INTERPRETING AND MANAGING PEDIATRIC BLOOD LEAD LEVELS < 10 µg/dL: A Guide for Clinicians

PEHSU Pediatric Environmental Health Specialty Units

What does a Blood Lead Level (BLL) < 10 µg/dL mean?

The BLL is a useful indication of the extent of exposure to lead, a common environmental contaminant. The most recent population-based sampling by the CDC (2005-2006) provides an estimate of the geometric mean BLL for U.S. children, which can help frame a reference for exposures for individuals. The geometric mean BLL for children aged 1-5 years is 1.5 µg/dL, aged 6-11 is 1.0 µg/dL, and aged 12-18 years is 0.8 µ/dL. For these age groups, a BLL of 3 µg/dL represents approximately the 90th, 95th, and >95th percentile, respectively.

Unfortunately, there is no safe level of lead exposure for children, and even lower ranges of BLLs (below 10 µg/dL) are known to be a risk factor for impaired cognitive and behavioral outcomes in children. In fact, current and consistent evidence suggests that the reduction in children's IQ scores (per unit increase in BLL) is greater in the range of BLLs that are 0 to 10 µg/dL than it is for BLLs > 10 µg/dL.

However, remember that a single blood lead level in this range for any individual child is not predictive of effects for that child. It is one of multiple risk factors. Cognitive effects related to lead are dwarfed by the impact of the home psychosocial environment and genetic inheritance. Parent interaction with the child may have a much greater impact than lead in these ranges.

Blood lead measurement interpretation considerations

Providers should have children wash hands with soap and water prior to obtaining a capillary sample to minimize fingerstick contamination issues.

An initial BLL > 4 µg/dL should be confirmed in 1-4 weeks because laboratory and sample collection methods can influence the results.

Most laboratories performing BLL testing can achieve an error range within +/- 2 µg/dL, however, currently the allowable error range for a lab to be in compliance with proficiency testing is +/- 4 mcg/dL. The limit of detection is typically 1 µg/dL or less when the most sophisticated machines (inductively coupled plasma method – ICP MS) are used. Many sites do not have these and instead use graphite furnace atomic absorption spectrophotometry (AAS). The limit of detection for AAS is around 5 mcg/dl. The error range for the handheld LeadCheck II instruments (a CLIA-waived instrument using a capillary sample) is +/- 3 mcg/dL.

Ingested lead distributes first into the red blood cell, and then re-distributes into soft tissues (25%) and bone (70%). For children with baseline low levels of lead exposure, after an acute exposure, the level will fall rapidly (weeks). So a large decrease from the first to second lead level may reflect an acute exposure followed by body equilibration, or may result from laboratory or fingerstick contamination issues.

Medical management of a BLL < 10 µg/dL (For the management of BLLs ≥ 10 µg/dL, see key references or contact NW PEHSU).

The first priority is to identify sources and prevent ongoing exposure. Lead paint and contaminated dust/soil are sources responsible for the majority of elevated BLLs in U.S. children, but there is increasing evidence of exposure through other sources. It is important to question families about the child's home environment as well as other potential exposure sources. Talk to parents about exposure pathways (floor to hand to mouth) and important sites of exposure (windowsills).

- Does the child live in a home or regularly visit a building (*e.g. school, daycare*) built before 1950, or a building built before 1978 with recent or ongoing painting, repair, and/or remodeling?
- Could the soil where the child lives or plays be contaminated with lead (*e.g., neighborhood with older housing, current or historical mining, smelting, or agriculture)*?
- Could the child's drinking water be contaminated? Consider testing water sources for lead contamination. Most NSF certified faucet mounted water filters remove lead - see PEHSU factsheet on lead removal from drinking water.
- Does the family have older or antique furniture with lead-based paint? Older children's toys?
- Does the child spend time with anyone who has a job or hobby where they may work with lead in the home or bring lead dust home on shoes and clothing (*e.g. painting, remodeling, auto radiators, ship repair, soldering, making sinkers or bullets, going to shooting ranges, welding, mining, stained glass, pottery, jewelry, antiques, or imported toys*)?
- Does the family use pottery or ceramics made in other countries (especially Mexico and China), lead crystal or pewter, or vintage dishes for cooking, storing, or serving food or drink? (Restrictions on lead in dishes were implemented in late 1980s and strengthened in early 1990s—since then US made dishes are without lead)
- Are imported spices used or home spices brought from other countries?
- Has the child ever used imported cosmetics or taken any traditional home remedies (*e.g. Azarcon, Alarcon, Greta, Rueda, Pay-loo-ah, Kohl*)?
- Has the child been adopted from, lived in, or visited another country?
- For children < 12 months, consider mother as the source for transmission prenatally and through human milk. Are there maternal risks for lead exposure (see CDC Guidelines for Pregnant and Lactating Mothers)?

Although a specific source may not be identified, the medical provider can still provide information and counseling to the family on common sources of exposure and how to avoid them (*e.g. use a doormat and take off shoes when entering the home, wash children's and adults' hands often, do not allow children to chew on painted wooden toys or furniture or windowsills).*

If a lead paint hazard is identified (e.g. paint prior to 1978), some practical lower cost approaches include simply keeping it in good condition, cleaning up dust often (wet wiping and using vacuums with HEPA filters), or painting over suspect paint.

A preventive home inspection may be the best approach to identify and characterize lead hazards in the home. Such inspections typically cost ($400-$1000) and individual dust wipe samples cost about $35 each. Information on EPA recommended test kits is available at http://epa.gov/lead/pubs/testkit.htm. Proper and safe remediation is important to avoid actually increasing the risk for a child's exposure. Information on proper remediation and repair is available from the EPA at http://www.epa.gov/lead/pubs/renovation.htm - homeowners

Also, note that federal law requires that home sellers must disclose a lead hazard at the time of sale.

Further Medical Management

- Sufficient body iron stores are very important, since inadequate iron increases absorption of ingested lead. Evaluate anemia (Hemoglobin level) and iron stores (iron level, ferritin, or TIBC). Treat low hemoglobin or low iron stores with iron, 4-5 mg/kg/day x 3 months
- Adequate intake of calcium and vitamin C also has the benefit of minimizing lead absorption. A multivitamin with iron and/or counseling on the improved absorption of iron with adequate vitamin C ("fruit at every meal") may be advised.
- For confirmed BLLs in range of 4-9 µg/dL, recheck child's BLL within 12 weeks, preferably using the most sensitive method (ICP MS).
    - For infants with BLLs > 4 mcg/dL, recheck earlier and include iron status. Their increasing mobility increases their risk of exposure.
- Consider testing other members of the household/family, as this may aid identification of lead sources.
- Chelation therapy is *not* recommended for BLL's < 45 µg/dL except in special circumstances. Consult the PEHSU for chelation questions. The FDA recently released a statement warning of the dangers of off-label use of chelation therapies: http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm229358.htm

Resources for advice on identifying and reducing potential exposure sources

Call the local health department for assistance in evaluating the home environment for lead.

Region X State-specific lead programs

- Alaska Lead Surveillance Program: http://www.epi.hss.state.ak.us/eh/lead/default.htm
- Idaho Department of Health and Welfare lead education:http://healthandwelfare.idaho.gov/Health/EnvironmentalHealth/IndoorEnvironment/Lead/tabid/941/Default.aspx
- Oregon lead poisoning prevention: http://www.oregon.gov/DHS/ph/lead/index.shtml
- Washington State Childhood Lead Poisoning Prevention program: http://www.doh.wa.gov/ehp/lead/default.htm

National programs

- CDC tips for reducing lead exposure: http://www.cdc.gov/nceh/lead/tips.htm
- EPA tips for reducing lead exposure and safe home remodeling: http://www.epa.gov/iaq/homes/hip-lead.html - Ways to Reduce Exposure to Lead
- EPA web-based information on childhood lead exposure: http://www.epa.gov/lead/index.html

For additional questions or guidance, contact the NW PEHSU. The University of Washington based Pediatric Environmental Health Specialty Unit (PEHSU) serves medical and public health professionals in Alaska, Washington, Idaho, and Oregon. For more information contact us at 206-744-9380 or pehsu@uw.edu or visit our website http://www.depts.washington.edu/pehsu.

Key References

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