

Understanding Blood Testing Results for Adult Exposure to Lead

Adult exposures to lead are generally by inhalation of lead dust. Lead can also be taken in when lead dust on the hands or face is accidentally swallowed while eating, drinking or smoking. Lead accumulates in the body and is stored in bone for decades.

There are several methods to identify and measure lead in human tissue or fluids. The most useful and common method is to measure the amount of lead in whole blood. A blood lead test is mainly an estimate of recent exposure to lead, but it is also in equilibrium with bone lead stores. The blood lead level (BLL) alone is not a reliable indicator of prior or cumulative dose or total body burden. When interpreting the BLL, key questions are whether the exposure has been 1) of short-term or long-term in duration; 2) recent or in the past; and 3) in large or small amounts.

The Oregon Lead Poisoning Prevention Program advises against the use of hair or urinalysis for diagnosing lead poisoning. Chelation or challenge testing should also not be used for diagnostic purposes.

We recommend that adults who have occupational lead exposure or who have non-occupational intermittent lead exposures have a protoporphyrin test in addition to the whole blood lead test. This additional test can be made on the same sample of blood as the blood lead test.

There are two tests available to measure intermittent lead exposures over time, the erythrocyte protoporphyrin (EP), which can be measured as free EP (FEP) or zinc protoporphyrin (ZPP). These tests measure biological effect and are an indirect reflection of lead exposure. Following lead absorption, one of the physiological changes that occur in the body is a buildup of protoporphyrin in red blood cells. This physiological change can be accurately measured with an FEP or a ZPP test. Increases in FEP or ZPP are not detectable until BLLs reach 25µg/dL. An increase in FEP or ZPP usually lags behind an increase in BLL by two to six weeks.

Elevated BLL and Normal FEP/ZPP = Recent exposure 2-6 weeks.

Elevated BLL and Elevated FEP/ZPP = Chronic/ongoing exposure.

Although some diseases and iron deficiency anemia can elevate FEP or ZPP, lead absorption is the most likely cause for such an increase in healthy working individuals. Further, the FEP or ZPP levels increase abruptly when blood lead levels reach about 40 µg/dL, and they tend to stay elevated for 3-4 months (the average life span of a red blood cell).

Reference ranges for blood lead, FEP and ZPP may vary, depending upon the laboratory. **It is important that medical providers evaluate the reference range used by the particular laboratory.** Reference ranges are generally printed on the laboratory test results report.

Example ZPP/FEP Reference Range for Adults: LABCORP: FEP: 0-34 µg/dL. ZPP: 0-34 µg/dL

Oregon's Public Health Action Level or Elevated Blood Lead Level for Adults: $\geq 25\mu\text{g/dL}$

Oregon's Public Health Action Level or Elevated Blood Lead Level for Children: $\geq 10\mu\text{g/dL}$

There are a number of reasons why a medical provider may want to do additional screening on an individual where there is a blood lead level in the normal range or a low level of blood lead, but an elevated FEP or ZPP:

1. A person may have had a recent acute lead exposure in which the blood lead level has spontaneously declined, but the FEP or ZPP is continuing to be high over the life span of a red blood cell (erythrocyte). The life span of a blood cell is about 120 days, and lead levels may decline substantially over a period of weeks.
2. A repeated FEP or ZPP test may be useful to rule out iron-deficiency anemia.
3. Alternative diagnoses may be indicated in cases of an elevated FEP or ZPP, beyond the 120 day red blood cell lifespan.

The Oregon Adult Lead Poisoning Prevention Program can consult and assist in the interpretation of lead test results, but we generally advise employers and employees to contact their occupational medical provider if they have questions or concerns about their test results.

Blood Lead Test Criteria

$< 2\mu\text{g/dL}$ – Average whole BLL for the general population in the U.S. (CDC 2005).

$\geq 10\mu\text{g/dL}$ – Public health action level for children. Pregnant or women likely to become pregnant should be advised to maintain lead levels below $10\mu\text{g/dL}$ and as low as possible.

$\geq 25\mu\text{g/dL}$ - Action level for DHS adult case follow-up. Oregon DHS provides source identification and educational follow-up for worker. DHS will consult with provider.

$\geq 50\mu\text{g/dL}$ - On an initial test, a two week follow-up blood lead test is indicated to confirm the lead level. Workers with an average lead levels of $50\mu\text{g/dl}$ or greater must be removed from working with lead.

$\geq 60\mu\text{g/dL}$ - Workers with whole blood lead levels greater than $60\mu\text{g/dl}$ must be immediately removed from further lead exposure if confirmed by a follow-up test.

For More Information on Adult Lead Exposure

Oregon Lead Poisoning Prevention Program at 971-673-0440 or www.healthoregon.org/lead

Oregon Occupational Health and Safety Administration at (800) 922-2689 or www.orosha.org.