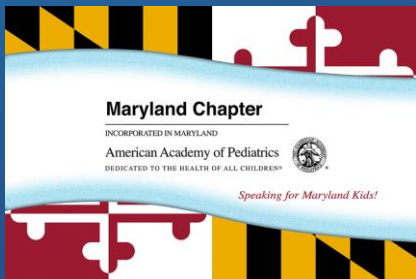


MDAAP/AAP Lead Testing ECHO

January 4, 2023

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



American Academy of Pediatrics
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ACKNOWLEDGMENTS

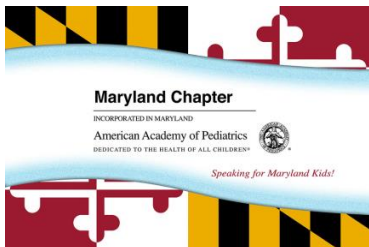
This material was supported by the American Academy of Pediatrics (AAP) and funded (in part) by the cooperative agreement award number 5 NU61TS000296-02-00 from the Agency for Toxic Substances and Disease Registry (ATSDR).

Acknowledgement: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing partial funding to ATSDR under Inter-Agency Agreement number DW-75-9587770. The content in this material represents the views of the various contributors. It does not represent the views of the Centers for Disease Control and Prevention (CDC)/ATSDR nor EPA and does not represent endorsement by CDC/ATSDR nor EPA of the purchase of any commercial products or services that are mentioned.



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

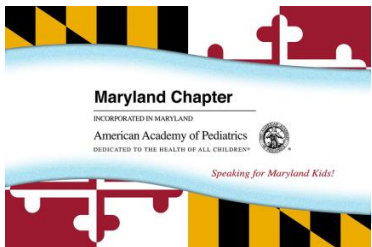
Paul Rogers, MD, FAAP

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

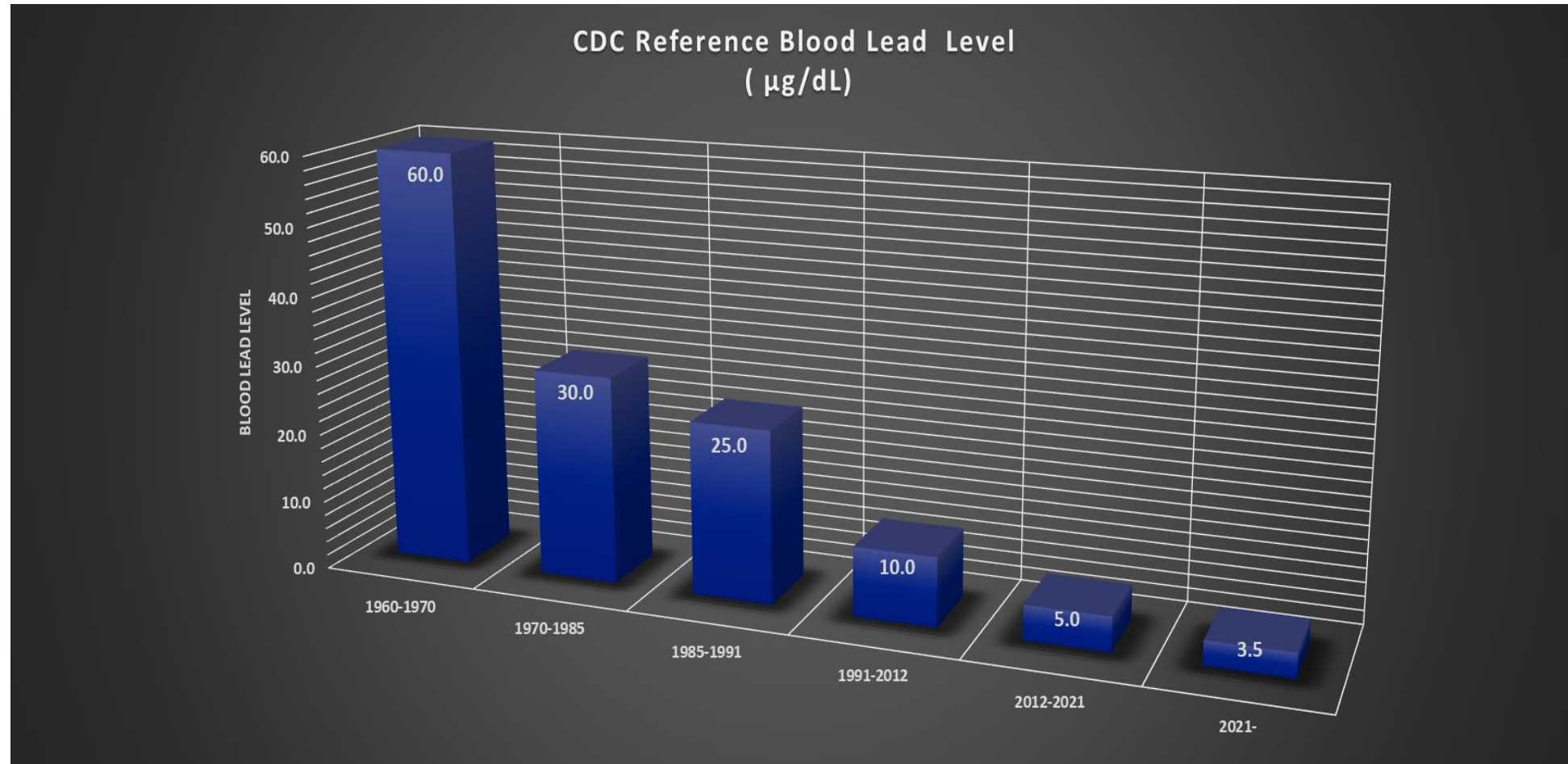
Tertiary Prevention: Prevention of additional morbidity of lead toxication through chelation



From: <https://www.uptodate.com/lookup>
(requires subscription)



CDC REFERENCE VALUE



Source: https://www.atsdr.cdc.gov/csem/leadtoxicity/safety_standards.html

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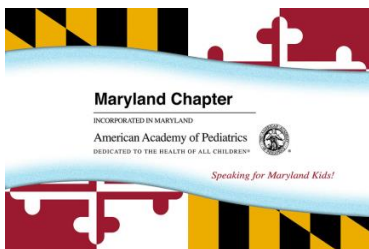
CDC REFERENCE VALUE: WHAT DOES IT MEAN?

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](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 $\mu\text{g}/\text{dL}$

Inductively coupled plasma mass spectrometry (ICP-MS):
Reference method; accurately measures to 1 $\mu\text{g}/\text{dL}$



ICP/MS-Wikipedia

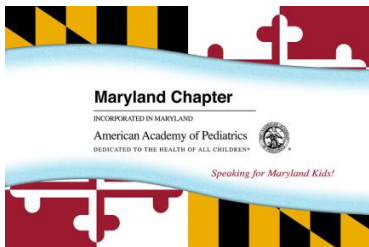
LEADCARE[®] II: BENEFITS

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 $\geq 5 \mu\text{g}/\text{dL}$ must be reported to MDE by the close of next business day*

Limit of accuracy is $3.3 \mu\text{g}/\text{dL}$



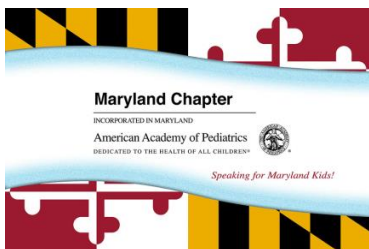
Legal definition of an elevated blood lead level in Maryland which remains at $5 \mu\text{g}/\text{dL}$: Letter from Clifford S. Mitchell, January 25, 2022, Maryland Department of Health



BEST ESTIMATES OF PRECISION OF BLOOD LEAD MEASUREMENTS AT 5 MG/DL

	95% confidence interval ($\mu\text{g/dL}$)	N
LeadCare II	± 1.8	1469
GFAAS	± 1.5	908
ICP-MS	± 0.97	769

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

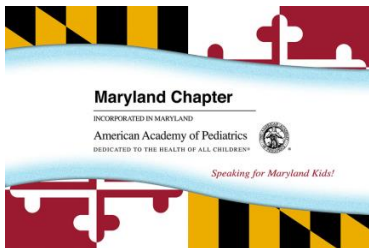


Erythrocyte Protoporphyrin

- 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

≤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/lookup>
(requires subscription)

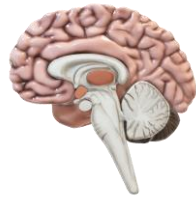


TARGET ORGANS IN ELEVATED BLOOD LEAD LEVEL



Blood

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



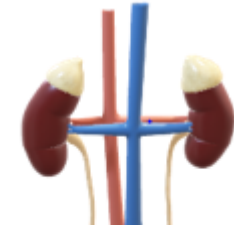
Brain

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



Bone

- Percent body lead load: 80%
- Half-life: \pm 20 years



Kidney

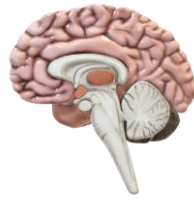
- Percent Body lead load 10%
- Half-life: 40 days

EFFECTS OF AN ELEVATED BLOOD LEAD LEVEL ON TARGET ORGANS



Blood

- Decreased RBC biosynthesis
- Decreased RBC survival



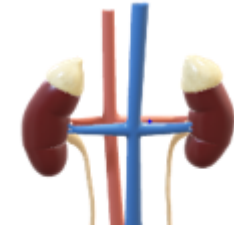
Brain

- 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

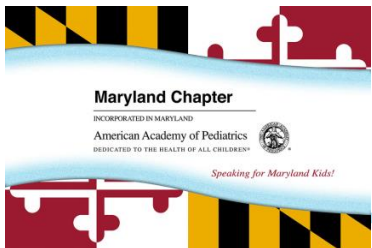


- **CDC Spanish resources :**

<https://www.cdc.gov/nceh/lead/resources/spanish-communication-resources.html>

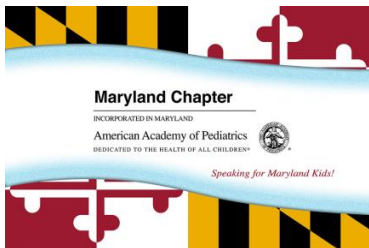


QUESTIONS?



QI DATA REVIEW

Troy A. Jacobs, MD, MPH, FAAP

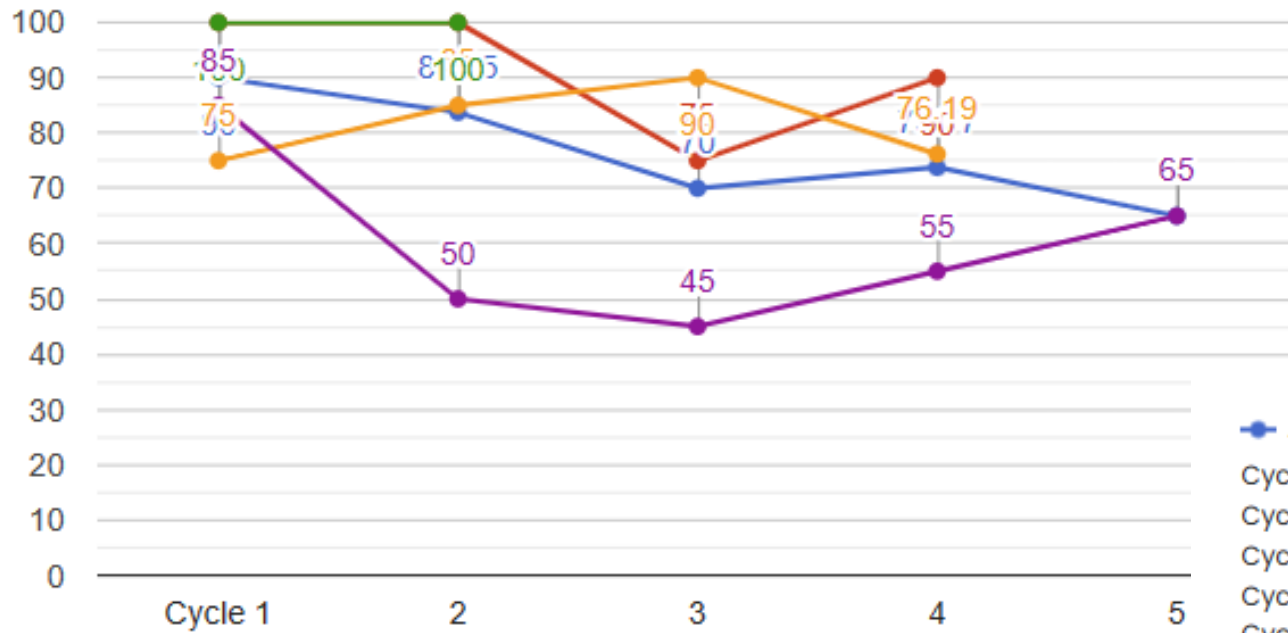


DATA COLLECTION

Data Cycle #	Month of Visit (pull charts from time period listed below)	Date Entry in QIDA
1 (baseline)	August 1-31, 2022	September 28, 2022
2	September 1-30, 2022	October 14, 2022
3	October 1-31, 2022	November 11, 2022
4	November 1-30, 2022	December 9, 2022
5	December 1-31, 2022	January 13, 2023
6	January 1-31, 2023	February 10, 2023
7	February 1-28, 2023	March 10, 2023



Risk Assessment



All Groups

Cycle 1 (N = 80)
 Cycle: 2 (N = 80)
 Cycle: 3 (N = 60)
 Cycle: 4 (N = 61)
 Cycle: 5 (N = 20)

Greenspring Pediatric Associates

Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 20)
 Cycle: 4 (N = 20)
 Cycle: 5 (N = 0)

MENCHAVEZ Pediatrics

Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 20)
 Cycle: 4 (N = 21)
 Cycle: 5 (N = 0)

Sanchez Pediatrics

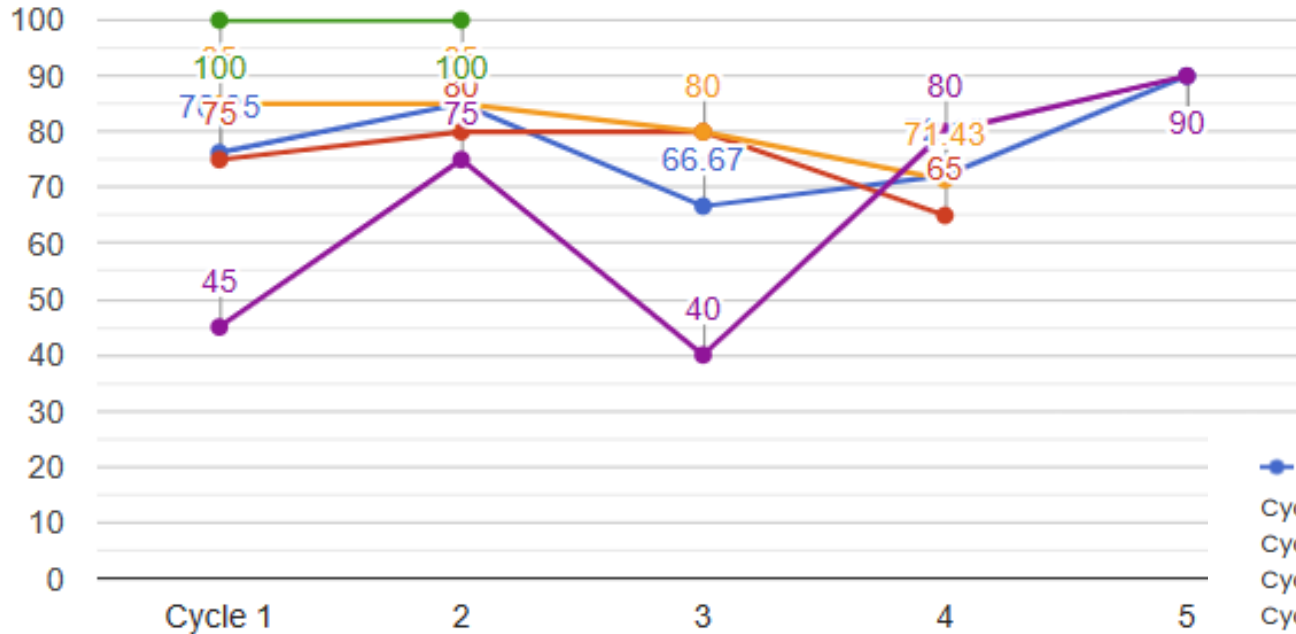
Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 0)
 Cycle: 4 (N = 0)
 Cycle: 5 (N = 0)

University of Maryland Shore Medical Group Pediatrics

Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 20)
 Cycle: 4 (N = 20)
 Cycle: 5 (N = 20)



Documented Initial Blood Lead Test



All Groups

Cycle 1 (N = 80)
 Cycle: 2 (N = 80)
 Cycle: 3 (N = 60)
 Cycle: 4 (N = 61)
 Cycle: 5 (N = 20)

Greenspring Pediatric Associates

Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 20)
 Cycle: 4 (N = 20)
 Cycle: 5 (N = 0)

MENCHAVEZ Pediatrics

Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 20)
 Cycle: 4 (N = 21)
 Cycle: 5 (N = 0)

Sanchez Pediatrics

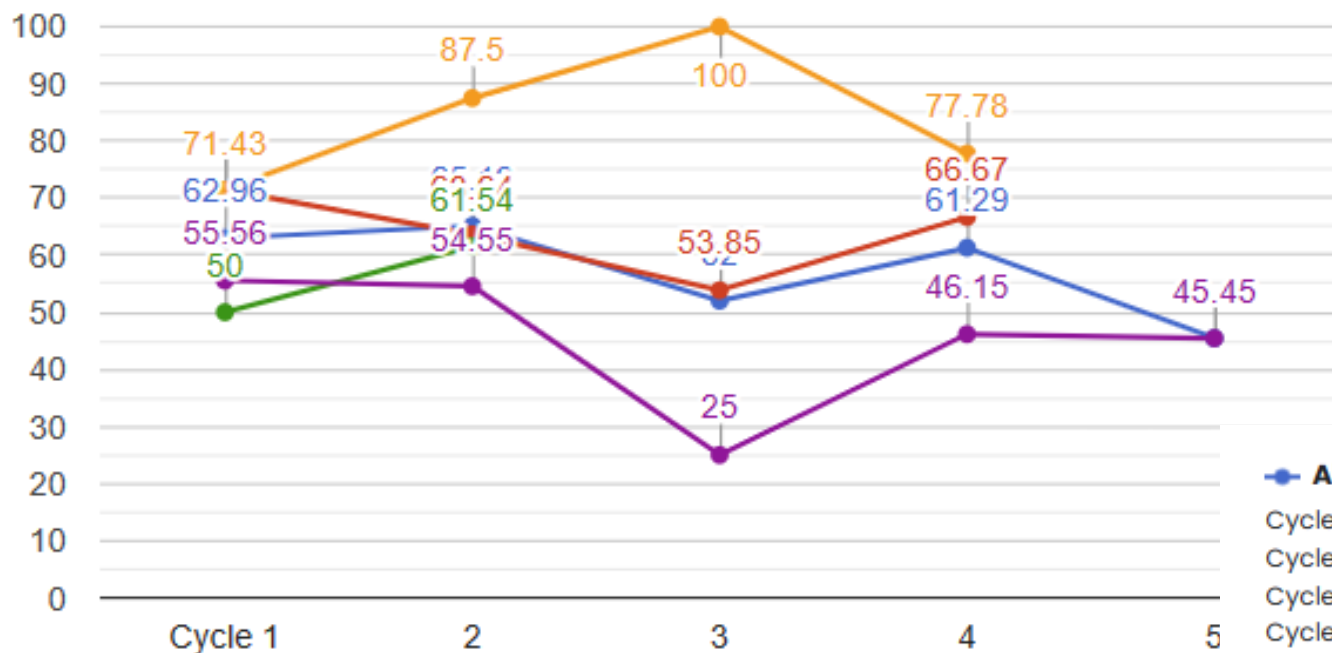
Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 0)
 Cycle: 4 (N = 0)
 Cycle: 5 (N = 0)

University of Maryland Shore Medical Group Pediatrics

Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 20)
 Cycle: 4 (N = 20)
 Cycle: 5 (N = 20)



Blood Lead Testing



All Groups

Cycle 1 (N = 27)
 Cycle 2 (N = 43)
 Cycle 3 (N = 25)
 Cycle 4 (N = 31)
 Cycle 5 (N = 11)

Greenspring Pediatric Associates

Cycle 1 (N = 7)
 Cycle 2 (N = 11)
 Cycle 3 (N = 13)
 Cycle 4 (N = 9)
 Cycle 5 (N = 0)

MENCHAVEZ Pediatrics

Cycle 1 (N = 7)
 Cycle 2 (N = 8)
 Cycle 3 (N = 4)
 Cycle 4 (N = 9)
 Cycle 5 (N = 0)

Sanchez Pediatrics

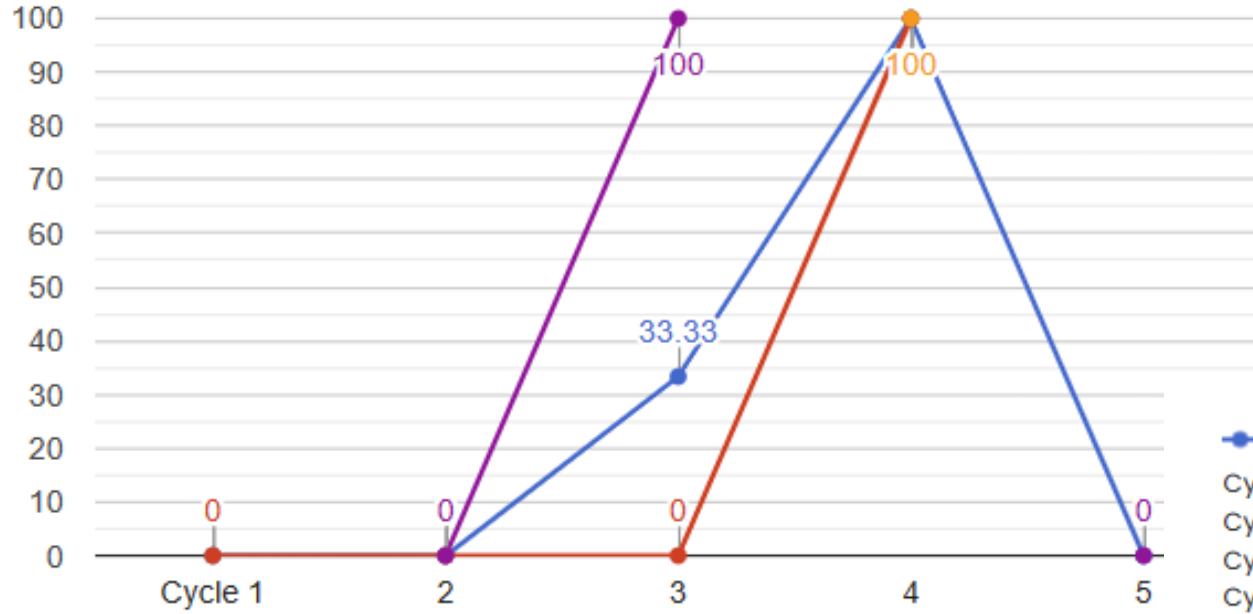
Cycle 1 (N = 4)
 Cycle 2 (N = 13)
 Cycle 3 (N = 0)
 Cycle 4 (N = 0)
 Cycle 5 (N = 0)

University of Maryland Shore Medical Group Pediatrics

Cycle 1 (N = 9)
 Cycle 2 (N = 11)
 Cycle 3 (N = 8)
 Cycle 4 (N = 13)
 Cycle 5 (N = 11)



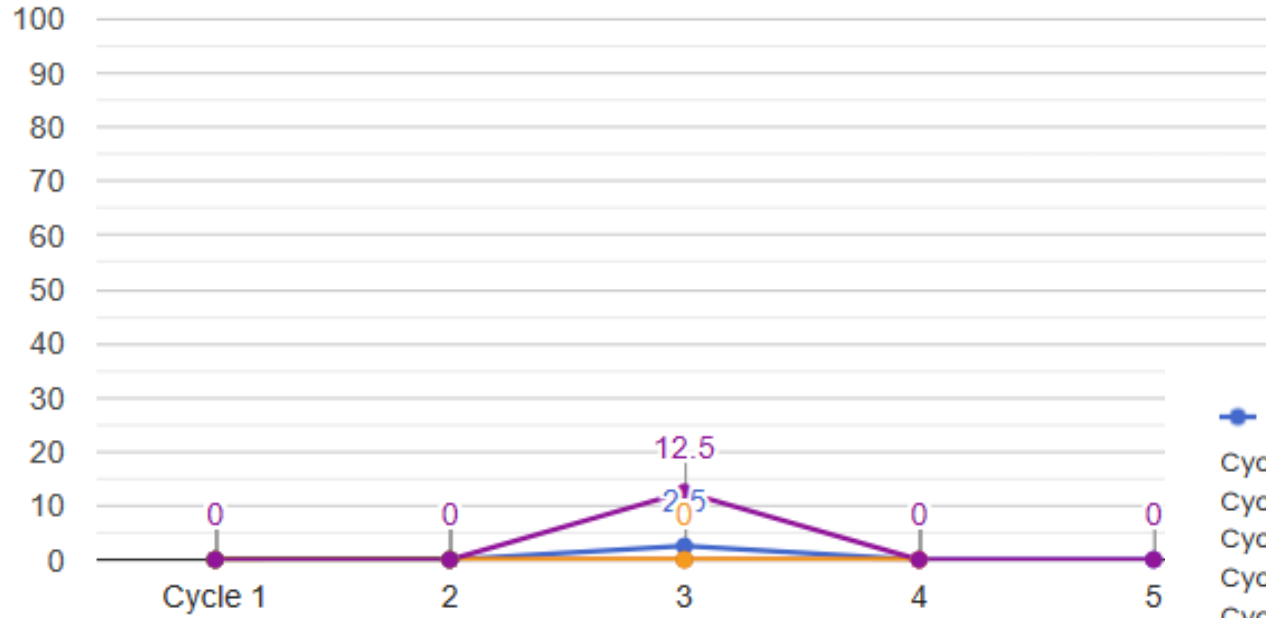
Blood Lead Results Interpretation (Follow Up Testing)



- | | | |
|---|--|---|
| <p>All Groups</p> <p>Cycle 1 (N = 1)</p> <p>Cycle: 2 (N = 2)</p> <p>Cycle: 3 (N = 3)</p> <p>Cycle: 4 (N = 3)</p> <p>Cycle: 5 (N = 1)</p> | <p>Greenspring Pediatric Associates</p> <p>Cycle 1 (N = 1)</p> <p>Cycle: 2 (N = 1)</p> <p>Cycle: 3 (N = 2)</p> <p>Cycle: 4 (N = 2)</p> <p>Cycle: 5 (N = 0)</p> | <p>MENCHAVEZ Pediatrics</p> <p>Cycle 1 (N = 0)</p> <p>Cycle: 2 (N = 0)</p> <p>Cycle: 3 (N = 0)</p> <p>Cycle: 4 (N = 1)</p> <p>Cycle: 5 (N = 0)</p> |
| <p>Sanchez Pediatrics</p> <p>Cycle 1 (N = 0)</p> <p>Cycle: 2 (N = 0)</p> <p>Cycle: 3 (N = 0)</p> <p>Cycle: 4 (N = 0)</p> <p>Cycle: 5 (N = 0)</p> | <p>University of Maryland Shore Medical Group Pediatrics</p> <p>Cycle 1 (N = 0)</p> <p>Cycle: 2 (N = 1)</p> <p>Cycle: 3 (N = 1)</p> <p>Cycle: 4 (N = 0)</p> <p>Cycle: 5 (N = 1)</p> | |



Care Management



All Groups

Cycle 1 (N = 80)
 Cycle: 2 (N = 72)
 Cycle: 3 (N = 40)
 Cycle: 4 (N = 44)
 Cycle: 5 (N = 18)

Greenspring Pediatric Associates

Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 16)
 Cycle: 4 (N = 13)
 Cycle: 5 (N = 0)

MENCHAVEZ Pediatrics

Cycle 1 (N = 20)
 Cycle: 2 (N = 17)
 Cycle: 3 (N = 16)
 Cycle: 4 (N = 15)
 Cycle: 5 (N = 0)

Sanchez Pediatrics

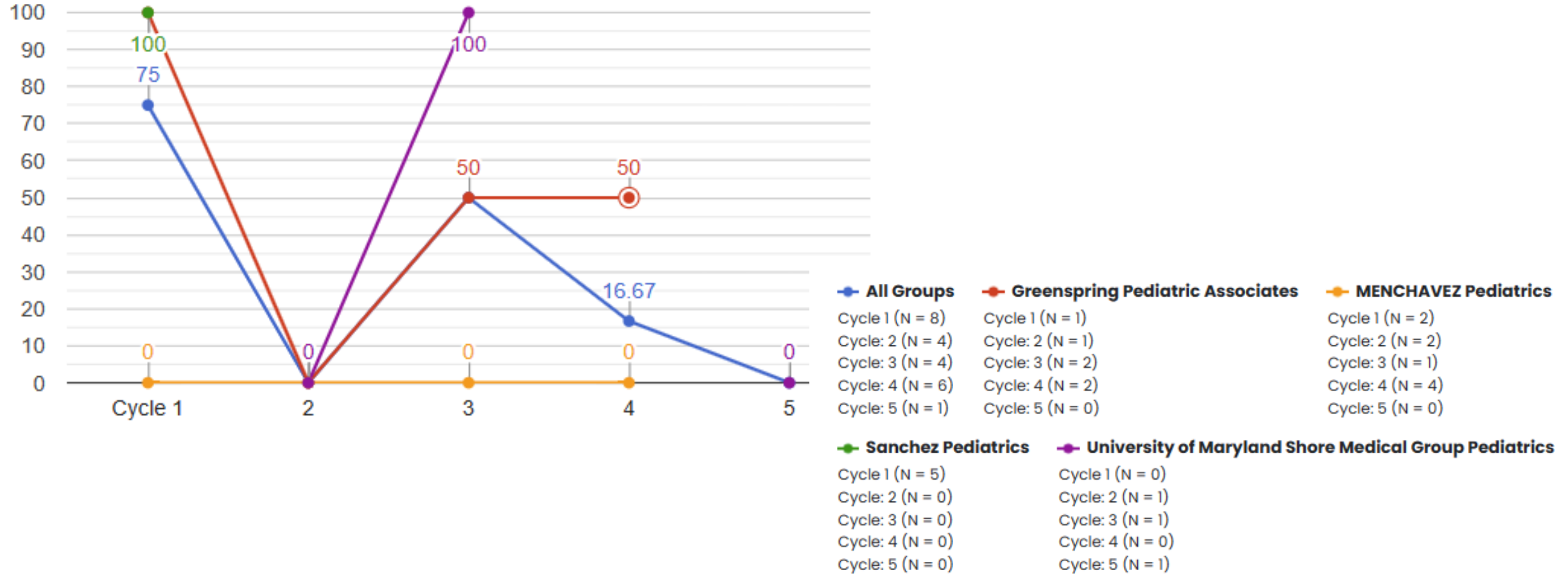
Cycle 1 (N = 20)
 Cycle: 2 (N = 20)
 Cycle: 3 (N = 0)
 Cycle: 4 (N = 0)
 Cycle: 5 (N = 0)

University of Maryland Shore Medical Group Pediatrics

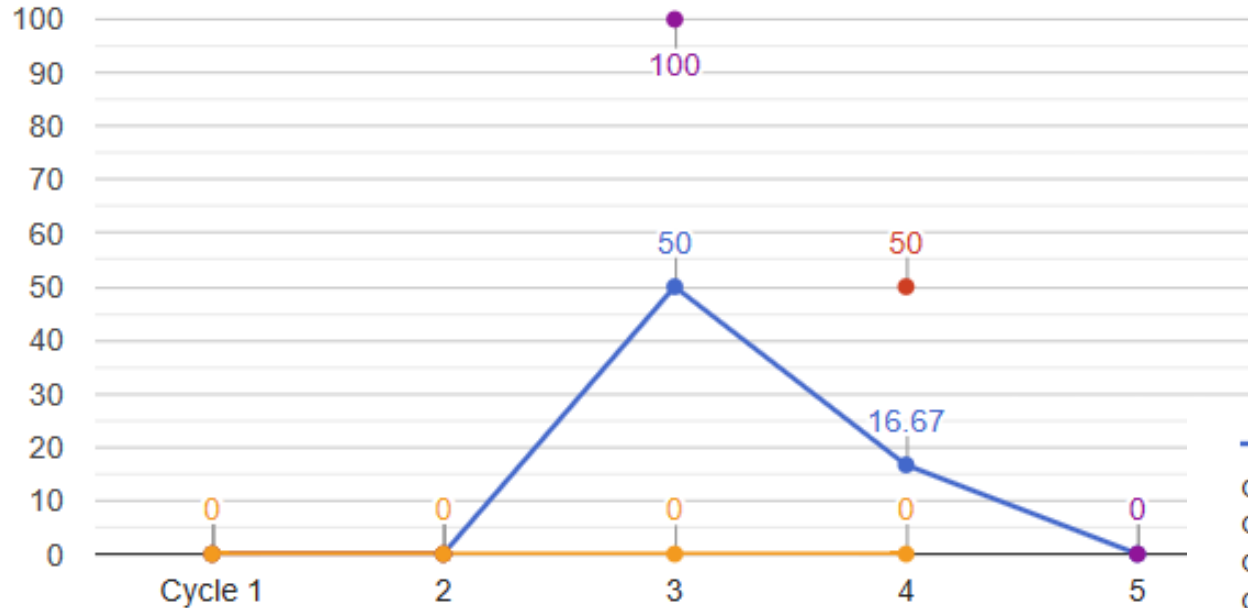
Cycle 1 (N = 20)
 Cycle: 2 (N = 15)
 Cycle: 3 (N = 8)
 Cycle: 4 (N = 16)
 Cycle: 5 (N = 18)



Counseling Parents



Referral to Academic programming



All Groups

Cycle 1 (N = 3)
 Cycle: 2 (N = 3)
 Cycle: 3 (N = 2)
 Cycle: 4 (N = 6)
 Cycle: 5 (N = 1)

Greenspring Pediatric Associates

Cycle 1 (N = 1)
 Cycle: 2 (N = 1)
 Cycle: 3 (N = 0)
 Cycle: 4 (N = 2)
 Cycle: 5 (N = 0)

MENCHAVEZ Pediatrics

Cycle 1 (N = 2)
 Cycle: 2 (N = 2)
 Cycle: 3 (N = 1)
 Cycle: 4 (N = 4)
 Cycle: 5 (N = 0)

Sanchez Pediatrics

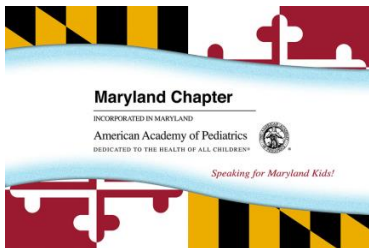
Cycle 1 (N = 0)
 Cycle: 2 (N = 0)
 Cycle: 3 (N = 0)
 Cycle: 4 (N = 0)
 Cycle: 5 (N = 0)

University of Maryland Shore Medical Group Pediatrics

Cycle 1 (N = 0)
 Cycle: 2 (N = 0)
 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 $\mu\text{g}/\text{dL}$. 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.

LEAD POISONING IN ROOFERS. HAROLD J. MAGNUSON, M.D.; JAMA. 1940;114(16):1528-1530. doi:10.1001/jama.1940.02810160030007



American Academy of Pediatrics

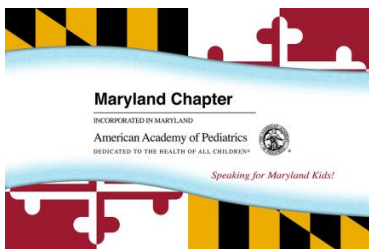
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CASE PRESENTATION

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 Multi-vitamins.

ELL	Date	Age	HgB	Comment
<1 µg/dL	6/29/2021	10 months	9.9	Capillary
12.9 µg/dL	9/22/2022	24 months	12.7	Capillary
42 µg/dL	9/29/2022	24 months	12.8	Venous
25.9 µg/dL	10/11/2022	26 months	-	Venous
23.3 µg/dL	11/18/2022	27 months	-	Venous
16.6 µg/dL	12/13/2022	28 months	11.7	Venous Avg. 20 µg/dL



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

- **Agency for Toxic Substances and Disease Registry** 2020. Toxicological profile for lead. (<https://atsdr.cdc.gov/ToxProfiles/tp13.pdf>)
- **Chandramouli K.** Effects of early childhood lead exposure on academic performance and behavior of school age children. Arch Dis. Child 2009;94:844-848.
- **Dignam 2008.** Reduction of EBL in children in NC and VT 1996-1999. Environmental Health Perspectives. Vol. 116(7) 981-985.
- **EPA** 2013. Integrated science assessment for lead. US EPA?600/R-10/075F 6/2013 (www.epa.gov)
- **US Dept of HUD** publication 2012. Guidelines for the evaluation and control of lead-based paint hazards in housing. 2nd ed. 2012.
- **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>

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

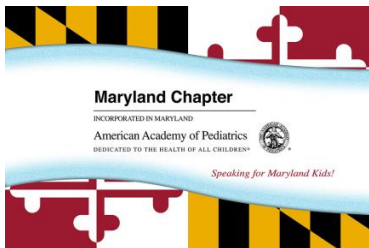


- **CDC Spanish resources :**

<https://www.cdc.gov/nceh/lead/resources/spanish-communication-resources.html>



QUESTIONS?



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!

