

Clinical Management of Lead Exposure in Pregnant and Lactating Women and the Breastfed Infant

Adapted from CDC Guidelines¹ and ACOG Recommendations²

- There is no blood lead level (BLL) that is not associated with adverse health outcomes (no safe level).
- Lead readily crosses the placenta and is transferred through breast milk.
- Elevated BLLs during pregnancy and early life are associated with significant adverse outcomes.
- Evaluate *all* women for lead exposure risk factors early in pregnancy or prior to conception.
- Obtain a blood lead level on women who are positive for any lead exposure risk factor.
- Follow medical management guidelines for pregnant or breastfeeding women with a BLL \geq 5 ug/dL.
- Document maternal BLL and the cord or newborn venous BLL in medical records.
- Encourage breastfeeding with medical monitoring unless the mothers BLL \geq 40 ug/dL or the infant's BLL fails to decline as expected over time.

Lead Exposure in Pregnant and Breastfeeding Women: The Basics

- After entering the bloodstream, lead is deposited and stored primarily (90%) in bones. A BLL measures lead circulating in the blood at a given time but cannot measure the body's total lead burden.
- Because maternal bone lead stores acquired from previous exposure are mobilized during pregnancy, an elevated BLL may occur in the absence of any recent, or acute exposures to lead.
- BLLs may start increasing in the third trimester and through the postpartum period without changes in environmental lead exposure due to increased mobilization of lead from bones for women with bone lead stores.³
- Lead readily crosses the placenta by passive diffusion. Cord blood lead levels are strongly correlated to maternal blood lead levels (with cord BLL being on average 0.80 times that of maternal BLL.)¹
- Lead transfers into human milk and is a source of lead exposure for breastfed infants.
- Lead is neurotoxic. Prenatal and early childhood lead exposure are associated with decreased IQ, learning and behavior problems, and reduced growth.
- Elevated maternal BLLs are associated with an increased risk for gestational hypertension, spontaneous abortion, and preterm delivery.
- Providers can prevent or mitigate harm to pregnant women and children by:
 - evaluating all women who are pregnant, considering pregnancy, or lactating for lead exposure risk factors and performing blood lead screening on women positive for risk factors
 - following recommended medical management for those with elevated BLLs
 - providing anticipatory guidance on preventing exposure to those without current risk factors

Risk Factors for Lead Exposure

- Recent immigration
- Living near a contamination source
- Occupational exposure
- Lead-glazed ceramic pottery
- Pica – eating nonfood substances
- Folk remedies or alternative therapies
- Imported products like cosmetics or spices
- Recreational activities using lead
- Renovating/remodeling pre-1978 homes
- Contaminated drinking water
- History of previous lead exposure
- House member with an elevated lead level

Evaluation for Risk Factors of Lead Exposure

Evaluate women as early in the clinical relationship as possible for lead exposure risk factors. Ideally, women of reproductive age who are considering having children would be screened for risk factors of lead exposure since lead exposure prior to conception can later be mobilized from bone stores and transferred to the fetus or breastfeeding infant. It is wise to reevaluate for certain risk factors as they may change from pre to postpartum, such as housing, home renovation, family member's jobs and hobbies, use of imported personal products or food/spices, and use of folk remedies or alternative therapies. Ask the following questions:

- Were you born, or have you spent any time living, outside of the United States?
- Do you live in a home that was built before 1978? If so, in the last 12 months, has there been any renovation or repair work in your home or apartment building?
- To your knowledge, has your home drinking water been tested for lead and if so, were you told that the level was high? *Screen as positive only if answer is "yes."*
- During the past 12 months, did you use any imported health remedies (like traditional folk remedies), spices, foods/candies, ceramics, or cosmetics?
- Sometimes pregnant women have the urge to eat things that are not food, such as clay, soil, plaster, or paint chips. During your pregnancy did you ever eat, chew on, or mouth nonfood items—even accidentally?
- Have you ever had a job or hobby that involved possible lead exposure, such as home renovation, refinishing painted wood, fishing, hunting, or working with glass, ceramics, or jewelry?
- Do you or others in your household have an occupation or hobby that involves lead exposure?
- Do you live near any industrial operations, such as a mine, smelter, or battery manufacturing plant? A hazardous waste site? Have you been told there is lead in the soil near your home? (*positive only if yes*)

Blood Lead Screening

The American College of Obstetricians and Gynecologists (ACOG) recommends obtaining blood lead tests to screen pregnant women for exposure only if they are positive for any risk factors for lead exposure² (answer "yes" or "don't know" to the above questions). Venous blood samples are recommended. Elevated capillary BLLs will need to be verified by a venous BLL.

Medical Management of Elevated BLL during Pregnancy

BLLs < 5 µg/dL

- Provide anticipatory guidance on steps to prevent exposure to lead, including:
 - Never eat or mouth nonfood items, such as clay, soil, pottery, or paint chips, because they may be contaminated with lead.
 - Avoid jobs or hobbies that may involve lead exposure and take precautions to avoid lead contamination if a household member works with lead. Such work includes construction or home renovation/repair in pre-1978 homes, and lead battery manufacturing or recycling.
 - Avoid using imported lead-glazed ceramic pottery, pewter, brass, or leaded crystal to cook, serve, or store food. Do not use dishes that are chipped or cracked.
 - Avoid participating in repair, repainting, renovation, and remodeling work being done in homes built before 1978 in order to avoid possible exposure to lead-contaminated dust. Take precautions to avoid potentially contaminated dust and deteriorated lead-based paint.
 - Avoid cosmetics, food additives, and medicines imported internationally that may contain lead, such as azarcon, kohl, kajal, surma, and many others.
 - Use caution when consuming candies, spices, and other foods that have been imported directly or brought into the country by travelers from abroad.
 - Eat a balanced diet with adequate intakes of iron, vitamin C, and calcium, and avoid the use of cigarettes and alcohol.

BLLs \geq 5-14 $\mu\text{g}/\text{dL}$

- Identify and eliminate any ongoing exposures. Provide anticipatory guidance on avoiding lead exposure to prevent additional exposures.
- Optimize nutrition, balanced diet, prenatal vitamins.
 - Assess for adequate dietary intake of Calcium, iron, zinc, Vitamins C, D and E.
 - Prescribe dietary intake of Ca^+ 2000 mg/day.
 - Evaluate iron status and treat anemia accordingly.
- Refer to nutrition assistance programs (i.e. SNAP) for those in need.
- **Repeat venous BLL within 1 month.**
- Obtain maternal BLL or cord BLL at delivery.
- Inform infant's healthcare provider of mother's lead exposure and BLL at delivery, so they may document it in the newborns medical record and provide on-going monitoring for child.
- Consider consulting an Environmental or Occupational Health Specialist for support.

BLLs \geq 15-44 $\mu\text{g}/\text{dL}$

ALL OF THE ABOVE (except bolded), PLUS:

- Encourage environmental risk assessment by health department with case management.
- **Repeat venous BLL within 1-4 weeks and then every 2-3 months, depending on risk factors. For $\text{BLL} < 25 \mu\text{g}/\text{dL}$, repeat monthly.**

BLLs \geq 45 $\mu\text{g}/\text{dL}$

ALL OF THE ABOVE (except bolded), PLUS:

- Treat as a high-risk pregnancy and consult with an expert in lead poisoning and chelation (chelation warranted in cases of life-threatening lead encephalopathy regardless of BLL).
- Refer to a maternal fetal medicine specialist.
- **Repeat venous BLL within 24 hours and then at frequent intervals as advised.**

Medical Management of Elevated BLL during Lactation

When CDC's guidance was published in 2010, available data indicated that levels of lead in breast milk were low and that the most probable value of maternal milk to blood lead ratio was substantially less than 3%¹. Additional research suggests that the toxicokinetics of lead between the compartments of blood, plasma, and breast milk are complex and acknowledges a range of variability in the research population's ratio of lead in breast milk versus plasma or blood⁴. However, the benefits of breastfeeding continue to outweigh the risks from potential exposure based on the current state of evidence.

- Encourage the initiation of breastfeeding unless the mothers BLL is $\geq 40 \mu\text{g}/\text{dL}$, in which case the mother should pump and discard her breast milk until her BLL is $< 40 \mu\text{g}/\text{dL}$.
- Evaluate mother for new lead exposure risks or ongoing sources of lead exposure.
- Assess maternal nutrition for iron, vitamin C, and calcium. Prescribe calcium supplementation of 1,200 mg/daily for lactating mothers with elevated BLLs.
- Assess lactating women for risk factors for new or ongoing lead exposure.
- Monitor maternal BLL and infant BLL according to the schedules in the tables below. Encourage the continuation of breastfeeding without interruption unless *all* the following are true:
 - Infant's BLL is $\geq 5 \mu\text{g}/\text{dL}$
 - maternal BLL is $\geq 20 \mu\text{g}/\text{dL}$ *and* the infant's BLL is rising or fails to decline by $5 \mu\text{g}/\text{dL}$ or more on follow-up testing (tables 2 and 3)
 - a comprehensive evaluation of the infant's diet and environment fails to identify any potential lead exposure sources other than breastmilk
- Because decisions on when to do follow up for maternal blood testing is impacted by the infant's BLL results, coordination of care between healthcare providers for both mother and infant is required in the postpartum period. Consider consulting a lead poisoning expert prior to making recommendations to interrupt breastfeeding based on maternal BLL.

Table 1. CDC Recommendations for Maternal Blood Lead Testing During Lactation¹

Initial ^a BLL (µg/dL)	Maternal Blood Lead Follow-up Testing During Lactation to Assess Risk for Infant Lead Exposure
5 – 9	Every 3 months, per guidelines for adult blood lead testing, unless infant BLLs are rising or fail to decline ^b
20 - 39	2 weeks postpartum and then at 1- to 3-month intervals depending on direction and magnitude of trend in infant BLLs ^b
≥ 40	Within 24 hours postpartum and then at frequent intervals depending on clinical interventions and trend in BLLs - Consultation with a clinician experienced in the management of lead poisoning is advised.

^aBLL at time of birth (mother’s venous blood or cord blood) or last BLL measured in pregnancy.

^bDecision on how soon to retest is informed by the infant’s BLL in follow-up blood lead testing (see Tables 2 and 3 below)

Medical Management Elevated BLL in the Breastfeeding Infant

A breastfed infants BLL will be influenced by their exposure to maternal lead in utero and subsequent mobilization of bone lead from in utero exposures, environmental exposure sources, and lead ingestion through breastmilk. Infant blood lead is significantly associated with maternal breast milk lead levels⁴. Monitoring maternal and infant blood lead levels ensures children are not at risk for harm from transfer of maternal lead into breastmilk.

- Evaluate for environmental and other sources of post-natal lead exposure in breastfed infants with BLL >5. Environmental sources of lead exposure in newborns and young children may include:
 - use of imported traditional products such as kohl or surma (on mother, infant, or others who come into contact with the infant)
 - interacting with individuals with occupational and recreational lead exposures
 - jewelry or metal toys that are touched or mouthed by infant
 - contaminated dust from renovations inhaled or ingested through hand to mouth behavior
- Encourage breastfeeding. If maternal BLL is >20 µg/dL, temporary interruption of breastfeeding may be warranted until maternal BLL ≤ 20 µg/dL, if *all* the following are true:
 - Infant’s BLL is ≥ 5 µg/dL
 - infant’s BLL is rising or failing to decline by ≥5 µg/dL on follow-up testing (Tables 2 and 3)
 - no potential sources of lead other than breastmilk are identified
- Consider consulting an expert in lead poisoning (medical toxicologist or pediatric environmental health specialist) prior to making recommendations to interrupt or discontinue breastfeeding given the many benefits of breastfeeding and complex nature of lead’s toxicokinetic properties.

Table 2. CDC Follow-up Blood Lead Testing of the Neonate (<1 Month of Age)¹

Initial ^a BLL (µg/dL)	Perform follow-up test(s) on the Neonate
<5	Follow local lead screening guidelines for children (refer to State Health Department.) Current Federal guidelines require <i>all</i> children on Medicare to be tested for lead at 12 and 24 mos.
5 -24	Within 1 month (at first newborn visit).
25 - 44	Within 2 weeks. Consultation with a clinician experienced in the management of children with BLLs in this range is strongly advised. ^b
≥45	Within 24 hours and then at frequent intervals depending on clinical interventions and trend in BLLs. Prompt consultation with a clinician experienced in the management of children with BLLs in this range is strongly advised. ^b

^aThe initial BLL may be from an umbilical cord sample at the time of delivery or an infant venous BLL. A venous blood sample is preferred over a capillary sample. Decisions to initiate or stop breastfeeding or initiate chelation therapy should be based on venous blood lead test results only.

^bThe higher the BLL on the initial test, the more urgent the need for confirmatory testing. Clinical experts can be reached at the Poison Center or your regional Pediatric Environmental Health Specialty Unit (contact information below).

Table 3. CDC Schedule for Follow-up Blood Lead Testing in Infants <6 Months of Age^{a, 1}

Venous BLL (µg/dL)	Early (first 2-4 tests after identification or until BLL begins to decline)	Later follow-up (after BLL begins to decline)
<5 ^b	Follow local lead screening guidelines for children ^a	Follow local lead screening guidelines for children ^a
5 ^b -14	3 months ^c	Within 6-9 months
15-19	1-3 months ^c	Within 3-6 months
20-24	1-3 months ^c	Within 1 -3 months
25-44	2 weeks-1 month ^d	Within 1 month
≥45	Within 24 hours ^d	As directed by clinician managing chelation treatment

^aAfter 6 months of age or for infants with BLL <10, follow blood testing follow-up recommendations from local or state public health department. Current Federal guidelines require all children on Medicare to be tested for lead at 12 and 24 mos.

^bThe original CDC schedule has been modified to reflect CDC's current BLL reference value for children of 5µg/dL.^{5,6}

^cSome case managers or primary care providers may choose to repeat blood lead tests on all new patients within a month to ensure that their BLL levels are not rising more quickly than anticipated. Seasonal variation of BLLs exists and may be more apparent in colder climate areas. Greater exposure in the summer months may necessitate more frequent follow ups.

^dConsultation with a clinician experienced in the management of children with BLLs in this range is strongly advised (PEHSU, Poison Control.)

About PEHSU

Northwest Pediatric Environmental Health Specialty Unit (PEHSU) is part of a national network of experts in pediatric environmental health capable of responding to requests for information or for assistance with medical management of nonurgent environmentally related health conditions. NW PEHSU is based at the University of Washington and provides services within Washington, Idaho, Oregon, and Alaska. Contact NW PEHSU at 1-877-KID-CHEM or pehsu@uw.edu or visit our website <http://www.deohs.washington.edu/pehsu>. To connect to the national PEHSU network and find the contact information for your regional PEHSU, go to pehsu.net.

If an individual is acutely symptomatic from a suspected environmental exposure, call the Poison Center (1-800-222-1222) or seek medical care immediately.

Citations

1. [Guidelines for the Identification and Management of Lead Exposure in Pregnant and Lactating Women](#). Centers for Diseases Control, 2010.
2. [Lead Screening During Pregnancy and Lactation](#). American College of Obstetrics and Gynecology (ACOG): Committee on Obstetrics Practice, 2016.
3. Gulson, B., Taylor, A., and Eisman, J. Bone remodeling during pregnancy and port-partum assessed by metal lead levels and isotropic concentrations. *Bone*. 89: 40-51. 2016.
4. Ettinger, A, et al. [Maternal Blood, Plasma, and Breast Milk Lead: Lactational Transfer and Contribution to Infant Exposure](#). *Environmental Health Perspectives*. 122:87-92. 2014
5. [Response to Advisory Committee on Childhood Lead Poisoning Prevention Recommendations in "Low Level Lead Exposure Harms Children: A Renewed Call of Primary Prevention."](#) Centers for Disease Control, 2012.
6. [Blood Lead Reference Value](#). Centers for Diseases Control, reviewed January 6, 2020.

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