MAYO CLINIC LABORATORIES

Test Definition: PBPFD

Lead Profile Occupational Exposure, Blood

Overview

Useful For

Detecting lead toxicity due to occupational exposure

Profile Information

Test Id	Reporting Name	Available Separately	Always Performed
PBB	Lead, B	Yes, (order PBDV)	Yes
PPFE	Protoporphyrins, Fractionation, WB	Yes	Yes
DEMO5	Patient Demographics	No	Yes

Special Instructions

- Lead and Heavy Metals Reporting
- Metals Analysis Specimen Collection and Transport

Method Name

PBB: Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

PPFE: High-Performance Liquid Chromatography (HPLC) with Fluorescence Detection

NY State Available

Yes

Specimen

Specimen Type

Whole blood

Ordering Guidance

This test is only for assessment of occupational exposure to lead. The preferred test for lead toxicity in children is blood lead. For more information see:

-PBDV / Lead, Venous, with Demographics, Blood

-PBDC / Lead, Capillary, with Demographics, Blood

The preferred screening test for suspicion of a hepatic porphyria is urine porphyrins. For more information see PQNRU / Porphyrins, Quantitative, Random, Urine.

Necessary Information

Include a list of medications the patient is currently taking.

Specimen Required

Both EDTA whole blood and heparin whole blood specimens are required.

Patient Preparation:

1. High concentrations of gadolinium and iodine are known to potentially interfere with most inductively couple plasma mass spectrometry-based metal tests. If either gadolinium- or iodine-containing contrast media has been administered, **a specimen should not be collected for 96 hours**.
2. Patient should abstain from alcohol for 24 hours prior to specimen collection.

Specimen Type: EDTA Whole blood
Supplies:
-Metal Free B-D Tube (EDTA), 6 mL (T183)
-Metal Free EDTA 3 mL Tube (T989)
-Microtainer (EDTA) Tube, 0.5 mL (T174)
Container/Tube:
Preferred: Royal blue-top BD vacutainer with EDTA blood collection tube (3 mL) (BD catalog no. 36777) (T989)
Acceptable: Royal blue-top BD Vacutainer Plus with EDTA blood collection tube (6 mL) (BD catalog no. 368381) (T183) or BD Microtainer with EDTA (0.5 mL) (T174)
Specimen Volume: 2 mL
Collection Instructions:
1. See Metal Analysis Specimen Collection and Transport for complete instructions.
2. Send whole blood specimen in original tube. **Do not aliquot.**
3. Refrigerate specimen as soon as possible after collection.

Specimen Type: Heparin Whole blood
Container/Tube:
Preferred: Green top (Sodium heparin)
Acceptable: Dark blue top (metal free heparin), green top (lithium heparin), or lavender top (EDTA)
Specimen Volume: 4 mL
Collection Instructions: Refrigerate specimen as soon as possible after collection.

Forms

Lead and Heavy Metals Reporting (T491)

Specimen Minimum Volume

See Specimen Required

Reject Due To

Gross hemolysis	Reject
Gross lipemia	Reject
Clotted blood	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Whole blood	Refrigerated	7 days	

Clinical & Interpretive

Clinical Information

Lead is a heavy metal commonly found in man's environment that can be an acute and chronic toxin.

Lead was banned from household paints in 1978 but is still found in paint produced for nondomestic use and in artistic pigments. Ceramic products available from noncommercial suppliers (such as local artists) often contain significant amounts of lead that can be leached from the ceramic by weak acids, such as vinegar and fruit juices. Lead is found in dirt from areas adjacent to homes painted with lead-based paints and highways where lead accumulates from use of leaded gasoline. Use of leaded gasoline has diminished significantly since the introduction of nonleaded gasolines that have been required in personal automobiles since 1972. Lead is found in soil near abandoned industrial sites where lead may have been used. Water transported through lead or lead-soldered pipe will contain some lead with higher concentrations found in water that is weakly acidic. Some foods/beverages (eg, moonshine distilled in lead pipes) and some traditional home medicines contain lead.

Lead expresses its toxicity by several mechanisms. It avidly inhibits aminolevulinic acid dehydratase and ferrochelatase, 2 of the enzymes that catalyze synthesis of heme; the end result is decreased hemoglobin synthesis resulting in anemia and increased levels of erythrocyte zinc protoporphyrin.

Lead is also an electrophile that avidly forms covalent bonds with the sulfhydryl group of cysteine in proteins. Thus, proteins in all tissues exposed to lead will have lead bound to them. The most common sites affected are epithelial cells of the gastrointestinal tract and epithelial cells of the proximal tubule of the kidney.

The typical diet in the United States contributes 1 to 3 mcg of lead per day, of which 1% to 10% is absorbed; children may absorb as much as 50% of the dietary intake, and the fraction of lead absorbed is enhanced by nutritional deficiency. The majority of the daily intake is excreted in the stool after direct passage through the gastrointestinal tract. While a significant fraction of the absorbed lead is rapidly incorporated into bone and erythrocytes, lead ultimately distributes among all tissues, with lipid-dense tissues such as the central nervous system being particularly sensitive to organic forms of lead. All absorbed lead is ultimately excreted in the bile or urine. Soft-tissue turnover of lead occurs within approximately 120 days.

Avoidance of exposure to lead is the treatment of choice. However, chelation therapy is available to treat severe disease. Oral dimercaprol may be used in the outpatient setting except in the most severe cases.

Reference Values

LEAD: <3.5 mcg/dL
The Occupational Safety and Health Administration (OSHA) recommended limit for blood lead level is 40 mcg/dL (OSHA 1978).
The biological exposure index (BEI) for Pb in blood of exposed workers is 20 mcg/dL (ACGIH 2018).

Critical Values:

Pediatrics (< or =15 years): > or =20.0 mcg/dL
Adults (> or =16 years): > or =70.0 mcg/dL

PROTOPORPHYRINS, FRACTIONATION
Free Protoporphyrin: <20 mcg/dL
Zinc-Complexed Protoporphyrin: <60 mcg/dL

Interpretation

The Centers for Disease Control and Prevention (CDC) has identified the blood lead test as the preferred test for detecting lead exposure. The most recent National Health and Nutrition Examination Survey (NHANES) data show that 97.5 percentile for blood lead levels in US adults 16 years and older is 3.46 mcg/dL. In concurrence with the reference value concept that there is no safe level of lead in blood, the Council of State and Territorial Epidemiologists Occupational Health Subcommittee approved lowering the blood lead threshold from 5 mcg/dL to 3.5 mcg/dL for adults. For children younger than 6 years, the current reference level at which the CDC recommends public health actions be initiated is 3.5 mcg/dL. Chelation therapy is indicated when whole blood lead concentration is above 25 mcg/dL in children or above 45 mcg/dL in adults.

Occupational Safety and Health Standards: Lead (1983). 29 CFR Part 1910.1025 App C Action required for workers with Elevated Lead Values OSHA, Occupational Exposure to Lead, 1978:

Number of tests performed	Whole blood lead concentration	Action required
1	> or =40 mcg/dL	Notification of worker in writing; medical examination of worker and consultation.
3 (average)	> or =50 mcg/dL	Removal of worker from job with potential lead exposure.
1	> or =60 mcg/dL	Removal of worker from job with potential lead exposure.
2	<40 mcg/dL	Reinstatement of worker in job with potential lead exposure is based upon symptoms and medical evaluation.

OSHA requirements in effect since 1978 call for the measurement of whole blood lead and zinc protoporphyrin (CLSI document C42-A, November 1996) to evaluate the occupational exposure to lead.

Elevated zinc protoporphyrin levels in adults may indicate long-term (chronic) lead exposure or may be indicative of iron deficiency anemia or anemia of chronic disease.

Cautions

For protoporphyrin testing, patients must abstain from alcohol for at least 24 hours prior to specimen collection. Alcohol suppresses enzyme activity potentially leading to false-positive results.

Clinical Reference

1. Centers for Disease Control and Prevention. National Report on Human Exposure to Environmental Chemicals. CDC; Updated September 2023. Accessed December 5, 2023. Available at www.cdc.gov/exposurereport
2. Occupational Safety and Health Administration. Medical surveillance guidelines. Occupational Health and Safety

Standards Toxic and Hazardous Substances from 1910.1025 App C. OSHA; 2001. Accessed December 5, 2023. Available at https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1025AppC
3. de Burbure C, Buchet J-P, Leroyer A, et al. Renal and neurologic effects of cadmium, lead, mercury, and arsenic in children: evidence of early effects and multiple interactions at environmental exposure levels. Environ Health Perspect. 2006;114(4):584-590
4. Kosnett MJ, Wedeen RP, Rothenberg SJ, et al. Recommendations for medical management of adult lead exposure. Environ Health Perspect. 2007;115(3):463-471
5. Jusko T, Henderson C, Lanphear B, et al. Blood lead concentrations <10 mcg/dL and child intelligence at 6 years of age. Environ Health Perspect. 2008;116(2):243-248

Performance

Method Description

Lead
The metal of interest is analyzed by inductively coupled plasma mass spectrometry.(Unpublished Mayo method)

Protoporphyrins, Fractionation
Extraction followed by fractionation by high-performance liquid chromatography. Zinc protoporphyrin and free protoporphyrin are separately quantitated.(Smith RM, Doran D, Mazur M, Bush B. High-performance liquid chromatographic determination of protoporphyrin and zinc protoporphyrin in blood. J Chromatogr.1980;181[3-4]:319-327; Gou EE, Balwani M, Bissell DM, et al. Pitfalls in erythrocyte protoporphyrin measurement for diagnosis and monitoring of protoporphyrias. Clin Chem. 2015;61[12]:1453-1456. doi:10.1373/clinchem.2015.245456)

PDF Report

No

Day(s) Performed

Monday, Wednesday, Friday

Report Available

2 to 6 days

Specimen Retention Time

14 days

Performing Laboratory Location

Mayo Clinic Laboratories - Rochester Superior Drive

Fees & Codes

Fees

- Authorized users can sign in to Test Prices for detailed fee information.
- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

Test Classification

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. It has not been cleared or approved by the US Food and Drug Administration.

CPT Code Information

83655
82542

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
PBPFD	Lead Profile Occ Exposure, B	29588-1

Result ID	Test Result Name	Result LOINC® Value
8602	Lead, B	77307-7
2327	Zinc-Complexed Protoporphyrin	2895-1
2326	Free Protoporphyrin	94491-8
29511	Interpretation	59462-2
VECP	Venous/Capillary	31208-2
PTADD	Patient Street Address	56799-0
PTCIT	Patient City	68997-6
PTSTA	Patient State	46499-0
PTZIP	Patient Zip Code	45401-7
PTCNT	Patient County	87721-7
PTPHO	Patient Home Phone	42077-8
PTRAC	Patient Race	32624-9
PTETH	Patient Ethnicity	69490-1
PTOCC	Patient Occupation	11341-5
PTEMP	Patient Employer	80427-8
GDFN	Guardian First Name	79183-0
GDLN	Guardian Last Name	79184-8
MDORD	Health Care Provider Name	52526-1
MDADD	Health Care Provider Street Address	74221-3
MDCIT	Health Care Provider City	52531-1
MDSTA	Health Care Provider State	52532-9
MDZIP	Health Care Provider Zip Code	87720-9
MDPHO	Health Care Provider Phone	68340-9
LABPH	Submitting Laboratory Phone	65651-2