MDAAP/AAP Lead Testing ECHO

January 4, 2023

Session 4: Blood Lead Reference Values and How to Interpret Results
ACKNOWLEDGMENTS

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HOUSEKEEPING

- For educational and quality improvement purposes, this teleECHO session will be recorded
  - By participating in this session, you are consenting to be recorded – we appreciate and value your participation
- To protect patient privacy, please do not provide any protected health information (PHI)
- Please mute your microphone when not speaking
- Please enable your video if possible
- Chat with Loretta I. Hoepfner in Chatbox if you need technical assistance
AGENDA

• Welcome – Loretta I. Hoepfner
• Lecture Presentation – Mike Ichniowski, MD, FAAP, and Paul Rogers, MD, FAAP
• QI Data Review – Troy Jacobs, MD, FAAP
• Case Presentation – Paul Rogers, MD, FAAP, and Corazon Sanchez, MD, FAAP
• Case Discussion – All
• Follow Up and Next Steps – Loretta I. Hoepfner
TODAY’S LECTURE

Blood Lead Reference Values and How to Interpret Results

Michael Ichniowski, MD, FAAP
Paul Rogers, MD, FAAP

December 7, 2022
LEARNING OBJECTIVES

1. Understand current CDC blood lead reference values
2. Understand how to interpret results of blood reference values
3. Understand the toxic effects of elevated blood lead levels
Screening vs. Testing

Screening: Questions and epidemiological data that define the degree of risk

Testing: The measuring of lead in blood

Photo source: shutterstock.com
PREVENTION OF LEAD POISONING

**Primary Prevention**: Removal of lead-based hazards from environment before the child’s exposure.

**Secondary Prevention**: Early detection of lead poisoned children through appropriate screening, lead testing, and minimizing further lead exposure.

**Tertiary Prevention**: Prevention of additional morbidity of lead toxication through chelation.

From: [https://www.uptodate.com/lk](https://www.uptodate.com/lk) (requires subscription)
CDC Reference Value

Source: https://www.atsdr.cdc.gov/csem/leadtoxicity/safety_standards.html
CDC Reference Value: What Does It Mean?

It is a number based on a nationally representative population of children 1-5 years old who had blood lead levels (bll’s) done: 97.5% of children were below that number.

It does NOT indicate lead “poisoning” or “toxicity”. It is a reference point based on population data.

It is NOT indicative of what the clinical laboratory can tell you about the individual child in your practice.

Slide content credit: Alan Woolf, AAP LEAD TESTING WEBINAR SERIES, HTTPS://WWW.PEHSU.NET/LEAD_EXPOSURE.HTML
LABORATORY TESTS AVAILABLE TO EVALUATE BLOOD LEAD LEVELS
COMMONLY USED AVAILABLE METHODS

- Anodic Stripping Voltammetry (ASV) LeadCare II
- Graphite furnace atomic absorption spectrometry (GFAAS): Reference method; accurately measures to 1 µg/dL
- Inductively coupled plasma mass spectrometry (ICP-MS): Reference method; accurately measures to 1 µg/dL
LEADCare® II: Benefits

- Point of care testing: Physician office
- Clinical Lab Improvement Amendments waived
- Improved compliance
- An elevated bll may indicate lead in the environment
**LEADCARE® II: LIMITATIONS**

- False positives due to poor technique in obtaining sample
- Confirmatory venous sample required
- Test results $\geq 5 \, \mu g/dL$ must be reported to MDE by the close of next business day*
- Limit of accuracy is $3.3 \, \mu g/dL$

Legal definition of an elevated blood lead level in Maryland which remains at $5 \, \mu g/dL$: Letter from Clifford S. Mitchell, January 25, 2022, Maryland Department of Health
### Best Estimates of Precision of Blood Lead Measurements at 5 Mg/dL

<table>
<thead>
<tr>
<th></th>
<th>95% confidence interval (µg/dL)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>LeadCare II</td>
<td>± 1.8</td>
<td>1469</td>
</tr>
<tr>
<td>GFAAS</td>
<td>± 1.5</td>
<td>908</td>
</tr>
<tr>
<td>ICP-MS</td>
<td>± 0.97</td>
<td>769</td>
</tr>
</tbody>
</table>

Source: National Center on Environmental Health (NCEH)/ATSDR Board of Scientific Counselors, Semi-Annual Meeting, January 2017
ADDITIONAL TESTS

Screen for Iron Deficiency Anemia

- CBC
- Ferritin
- C-reactive protein

Erythrocyte Protoporphyrin

- NOT good for screening
- Can help identify acuity of lead exposure
- Useful in determining need for chelation
IMPACT ON PATIENT
## Signs and Symptoms of Lead Poisoning

<table>
<thead>
<tr>
<th>Lead Level</th>
<th>Symptoms</th>
</tr>
</thead>
</table>
| ≤3.4-14 µg/dL | • Decreased learning and memory  
• Lowered IQ  
• ADHD  
• Speech disorder  
• Decreased verbal ability |
| ≤15-44 µg/dL | • Myalgia  
• Fatigue  
• Irritability  
• Occasional abdominal discomfort |
| 45-69 µg/dL | • Fatigue  
• Inattention  
• Tremor  
• Headache  
• Diffuse abdominal pain  
• Constipation  
• Weight loss |
| ≥ 70 µg/dL | • Paresis or paralysis  
• Severe abdominal cramps  
• Seizures  
• Changes in consciousness  
• Death |

From: [https://www.uptodate.com](https://www.uptodate.com) (requires subscription)
TARGET ORGANS IN ELEVATED BLOOD LEAD LEVEL

**Blood**
- Percent Body lead load: 1%
- Half-life: 28-32 days
- Chronic ingestion: 360 days

**Brain**
- Percent body lead load: 5%
- Half-life: 2 years

**Bone**
- Percent body lead load: 80%
- Half-life: ± 20 years
- Half-life: 40 days

**Kidney**
- Percent Body lead load 10%
- Half-life: 40 days
**Effects of an Elevated Blood Lead Level on Target Organs**

**Blood**
- Decreased RBC biosynthesis
- Decreased RBC survival

**Brain**
- Increased neuron death
- Impairs pruning process
- Impairs neurotransmitter function

**Bone**
- Impairs bone growth
- Delay fracture healing
- May contribute to osteoporosis

**Kidney**
- Chronic interstitial nephritis
- Hypertension
**Pediatrician Response to an Elevated Blood Lead Level**

- Make sure child removed from lead exposure
- Careful history and physical exam
- Determine if any siblings or other children are at risk for lead poisoning
- Laboratory evaluation
- Report elevated BLL to state
- Education of family
ADDITIONAL RESOURCES

• MDE, Lead Poisoning Prevention Program:
  https://mde.maryland.gov/programs/Land/LeadPoisoningPrevention/Pages/index.aspx
  Phone inquiries: 410-537-3825   Email: mdclr.mde@maryland.gov

• MDH Lead program:
  https://phpa.health.maryland.gov/OEHFP/EH/Pages/Lead.aspx
  New MDH programs for children with lead exposure who are enrolled in or eligible for

• Medicaid/MCHIP:
  https://phpa.health.maryland.gov/OEHFP/EH/Pages/CHIPEnvCaseMgmt.aspx
  Phone inquiries toll-free at 1-866-703-3266   Email: mdh.healthyhomes@maryland.gov

• CDC Spanish resources:
  https://www.cdc.gov/nceh/lead/resources/spanish-communication-resources.html
QUESTIONS?
QI Data Review

Troy A. Jacobs, MD, MPH, FAAP
# DATA COLLECTION

<table>
<thead>
<tr>
<th>Data Cycle #</th>
<th>Month of Visit (pull charts from time period listed below)</th>
<th>Date Entry in QIDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (baseline)</td>
<td>August 1-31, 2022</td>
<td>September 28, 2022</td>
</tr>
<tr>
<td>2</td>
<td>September 1-30, 2022</td>
<td>October 14, 2022</td>
</tr>
<tr>
<td>3</td>
<td>October 1-31, 2022</td>
<td>November 11, 2022</td>
</tr>
<tr>
<td>4</td>
<td>November 1-30, 2022</td>
<td>December 9, 2022</td>
</tr>
<tr>
<td>5</td>
<td>December 1-31, 2022</td>
<td>January 13, 2023</td>
</tr>
<tr>
<td>6</td>
<td>January 1-31, 2023</td>
<td>February 10, 2023</td>
</tr>
<tr>
<td>7</td>
<td>February 1-28, 2023</td>
<td>March 10, 2023</td>
</tr>
</tbody>
</table>
Blood Lead Testing

- All Groups
- Greenspring Pediatric Associates
- MENCHAVEZ Pediatrics
- Sanchez Pediatrics
- University of Maryland Shore Medical Group Pediatrics
Blood Lead Results Interpretation (Follow Up Testing)

- All Groups
  - Cycle 1 (N = 1)
  - Cycle 2 (N = 2)
  - Cycle 3 (N = 3)
  - Cycle 4 (N = 3)
  - Cycle 5 (N = 1)

- Greenspring Pediatric Associates
  - Cycle 1 (N = 1)
  - Cycle 2 (N = 1)
  - Cycle 3 (N = 2)
  - Cycle 4 (N = 2)
  - Cycle 5 (N = 0)

- MENCHAVEZ Pediatrics
  - Cycle 1 (N = 0)
  - Cycle 2 (N = 0)
  - Cycle 3 (N = 0)
  - Cycle 4 (N = 1)
  - Cycle 5 (N = 0)

- Sanchez Pediatrics
  - Cycle 1 (N = 0)
  - Cycle 2 (N = 0)
  - Cycle 3 (N = 0)
  - Cycle 4 (N = 0)
  - Cycle 5 (N = 0)

- University of Maryland Shore Medical Group Pediatrics
  - Cycle 1 (N = 0)
  - Cycle 2 (N = 1)
  - Cycle 3 (N = 1)
  - Cycle 4 (N = 0)
  - Cycle 5 (N = 1)
QUESTIONS?
CASE PRESENTATION

Paul Rogers, MD, FAAP
Corazon Sanchez, MD, FAAP
CASE PRESENTATION: “MARIA”

C/C: This 2-year-old Spanish female with a recent elevated venous blood lead level of 42 µg/dL. Her mother brought Maria back to the office to discuss next steps.

Environmental investigation: Maria lives since birth at a property in Essex, MD built in 2000. On the Environmental Investigation October 5, 2022, the investigators found no deteriorated paint and XRF testing detected no lead paint-based hazards in the house. Dad is a roofer carrying home lead contaminated dust on clothes. Maria has pica. Family uses Goya brand Badia Adobo spices in the home (“0.1 ppm lead”). No other lead hazards detected.

CASE PRESENTATION

Past Medical History: Maria’s birth at JHH was FT, NSVD with no complications. Her developmental milestones are normal, and she passed the MCHAT-R. Family speaks English and Spanish in the home. She has a 4-year-old brother developing normally. Maria has been in good health with acute care office visits for tear duct obstruction, OM., tick bite, vomiting, and oral thrush. She is currently on Fer-in-Sol and Muti-vitamins.

<table>
<thead>
<tr>
<th>ELL</th>
<th>Date</th>
<th>Age</th>
<th>HgB</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 µg/dL</td>
<td>6/29/2021</td>
<td>10 months</td>
<td>9.9</td>
<td>Capillary</td>
</tr>
<tr>
<td>12.9 µg/dL</td>
<td>9/22/2022</td>
<td>24 months</td>
<td>12.7</td>
<td>Capillary</td>
</tr>
<tr>
<td>42 µg/dL</td>
<td>9/29/2022</td>
<td>24 months</td>
<td>12.8</td>
<td>Venous</td>
</tr>
<tr>
<td>25.9 µg/dL</td>
<td>10/11/2022</td>
<td>26 months</td>
<td>-</td>
<td>Venous</td>
</tr>
<tr>
<td>23.3 µg/dL</td>
<td>11/18/2022</td>
<td>27 months</td>
<td>-</td>
<td>Venous</td>
</tr>
<tr>
<td>16.6 µg/dL</td>
<td>12/13/2022</td>
<td>28 months</td>
<td>11.7</td>
<td>Venous Avg. 20 µg/dL</td>
</tr>
</tbody>
</table>
CASE PRESENTATION

DISCUSSION QUESTIONS

1. Any other questions you would ask Dr. Sanchez?
2. Your first interventions?
3. What additional labs would you order?
4. What consultations would you arrange?
5. What referrals would you make?
6. How long would you anticipate Maria to have an elevated blood lead level?
7. What state resources would you use for family education?
CASE PRESENTATION REFERENCES

- **Kordas K.** Deficits in cognitive function and achievement in Mexican first graders with low blood lead concentrations. Environmental Research 100(3), 371-86. 2006.
MARYLAND RESOURCES

• MDE, Lead Poisoning Prevention Program:
  https://mde.maryland.gov/programs/Land/LeadPoisoningPrevention/Pages/index.aspx
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QUESTIONS?
FOLLOW UP AND NEXT STEPS

• You will receive a follow-up email from MDAAP with:
  – PPT slides from today and a recording of the session
  – Link to the post-session SurveyMonkey

• Next Steps:
  – Complete your PDSA form and return to troy_a_jacobs@hotmail.com and loretta@mdaap.org
  – Enter your data into QIDA
  – Complete your Case Presentation form and return to michich23@hotmail.com, mdpaul5381@aol.com, and loretta@mdaap.org
  – Next webinar/Didactic & QI Session #5 on Wednesday, February 1, 2023, at 12-1p ET
THANKS FOR TAKING CARE OF OUR MARYLAND KIDS!