Welcome!

Promoting Pediatric Lead Screening in Oregon

Disclosures

- Debra Cherry M.D., M.S., has no conflicts to disclose

- Audio  and video  are muted for all attendees.
- Select 

and to populate Chat and Q&A features to your right. Please ask questions using the Q&A featured and use the Chat function for everything else.
- Presentation slides and recordings will be posted shortly after the session at: https://www.ohsu.edu/orh.
- If you'd like the CEU for this session, please complete the survey.

Presents,

Promoting Pediatric Lead Screening in Oregon

Speaker:

Debra Cherry M.D., M.S. | Director of the Occupational and Environmental Residency Program |University of Washington

Oregon Health Authority
PUBLIC HEALTH DIVISION
Environmental Public Health

UW Medicine



Promoting Pediatric Lead Screening in Oregon

A review of lead exposure and an update on guidelines

Presented by: Debra Cherry, MD, MS

For Oregon Office of Rural Health

August 11, 2021; 8-9 AM PST

ENVIRONMENTAL & OCCUPATIONAL HEALTH SCIENCES
UNIVERSITY of WASHINGTON | SCHOOL OF PUBLIC HEALTH

Northwest PEHSU
Pediatric Environmental Health Specialty Units

Funding and Disclosure

- Funding for this program was provided by the CDC Cooperative Agreement and contract through Oregon Health Authority (OHA)
- 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) and the CDC Cooperative Agreement award, “Preventing Childhood Lead Poisoning in Oregon”: FAIN NUE2EH001388
- Acknowledgement: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing partial funding to ATSDR under Inter-Agency Agreement number DW-75-95877701. Neither EPA nor ATSDR endorse the purchase of any commercial products or services mentioned in PEHSU publications
- The findings and conclusions in this presentation are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry.
- The speaker has no conflicts of interest to disclose.

Outline and Learning Objectives of Today's Talk

- Lead poisoning is a local problem with local solutions!
- I. Sources of Lead Exposure
  - Identify 3 potential sources of lead exposure in Oregon.
- II. Health Effects
  - Describe the unique vulnerability of children to the effects of lead on IQ and behavior, even at low levels.
- III. Testing and Follow Up
  - Describe the screening and reporting guidelines for lead in Oregon, interpret the results of blood lead levels, and describe treatment guidance for various blood lead levels.
- IV. Anticipatory Guidance
  - List 3 resources available pertaining to lead screening, diagnosis, management, and prevention

Northwest PEHSU Pediatric Environmental Health Specialty Units

What source accounts for the majority of childhood lead exposure in Oregon?

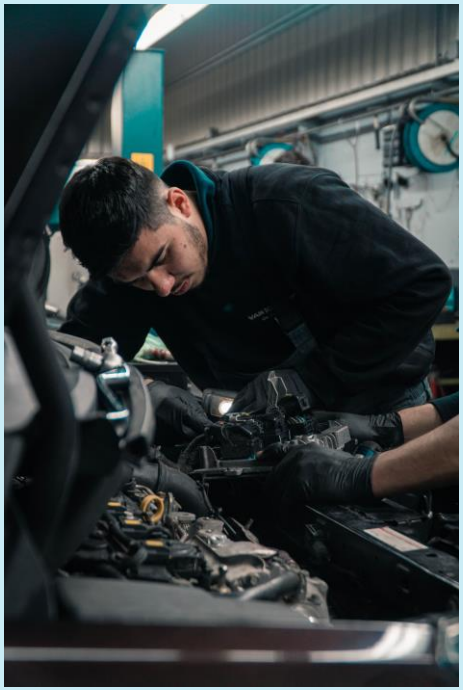


Photo by Sten Rademaker on Unsplash

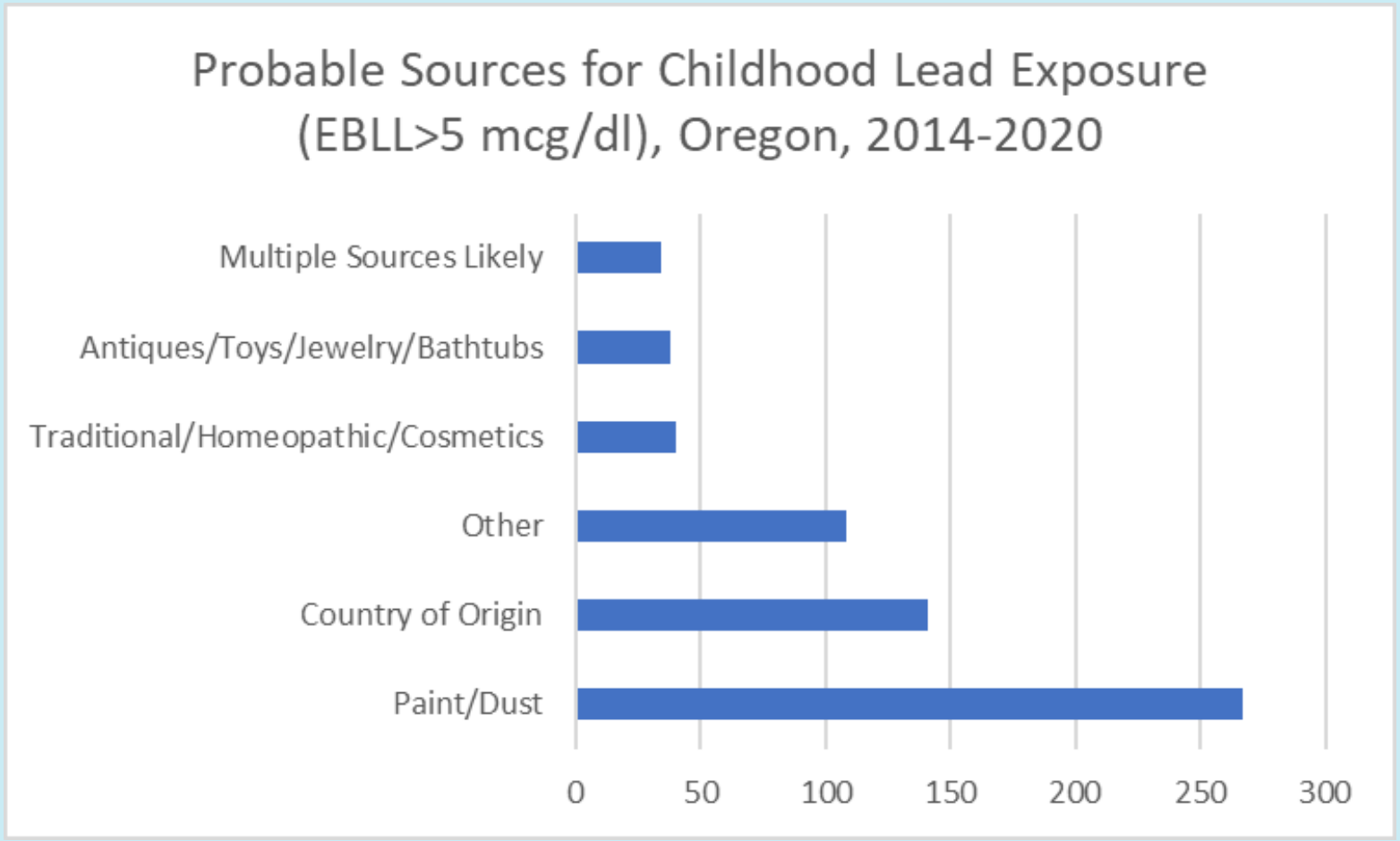
Image by Henryk Niestrój from Pixabay

Image source: Wikimedia Commons

Image by Hans Braxmeier from Pixabay

Image source: Wikimedia Commons

Photo by Ako Mahmoodi from Wikimedia Commons



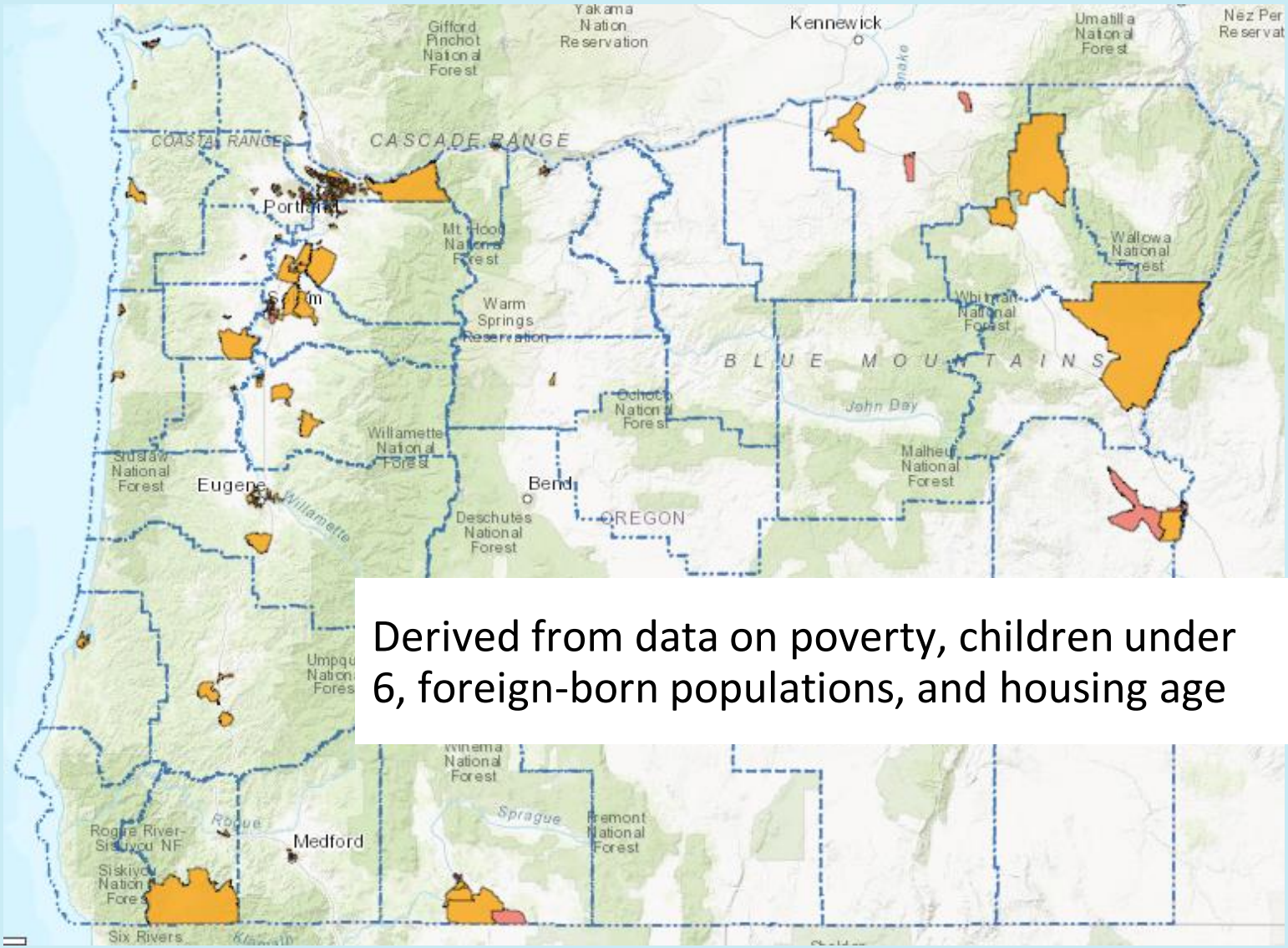
-Not drinking water

-Of cases that had investigations, 87% identified at least one probable source.

Source of OR data: Ryan Barker, OHA lead program

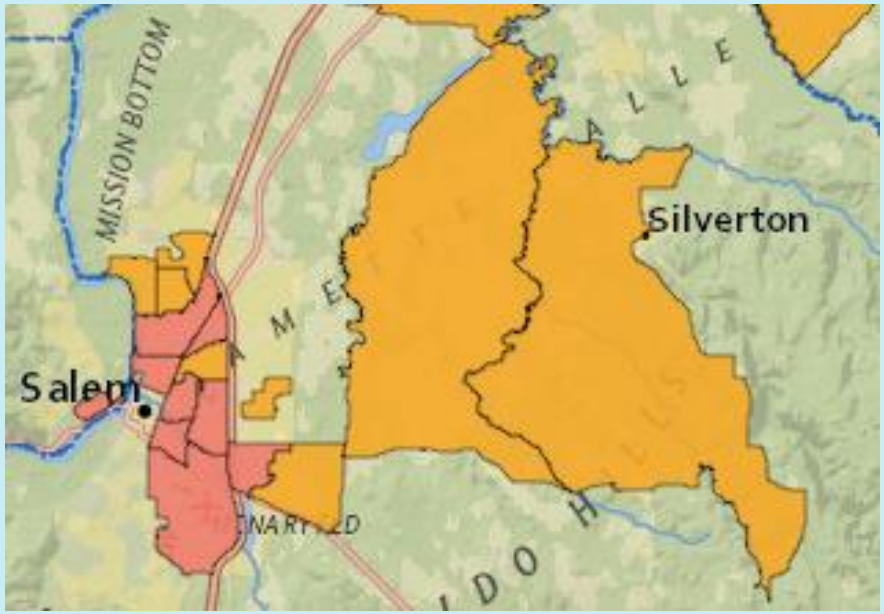
-About 2.5% of children screened nationally, or 1 in 50, have blood lead >5

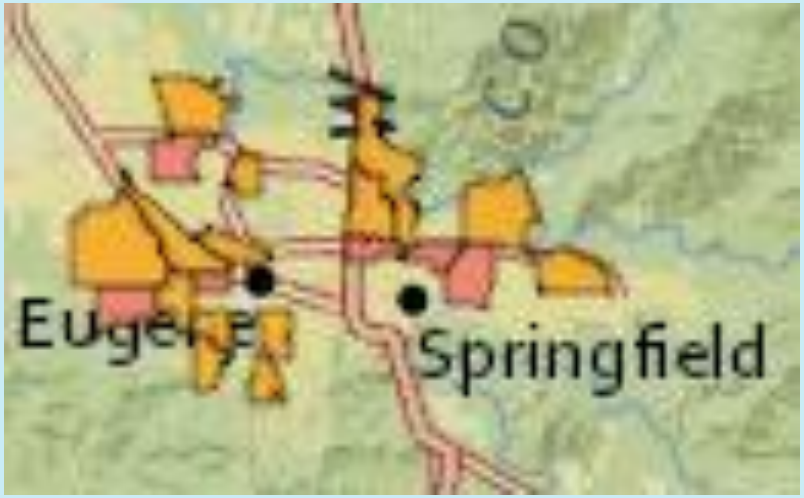
OR Lead Risk Map



Derived from data on poverty, children under 6, foreign-born populations, and housing age

OR Regional Lead Risk Maps





Azarcon / Greta

- In 2019, a 12-month old child in Oregon had elevated blood lead on routine screening
- In OHA home interview, parents stated the child had empacho and prescribed this medicine, “a bright orangish-red powder that is a virtually pure industrial compound…with an elemental lead content of approximately 93%.”

Photo courtesy of Ryan Barker, OHA

Soil in Portland

Image courtesy of CDC Public Health Image Library

Industrial contamination: About 5 yards of Portland homes were built at the site where Multnomah metals, a lead smelter, once stood. Lead contaminated soil was replaced.

Home hobby contamination: "Portland family faces the reality of a lead poisoned child," June 2016, Oregon Public Broadcasting News:
12 mo F screening lead level = 13 micrograms per deciliter

Source: Backyard soil; Previous homeowner had collection of junked cars in the yard
Soil was "12% lead"
EPA removed > 400 tons of soil from the property

Toys Containing Lead

2003 Portland Case

4 y/o boy presents with abdominal pain, constipation, inability to eat or sleep, and bit inside of his cheek. Blood lead = 123 µg/dL, 3 weeks after swallowing a lead medallion purchased from an Oregon vending machine

MMWR, 2003:52, No SS-10

FIGURE. Medallions from recalled toy necklaces that were sold in vending machines in Oregon and linked to lead poisoning

Photo/Oregon Department of Human Services

FAQ from OR Health Care Providers

Do local health departments in OR have the resources to do home investigations for elevated blood lead?

OR State encourages home visits, but if resources are lacking, providers may contact OHA directly at E-mail: leadprogram@dhsoha.state.or.us; Phone: 971-673-0440; program coordinator in 2019 is Ryan Barker, RYAN.S.BARKER@dhsoha.state.or.us

How does a family get their home tap water tested for lead?

Contact one of the Oregon Environmental Laboratory Accreditation Program (ORELAP) accredited lead testing labs; they will often provide a free home test kit; analysis may cost $30-$40

Are OR children getting lead poisoning from tap water in schools?

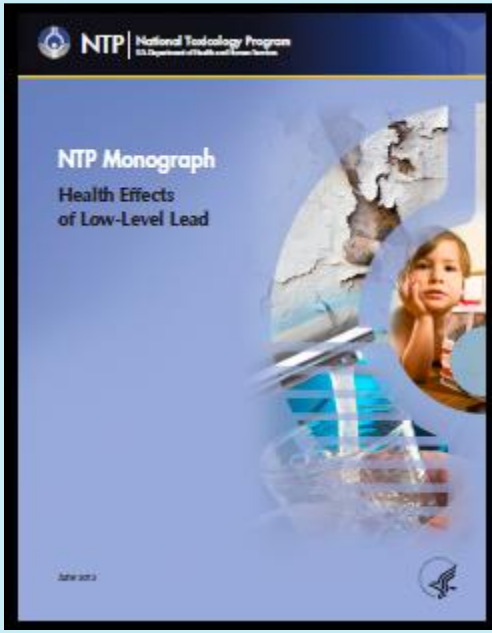
In 2016, several OR schools reported lead above the EPA limit of 15 parts per billion in tap water. The state is taking steps to reduce this level; OAR 333-061-0400 requires school drinking water testing by June 30, 2020. There are not any known cases of elevated blood lead from drinking water in OR schools.

II. What are the health effects of blood lead levels in the 5-10 mcg/dl range in children under 2 years of age?

Select all that apply:

a) ADHD at age 10
b) Loss of 5 IQ points by apx. age 10
c) Criminal behavior by age 20
d) Reduced hearing later in life
e) Anemia

Evidence Review of Low-Level Effects
Sufficient Evidence



Neurological Effects

Attention related problems

Anti social behavior

Criminal Behavior

Decreased cognitive ability

Decreased academic achievement

Decreased Hearing

Other Effects

Decreased postnatal growth

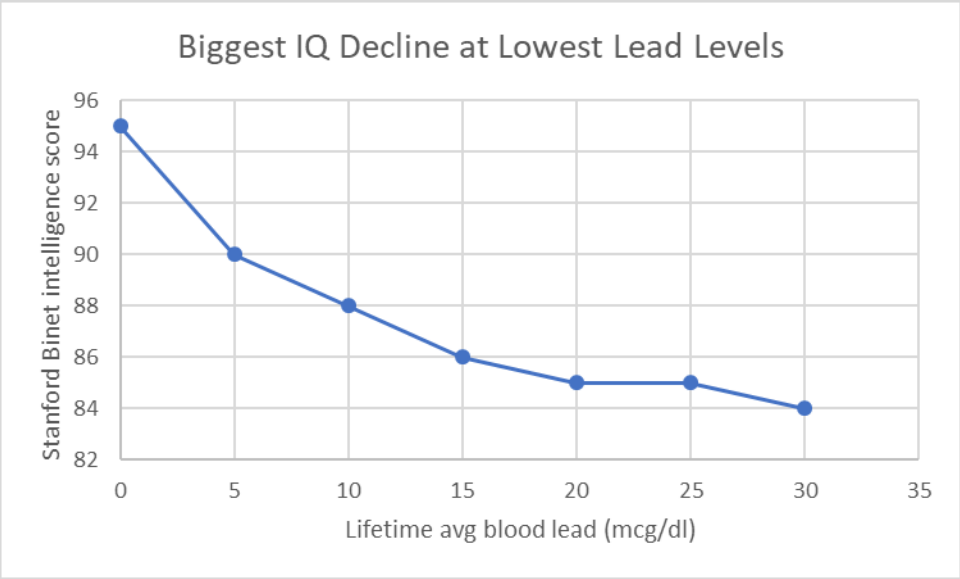
Delayed puberty

Reproductive Effects

Reduced fetal growth

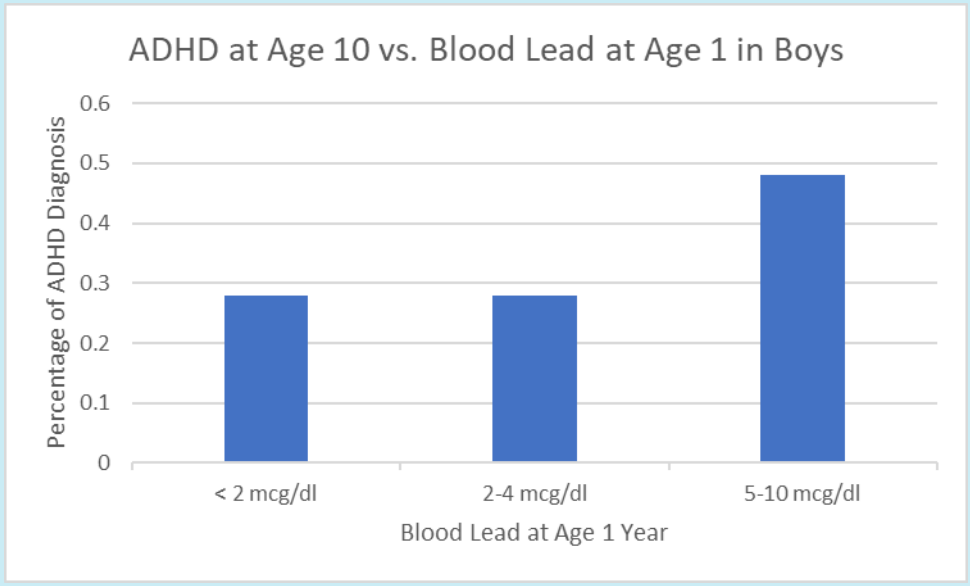
Adverse changes in sperm parameters and increased time to pregnancy

National Toxicology Program 2012



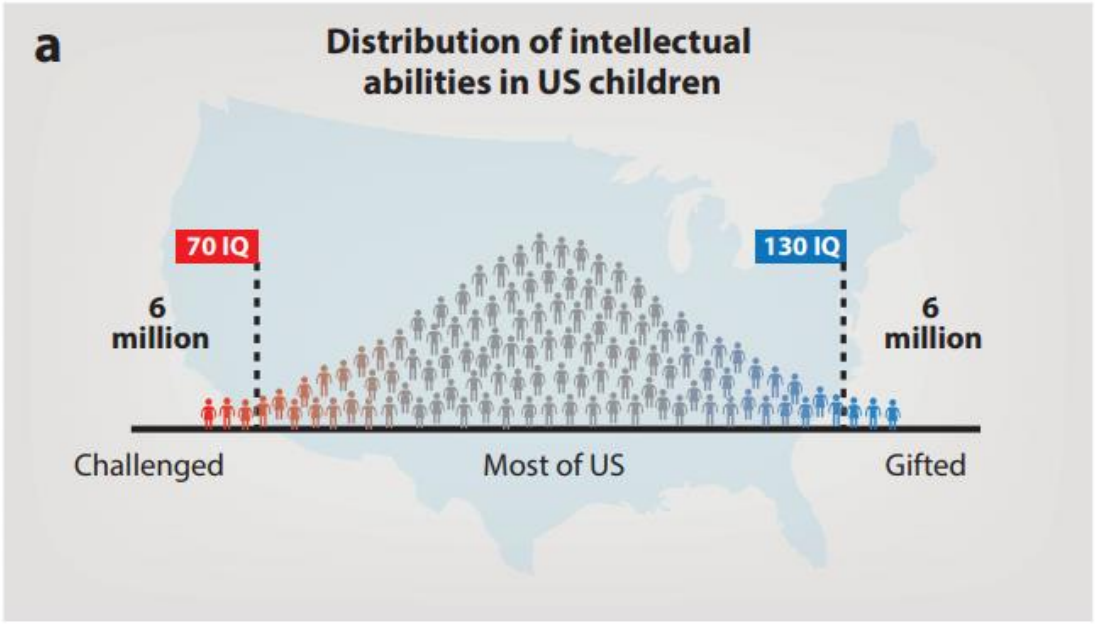
IQ declines 7 points as blood lead increases from 1 to 10 mcg/dl

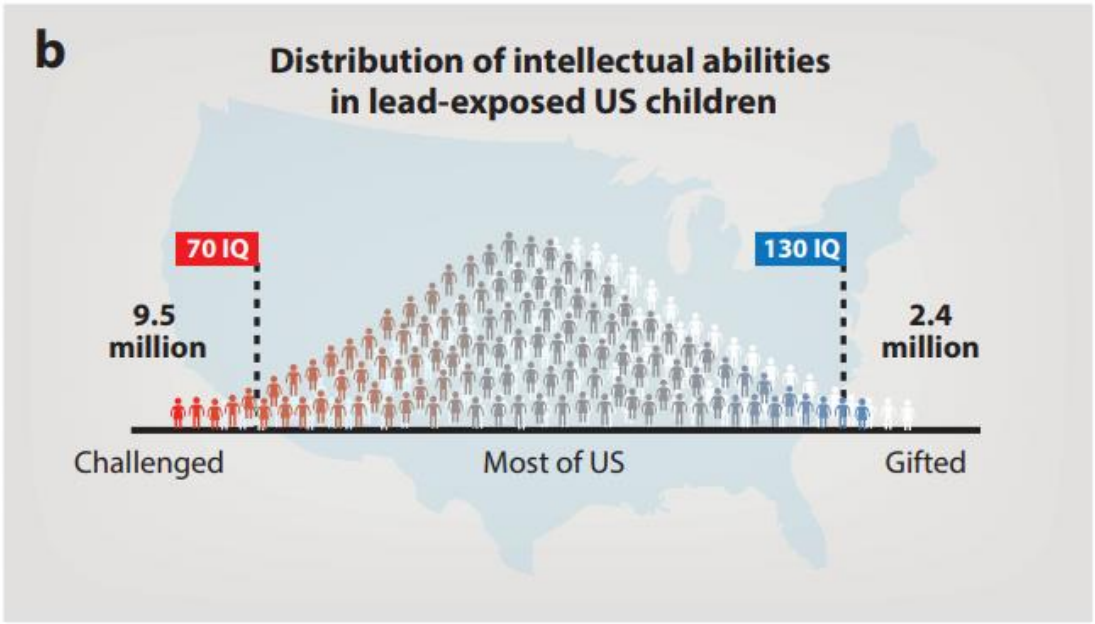
Data from IQ as a Function of Average Lifetime Blood Lead Concentration (Fig 5), Canfield et al, "Intellectual Impairment in Children with Blood Lead Concentrations below 10 µg per Deciliter," 2003



ADHD risk doubles in boys as lead increases from below 5 to between 5-10 mcg/dl

Data from Yulong et al, "A Prospective Birth Cohort Study on Early Childhood Lead Levels and Attention Deficit Hyperactivity Disorder: New Insight on Sex Differences," Journal of Pediatrics, 2018





Lanphear, "The Impact of Toxins on the Developing Brain," An Rvw Public Health, 2015, Fig 2

FAQ re Health Effects

- What are the most common signs of lead exposure?
  - For blood lead < 40 mcg/dl, there are no/minimal signs expected at the time of exposure. Developmental effects may occur later in life due to lead exposure early in life.
- What should I tell the parent of a child whose blood lead level is 4 mcg/dl regarding the impact on IQ?
  - Consider recheck, precision of test is +/- 2 mcg/dl
  - Individual impacts will reflect multiple influences on IQ (parent IQ, household with "learning enriched environment" such as books, etc.). It's impossible to predict individual impacts and how each factor plays out for a complex multifactorial trait like IQ, but population data show approx. 1 iq point change per 1 mcg/dl increase at low levels.

III. What is the purpose of childhood blood lead screening?

Select all that apply:

a) To reverse the effects of lead exposure
b) To comply with Medicaid/OHP guidelines
c) To identify asymptomatic lead-poisoned children
d) To intervene as quickly as possible to reduce blood lead levels

Expected vs. Reported Lead Cases- State by State[1]

The majority of states successfully identify *fewer than half* their children with EBLLs

WA and OR circled in red

(CDC data 2016

6% of children screened) [2]

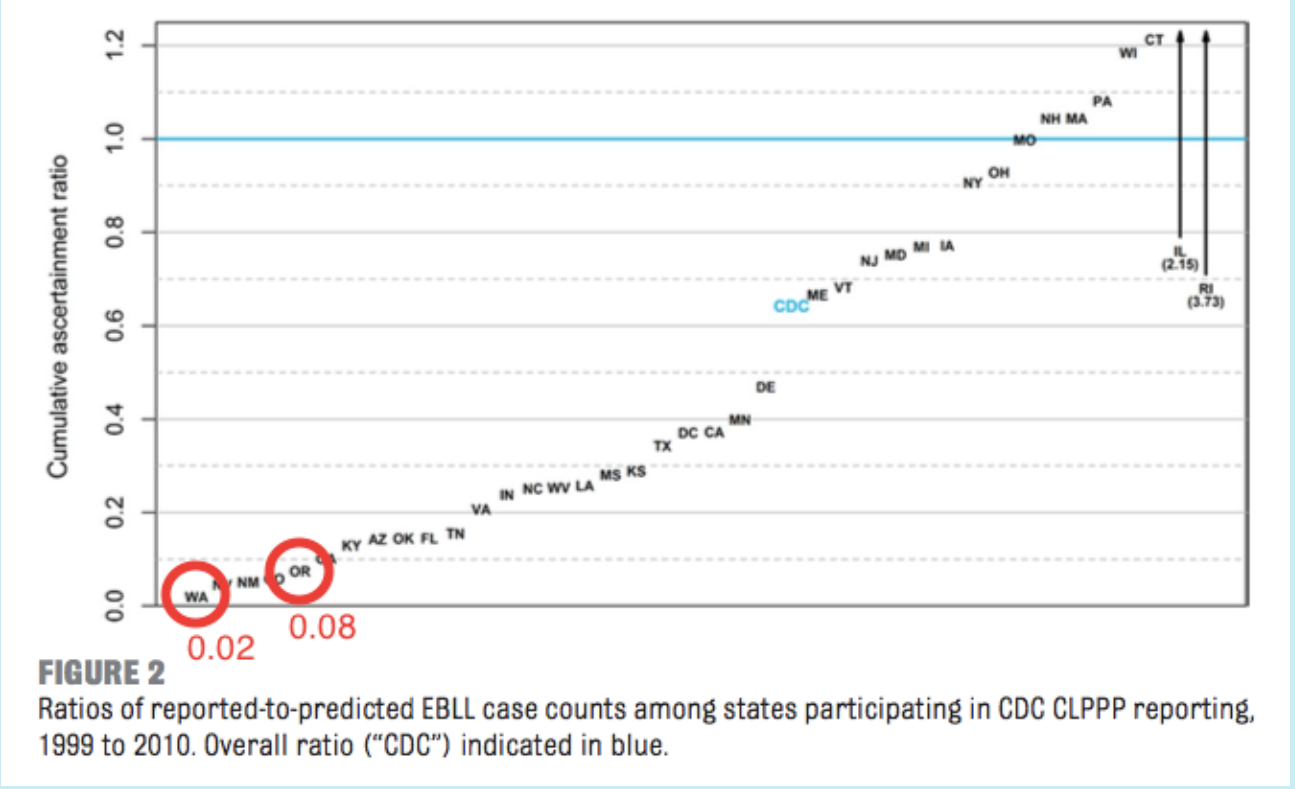
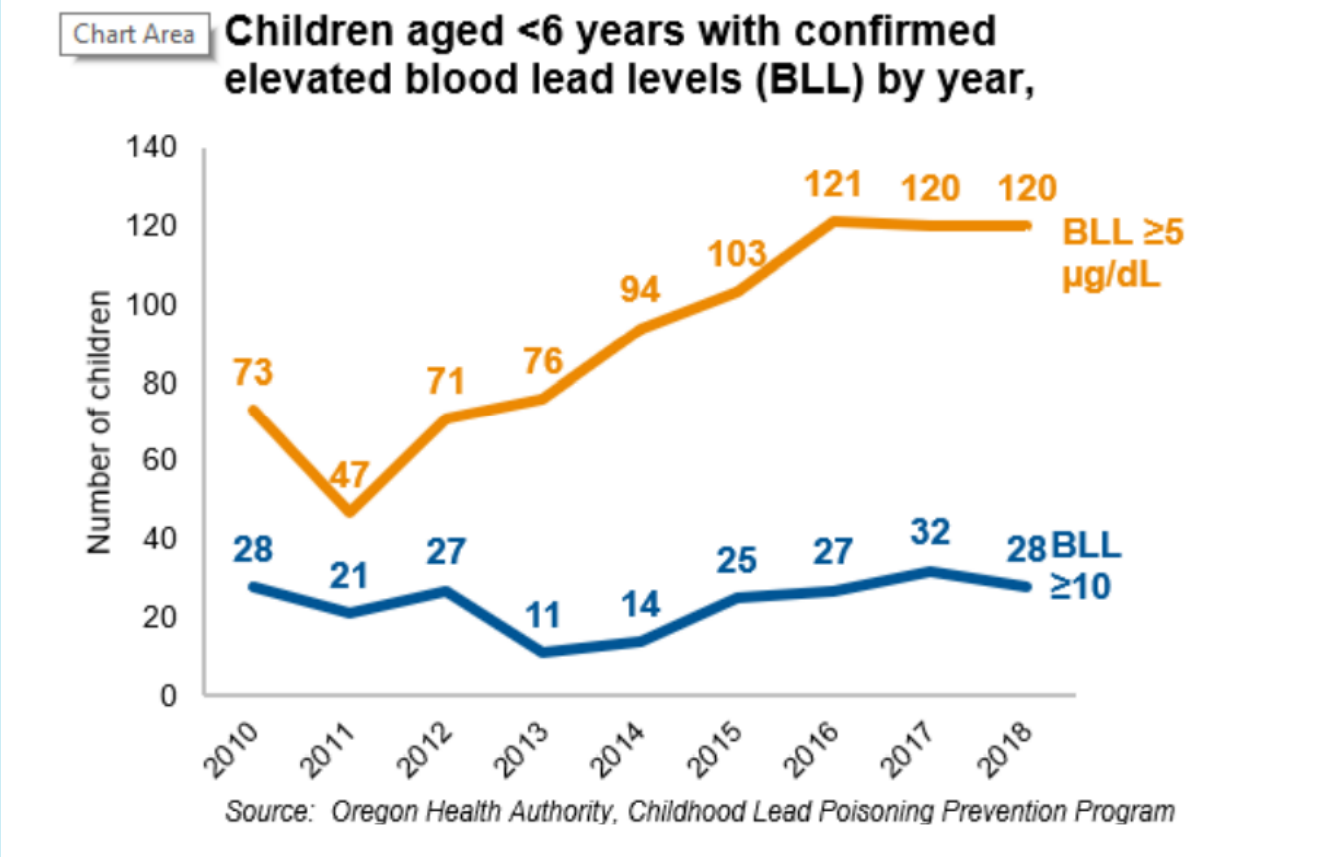


FIGURE 2
Ratios of reported-to-predicted EBLL case counts among states participating in CDC CLPPP reporting, 1999 to 2010. Overall ratio ("CDC") indicated in blue.

1. Roberts EM et al. *Pediatrics.* 2017;139(5):e20164266
2. https://www.cdc.gov/nceh/lead/data/CBLS-National-Table-508.pdf

Number of Elevated Blood Lead Cases, Oregon, 2010-2018



From 2010-2018, a total of 825 Oregon children had confirmed BLLs at or above 5 µg/dL. Of those children, 213 had confirmed blood lead levels ≥10 µg/dL.

Asked registrants: What are you doing now for childhood lead screening?

- Responses:
  - Who: Targeted screening - Questionnaire, or just ask about housing age (if before 1970); or blood test for all Medicaid children
  - When: At 1 and 2 years, 1 and 4 years, or just before starting Head Start
  - How: Capillary (heel or finger), venous confirmation at hospital lab or in office; dentists using a saliva test

OR State Screening Protocols

- All Medicaid patients ages 12 and 24 months, (or between 3-5 if never screened), should receive blood lead tests (not just the screening questionnaire)

- All patients **not** on Medicaid/OHP should be screened with the risk questionnaire (same ages as above) (and/or blood test)

- Waivers for blood lead tests for Medicaid/OHP patients are not accepted.

Survey of OR Health Care Providers Says….

- Are you aware of the Oregon Lead Screening Questionnaire, designed for medical providers to use in the clinic?
  - About half were aware
- Do you use a different lead screening method for your Oregon Health Plan (OHP, Medicaid) pediatric patients compared with non-OHP patients?
  - Most use the same methods for screening all patients
  - Only a few blood-screen Medicaid patients and questionnaire-screen non-Medicaid patients
- Are you aware that the Centers for Medicare and Medicaid Services (CMS) requires that all children on OHP/Medicaid should be screened using a blood test (capillary or venous), rather than using a questionnaire or some other method?
  - Mostly not aware

Preliminary results, OHA provider survey on childhood lead screening

Lead Screening Questionnaire

Targeted, non-Medicaid Screening

Northwest PEHSU Pediatric Environmental Health Specialty Units

Oregon Health Authority

Childhood Lead Poisoning Prevention Program
Health Care Provider Lead Screening Questionnaire

Name of patient: _____ Date: _____ Age of child: _____

Anticipatory guidance regarding lead hazard identification and risk reduction measures should be a routine part of an ongoing educational approach for pregnant women, children and their families. The goal of lead screening is to identify children who may have been exposed to lead, provide interventions and reduce the risk of exposure. All children should be assessed for risk of lead poisoning by administration of the following questionnaire. **This questionnaire should be administrated at 1 and 2 years of age or between 3 and 5 years of age if not previously screened.** If the answer to any of these questions is "Yes" or "Don't know" a blood lead test should be performed. Follow up questions may be needed to clarify responses.

Please circle the answers to the following questions:

Has your child lived in or regularly visited a home, child care or other building built before 1950?	**Yes** **Don't Know**	**No**
Has your child lived in or regularly visited a home, child care or other building built before 1978 with recent or ongoing painting, repair and/or remodeling?	**Yes** **Don't Know**	**No**
Is your child enrolled in or attending a Head Start program?	**Yes** **Don't Know**	**No**
Does your child have a brother, sister, other relative, housemate or playmate with lead poisoning?	**Yes** **Don't Know**	**No**
Does your child spend time with anyone that has a job or hobby where they may work with lead? *Examples: painting, remodeling, auto radiators, batteries, auto repair, soldering, making sinkers, bullets,* stained glass, pottery, going to shooting ranges, hunting or fishing.	**Yes** **Don't Know**	**No**
Do you have pottery or ceramics made in other countries or lead crystal or pewter that are used for cooking, storing or serving food or drink?	**Yes** **Don't Know**	**No**
Has your child ever taken any traditional home remedies or used imported cosmetics? *Examples: Azarcon, Alarcon, Greta, Rueda, Pay-loo-ah, or Kohl*	**Yes** **Don't Know**	**No**
Has your child been adopted from, lived in or visited another country?	**Yes** **Don't Know**	**No**
Do you have concerns about your child's development? **Concern(s):** _____	**Yes**	**No**

How to Collect Samples for Lead Screening

- Venipuncture
  - More accurate, less accessible
- Capillary or Fingerstick or Heelstick / Point of Care Testing
  - Sensitivity 87% to 91%, specificity 92% to 99% (good)
  - Contamination is an issue if using point of care devices. To reduce contamination:
    - Shake hands dry (no paper towels)
    - Take the lead sample first, before other blood samples
    - Take the second drop of blood as a sample
  - If lead is positive on fingerstick, confirm with venipuncture

What about oral fluid screening?

- "Evaluating Oral Fluid as a Screening Tool for Lead Poisoning"
  - J Anal Toxicol. 2016 Nov;40(9):744-748
  - Corresponding author: Bob Geller, MD at Emory
- Findings: 407 children 6 mos-5 yrs had concurrent blood and saliva tests
  - 223 true negatives (both tests <5)
  - 176 false positives (saliva +, blood -)
  - 8 true positives (both tests >5)
  - 0 false negatives
- Conclusions: Test needs further study
- Oral test is not acceptable to CDC or OHA; not reportable; OHA will not record or investigate oral lead tests

Confirmatory Testing Schedule in OR

- Any capillary screening BLL ≥ 5µg/dL must be confirmed with a venous sample, according to the following schedule:

BLL (ug/dL)	Confirmation Testing (venous)	Follow-Up Testing (venous)
5-9	**As soon as possible, or within 7-14 days**	3 months
10-19	As soon as possible, or within 7 days	3 months
20-44	As soon as possible, or within 7 days	1 months
45-59	As soon as possible, or within 2 days	Chelation with subsequent follow up
60-69	As soon as possible, or within 1 day	Chelation with subsequent follow up
>70	Immediately as an emergency lab test	Chelation with subsequent follow up

Oregon Health Authority (2016). Lead Screening Protocols for Children. Available at https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/LEADPOISONING/COUNTYHEALTHDEPARTMENTS/Pages/index.aspx

OR Lead Reporting

- Laboratories are required to report any BLL ≥ 5µg/dL within one business day. All other BLLs measured must be reported within seven working days.

- If a clinic does point of care testing for blood lead, those results (including negative tests) must be reported directly to the local health authority or OHA.

- OHA refers childhood EBLL reports from labs/clinics to Local Public Health Authorities (LPHA). If an LPHA is notified directly of a test result, it should report the case to the OHA.

- Forms used for reporting are available from the Lead Poisoning Prevention Program at (971) 673-0440 or www.healthoregon.org/lead.

CDC 2013 Screening for Lead during the Domestic Medical Examination for Newly Arrived Refugees

- Check BLL of all refugee children **6 months–16 years of age** upon their arrival in the United States (generally within 90 days, preferably within 30 days of arrival).
- For children aged **6 months–6 years of age,**
  - Within 3–6 months post-resettlement, conduct a follow-up blood lead regardless of the initial screening BLL result.
  - Within 90 days of their arrival in the United States, conduct a nutritional assessment and obtain a routine complete blood count with differential.
  - Provide daily pediatric multivitamins with iron to all refugee children in this age group.

www.cdc.gov/immigrantrefugeehealth/pdf/lead-guidelines.pdf

Lead Anticipatory Guidance for families with young children – **paint hazards messages**

- Keep your child away from peeling paint and home repairs that disturb lead paint.
- If you are renting, and you have concerns about lead exposure from renovations your landlord is performing, contact OHA.
- Frequently wash hands, toys, pacifiers, bottles and other items your child places in his or her mouth.
- Clean floors, windowsills, and dusty places often with wet disposable cleaning cloths, and vacuum with a sealed HEPA filter if possible.
- Use safe methods when doing home repair that disturbs paint. For information on lead safe methods see EPA's lead webpage at www.epa.gov/lead

Lead Anticipatory Guidance for families with young children – **beyond paint**

- Avoid using health remedies (such as azarcon, greta, paylooah) and eye cosmetics (such as kohl, kajal, surma) from other countries. Some of these products have been found to contain high levels of lead.
- Use caution when using candles, spices, snack foods, and children's toys and jewelry made in other countries. These may contain lead.
- Keep your child away from work clothes and tools of household members who do construction work or other work or hobbies that may expose them to lead
- Wash work clothes separately from other laundry. Remove work clothes and shoes before entering your home.

Northwest PEHSU Pediatric Environmental Health Specialty Units

Factsheets on Traditional Sources

PEHSU Pediatric Environmental Health Specialty Units

UNIVERSITY of WASHINGTON

Traditional Sources of Lead Exposures in Immigrant Populations

for clinicians

No level of lead in the blood is safe. At low levels, lead exposure may lead to neurodevelopmental problems and at high levels, lead poisoning may be fatal. Immigrant and refugee children are at especially high-risk for lead exposure due to their frequency of living in old housing stock and some traditional practices. This document provides a visual guide for clinicians to use to identify traditional sources of lead exposure in various immigrant populations.

Please note that not *all* listed spices, candy, and plant-based substances will always contain lead; keep them in mind as potential exposure sources given elevated blood lead levels. Furthermore, since new sources of lead are identified over time, this list is not comprehensive.

Common Potential Exposures for all Populations

- Glazed pottery– even if it says lead free.
- Some imported Cosmetics.
- Metal Jewelry.
- Some imported spices and candies.
- Old painted wooden and metal toys.
- Living in old homes with paint chips or lead pipes.
- Contaminated Soil.

For more information on the medical management of lead poisoning, go to: www.deohs.washington.edu/pehsu/factsheets

For additional questions or guidance, contact the NW PEHSU at 1-800-KID-CHEM or pehsu@uw.edu, or visit our website http://www.deohs.Washington.edu/pehsu

Acknowledgment: O. Halas, BA; C. Karr, MD, PhD; N. Beaudet, MS, CIH; S. Sathyanarayana, MD, MPH; E. Friedman, MD, MPH; K. Ivicek, MN, RN; M. Willis, BSN, MPH. **Last updated August 2018.**

This material was supported by the American College of Medical Toxicology (ACMT) and funded (in part) by the cooperative agreement FAIN: 1NETS1005238-04 from the Agency for Toxic Substances and Disease Registry (ATSDR).

Acknowledgment: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing partial funding to ATSDR under Inter-Agency Agreement number DW-75-92877701-4. Neither EPA nor ATSDR endorse the purchase of any commercial products or services mentioned in PEHSU publications.

DEPARTMENT OF ENVIRONMENTAL & OCCUPATIONAL HEALTH SCIENCES
UNIVERSITY of WASHINGTON - SCHOOL OF PUBLIC HEALTH

PEHSU Pediatric Environmental Health Specialty Units

UNIVERSITY of WASHINGTON

Traditional Potential Sources of Lead Exposure in South Asian Immigrant Populations**

Substance	Use
Bali goli/ bali gali, bala gali, ghasard. *Red or brown powder or black, flat bean.*	Treats upset stomachs.
Deshi Dewa, Koo Sar*. *Plant based pills.*	Addresses fertility issues, menstrual cramps.
Gugglu, Guggulu*. *Herbal supplement from Indian bdellium tree (myrrh). Typically orange, yellow, or brown powder.*	Maintains joint and heart health.
Jambrulin*. *Ayurvedic herbal medicine.*	Controls diabetes and sugar.
Kandu. *Red, lead containing powder.*	Treats stomach aches.
Kohl (Surma, Saoott), Alkohl. *Black powder made from lead or antimony sulfide.*	Treats skin infections, used as an astringent for eye injuries, and as a cosmetic.
Kustha, kushta*. *Root.*	Treats heart, liver, and brain diseases, and stomach aches.
Sundari Kalp, Sundri Kalp*. *Herbal supplement containing Ashok Bark, Nagarmotha, sonth, Dhataki, Bala, Dalchini and Kamal Phool .*	Treats menopause symptoms and addresses nutritional and stomach disorders.

*Please note that not *all* listed spices, candy, and plant-based substances will always contain lead; keep them in mind as potential exposure sources given elevated blood lead levels.

**Since new sources are recognized over time, this list is not comprehensive

DEPARTMENT OF ENVIRONMENTAL & OCCUPATIONAL HEALTH SCIENCES
UNIVERSITY of WASHINGTON - SCHOOL OF PUBLIC HEALTH

Guidance on reducing lead in drinking water

- **If you live in older housing** (pre-1985, which is the year lead solder was banned in OR) run tap >2 minutes after water has sat in the pipes for > 6 hours. This will help flush out any lead that may have accumulated in your pipes.
- **If you live in newer housing** and are concerned, you can flush your pipes by running your tap until the water is noticeably cooler.
- Use only cold water for drinking, cooking, and making baby formula. Hot water may contain higher levels of lead.
- Clean the screens and aerators in faucets frequently to remove captured lead particles.
- Use only “lead free” piping and materials for plumbing when building or remodeling.
- Consider using a filter.
  Check whether it reduces lead - not all filters do. Be sure to maintain and replace a filter device in accordance with the manufacturer's instructions. Contact NSF for performance standards

Lead and Drinking water factsheet available at deohs.washington.edu/pehsu/

Promoting Healthy Neurocognitive Development

Lead exposure not “reversible”; but exposure not guarantee of damage either…

Photo courtesy of CDC/ Amanda Mills

Cognitive and behavioral development is positively influenced by nurturing (parents, caregivers, teachers) and safe, stable, supportive environment…

- ✓ Good nutrition
- ✓ Educational enrichment
- ✓ Physical activity
- ✓ Limited screen time
- ✓ Safe environments
- ✓ Good sleep

Image by luvmybry from Pixabay

Photo by Andrew Ebrahim on Unsplash

Early Intervention Referral

Oregon Health Authority

Medical Providers and Laboratories

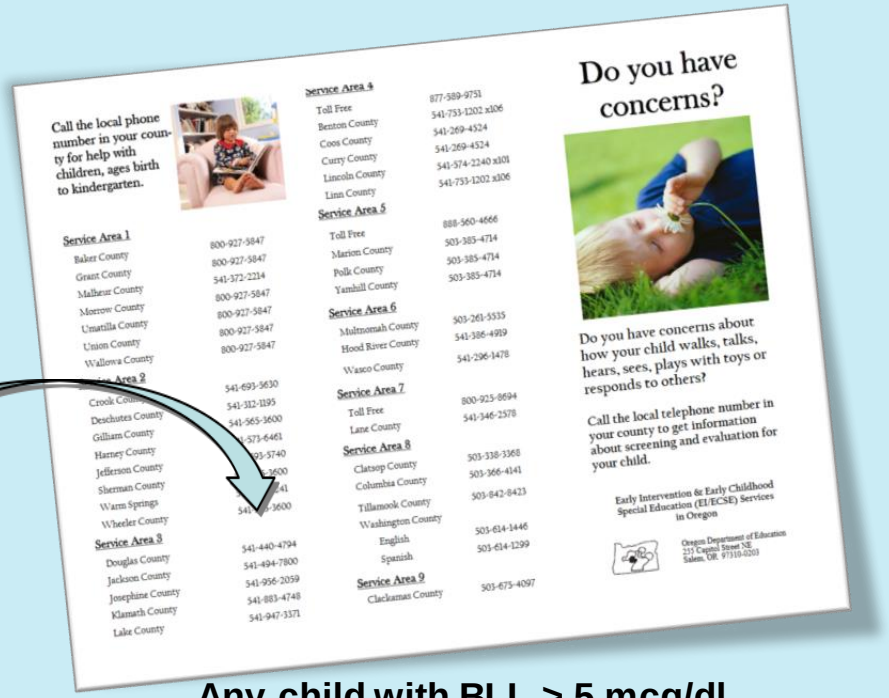
Lead Poisoning and Exposure to Lead

Public Health Division › Environmental Public Health › Healthy Homes and Neighborhoods › Lead Poisoning and Exposure to Lead › Medical Providers and Laboratories

Medical Management

Children

- Medical Information Form (pdf) - to be completed by medical provider for children with elevated blood lead levels.
- Medical Evaluation and Recommendations (pdf) - This document is intended to provide evidence-based guidance for medical providers caring for children with confirmed elevated blood lead levels (EBLLs).
- Medical Management Recommendations (pdf) - this document provides recommendations from the Pediatric Environmental Health Specialty Units and the American Academy of Pediatrics.
- **Early Intervention/Early Childhood Special Education (EI/ECSE) Referral** - Children diagnosed with lead poisoning may be eligible for EI/ECSE services. Please refer to the Oregon Department of Education's website for more details and the EI/ECSE Universal Referral Form (doc).



Any child with BLL > 5 mcg/dl may qualify for EI/ECSE in OR

Resources

- PEHSU Network
  - http://www.pehsu.net/_Childhood_Lead_Exposure.html
  - 1-877-KID-CHEM
  - NW PEHSU: https://deohs.washington.edu/pehsu/home , has regional resources including “Traditional Sources of Lead Exposure in Immigrant Populations”
- OHA: Lead Poisoning Prevention Program
  - https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/LEADPOISONING/Pages/Program-Information.aspx
- AAP: Detection of Lead Poisoning
  - https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/lead-exposure/Pages/Detection-of-Lead-Poisoning.aspx
- US EPA: Lead Sources
  - https://www.epa.gov/lead

References

A Targeted Approach to Blood Lead Screening in Children, Washington State. 2015 Expert Panel Recommendations: November 2015

Bellinger, D. Putting it into Practice: Pediatric Environmental Health Training Resource. “Childhood Lead Poisoning.” Children’s Environmental Health Network. 2014.

CDC Advisory Committee on Childhood Lead Poisoning Prevention. Preventing Lead Poisoning in Young Children. 1991 and 2005.

Council on Environmental Health. Prevention of Childhood Lead Toxicity. Pediatrics 2016;138.

Hauptman, M. Bruccoleri R. Woolf A. An Update on Childhood Lead Poisoning. Clinical Pediatric Emergency Medicine 18(3) · July 2017. 18(3)181-191.

Roberts, J. et al. Time Required for Blood Lead Levels to Decline in Non-chelated Children Clinical Toxicology, 39(2), 153–160 (2001).

Schmidt, C. After the Screening: What Happens Next for Children with Elevated Blood Lead? Environmental Health Perspectives. https://doi.org/10.1289/EHP2482 (2017).