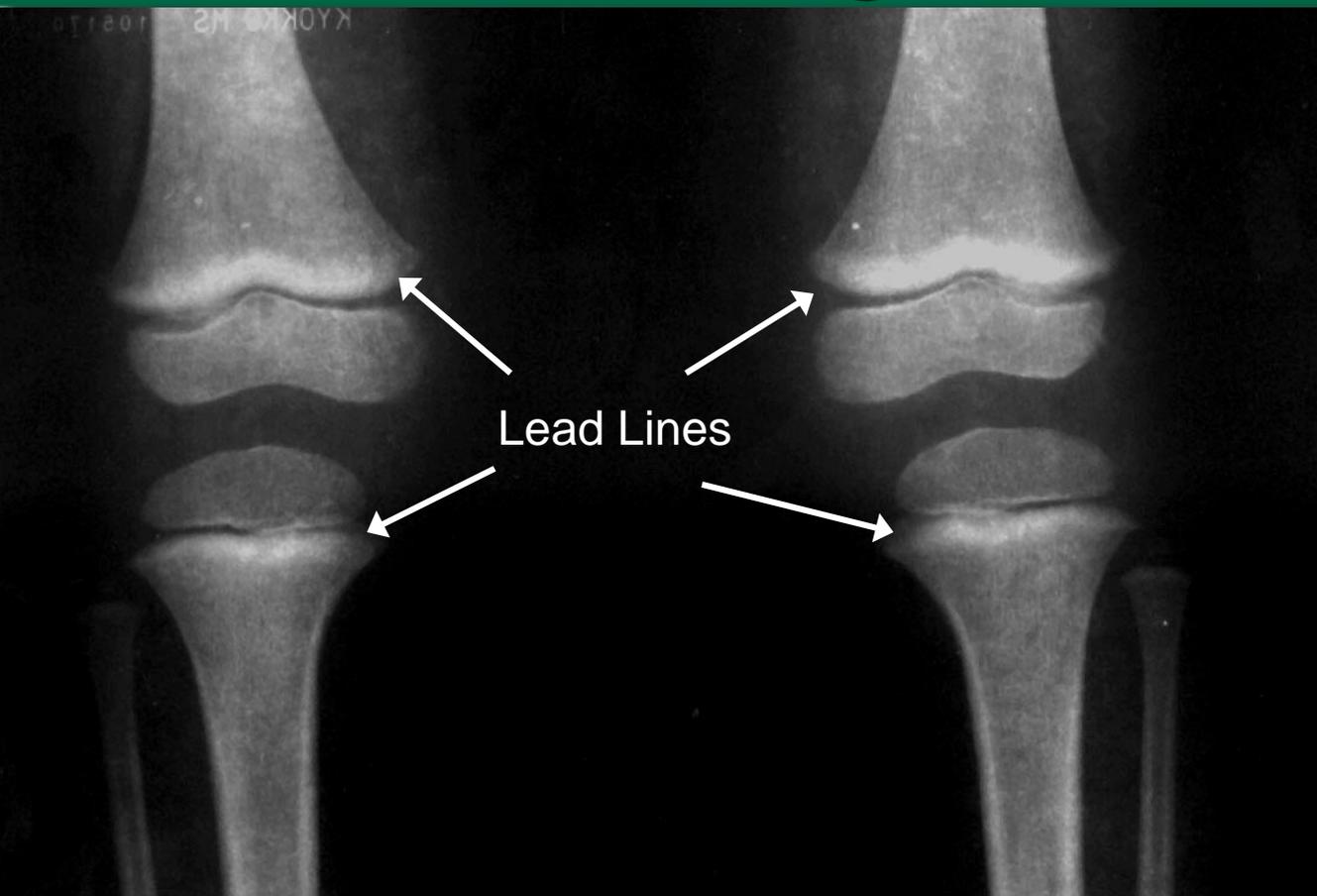
“Lead Lines” in five year old male with radiological growth retardation and blood lead level of  $37.7\mu\text{g}/\text{dl}$

(Photo courtesy of Dr. Celsa López Campos,  
Clinical Epidemiologic Research Unit, IMSS, Torreón, México)

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# Lead Lines in Legs



“Lead Lines” in three-year-two-month-old girl with Blood lead level of  $10.6 \mu\text{g}/\text{dl}$

Notice the increased density on the metaphysis growth plate of the knee.

(Photo courtesy of Dr. Celsa López Campos,  
Clinical Epidemiologic Research Unit, IMSS, Torreón, México)

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# U.S. Standards for Lead

## **Blood:**

**CDC level of concern for children: 10 mcg/dL**

**OSHA workplace standard:**

**50 mcg/dL for removal from the job**

**40 mcg/dL for mandatory notification**

## **Environmental:**

**Agencies have set standards for lead in water, air, and soil**



# Clinical Management

- **Most important step is removal of lead exposure**
  - **Referral to health department**
  - **Environmental Investigations**
  - **Other potential sources of lead**
  - **Education about prevention**



# Chelation Therapy

- **At very high blood lead levels (over 40 mcg/dL for children), chelation may be indicated**
- **Consult with physicians or medical centers with chelation therapy experience**



# Instructions to Patients

- **Reduce source(s) of lead exposure**
- **Maintain a diet high in calcium and iron**
- **Continue to monitor blood lead levels**
- **If workplace exposure suspected, contact:**
  - **Workplace health and safety officer**
  - **Occupational Safety and Health Administration (OSHA)**



# Instructions to Patients with Pre-1978 Homes

- **Test for lead hazards**
- **Assume paint has lead**
- **Make sure all paint is in good condition**
- **Fix lead paint hazards safely**



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# Instructions to Patients with Pre-1978 Homes

- **Use “lead-safe” work practices when disturbing paint**
  - **Work wet**
  - **Contain dust and debris**
  - **Keep children away**
  - **Use proper equipment and materials**
  - **Specialized clean-up and testing after work is done**



# Instructions to Patients with Pre-1978 Homes

- Avoid exposure to sources of lead
- Do not let children chew painted surfaces
- Wet-clean surfaces weekly
- Clean window sills and wells
- Do not let children play in bare soil
- Cover bare soil in the yard with
  - Grass
  - 6 inches of mulch



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# Instructions to Patients with Pre-1978 Homes

- **Run cold water for 1 to 2 minutes before using**
- **Wash children's hands and faces**
- **Wash toys with soap and water**
- **Feed children plenty of calcium and iron rich foods**

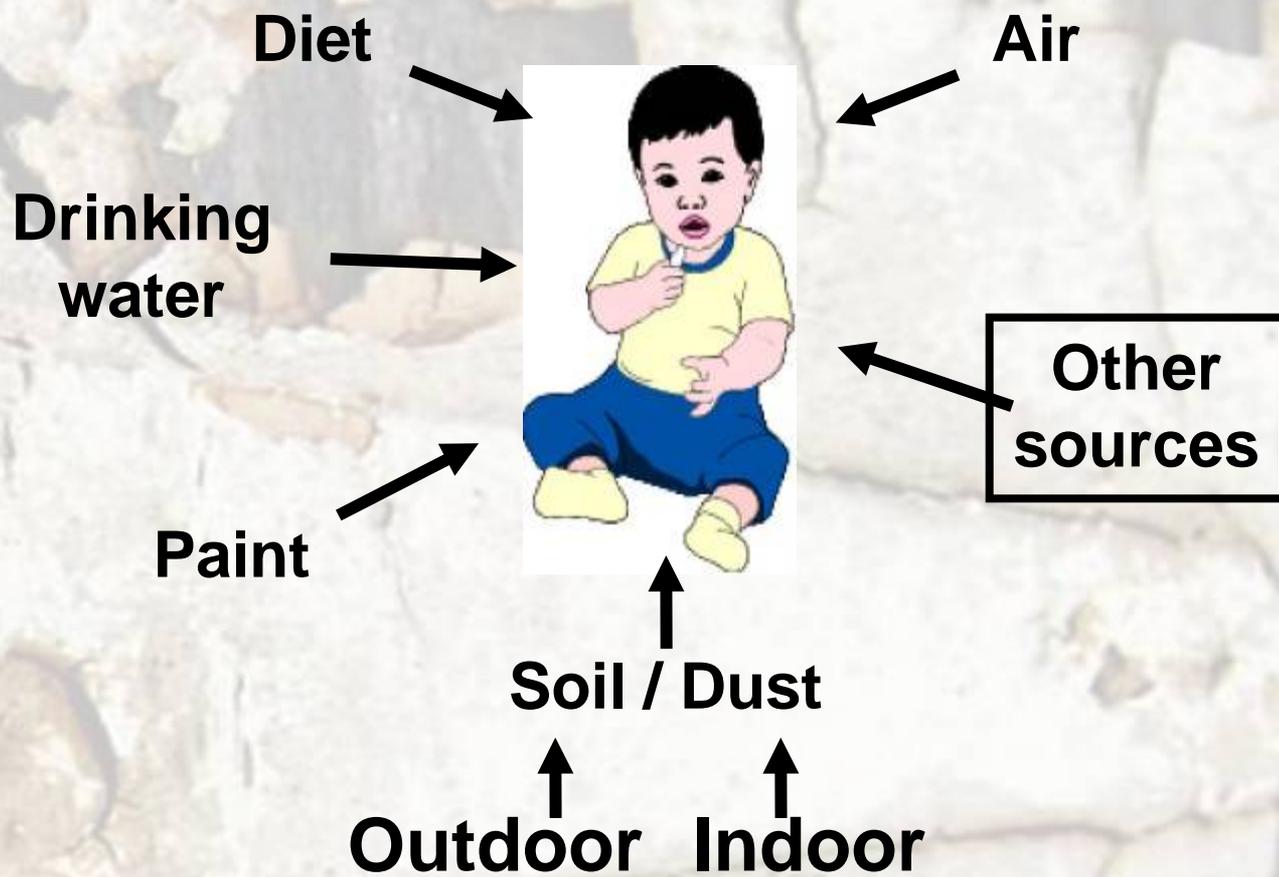


# Summary

- **Primary sources: deteriorated paint, contaminated dust or soil, and some products**
- **Lead is very dangerous to young children and the developing fetus**
- **Certain workers may be exposed**
- **Focus on preventing exposure/removing source**



# Summary



# How can I get more Information?

- **Regional poison control center**
- **Your local or state health department**
- **National Lead Information Center:**  
1-800-424-LEAD  
[www.epa.gov/lead/nlic.htm](http://www.epa.gov/lead/nlic.htm)
- **Information on lead safe work practices:**  
[www.epa.gov/lead/epahudrrmodel.htm](http://www.epa.gov/lead/epahudrrmodel.htm)
- **“Lead in Your Home: A Parent’s Reference Guide”** [www.epa.gov/lead/leadrev.pdf](http://www.epa.gov/lead/leadrev.pdf)
- **Alliance for Healthy Homes:**  
(202) 543-1147  
[www.afhh.org](http://www.afhh.org)



# Additional Information

- **Agency for Toxic Substances and Disease Registry (ATSDR)** [www.atsdr.cdc.gov](http://www.atsdr.cdc.gov)
- **Association of Occupational and Environmental Clinics (AOEC)** [www.aoec.org](http://www.aoec.org)
- **Pediatric Environmental Health Specialty Units (PEHSUs)** [www.aoec.org/PEHSU.htm](http://www.aoec.org/PEHSU.htm)
- **American College of Occupational and Environmental Medicine** [www.acoem.org](http://www.acoem.org)
- **American College of Medical Toxicologists**  
[www.acmt.net](http://www.acmt.net)
- **American College of Preventive Medicine**  
[www.acpm.org](http://www.acpm.org)

