Lead Poisoning

1. Disease Reporting and Follow-Up

A. Purpose of Reporting and Surveillance

1. To assess the magnitude of the lead exposure problem in Oregon.
2. To identify all tested individuals with elevated blood lead levels (EBLL).
3. To identify the sources of lead exposure for people with EBLL, and to identify, notify, and evaluate others who may be at risk from those sources.
4. To ensure that persons with EBLL receive proper medical management, including follow-up, until their concentration of blood lead is brought down to acceptable levels.
5. To ensure that adequate environmental follow-up occurs, in order to reduce or eliminate the risk of further lead exposure from identified sources for the affected child and any family members, playmates, etc. who could also be exposed to the same source.
6. For occupational exposures, to ensure that Oregon Occupational Safety and Health Administration (OR-OSHA) is provided the names of companies where employees have EBLLs where appropriate; and to collect data needed to develop strategies to minimize occupational lead exposure.

B. Laboratory Disease Reporting Requirements

1. Labs must report all blood lead tests directly to the Department of Human Services (DHS) within 7 days [333-018-0015 5(d)]. Lab results may be sent electronically or faxed to (971) 673-0457. Reporting of elevated levels within 1 working day is recommended. For more information on laboratory reporting contact the Lead Poisoning Prevention Program at (971) 673-0440.

C. Local Health Authority Follow-Up Responsibilities

1. DHS will refer childhood and non-occupational EBLL reports received directly from laboratories or providers to Local Public Health Authorities (LPHA) within one week for follow-up. If the LPHA is directly notified of an EBLL, they shall report the case to DHS using case report form (DHS 42-10). LPHA will be notified of occupational case reports. No additional follow-up by the LPHA is required.

2. All of the forms that should be used for reporting and recording the results of follow-up investigations are available from the Lead Poisoning Prevention Program at (971) 673-0440. Except for initial reporting, different forms are used for children and adults; they are listed in tables 1 and 2, respectively. Fax copies of the completed forms to the Lead Poisoning Prevention Program at (971) 673-0457, or mail to 800 NE Oregon St., Suite 640, Portland, OR 97232.

3. The nature and urgency of follow-up varies depending on the blood lead level (see table 3 and 4).

Table 1. Lead Poisoning Forms for Children (≤ 17 years old)

Form Title	Form Number	Usage
Elevated Blood Lead Reporting Form	**DHS 42-10**	**All cases with BLL ≥ 10 µg/dL**
Oregon Childhood Lead Poisoning Prevention Program Lab Slip	**OCLPPP 01**	**Lab slip for blood lead test analysis**
Medical Information Form	**OCLPPP MIF 01**	**All confirmed EBLLs ≥ 10 µg/dL**
Elevated Blood Lead Investigation Report	**OCLPPP EIQ 01**	**All confirmed EBLLs ≥ 10 µg/dL**

Table 2. Lead Poisoning Forms for Adults (≥18 years old)

Form Title	Form Number	Usage
Elevated Blood Lead Reporting Form	**DHS 42-10**	**All cases with BLL ≥ 25 µg/dL**
Physician Interview Form	**DHS 44-2**	**All Cases with BLL ≥ 25 µg/dL**
Adult Lead Case Interview Form	**DHS 44-3**	**All cases with BLL ≥ 25 µg/dL**

2. THE DISEASE AND ITS EPIDEMIOLOGY

A. Description of Illness

Lead is ingested or inhaled. The most common source of lead exposure is ingestion of lead-containing dust. The rate of lead uptake is affected by the individual's developmental stage, the route of exposure, and the nature of the lead [compounds] to which the individual is exposed. Nutritional status is also important: a healthy diet high in iron and calcium and low in fat, for example, may slow the rate of lead absorption.

Absorption depends on the form of the lead. Inhaled, airborne lead is almost totally absorbed, while ingested lead absorption rates may vary from 10% in adults to 50% in children. Lead is absorbed more efficiently from dust from sanded lead-based paint than from whole paint chips. The most dangerous exposure is to lead vapors (formed whenever lead is melted) or other respirable lead compounds. Absorbed lead is detectable in blood, soft tissue and bone. The half-life of lead varies from about a month in blood, 1-1.5 months in soft tissue, and about 25-30 years in bone [Agency for Toxic Substances and Disease Registry (ATSDR) 1999].

For the purposes of these guidelines, persons with EBLLs are considered to have lead poisoning. Lead poisoning can affect both children and adults, although the effects may vary markedly with age. It is convenient, albeit somewhat artificial, to divide lead poisoning into an acute disease that relates to current BLLs, and a chronic disease that relates to the cumulative effects of body lead burden. In both cases, the most prominent signs and symptoms are neurological. Bear in mind that persons with very high BLLs (≥70 µg /dL in children) should be treated as medical emergencies, regardless of overt symptomatology. Ingestion of a metallic object that may contain lead can result in an EBLL within hours. **Any child that has ingested such an object should receive immediate medical attention including a blood lead test and abdominal x-ray.**

Acute Disease

Acute exposure to lead generally means exposure for a short time, but at high levels. There are few data sources available for acute exposures in humans. This may be a function of the time required for the expression of effects (decreased heme synthesis, neurobehavioral changes, increased blood pressure, and interference with vitamin D metabolism) and the modes of exposure in humans, which are repeated ingestion of lead containing dust and/or dirt for children and continuous occupational inhalation exposures for adults. The most common symptom of acute lead poisoning is colicky abdominal pain evolving over days to weeks. Constipation, diarrhea, and nonspecific complaints of irritability, fatigue, weakness and muscle pain may also occur. These symptoms are seldom caused by BLLs less than 50 µg/dL. In more severe cases, warning signs of acute, serious brain swelling include vomiting, irritability, restlessness, tremors, and progressive drowsiness. These symptoms may herald the onset of seizures, coma, and possibly death. The BLLs associated with encephalopathy in children vary from study to study, but BLLs of 70-80 µg/dL or greater appear to indicate a serious risk (ATSDR 1999).

Chronic Effects

Chronic lead exposure generally means exposure to low to moderate levels of lead over a long period of time. Recent studies suggest that lead absorption is harmful at any concentration. Relatively low blood lead levels rarely cause overt signs and symptoms, but such exposure can cause permanent damage—especially in young children—including decreased IQ, developmental delays and behavioral disturbances.

B. Sources of Lead Exposure

- **Paint**

Lead was used in common house paint until 1978 when the Consumer Produce Safety Commission (CPSC) restricted its use in household paint. Many buildings built before 1978 have lead-based paint inside and outside. Housing built before 1950 is at even greater risk of having interior lead-based paint, the older the building, the more likely it is to contain lead paint. Lead paint in good condition poses little risk. Chipping, peeling or chalking lead paint is a common source of ingestible lead dust and may be a hazard.

- **Dust**

Lead paint dust is the most common source of lead exposure for children. Lead in this form is much more easily absorbed. Interior house dust can become contaminated with lead as the result of the deterioration or disturbance of leaded paint, the tracking in of contaminated soil, and the fallout of airborne lead particulate from industrial or vehicular sources. Fine lead dust, and resulting contamination, can be created when painted surfaces rub against each other, such as where double hung windows slide up and down or when doors open and close. Lead in dust is increased after older paint has been disturbed through remodeling, renovation or repainting.

- **Occupational Exposures and "Secondary Transmission"**

While lead poisoning is obviously not a communicable disease, household contacts of persons with occupational, vocational, or other exposures may be exposed to lead dust or other compounds brought home. Many occupations can expose a worker to lead. Some of the occupations that carry a potential for exposure to lead include building demolition, painting, remodeling/renovation, construction, battery recycling, radiator repair, and bridge construction. People who work in a lead environment may bring lead dust into their car or home on their clothes and bodies unintentionally exposing family members. Good hygiene practices need to be observed to avoid bringing lead dust into the home from the work place. These include washing or showering and changing out of work clothes before leaving for home.

- **Hobby Sources**

Many hobbies involve lead use (e.g., making or handling lead shot/bullets, fishing weights/sinkers, toy soldiers, stained glass solder, ceramic glazing, etc). Heating and melting lead is particularly dangerous because of the formation of lead vapor, so respirator use and adequate ventilation are essential to prevent exposure. Other hobbies that carry a potential for exposure to lead include furniture refinishing, welding, auto or boat repair, home remodeling, painting and target shooting at firing ranges. Hobbyists can protect their families by keeping the hobby activity away from living areas and by showering or changing clothes before entering the home.

- **Folk Medicines and Cosmetics**

Many home remedies, particularly popular in some ethnic communities, may contain lead. Medications such as *greta, alarcon, rueda* and *azarcon,* used in the Latino community for stomach ailments (*empacho*), or "pay-*loo-ah,*" similarly used by many Southeast Asians, may be as much as 90% lead by weight. Cosmetic products are a primary source of lead in Asian and Arab countries. Application of Kohl results in lead exposure primarily via hand-to-eye-to-mouth movement and subsequent ingestion of particles.

- **Tableware**

Imported, old, handmade, or poorly glazed ceramic dishes and pottery may contain lead. Lead may also be found in leaded crystal, pewter and brass dishware. In these pieces, acid substances may interact chemically with the glaze and accelerate the lead release. Therefore, acidic foods (such as orange, tomato and other fruit juices, tomato sauces, wines, and vinegar) stored in improperly glazed containers are potentially the most dangerous. If it is not known whether or not a particular tableware item contains lead, the item should not be used to store, cook or serve food or beverages.

- **Water**

Most well or city water does not naturally contain lead. Lead in drinking water is an infrequent source of lead poisoning in Oregon. Lead leaches into drinking water from brass faucets, lead solder that connects the pipes, or lead pipes. Hot water is particularly corrosive and should not be used for drinking, cooking, or preparing infant formula. The cold-water tap should be flushed for several minutes each morning or after sitting until there is a noticeable change in temperature of the water before any water is consumed.

- **Miscellaneous Sources**

Lead solder is no longer used in the processing of canned foods in the United States; therefore, lead in food has been dramatically reduced. Imported food products may still contain lead as some foreign manufactures use lead solder in cans. Food may also be contaminated with lead from the soil or use of lead based pesticides in the growing process. Some imported food products that are sold in ethnic markets, at swap meets, and by door-to-door vendors may contain high levels of lead. In recent years, lead has been found in candy imported from countries such as Mexico. The lead ink from the paper wrapper contaminates the candy, especially if these products are acidic tamarind and tejocote fruit.

There continues to be an ever-increasing array of household products that contain lead, especially imported products. In recent years, lead has been found in vinyl miniblinds, curtain weights, calcium supplements, hair dyes, crayons, and children's jewelry and toys. Ingestion of any object that may contain lead should be treated as a medical emergency and treatment should include a blood lead test and abdominal x-ray.

C. History of Lead Poisoning Guidelines

Lead poisoning in children was first recognized as a problem in the 1890s by two Australian physicians. In the United States, deleterious effects of long term lead exposure on children were documented as early as 1943. As evidence has accumulated on the often-subtle effects of low-dose exposure, the concentration of blood lead considered "harmless" has steadily declined. Levels that 30 years ago were considered acceptable may today be classified as a medical emergency.

The insidious nature of lead poisoning means that the only way to know if an adult or child has an EBLL is to do a blood test. In adults the zinc protoporphyrin (ZPP) level may also be helpful in assessing exposure over the last three months. Some degree of lead exposure is ubiquitous in our society, but increasing awareness of the hazards of lead has lead to marked reductions in exposure for many Americans. The average overall BLL in the U.S. was less than 2 µg/dL in 2005—down from 12.8 µg/dL in 1976

D. Occupational Exposures and OR-OSHA Involvement

OSHA standards govern occupational lead exposure in General Industry and Construction. These standards have very specific guidelines on blood lead monitoring of workers and provisions for removing workers from exposure when blood lead levels exceed 50 mg/dL. The DHS is responsible for ensuring follow-up of EBLLs in occupationally exposed adults and referral of cases to OR-OSHA as necessary. A quarterly listings of firms with at least one employee having a BLL 50 µg/dL is provided to OR-OSHA.

3. CASE DEFINITIONS, DIAGNOSIS, AND LABORATORY

A. Testing Methods

Blood lead testing is the only acceptable laboratory test for screening and confirming lead poisoning. Venipuncture is preferred for specimen collection, but capillary testing is acceptable if care is taken to properly clean and prepare the finger. Capillary samples are easier to contaminate because of the possibility of lead containing dust and dirt on the hand or under the fingernails. All capillary BLLs of 10 µg/dL or higher must be followed with a confirmatory venous test. The higher the capillary screening BLL, the more urgent the need for a venous confirmatory test. The schedule for confirmatory testing of a child with an EBLL is in table 3.

Several tests have been found to be insensitive and/or imprecise as **screening** tests for lead, and are not recommended. These include: erythrocyte protoporphyrin (EP), zinc protoporphyrin (ZPP) basophilic stippling, urine testing, and assays of hair or fingernail lead levels.

Table 3. Confirmatory Testing Schedule (Source: Centers for Disease Control and Prevention)

Any capillary screening BLL above 10 µg /dL must be confirmed with a venous sample. The higher the BLL on the capillary test, the more urgent the need for confirmatory testing.

If result of capillary test (µg/dL) is:	Perform confirmatory test on venous blood within:
5-9	Children under 12 months: Confirmation within 3 months recommended. Children over 12 months: Confirmatory testing optional, parents should discuss with provider. If recent known exposure: confirm as soon as possible.
10-14	3 months
15-19	1 month
20-44	1 week-1 month
45-59	48 hours
60-69	24 hours
≥ 70	Immediately as an emergency lab test

Exception to confirmatory testing schedule: If a child with an elevated capillary screening test result is less than **12 months old,** or if there is reason to believe that a child's BLL may be increasing rapidly (e.g. foreign body ingestion of leaded object) consider performing the confirmatory test sooner than indicated in the accompanying schedule.

B. Case Definitions

1. **Confirmed EBLL**

   Children (≤ 17 years old*).* Venous BLL ≥ 10 µg /dL

   Adults (≥ 18 years old*).* Venous BLL ≥ 25 µg /dL

4. SCREENING SCHEDULES AND MEDICAL MANAGEMENT

A. Overview

The goal of lead screening is to identify children who have been exposed to lead, provide appropriate interventions and reduce the risk of exposure. If an EBLL is detected, the nature of care and the frequency of follow-up testing vary with the patient's age and the BLL. Whatever the age, people with EBLLs (or their parents) should be educated about what lead poisoning is and what they can do about it. **The single most important factor in managing lead poisoning is identifying and reducing exposure to lead.** A variety of culturally appropriate educational pamphlets are available; they should be sent to the family of anyone identified as having an EBLL.

B. Anticipatory Guidance

Anticipatory guidance regarding lead hazard identification and risk reduction measures should be a routine part of an ongoing educational approach for pregnant women, children and their families. Health Care Providers should provide source identification and risk reduction educational materials. There is no safe level of lead and the majority of children and adults in the U.S. have blood lead levels less than 2 µg /dL. Therefore, children and adults should be encouraged to maintain the lowest possible blood lead level.

Lead exposure during pregnancy is especially problematic as lead can cross the placenta and interfere with normal development of the fetal brain. Pregnant women can be exposed to lead through all of the sources described previously. Pregnant or women likely to become pregnant should try to maintain lead levels below 10 µg /dL and as low as possible. Anticipatory guidance should focus on decreasing the risk of exposure to lead by advising against activities such as remodeling or repainting the baby's room or restoring old furniture. Women exposed occupationally may need special counseling.

C. Screening Protocols for Children

All children should be assessed for risk of lead poisoning by administration of the Oregon Lead Risk Assessment Questionnaire (see below). This questionnaire should be administrated at 1 and 2 years of age and between 3 and 5 years of age if not previously screened. If the answer to any question is "Yes" or "Don't know" a blood lead test should be performed. Follow-up questions may be needed to clarify responses.

1. Does your child live in or regularly visit a home, child care or other building built before 1950?
2. During the past 6 months has your child lived in or regularly visited a home, child care or other building built before 1980 with recent or ongoing painting, repair, remodeling or damage?

3. Does your child have a brother, sister, other relative, housemate or playmate with lead poisoning?
4. Does your child spend time with an adult that has a job or hobby where they may work with lead (such as painting, remodeling, auto radiators, batteries, auto repair, soldering, making sinkers, bullets, stained glass, pottery, going to shooting ranges, hunting or fishing)?
5. Do you have pottery or ceramics made in other countries or lead crystal or pewter that are used for cooking, storing or serving food or drink?
6. Has your child ever used any traditional, imported or home remedies or cosmetics such as Azarcon, Alarcon, Greta, Rueda, Pay-loo-ah, or Kohl?
7. Has your child been adopted from, lived in or visited a foreign country in the last 6 months?
8. Do you have concerns about your child's development?

D. Diagnostic Blood Lead Testing

Blood lead testing should also be considered as part of a diagnostic work-up of any child regardless of age with the following symptoms:

- **Behavioral problems:** aggression, hyperactivity, attention deficit, school problems, learning disabilities, excessive mouthing or pica behavior and other behavior disorders.
- **Developmental problems**: growth, speech and language delays and/or hearing loss.
- **Symptoms or signs consistent with lead poisoning:** irritability, headaches, vomiting, seizures or other neurological symptoms, anemia, loss of appetite, abdominal pain and cramping or constipation.
- **Ingestion of foreign body.**

E. Follow-up for Childhood Blood Lead Results

Any capillary screening BLL above 10 µg/dL must be confirmed with a venous sample. The higher the BLL on the capillary test, the more urgent the need for venous confirmatory testing.

The table below is to be used as guidance. Case managers and medical providers should consider individual patient characteristics and caregiver capabilities and adjust the frequency of follow-up tests accordingly.

Exception to confirmatory testing schedule: If a child with an elevated capillary screening test result is less than **12 months old,** or if there is reason to believe that a child's BLL may be increasing rapidly (e.g. foreign body ingestion of leaded object) consider performing the confirmatory venous test sooner than indicated in the accompanying schedule.

Table 4. Follow-up Schedule for Childhood Blood Lead Results

BLL (µg/dL)	Confirmation Testing (venous)	Follow-Up Testing (venous)	Case-management (with confirmed EBLL)
5-9	**Children under 12 months:** Confirmation within 3 months recommended. **Children over 12 months:** Confirmatory testing optional, parents should discuss with provider. If recent known exposure: confirm as soon as possible.	Follow-up testing optional.	No local health department case management required. Health Care Provider to provide source identification and risk reduction education. No additional action necessary unless exposure sources change.
10-14	3 months	3 months	Have medical provider complete medical information form (OCLPPP MIF 01). Send letter to caregiver confirming child's BLL Complete environmental questionnaire over phone or perform on-site investigation to determine possible lead hazards. Refer family to lead hazard control services if applicable and/or available. Provide nutritional and risk reduction education. If WIC enrolled notify local WIC program of EBLL. Refer family to WIC, social services, public assistance and early intervention as needed. Assure follow up blood lead testing. Advise medical provider of environmental investigation results and need to include history of EBLL in problem list of child's medical record. Monitor for developmental problems and discuss with caregiver and medical provider of need for long-term developmental surveillance. Send copies of forms to DHS.
15-19	1 month	3 months	Above actions.
20-44	1 week-1 month	1 month	Above actions, plus: Children with BLLs $\geq$ 20 µg/dL should have physical exams.
45-59	48 hours	Chelation with subsequent follow-up.	Above actions plus chelation therapy.
60-69	24 hours	Chelation with subsequent follow-up	Above actions plus chelation therapy.
>70	Immediately as an emergency lab test	Chelation with subsequent follow-up	Above actions, plus hospitalize child for chelation therapy immediately. The child should not be permitted to return to any environment that would expose him/her to lead.

F. Case Management Time Frame

Time frame for beginning case management or providing environmental investigations should begin as soon as confirmatory EBLL results are received.

G. Follow-up for Adult Cases

1. Occupational Exposures

All occupational case follow-up will be conducted by DHS staff. If the initial report form is sent to the LPHA directly by a health care provider or lab, and you cannot tell if it is an occupational exposure, the LPHA may contact the provider or refer the report to DHS to determine the type of exposure.

2. Non-occupational reports

25-39 µg /dL
Interview the patient's physician (DHS 44-2) to obtain suspected source of exposure and determine if other household members, especially children and pregnant women, are also being exposed. Consult with DHS adult blood lead surveillance staff (971-673-0440) to determine whether additional follow-up actions are necessary. If exposure source is non-occupational please complete the Adult Lead Case Interview form (DHS 44-3).

≥ 40 µg /dL
Interview the patient's physician (DHS 44-2) to obtain suspected source of exposure and determine if other household members, especially children and pregnant women, are also being exposed. Complete the Adult Lead Case Interview form (DHS 44-3). Discuss findings with DHS adult blood lead surveillance staff (971-673-0440) to determine whether additional follow-up is necessary to prevent ongoing exposures to the individual.

≥ 50 µg /dL
Same actions, plus: If occupational exposure, worker should be transferred to a job that doesn't expose the employee to lead.

≥ 60 µg/dL
BLLs at this level should be considered urgent. The Oregon Poison Center (1-800-222-1222) is a referral source for physicians requesting advice on treatment of adults. The greatest concern with adult cases is determining the source of exposure and determining whether other individuals are at risk from the same lead source.

H. Chelation Therapy

Chelating agents solubilize lead, depleting it from soft and hard tissue and thereby reducing its acute toxicity. While chelation therapy is considered a mainstay in the medical management of children with BLLs ≥45 µg/dL, it should be used with caution. Treatment with chelating agents lowers BLLs, but does not improve scores on tests of cognition, behavior, or neuropsychological functions except in patients with extremely high BLLs. Primary care providers (PCP) should consult with the DHS Lead Poisoning Prevention Program or Oregon Poison Center prior to using chelating agents. In the short term, chelation can redistribute body lead, causing an increase in lead concentrations in soft tissue, including the brain. Some chelators may remove essential minerals, such as iron, zinc, copper and other trace minerals, as well as lead. There is general agreement that individuals with very high BLLs (in children ≥ 45 µg/dL; in adult ≥100 µg/dL) should be chelated. Patients with lower BLLs (children, <25 µg/dL; adults, <65 µg/dL) are usually not chelated unless symptomatic and/or unresponsive to removal from exposure. For patients with in-between BLLs, chelation may or may not be appropriate.

I. Case Closure

It often takes an extended period of time to complete all elements of case management. Cases may be closed when the following criteria have been met:

1. **Laboratory case closure**- Child's BLL has declined to below 10 µg/dL on **two** consecutive tests.
2. **Administrative case closure**-Child is lost to follow-up. If child/family move out of state, please notify DHS so that the Childhood Lead Poisoning Prevention Program in the state where child has relocated can be notified. There should be at least three documented attempts to contact the family, whether by phone or letters. If possible, the last attempt to reach family should be through certified mail.