



## Lead Grand Rounds STORYBOARD

SCRIPT	GRAPHICS
None	Slide 1: Lead Medical Grand Rounds Title Slide  (CHAPTER - Introduction) 
<p>Hello. My name is Dr. Kim Gehle and I come to you from the Centers for Disease Control and Prevention, Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine. I'm a physician, board certified in occupational medicine. This is the Environmental Medicine Grand Rounds on Lead Toxicity.</p> <p>If you'd like to receive continuing education credits for this seminar, please go to the web page where this web cast is located and click on the course hyperlink for continuing education. There you can view the types and amounts of CE available. These include CME, CNE, CEUs, and CECH credits.</p> <p>After completing the assessment questionnaire and post test online, you can immediately print your continuing education certificate.</p> <p>The goal of this seminar is to increase your knowledge of lead toxicity and your ability to evaluate potentially exposed patients. By the end of this seminar, you will be able to meet the full list of objectives which cover the general areas of:</p>	CAMERA
<ul style="list-style-type: none"> <li>• what lead is,</li> <li>• where it's found,</li> <li>• how persons are exposed, and</li> <li>• populations at risk,</li> </ul> <p>You'll become familiar with CDC's concern for blood lead and</p>	Slide 2: Learning Objectives

<p>recommendations for screening, as well as the OSHA standards and regulations for lead exposure.</p>	<p><b>Learning Objectives</b></p> <ul style="list-style-type: none"> <li>• Explain what lead is</li> <li>• Identify where lead is most commonly found in the United States today</li> <li>• Identify the most important routes of exposure to lead</li> <li>• Identify the populations most heavily exposed to lead</li> <li>• State the CDC's level of concern for lead in children's blood and recommendations for screening</li> <li>• State the OSHA level for intervention for occupational exposure to lead</li> </ul>
<p>You'll be able to:</p> <ul style="list-style-type: none"> <li>• Describe the way lead is absorbed, distributed, and stored throughout the body,</li> <li>• Describe the major physiologic effects of lead,</li> <li>• Describe the symptoms of mild and acute lead toxicity,</li> <li>• Describe the most useful test for lead toxicity,</li> </ul>	<p><b>Slide 3: Learning Objectives, Con't</b></p> <p><b>Learning Objectives (cont'd)</b></p> <ul style="list-style-type: none"> <li>• Describe the way lead is taken up, distributed, and stored throughout the body</li> <li>• Describe at least three major physiologic effects of lead</li> <li>• Name three symptoms of mild lead toxicity</li> <li>• Name three symptoms of acute lead toxicity</li> <li>• Name the most useful test for lead toxicity</li> </ul>
<ul style="list-style-type: none"> <li>• List steps that should be taken at various blood lead levels,</li> <li>• And finally, list steps patients with domestic and occupational exposures can take to protect themselves from further exposure.</li> </ul>	<p><b>Slide 4: Learning Objectives, Con't</b></p> <p><b>Learning Objectives (cont'd)</b></p> <ul style="list-style-type: none"> <li>• List three steps that should be take at blood lead levels between 10 and 19 mcg/dL</li> <li>• Describe additional steps that should be take for BLL 20-44 mcg/dL, 45-69 mcg/dL and 70 mcg/dL and above</li> <li>• List steps patients with domestic exposures can take to reduce lead exposure</li> <li>• List steps patients with occupational exposures should take</li> </ul>
<p>Okay, so what is lead and how are people exposed? People have used lead almost since the beginning of civilization. Human activities have spread lead widely throughout the environment, including air, water, soil, plants, animals, and man-made constructions. Because lead is spread so widely throughout the environment, it can be found in everyone's body today.</p>	<p><b>CAMERA</b></p> <p><b>(CHAPTER – Lead Exposure Routes)</b></p>
<p>Lead is a soft gray metal which occurs naturally, but much of its presence in the environment stems from its historic use in paint and gasoline and from ongoing or historic mining and commercial operations.</p> <p>People used to be exposed to organic lead from leaded gasoline, also known as tetraethyl lead.</p> <p>Imported canned food, jewelry, and some home remedies may also contain lead.</p>	<p><b>Slide 5: What is Lead?</b></p> <p><b>What is Lead?</b></p> <ul style="list-style-type: none"> <li>• Soft blue-gray metal</li> <li>• Found in the natural environment</li> <li>• Was added to paint and gasoline in past</li> <li>• Still used in consumer products</li> </ul> 
<p>The biggest concern in the U.S. today regarding lead is the use of leaded paint in housing before 1978 which is now cracked or</p>	<p><b>Slide 6: How does lead get into the</b></p>

peeling on doors and window sills.

This lead can get into household dust from activities like friction created by windows and doors as they open and close. In addition, home renovations that disturb old paint can easily spread lead dust throughout the home. Outside these homes, lead may enter soil from paint chips that are ground into the surrounding soil over time.

In addition, soil may have been contaminated by lead used in gasoline before 1976. This lead doesn't go away, but instead remains in soil. If this has happened, bare soil can pose a hazard.


Lead may enter the dust or air in work environments which involve lead.

Finally, in mining and smelting areas, deposited lead from the air may result in high soil levels.

### environment?

**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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Today, everyone is exposed to environmental lead. Exposure to lead occurs through inhalation, ingestion and dermal contact. Examples include drinking lead contaminated water, eating contaminated foods, and swallowing or touching dust or dirt that contains lead.

Lead exposure in the general population, including children, occurs primarily through ingestion, although inhalation also contributes to lead body burden and may be the major contributor for workers in lead-related occupations.

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Lead paint is the major source of lead exposure for children in the U.S. As lead paint deteriorates, peels, chips, or is removed by renovation, or pulverizes due to friction, such as in windowsills, house dust and surrounding soil may become contaminated. Lead then enters the body through normal hand-to-mouth activity and inhalation.

Ingestion of contaminated food, water or alcohol may be significant for some populations.


In addition, ingesting certain home remedy medicines may expose people to lead or lead compounds.

It's important to remember that once lead is absorbed into the body, it may be stored for long periods in mineralizing tissue,

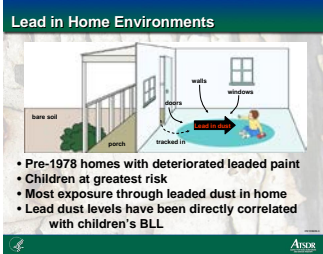
### Slide 7: How are people exposed to lead?

**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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<p>such as teeth and bones. It can then be released into the bloodstream, especially in times of calcium stress, such as pregnancy, lactation, osteoporosis, or calcium deficiency. This endogenous exposure can be significant, especially for individuals with a long history of lead exposure.</p>	
<p>As noted earlier, lead paint is the major source of lead exposure in the United States, especially for children. Lead was banned from paint in the U.S. in 1978.</p> <p>Even though leaded paint may have been covered with non-leaded paint, it may still be released into the home environment by peeling, chipping, chalking, friction, impact, or by home renovation.</p>	<p>CAMERA</p>
<p>In fact, between 83 and 86% of all homes built in the U.S. before 1978 have lead-based paint in them. The older the house, the more likely it is to contain lead-based paint and to have a higher concentration of lead in the paint. Before 1955, most white house paint contained up to 50% lead.</p> <p>Many people think that children will be safe if they are prevented from eating paint chips. Children with pica are certainly at higher risk. However, significant blood lead elevations can result from invisible, lead contaminated dust or soil ingested through normal hand to mouth behaviors.</p> <p>As this slide shows, children may ingest leaded paint, dust, or soil from many sources in their homes. Windows, porches, and doors are usually the most significant contributors of lead dust to the home environment.</p> <p>Playing in, or the tracking indoors of contaminated exterior soil, can also be a major source of lead exposure.</p> <p>Any home renovation that disturbs lead paint can create hazardous levels of lead in dust that may not be visible to the eye.</p> <p>The amount of dust in the home environment is directly correlated with children's blood lead levels. There is no safe threshold for lead.</p>	<p>Slide 8: Lead in home environments.</p>  <p><b>Lead in Home Environments</b></p> <ul style="list-style-type: none"> <li>• Pre-1978 homes with deteriorated leaded paint</li> <li>• Children at greatest risk</li> <li>• Most exposure through leaded dust in home</li> <li>• Lead dust levels have been directly correlated with children's BLL</li> </ul>
<p>Most adult exposures are occupational and occur in lead-related industries, through inhalation, ingestion, and dermal contact with lead.</p>	<p>Slide 9: How are people exposed to lead in Work</p>


If showers and a change of clothing are not provided, workers can bring lead dust home on their skin, shoes, and clothing, inadvertently exposing family members.

In addition to direct ingestion of lead dust during their work, workers may inhale lead dust and lead oxide fumes, as well as eat, drink, and smoke in or near contaminated areas, thereby increasing their probability of lead ingestion. Between point five and one point five million workers are exposed to lead in the workplace.

### Environments?

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




Activities that involve lead include: lead smelting, refining, and manufacturing industries. Other jobs that may involve lead include: construction, automobile repair, plumbing, printing, and work involving fire arms.

### Slide 10: What jobs involve lead?

What Jobs Involve Lead?

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



Adults can also be exposed during hobbies and activities where lead is used. Certain hobbies, home activities,

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(CHAPTER – How Exposure Occurs)


and car repairs, such as radiator repair, can contribute to lead exposure. Some common hobbies include glazed pottery making; artistic painting; stained-glass making; glass or metal soldering; target shooting; electronics soldering; and molding of bullets, slugs, or fishing sinkers.

One frequent source of lead exposure is house renovation that involves scraping, remodeling, or otherwise disturbing lead-based paint. Renovation involving lead-based paint should only be undertaken after proper training.

### Slide 11: What hobbies involve Lead?

What Hobbies Involve Lead?

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




Lead occurs in drinking water through leaching from lead-containing pipes, faucets, and solder, which can be found in the plumbing of older buildings. Other potential sources of lead contamination include brass fixtures, older drinking water coolers, and older coffee urns.


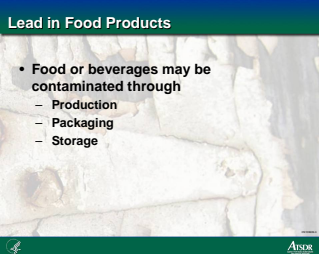
Leaching rates accelerate when water is acidic or hot, or when it's been standing in the pipes for extended periods, such as overnight. Boiling water will not get rid of lead. Flushing standing water from lines and faucets for a few minutes before

### Slide 12: Lead in drinking water.

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



<p>use, and using cold water for drinking may reduce exposure.</p>	
<p>Lead is still used in commercial products, such as bridge paint, computers, solder, pewter, some ceramic glazes, jewelry, and automotive batteries.</p> <p>While lead may be prohibited from many of these products in the U.S., imported or pre-regulation products may still pose a risk.</p>	<p>Slide 13: Lead in commercial products.</p> 
<p>Lead may also contaminate food or beverages through production, packaging, or storage.</p> <p>Production sources may include the uptake of lead from soil by root vegetables or atmospheric lead deposition onto leafy vegetables. Homemade "moonshine" that was distilled and/or stored in leaded containers is another example of a production source.</p> <p>Packaging may also pose a risk. Until the phase-out in the United States of lead-soldered food cans during the 1980s, canned food was the major source of lead in our diet. Although some plastic food wrappers may be printed with lead-containing pigments, and although some food cans produced and sold in foreign countries may be lead-soldered, the amount of lead in the American diet has declined substantially.</p> <p>Storage or serving of food or beverages in lead-containing vessels may cause contamination, including some ceramic tableware, especially if it's imported, as well as leaded-crystal glassware.</p>	<p>Slide 14: Lead in food products.</p> 
<p>Lead-glazed pottery, particularly if it's imported, is a potential source of exposure that's often overlooked. Even "safe" pottery and ceramic-ware can become harmful to human health. For example, dishwashing may chip or wear off the protective glaze and expose people to lead-containing pigments.</p> <p>Certain ethnic groups may use products that contain lead. Examples include some remedies and cosmetics of Mexican, Asian, and Middle Eastern origin.</p>	<p>CAMERA</p>
<p>Azarcon and greta, which are Mexican folk remedies used to treat the colic-like illness "empacho," may contain lead. Azarcon and greta are also known as: liga, Maria Luisa,</p>	<p>Slide 15: Lead in Ethnic products.</p>

alarcon, coral, and rueda.

Lead containing remedies used by some Asian communities include chuifong, tokuwan, ghasard, bali goli, kandu, surma, and ba-baw-san.

Middle Eastern remedies and cosmetics include: alkohl, saoott, and cebagin.

A web site has been provided on the slide where you may go to find more listings.

#### 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/CasellManagement>



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Because of widespread human use of lead, lead is ubiquitous in the environment. These background levels vary, depending on historic uses in the area. The past use of lead in gasoline has contaminated soil, especially along roadways.

Industries, such as mining and lead smelting, have also contributed to high levels of lead in the soil, water, and air around such facilities. This applies to both present-day and historic facilities.

Smaller businesses, such as auto repair shops, can contribute to elevations of lead in adjacent areas.

Slide 16: Lead in the environment.

#### 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



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While children's lead levels have declined in recent decades, children who reside in housing built before 1978, particularly those in the inner cities or those built before the 1950s are at greater risk.

These children are more likely to be poor and from racial or ethnic minority groups.

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(CHAPTER – How Lead Effects The Body)

Because of their behavior and physiology, children are more affected by exposure to lead than adults. For example, children generally ingest lead-contaminated soil and house dust at higher rates than adults because of mouthing and hand-to-mouth behaviors. This is especially true for children who exhibit pica, a compulsive hand-to-mouth behavior and repeated eating of nonfood items.

Being closer to the ground than adults, children also breathe lead-contaminated dust and soil, as well as fumes or vapors that are close to the ground, and they ingest more food and water than adults per body weight.

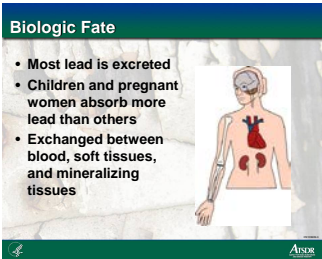
Slide 17: Who is most at risk of lead exposure?

#### Who is Most at Risk of Lead Exposure?

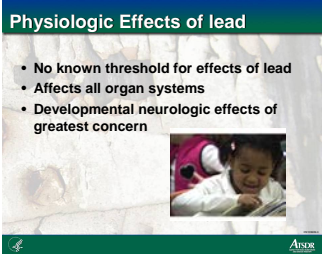
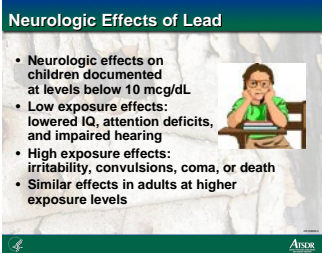
- Children living in older housing
- Pregnant women and developing fetus

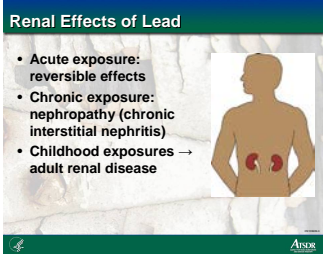
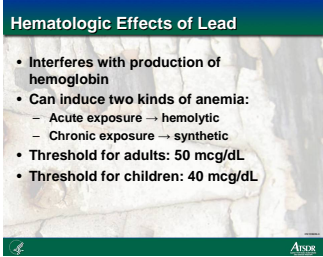


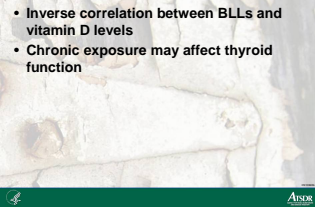
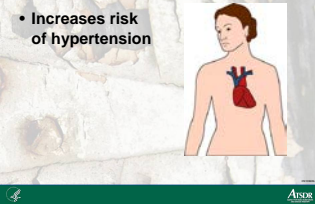
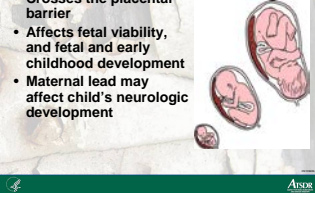
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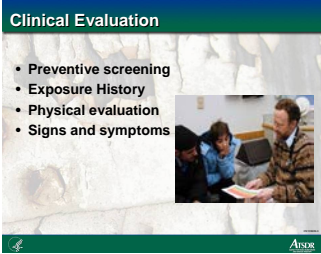
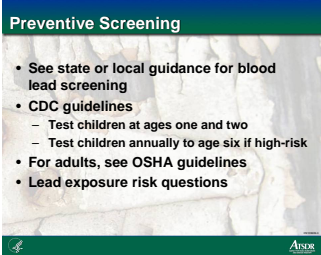
<p>Although children are at greater risk for harmful health effects from lead exposure, adult exposures can also result in harmful effects.</p> <p>Pregnant women and developing fetuses are also at risk. The mother's blood lead level is an important indication of risk to the fetus. In addition, mothers who had exposure to lead in the past may store lead in their bones. Lead may be released from bones during times of calcium stress, such as pregnancy and lactation.</p>	
<p>Now let's talk about what happens when lead is absorbed.</p>	CAMERA
<p>Most of the lead that's absorbed is excreted through urine or through biliary clearance in the feces. The absorption and biologic fate of lead, once it enters the human body, depends on a variety of factors, including nutritional status, health, and age.</p> <p>Children and pregnant women absorb more of the lead they ingest than others. They can absorb up to seventy percent of ingested lead, whereas nonpregnant females and male adults typically absorb up to twenty percent.</p> <p>Absorbed lead is exchanged between blood, soft tissues, and mineralizing tissues. Although the blood generally carries only a small fraction of total lead body burden, it does serve as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available to other tissues (or for excretion).</p> <p>Blood lead is also important because the <b>BLOOD LEAD LEVEL</b> is the most widely used measure of lead exposure. The half-life of lead in adult human blood has been estimated to be 28 days.</p>	<p>Slide 18: Biologic Fate.</p> 
<p>The brain is also a site of distribution. Lead in soft tissues has an approximate half-life of 40 days.</p> <p>Under certain circumstances the lead will leave the bones and reenter the blood and soft tissue organs. Bone-to-blood lead mobilization increases during periods of pregnancy, lactation, menopause, physiologic stress, chronic disease, hyperthyroidism, kidney disease, broken bones, and advanced age, which is exacerbated by calcium deficiency.</p>	CAMERA

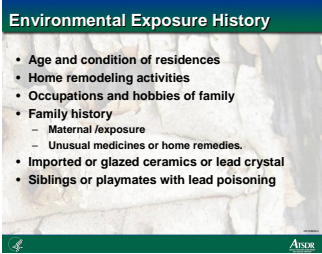
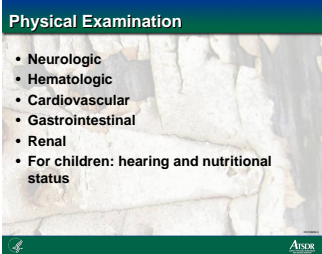


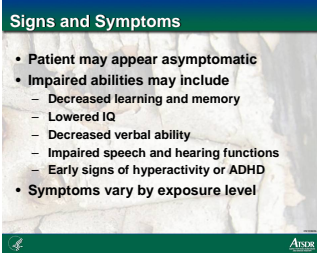

<p>Consequently, the normally inert pool of stored lead poses a special risk because it is a potential endogenous source of lead that can maintain blood lead levels long after exposure has ended.</p>	
<p>Lead serves no useful purpose in the human body, but its presence in the body can lead to toxic effects, regardless of exposure pathway. Lead toxicity can affect every organ system. It must be emphasized that, for children, there may be no threshold for developmental effects.</p> <p>While the immediate health effect of concern in children is typically neurologic, it is important to remember that childhood lead poisoning can lead to health effects later in life including renal effects, hypertension, reproductive effects, and developmental problems in offspring. These effects may occur as a result of lead exposure as an adult, but usually from higher (such as occupational) levels than those levels that affect children.</p>	<p>Slide 19: Physiologic Effects of Lead.</p> 
<p>The nervous system is the most sensitive target of lead exposure. Because otherwise asymptomatic individuals may experience neurological effects from lead exposure, clinicians should have a high index of suspicion for lead exposure, especially in the case of children.</p>	<p>CAMERA</p>
<p>Children may suffer neurological effects at low exposure doses, including a decrement in IQ performance and other neuropsychologic defects. Some studies have found, for example, that for every 10 mcg/dL increase in BLOOD LEAD LEVEL, children's IQs fell four to seven points.</p> <p>There is also evidence that attention deficit hyperactivity disorder or (ADHD) and hearing impairment in children increase with increasing BLOOD LEAD LEVEL, and that lead exposure may disrupt balance and impair peripheral nerve function.</p> <p>In children, a high lead exposure dose may produce encephalopathy and other attendant signs such as hyperirritability, ataxia, convulsions, stupor, coma and death. Some of the neurological effects of lead in children may persist into adulthood.</p> <p>The BLOOD LEAD Levels associated with encephalopathy in children vary from study to study, but BLOOD LEAD Levels of</p>	<p>Slide 20: Neurologic Effects of Lead.</p> 

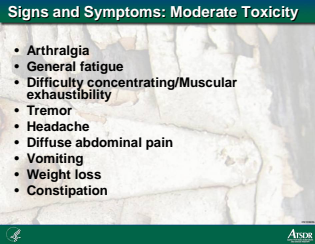
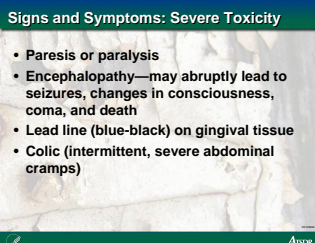
<p>70 to 80 micrograms per deciliter or greater appear to indicate a serious risk.</p> <p>Adults with current lead exposure may have similar neurologic effects to children, but normally these occur at higher exposure dose levels. Slowed nerve conduction and forearm extensor weakness (or wrist drop), as late signs of lead intoxication, are more classic signs in workers chronically exposed to high lead levels.</p>	
<p>Acute, high dose lead-induced impairment of proximal tubular function manifests in aminoaciduria, glycosuria, and hyperphosphaturia (a Fanconi-like syndrome); these effects appear to be reversible. However, continued or repetitive exposures can cause a toxic stress on the kidney that, if unrelieved, may develop into chronic and often irreversible lead nephropathy (for example, chronic interstitial nephritis).</p> <p>Some chronic advanced renal disease or decrement in renal function may be caused by latent effects of lead exposure that occurred years earlier in childhood.</p>	<p>Slide 21: Renal Effects of Lead.</p> 
<p>Because past or ongoing excessive lead exposure may also be a causative agent in kidney disease associated with essential hypertension, primary care providers should follow closely the renal function of patients with hypertension and a past history of lead exposure.</p>	<p>CAMERA</p>
<p>Lead inhibits the body's ability to make hemoglobin by interfering with several enzymatic steps in the heme pathway.</p> <p>Lead can induce two types of anemia, often accompanied by basophilic stippling of the erythrocytes.</p> <ul style="list-style-type: none"> <li>• First, Acute, high-dose lead exposure has been associated with hemolytic anemia.</li> <li>• In chronic lead exposure, lead induces anemia by both interfering with heme biosynthesis and by diminishing red blood cell survival.</li> </ul>	<p>Slide 22: Hematologic Effects of Lead.</p> 
<p>Studies of children with high lead exposure have found that a strong inverse correlation exists between BLOOD LEAD LEVEL and vitamin D levels. Lead impedes vitamin D conversion into its hormonal form, 1,25-dihydroxyvitamin D, which is largely responsible for the maintenance of extra- and intra-cellular calcium homeostasis.</p>	<p>Slide 23: Endocrine Effects of Lead.</p>


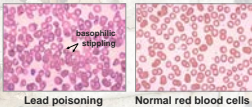
<p>Minimizing lead exposure, and assuring sufficient calcium in the diet throughout all stages of life, can help individual patients to ensure peak bone densities and diminish osteoporosis risk factors.</p> <p>The effects of lead exposure on thyroid function have been examined in occupationally exposed adult workers and in children.</p>	<p><b>Endocrine Effects of Lead</b></p> <ul style="list-style-type: none"> <li>• Inverse correlation between BLLs and vitamin D levels</li> <li>• Chronic exposure may affect thyroid function</li> </ul> 
<p>Hypertension is a complex condition with many different causes and risk factors, including age, weight, diet, and exercise habits.</p>	<p>CAMERA</p>
<p>Lead exposure is one factor of many that may contribute to the onset and development of hypertension.</p> <p>Although low lead level exposures (resulting in BLOOD LEAD LEVELS &lt;30 micrograms per deciliter) show less of an association with hypertension, studies show that greater lead level exposures (primarily occupational) increase the risk for hypertensive heart disease and cerebrovascular disease as latent effects.</p> <p>On a population basis, this could increase the incidence of hypertension a substantial amount, due to the high prevalence of hypertension of all causes in general populations.</p>	<p>Slide 24: Cardiovascular Effects of Lead.</p> <p><b>Cardiovascular Effects of Lead</b></p> <ul style="list-style-type: none"> <li>• Increases risk of hypertension</li> </ul> 
<p>Lead readily crosses the placenta and developmental effects include pregnancy outcomes (such as premature births and low birth weights), congenital abnormalities, and post birth effects on growth or neurologic development.</p> <p>In a retrospective study, a higher proportion of learning disabilities were found among school-aged children with biological parents who were lead poisoned as children 50 years previously.</p> <p>This suggests that the children of parents who experienced overt lead poisoning as children could be at greater risk for neurologic development impairment.</p>	<p>Slide 25: Developmental Effects of Lead.</p> <p><b>Developmental Effects of Lead</b></p> <ul style="list-style-type: none"> <li>• Crosses the placental barrier</li> <li>• Affects fetal viability, and fetal and early childhood development</li> <li>• Maternal lead may affect child's neurologic development</li> </ul> 
<p>I have discussed what lead is, who is at risk for exposure, and the health effects that are associated with lead, I will now discuss what happens in the clinical setting. As you know, lead toxicity is irreversible. However, an early and accurate</p>	<p>CAMERA</p> <p>(CHAPTER – Determining If Lead</p>

<p>diagnosis can greatly improve the patient's prognosis.</p>	<p>Exposure Has Occurred)</p>
<p>Because lead poisoning is often asymptomatic, preventive screening is very important. This includes asking questions to evaluate the risk of lead exposure and, if indicated, blood sampling.</p> <p>Whether a patient has been exposed to lead but is asymptomatic, or the patient is already exhibiting symptoms that may be related to a past or current exposure, it is important to perform a thorough exposure history and physical evaluation.</p> <p>In order to correctly interpret the physical evaluation, it is important to be familiar with the signs and symptoms of lead poisoning and the lead exposure history.</p>	<p>Slide 26: Clinical Evaluation.</p> 
<p>Because lead poisoning is often asymptomatic, recognition of lead exposure often depends on the initial reporting of high BLOOD LEAD Levels by primary care providers.</p> <p>In the case of children, CDC recommends that states develop statewide plans for BLOOD LEAD LEVEL screening. Contact your state or local health department to see if your state has a lead screening plan.</p> <p>In the absence of a local plan, CDC recommends screening at one and two years of age, and annually up to age 6 if there is an identified lead risk.</p> <p>For occupationally exposed adults, consult the federal lead standard for the mandated type and frequency of lead screening.</p> <p>Asking lead exposure risk questions through an environmental exposure history can assist you in determining if a child or adult has been exposed to lead in the environment.</p>	<p>Slide 27: Preventive Screening.</p> 
<p>In the absence of health department guidance on screening, the first step in identifying individuals with potential lead exposure is to determine through appropriate questioning whether or not any of the typical lead exposure pathways are cause for heightened concern. Many health departments can provide physicians with personal risk or lead exposure history questionnaires and/or localized risk information to help in this</p>	<p>CAMERA</p>

<p>process.</p>	
<p>Some of the issues a physician might discuss with the patient and/or family include the patient's location, age, the physical condition of current and past residences, schools, day-care centers as applicable, to identify potential for lead paint exposure as well as proximity to industrial facilities, hazardous waste sites, and other potential lead sources.</p> <p>It is also important to ask about any home remodeling activities current or past. Questions about the occupations and hobbies of all home occupants should also be included. In addition, the patient's family history, including the possibility of maternal/family lead exposure and the potential use of unusual medicines or home remedies should be asked.</p> <p>Other questions to ask relate to the use of imported or glazed ceramics and leaded crystal. If your patient is a child, have any of their siblings or playmates been diagnosed with lead poisoning?</p> <p>If any of these questions indicate a risk of lead exposure, a blood test should be ordered.</p>	<p>Slide 28: Environmental Exposure History</p>  <p><b>Environmental Exposure History</b></p> <ul style="list-style-type: none"> <li>• Age and condition of residences</li> <li>• Home remodeling activities</li> <li>• Occupations and hobbies of family</li> <li>• Family history <ul style="list-style-type: none"> <li>- Maternal exposure</li> <li>- Unusual medicines or home remedies.</li> </ul> </li> <li>• Imported or glazed ceramics or lead crystal</li> <li>• Siblings or playmates with lead poisoning</li> </ul>
<p>In addition to the environmental and family exposure history and BLOOD LEAD LEVEL screening just mentioned, physicians should conduct a complete physical examination of patients with potential exposure to lead. It is important to keep in mind, however, that even a complete physical examination may not identify subtle neurological effects that may be associated with low-dose lead exposure in children.</p> <p>The physical examination should include special attention to the</p> <ul style="list-style-type: none"> <li>• neurologic,</li> <li>• hematologic,</li> <li>• cardiovascular,</li> <li>• gastrointestinal,</li> <li>• and renal systems.</li> </ul> <p>The health care provider should be certain to check blood pressure to evaluate whether the patient is hypertensive and pay special attention to the renal system in those who are positive for hypertension. Careful evaluation of the nervous system, including behavioral changes should be noted. In</p>	<p>Slide 29: Physical Examination.</p>  <p><b>Physical Examination</b></p> <ul style="list-style-type: none"> <li>• Neurologic</li> <li>• Hematologic</li> <li>• Cardiovascular</li> <li>• Gastrointestinal</li> <li>• Renal</li> <li>• For children: hearing and nutritional status</li> </ul>

<p>addition, check for a purplish or blue/black line on the gingival tissues also known as the (lead line). This is rarely seen today, but if present, usually indicates severe and prolonged lead poisoning.</p> <p>For children the physical exam should include: hearing, speech, and other developmental milestones, in addition to the nutritional status, which should be carefully evaluated and documented. When the neurologic exam, milestones, or behavior suggest it, further neurobehavioral testing, or evaluation for ADHD, may be indicated.</p> <p>Since iron and calcium deficiencies are known to enhance the absorption of lead and to aggravate pica, it is especially important to assess the nutritional status of young children.</p>	
<p>Most patients who suffer from lead poisoning are asymptomatic, hence the importance of exposure assessment and screening. There is a continuum of signs and symptoms depending on the level and duration of lead exposure (or lead exposure dose). Because of differences in individual susceptibility, symptoms of lead exposure and their onset may vary.</p> <p>At the lowest lead exposure dose, patients may appear asymptomatic with impaired abilities. This may occur at BLOOD LEAD LEVELs ranging from 10 to 25 micrograms per deciliter and may include: decreased learning and memory; lowered IQ, decreased verbal ability, impaired speech and hearing functions; and early signs of hyperactivity or ADHD. The symptoms vary by exposure level.</p>	<p>Slide 30: Signs and Symptoms.</p>  <p><b>Signs and Symptoms</b></p> <ul style="list-style-type: none"> <li>• Patient may appear asymptomatic</li> <li>• Impaired abilities may include <ul style="list-style-type: none"> <li>– Decreased learning and memory</li> <li>– Lowered IQ</li> <li>– Decreased verbal ability</li> <li>– Impaired speech and hearing functions</li> <li>– Early signs of hyperactivity or ADHD</li> </ul> </li> <li>• Symptoms vary by exposure level</li> </ul>
<p>In symptomatic lead intoxication, BLOOD LEAD LEVELs generally range from thirty five to fifty micrograms per deciliter in children and forty to sixty micrograms per deciliter in adults.</p> <p>At low lead exposure dose, symptoms may include:</p> <ul style="list-style-type: none"> <li>• myalgia or paresthesia,</li> <li>• mild fatigue</li> <li>• irritability</li> <li>• lethargy, and</li> <li>• occasional abdominal discomfort.</li> </ul>	<p>Slide 31: Signs and Symptoms: low toxicity.</p>  <p><b>Signs and Symptoms: Low Toxicity</b></p> <ul style="list-style-type: none"> <li>• Myalgia or paresthesia</li> <li>• Mild fatigue</li> <li>• Irritability</li> <li>• Lethargy</li> <li>• Occasional abdominal discomfort</li> </ul>
<p>Signs and symptoms of moderate lead exposure dose may include:</p>	<p>Slide 32: Signs and Symptoms: moderate</p>

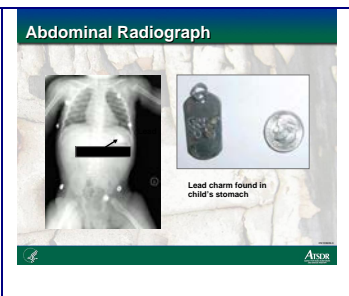
<ul style="list-style-type: none"> <li>• arthralgia,</li> <li>• general fatigue,</li> <li>• difficulty concentrating,</li> <li>• muscular exhaustibility,</li> <li>• tremor,</li> <li>• headache,</li> <li>• diffuse abdominal pain,</li> <li>• vomiting,</li> <li>• weight loss, and</li> <li>• constipation.</li> </ul>	<p>toxicity.</p>  <p>Signs and Symptoms: Moderate Toxicity</p> <ul style="list-style-type: none"> <li>• Arthralgia</li> <li>• General fatigue</li> <li>• Difficulty concentrating/Muscular exhaustibility</li> <li>• Tremor</li> <li>• Headache</li> <li>• Diffuse abdominal pain</li> <li>• Vomiting</li> <li>• Weight loss</li> <li>• Constipation</li> </ul>
<p>High exposure dose is frequently found in association with BLOOD LEAD LEVELs of seventy micrograms per deciliter or more in children and one hundred micrograms per deciliter or more in adults.</p> <p>Signs and symptoms may include:</p>	<p>CAMERA</p>
<ul style="list-style-type: none"> <li>• paresis or paralysis,</li> <li>• encephalopathy which may abruptly lead to seizures,</li> <li>• changes in consciousness,</li> <li>• coma, and death,</li> <li>• presence of a lead line, and</li> <li>• colic (or intermittent, severe abdominal cramps).</li> </ul> <p>Keep in mind that the signs and symptoms generally relate to exposure dose levels but may also appear at variance with these designations.</p> <p>The importance for the clinician is to recognize ongoing lead exposure, stop that exposure, and treat the patient as appropriate.</p>	<p>Slide 33: Signs and Symptoms: severe toxicity.</p>  <p>Signs and Symptoms: Severe Toxicity</p> <ul style="list-style-type: none"> <li>• Paresis or paralysis</li> <li>• Encephalopathy—may abruptly lead to seizures, changes in consciousness, coma, and death</li> <li>• Lead line (blue-black) on gingival tissue</li> <li>• Colic (intermittent, severe abdominal cramps)</li> </ul>
<p>Now let's look at biologic testing. I will be discussing biologic indicators of exposure and biologic indicators of effect from lead exposure.</p>	<p>CAMERA</p> <p>(CHAPTER – Tests to Determine Level of Exposure)</p>
<p>Venous BLOOD LEAD LEVEL testing is the most useful screening and diagnostic test for recent or ongoing lead exposure as opposed to past exposures. Given the greater risk of contamination using the finger-stick method, an elevated BLOOD LEAD LEVEL obtained by finger-stick should always</p>	<p>Slide 34: Laboratory Tests.</p>

<p>be confirmed through venipuncture.</p> <p>BLOOD LEAD LEVELs respond quickly to abrupt or intermittent changes in lead intake.</p> <p>For individuals with high or chronic past exposure, however, BLOOD LEAD LEVELs often under-represent the total body burden because most lead is stored in the bone. In some cases, Blood lead levels may even be “normal”.</p> <p>For higher exposure levels, the Erythrocyte protoporphyrin (also called EP) may be useful. EP, which is commonly assayed as zinc protoporphyrin (or ZPP), was previously considered the best test for screening for asymptomatic children. However, the ZPP assay is not sufficiently sensitive at lower BLOOD LEAD LEVELs and therefore is not as useful a screening test for lead exposure as previously thought.</p>	<p><b>Laboratory Tests</b></p> <ul style="list-style-type: none"> <li>• Venous blood sample</li> <li>• Confirm elevated finger-stick</li> <li>• Erythrocyte protoporphyrin (EP) is no longer considered useful</li> </ul> 
<p>Lab testing may also appropriately include biologic markers of effect, such as renal function or secondary testing, such as a neurobehavioral and psychological evaluation for children with indicative findings on exam.</p> <p>In lead-exposed patients, the hemocrit and hemoglobin values may be slightly to moderately low in the complete blood count or CBC, and the peripheral smear may be either normochromic/ normocytic or hypochromic/microcytic.</p>	<p>CAMERA</p>
<p>There may be basophilic stippling in patients who have been significantly poisoned for a prolonged period. However, because these results are not specific to lead exposure, the CBC test is not as valuable for detecting lead exposure as is the BLOOD LEAD LEVEL and ZPP assays.</p> <p>In addition, a hypochromic, microcytic anemia should be appropriately differentiated from other causes of anemia, especially iron-deficiency anemia, by the use of testing for iron, iron binding capacity, and ferritin.</p>	<p>Slide 35: Complete Blood Count.</p> <p><b>Complete Blood Count</b></p> <ul style="list-style-type: none"> <li>• May show basophilic stippling* in patients with extended significant exposure</li> </ul> 
<p>Abdominal radiographs may show the presence of radiodense lead foreign bodies in the gastrointestinal tract. These are helpful only in cases of acute ingestion of lead sinkers, curtain weights, jewelry, or paint chips or unusual persistence of high blood lead values.</p> <p>The picture on the right was taken in 2004 and shows a</p>	<p>Slide 36: Abdominal radiographs.</p>

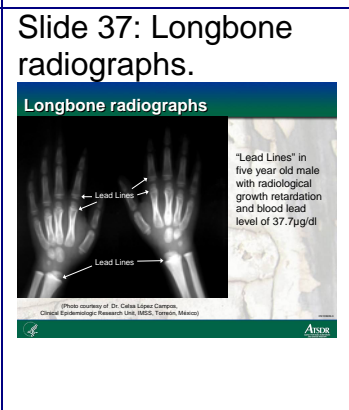


radiograph of a child who had swallowed a pendant containing lead. The child's blood lead level was over twenty micrograms per deciliter, but no environmental sources could be found.

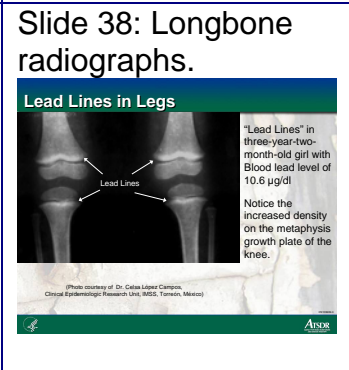
This radiograph was able to detect the source of ongoing lead exposure.



Longbone radiographs may show the presence of "lead lines" which are denser areas of bone near the growth plate. Lead lines indicate prolonged exposure to lead while growing. This radiograph shows "Lead Lines" in a five year old male with radiological growth retardation and a blood lead level of thirty seven point seven micrograms per deciliter.



This x-ray shows "Lead Lines" in a three-year old girl with a Blood lead level of ten point six micrograms per deciliter. Notice the increased density on the metaphysis growth plate of the knee.



The CDC currently considers children to have an elevated level of lead if their BLOOD LEAD LEVEL is ten micrograms per deciliter or higher. In many states, there is a requirement for reporting BLOOD LEAD LEVELS over ten micrograms per deciliter to the local or state health department. As mentioned earlier, however, health effects of lead have been shown to occur below this level.

For adults in the workplace, OSHA considers an average BLOOD LEAD LEVEL of fifty micrograms per deciliter as cause for removal from the job and a BLOOD LEAD LEVEL of forty micrograms per deciliter as cause for mandatory notification.

**Slide 39: U.S. Standards for Lead.**

An attempt should be made to identify and minimize lead exposures when BLOOD LEAD LEVELS indicate that they are occurring at any blood lead level above background population levels.

**CAMERA**

**(CHAPTER – Treatment and**

<p>The average BLOOD LEAD LEVEL for children 1 to 5 years of age was two point seven micrograms per deciliter from 1991 to 1994. The average BLOOD LEAD LEVEL for adults eighteen to seventy four years of age, from 1988 to 1991, was three micrograms per deciliter.</p> <p>It's important to remember that the average population BLOOD LEAD LEVEL may vary from place to place, depending on the extent of environmental lead in that area.</p>	<p>Instructions For Patients)</p>
<p>In general, the most important management tool for lead-associated health effects is to remove the source of lead exposure. It's important to refer patients to local or state health departments which can help determine the sources of lead exposure.</p> <p>Health departments often provide environmental investigations for children with elevated blood lead levels. These may include looking for lead hazards in their homes and other places where they spend time. If this isn't offered, refer patients to private risk assessors or information on home lead hazards, available from health departments or agencies such as the U.S. Department of Housing and Urban Development.</p> <p>Health departments can also help patients by looking for other sources of lead exposure, such as ceramics with leaded glaze, home remedies, or foods containing lead, and family members' occupations or hobbies.</p> <p>Health departments can also provide education. Patients with elevated BLOOD LEAD LEVELS, and their families, should receive education about the potential health effects of lead exposure, environmental and behavioral interventions to reduce potential for lead exposure, and the importance of good nutrition in reducing the absorption and effects of lead.</p> <p>Health departments can often furnish educational materials to health-care providers, and many times have an established program for education and coordination of care and case management.</p>	<p>Slide 40: Clinical Management.</p>
<p>In addition to education and aggressive intervention, chelation may be indicated for children with blood lead levels over forty micrograms per deciliter.</p>	<p>Slide 41: Chelation Therapy.</p>

<p>Because there are potential side effects associated with each chelation drug, and because treatment protocols differ for each, it is vital that physicians with experience in chelation therapy be consulted before any chelation therapy is begun. An accredited regional poison control center, a university medical center, or a state or local health department can help identify an experienced physician.</p>	
<p>Now, what to tell your patients. People who are exposed to lead may be exposed through a variety of sources, including deteriorating paint or contaminated soil, water, or other products.</p> <p>There may be multiple sources of exposure. Therefore, it's important to encourage patients to address all potential sources of lead and to continue blood lead monitoring to help confirm that the source or sources have been effectively eliminated. In all cases,</p>	CAMERA
<p>patients should be advised to: reduce sources of lead exposure, consume a diet high in calcium and iron, and continue to monitor BLOOD LEAD LEVELS.</p> <p>If a patient is concerned about exposure to lead at work, they should talk to their employer's health and safety officer about removal from exposure. They may also contact OSHA.</p>	Slide 42: Instructions to Patients.
<p>Patients also need to understand when and why they should call you for further medical attention. In particular, they should know to have their blood lead monitored on an ongoing basis to confirm removal from the source of exposure.</p> <p>The Agency for Toxic Substances and Disease Registry has developed a patient education sheet on lead toxicity that can help you explain this to patients. I will provide the web link to obtain this and other related products and information at the end of the program.</p>	CAMERA
<p>If your patient lives in a home built before 1978, advise them to consider the following:</p> <ul style="list-style-type: none"> <li>• test for lead hazards,</li> <li>• assume the paint has lead,</li> <li>• make sure all paint is in good condition, and</li> <li>• fix lead paint hazards safely.</li> </ul>	Slide 43: Instructions to Patients with pre-1978 homes.

<p>In addition, they should use “lead-safe” work practices when disturbing paint, which includes “working wet”, containing dust and debris, keeping the children away, using proper equipment and materials, and using specialized clean up and testing techniques after work is done.</p>	<p>Slide 44: Instructions to Patients with pre-1978 homes, Con’t.</p>
<p>It's important to avoid sources of lead by not allowing children to chew painted surfaces, wet cleaning surfaces weekly, cleaning window sills and wells, not letting children play in bare soil, and covering bare silt in the yard with grass or 6 inches of mulch.</p>	<p>Slide 45: Instructions to Patients with pre-1978 homes, Con’t</p>
<p>Other measures include: <input type="checkbox"/> running cold water for one to two minutes before using <input type="checkbox"/>, washing children’s hands and faces frequently, washing toys with soap and water <input type="checkbox"/>, and feeding children plenty of calcium <input type="checkbox"/> and iron rich foods <input type="checkbox"/></p>	<p>Slide 46: Instructions to Patients with pre-1978 homes, Con’t</p>
<p>Now I’d like to review some of the information discussed in this program. Lead was widely used in gasoline and paint throughout the United States until the mid 1970s. Because of this, lead is common in the environment.</p>	<p>CAMERA  (CHAPTER – Summary)</p>
<p>The most common route of exposure is ingestion of lead-contaminated dust in housing built before 1978. Both normal wear and tear and renovation can create dangerous levels of lead dust.</p> <p>Because of their physiology and behavior, children are at greatest risk of lead poisoning. Lead poisoning is often asymptomatic, even at levels that can cause harm. Therefore, children’s blood should be tested for lead at ages one and two, and annually up to age six, if they are at risk of lead poisoning.</p> <p>Occupations, including construction workers, automobile repair workers, and people working in lead mining or smelting may be exposed to high levels of lead.</p> <p>The most important step in managing lead poisoning is removal of the source of exposure. Local or state health departments often offer services that can assist with this aspect of case management.</p>	<p>Slide 47: Summary.</p>
<p>Patients should receive education about how to reduce or avoid future exposures.</p>	<p>Slide 48: Summary, Con’t.</p>
<p>You can get more information from your regional poison control center; State, county or local health departments; EPA</p>	<p>Slide 49: How can I get more Information?</p>

<p>National Lead Information Center; and the Alliance for Healthy Homes.</p>	
<p>For more information please contact the resources listed on the slide.</p> <p>This concludes the Environmental Medicine Grand Rounds on Lead Toxicity.</p> <p>Thank you.</p>	<p>CAMERA</p>
<p>None.</p>	<p>Slide 50: Information on home environments.</p>