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Best Practices for Sampling and Testing Blood for Lead

Lead is a neurotoxin that has been shown to negatively impact neurological development in children upon exposure at any level. As efforts to reduce blood lead levels in children continue, care must be taken to accurately measure lower concentrations of lead in blood samples. This raises a variety of challenges for specimen collection and laboratory testing practices. High-quality blood lead measurements are necessary to ensure proper case management is provided to individual children and that surveillance leads to proper public health interventions for exposed populations. This fact sheet serves to outline quality improvement guidance for the sampling and measurement of blood lead.

Lead is found in the ambient environment and care must be taken to avoid contamination of specimen collection and testing supplies and to use practices that do not contaminate the specimen throughout the sampling and testing processes.

Potential sources of contamination include:

- The environment in which blood collection is performed.
- Contamination on the skin of the person giving blood (esp. finger-stick)
- Collection supplies which come into contact with the blood sample (e.g., tubes, needles, pipette tips, vials).
- The testing environment.

BLOOD SAMPLE COLLECTION: A CRITICAL FIRST STEP

Minimize contamination of specimens by:

- ☐ Providing detailed written specimen collection instructions to clinical providers who will be collecting the specimens. These should also include details about specimen handling and transport to ensure the specimens are of appropriate quality for testing.
- ☐ Using venipuncture samples as preferred specimen type to reduce contamination from the patient's skin.
- ☐ Using supplies designated or pre-screened for trace-metals and encourage clinical partners to do the same
- ☐ Screening each lot of sampling and testing supplies for lead contamination, if possible.
- ☐ Collecting blood samples in a clean environment to prevent contamination, away from known sources of lead (e.g., soil, paint, dust)
- ☐ Collecting a metals analysis evacuated blood tube first, if collecting multiple tubes, to prevent lead contamination carrying over from tubes not pre-screened for lead
- ☐ Including field blanks, if collection is part of a biomonitoring study.
- ☐ Develop specimen acceptance and rejection criteria:
- ☐ Clotted specimens must be rejected as lead will be preferential found in the red blood cells in the clot
- ☐ Specimens were collected in the wrong type of tubes.

THE LABORATORY ENVIRONMENT: KEEP IT CLEAN

- ☐ Minimize contamination from the ambient environment.
- ☐ Keep corrugated cardboard and brown recycled paper out of the laboratory.
- ☐ Use shoe cleaners and tacky mats at entrances to collect dust and dirt.
- ☐ Provide shoe covers at the lab entrance.

Ensure laboratory processes and practices do not contribute to contamination by:

- ☐ Training laboratory scientists to use laboratory practices that minimize the likelihood of specimen contamination.
- ☐ Installing an auto sampler enclosure to prevent airborne contamination of the specimens.
- ☐ Providing airflow either through filtered (e.g., HEPA or ULPA) fans or by attaching building exhaust.
- ☐ Testing environmental samples and clinical specimens in different laboratory spaces.
- ☐ Developing detailed cleaning and decontamination procedures for the laboratory.

SAMPLE PREPARATION: KEEP IT SAFE, CLEAN, ACCURATE AND PRECISE

- ☐ Use universal precautions when working with clinical specimens to prevent exposure to blood borne pathogens.
- ☐ Work within a biological safety cabinet (BSC) to protect both the worker as well as the sample because air entering the cabinet is HEPA filtered before being directed to the work surface.
- ☐ Prepare analytical standards and reagents in a chemical fume hood.
- ☐ Wear appropriate personal protective equipment (PPE) including: lab coat, safety glasses, and nitrile gloves.
- ☐ Use high quality reagents (e.g., double distilled), that have lower background levels of lead. Access to high quality lab water (≥18.2 MΩ·cm) is critical.
- ☐ Acid wash bottles and flasks used for reagents before each use; dedicate to lead testing.
- ☐ Lot screen tubes and auto sample vials used for testing lead.
- ☐ Mix blood prior to removing an aliquot using a vortex, a rocker, or pipette pump to ensure homogenous sample.
- ☐ Inspect blood samples for clots and reject those with clots.
- ☐ Use a dual-syringe dilutor for consistent and complete volumetric transfers when diluting blood for analysis. Diluent (syringe 1) flushes blood (syringe 2) out of the pipette tip making for a more complete transfer. Initial cleaning (flushing diluent through all syringes and tubing) is important prior to sample preparation.
- ☐ Check lead background levels of reagents before preparing samples, including diluent before and after the dual-syringe diluter and water that will be used in sample preparation.

POST-MEASUREMENT QUALITY CONTROL

- ☐ Analyst and supervisor (or designee): Review all analytical data to verify quality control compliance.
- ☐ Review transcription for errors if data capture is not used.
- ☐ Follow your laboratory SOP for confirmatory repeat and or reflex testing for all specimens which initially result in blood lead levels greater than or equal to 5 µg/dL.

RESOURCES

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6. Tevis, Denise S., et al. (2018). Assessing the stability of Cd, Mn, Pb, Se, and total Hg in whole human blood by ICP-DRC-MS as a function of temperature and time [Scientific Article]. Clinica Chimica Acta, 485, pp 1-6. Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/S0009898118302614?via%3Dihub

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