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Health Effects and Treatment of Lead Poisoning in Childhood and Pregnancy

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NC Childhood Lead Poisoning Prevention Program

NC Division of Public health

March 4, 2020

DISCLOSURE

I have no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider(s) of commercial services discussed in this CME activity. I do not intend to discuss an unapproved/investigative use of a commercial product/device in my presentation.

Objectives

- Discuss the absorption and storage of lead
- Discuss the major health effects in childhood and pregnancy
- Use cases to illustrate toxic health effects of lead in children
- Discuss testing and treatment

Your work makes a difference!

Photo used with permission from the UNC Institute for the Environment

Reference: NC Childhood Lead Testing and Follow-Up Manual

https://nchealthyhomes.com/files/2019/09/2019-Clinical-Manual-Text-and-Appendices-FINAL-Sept-2019.pdf

How does lead get into the body?

Photo courtesy of the Institute for the Environment, UNC-Chapel Hill

Lead: Primary routes of exposure

Ingestion

- Children absorb 40-50% of ingested lead vs 10-15% absorption for adults
- Iron deficiency enhances absorption of ingested lead
- Iron deficiency can cause "pica" = consumption of non-food items that may contain lead

Inhalation

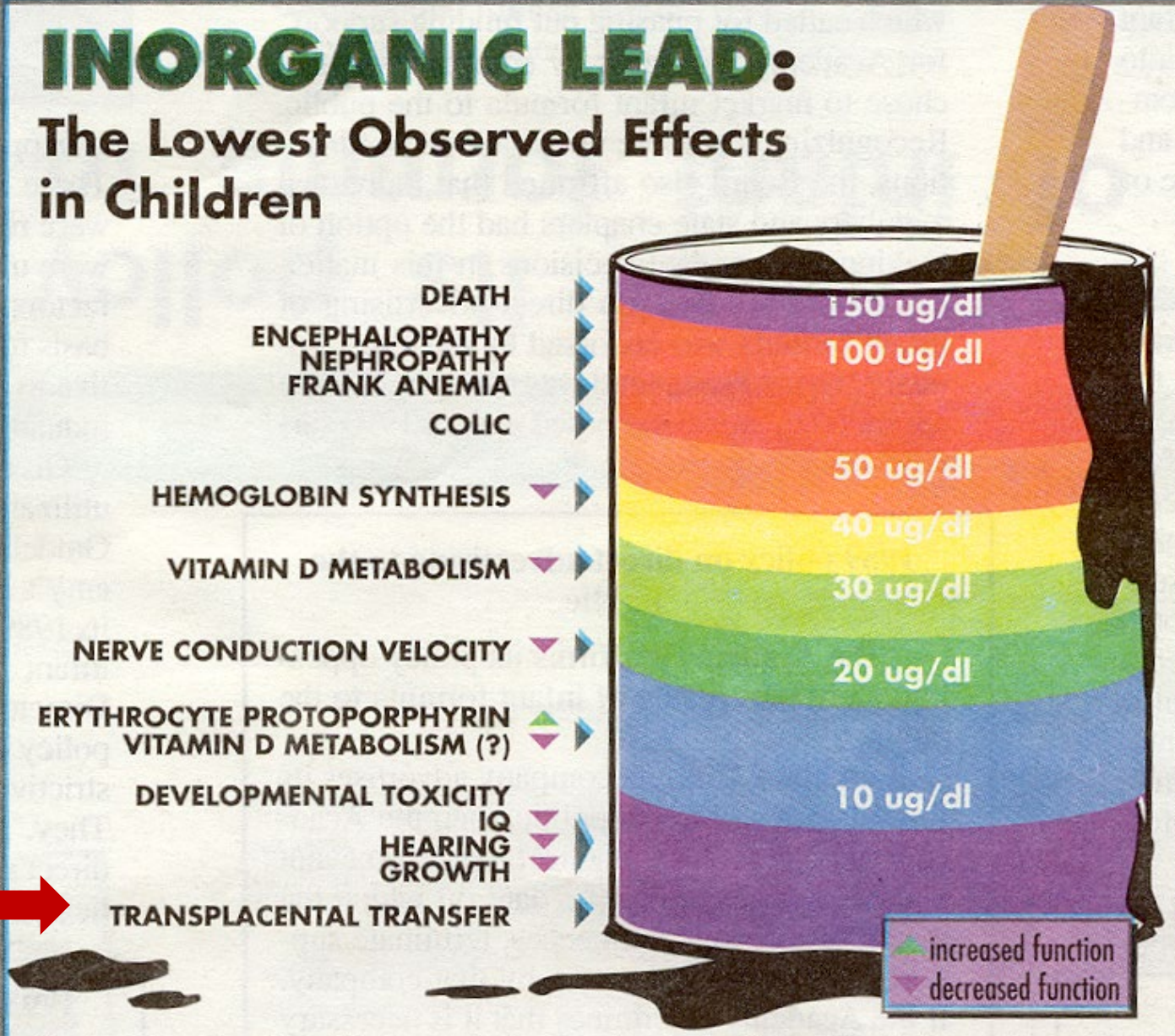
- 30-40% absorption overall
- Children have higher metabolic rates and deposit 2.7 fold more lead in lung tissue than adults
- Skin--not a significant source for inorganic lead absorption]

Children are more susceptible to lead poisoning than adults

- Hand to mouth /developmental behavior
- Absorption 5-10 times greater
- Take in more food and water per body mass
- Developing organs are more sensitive to toxins
- Incomplete development of blood-brain barrier up to 36 months of age increases exposure of brain tissue

INORGANIC LEAD:

The Lowest Observed Effects in Children



The chart shows the effects of lead contamination at various levels. The levels in this diagram do not necessarily indicate the lowest levels at which lead exerts an effect. These are the levels at which studies have adequately demonstrated an effect.

Source: ATSDR, 1990.

Brelund Graphics

Effects on Reproductive Health and Pregnancy

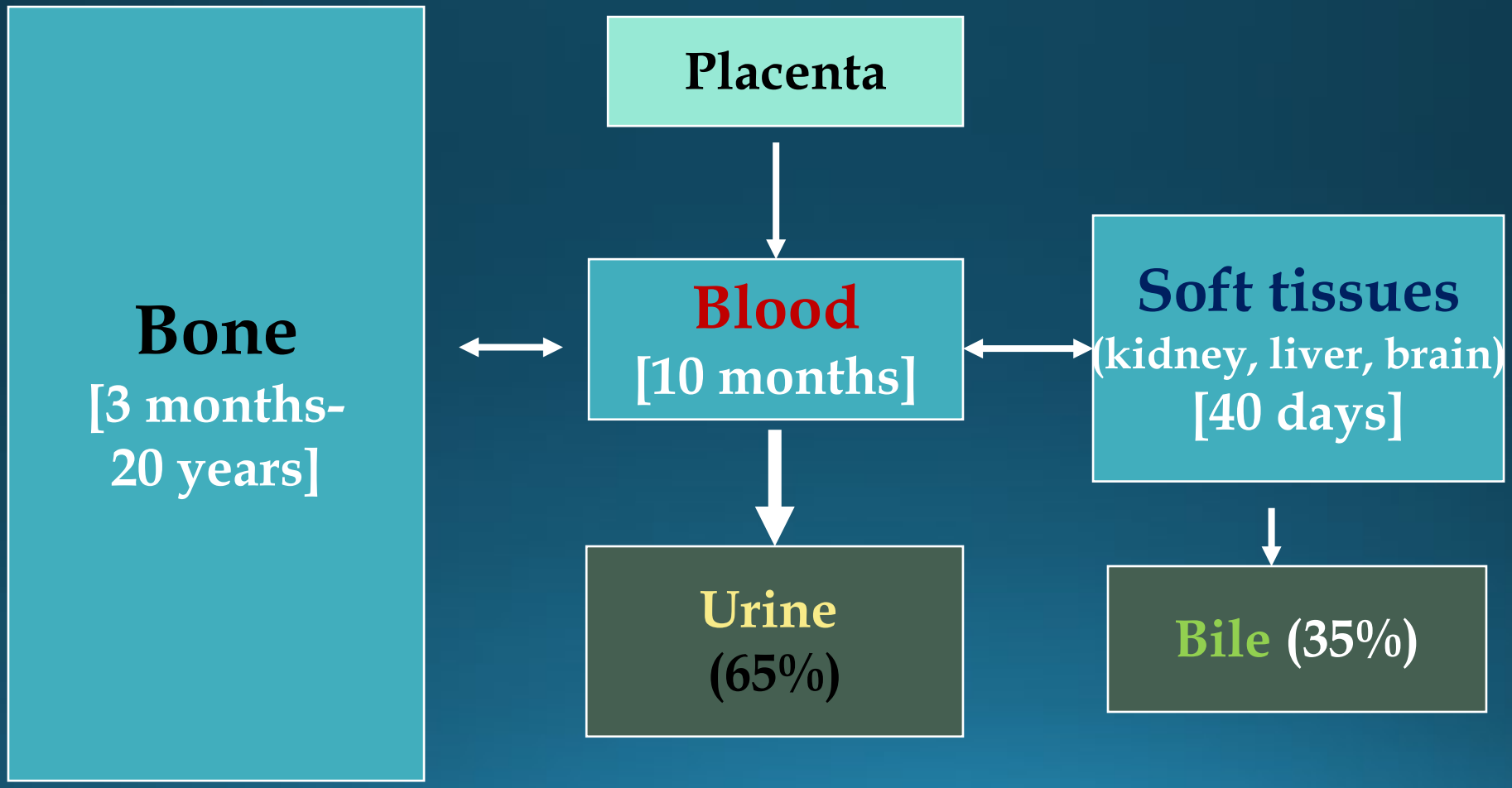
- **Lead crosses the placenta, exposing the fetus**
- **High Maternal BLL* increases the risk of spontaneous abortion, reduced birth weight and premature birth at high levels of exposure**
- **Increased risk of hypertension in pregnancy**
- **Adverse effect on infant's neural development**
- **Decreased sperm counts at EBLs of 30-40 *u*g/dL**
- **May adversely affect postnatal growth**
- Source: ACOG, 2012

*BLL = blood lead level

Once it enters the body, where does lead go?

Photo used with permission from the UNC Institute for the Environment

Distribution and Persistence of Absorbed Lead



Once absorbed, what are the health effects of lead for children?

Photo courtesy of the UNC Institute for the Environment, UNC-Chapel Hill

Adverse effects on multiple systems

Photo courtesy of the UNC Institute for the Environment, UNC-Chapel Hill

1. Brain and peripheral nervous system
2. Hematologic--red blood cells, heme synthesis
3. Renal - nephrotoxicity,chronic interstitial nephritis, gout

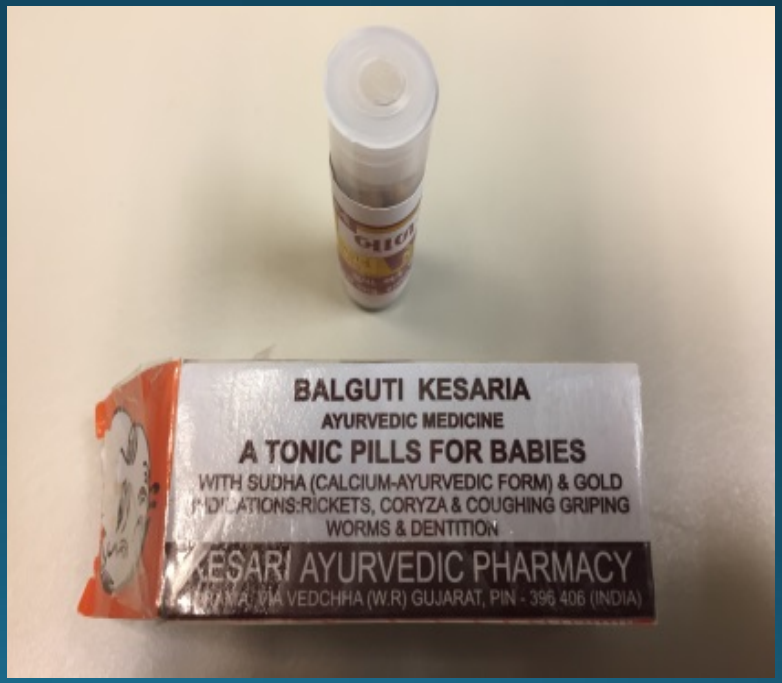
- Metabolic: Iron, Vitamin D, calcium
- GI – colic, nausea, abdominal pain

Let's look at some real cases... Case 1: North Carolina, 2017

- **13-month-old child with developmental delay**
- **A *confirmed* blood lead level was 22 µg/dL (lead poisoning)**
- **The child's home was built after 1978 and no lead paint hazards were found**
- **Family of SE Asian/Indian origin**

Balguti kesaria

- An Ayurvedic medicine, *Balguti kesaria*, that the parents had been giving the child was found to contain 220mg/kg lead



https://www.fda.gov/drugs/drugsafety/ucm570237.htm

Safety Alerts for Human Medical Products

2018 Safety Alerts for Human Medical Products

2017 Safety Alerts for Human Medical Products

Balguti Kesaria Ayurvedic Medicine: FDA Warning - High Levels Of Lead

[Posted 08/04/2017]

AUDIENCE: Consumer, Health Care Professional

ISSUE: The U.S. Food and Drug Administration is warning parents and caregivers not to use "Balguti Kesaria (or Kesaria Balguti) Ayurvedic Medicine" due to the risk of lead poisoning.

FDA has not reviewed this product for safety or effectiveness. Exposure to lead can cause serious damage to the central nervous system, the kidneys and the immune system. In children, chronic exposure to lead—even at low levels—is associated with impaired cognitive function, including reduced IQ, behavioral difficulties, and other problems.

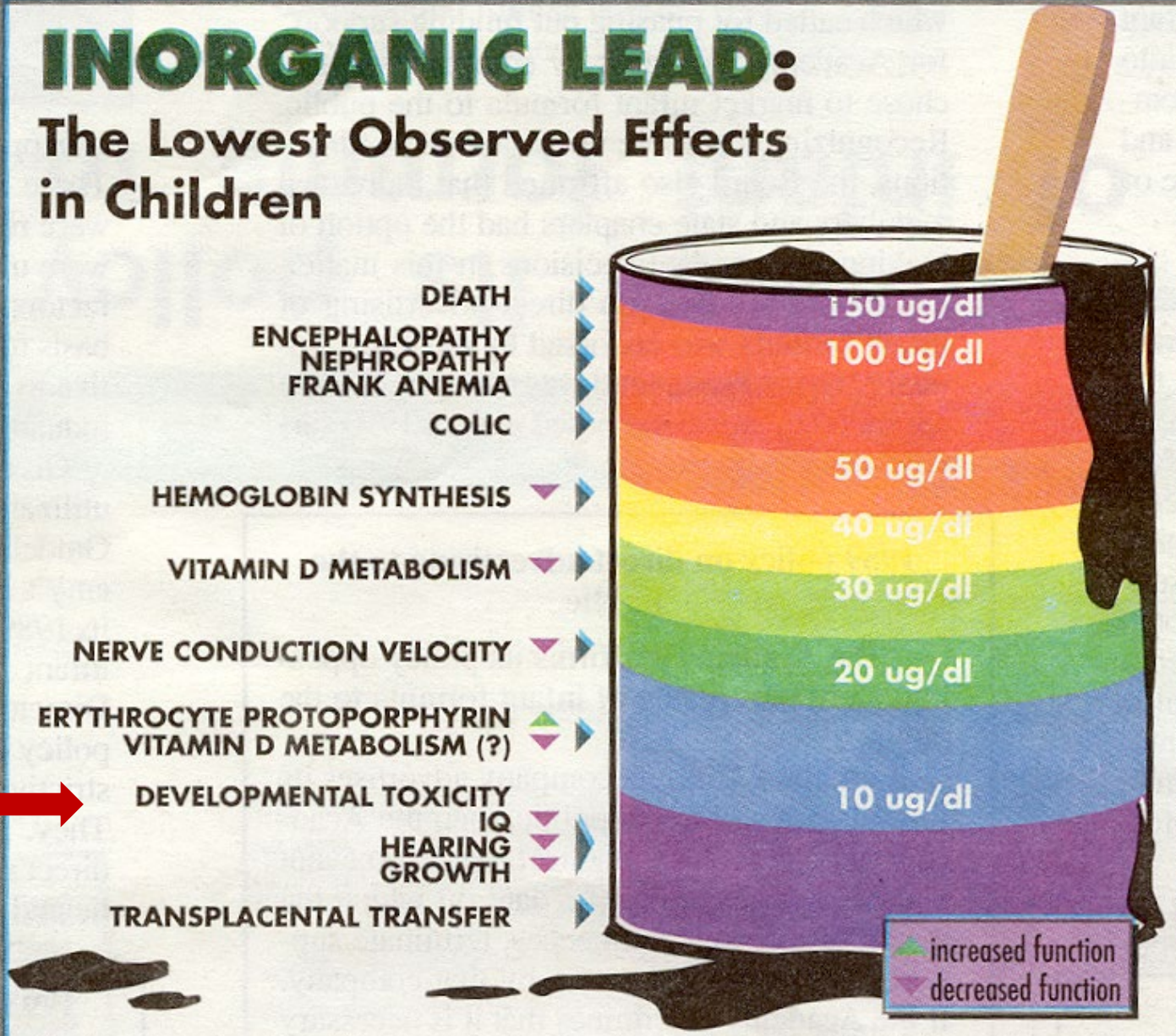
BACKGROUND: This product is sold online and manufactured by multiple companies, including Kesari Ayurvedic Pharmacy in India. Individuals have also mailed or brought the product into the United States. "Balguti Kesaria Ayurvedic Medicine" is used with infants and children for a variety of conditions including rickets, cough and cold, worms and dentition (teething).

FDA initially learned of this risk from the North Carolina Division of Public Health after the product was tested and found to contain high levels of lead. FDA was also notified by the Michigan Department of Health and Human Services of high levels of lead in two children who were given this product. Michigan's testing also found high levels of lead in the product. To date, FDA has received one adverse event report of high levels of lead and developmental delays in a child who was given this product.

RECOMMENDATION: Anyone who is using this product or giving it to a child should stop immediately and consult a health care professional.

INORGANIC LEAD:

The Lowest Observed Effects in Children



The chart shows the effects of lead contamination at various levels. The levels in this diagram do not necessarily indicate the lowest levels at which lead exerts an effect. These are the levels at which studies have adequately demonstrated an effect.

Source: ATSDR, 1990.

Brelund Graphics

Health Effects at Low Levels of Exposure

"There is evidence that at low levels of lead exposure, biomarkers of cumulative lead exposure, such as lead in bone, may be associated with an adverse impact on neurocognitive function that is not reflected by measurement of lead in blood."

(Shih et al., 2007; Bandeen-Roche et al., 2009; Weuve et al., 2009)

{Past exposure may have been *higher* than the blood level}

Central Nervous System Toxicity

- **Impairs neurotransmitter function**
- **The hippocampus (important for learning and memory) is one of the most affected areas of the brain**
- **At high doses lead causes increased permeability of the blood – brain barrier leading to edema**
- **Chemically similar, so interferes with many metabolic pathways that use calcium (Ca++)**

Central Nervous System Toxicity

Health effects of low-level lead exposure

- **Lower IQ**
- **Problems with attention, school performance**
- **Speech and language difficulties**

Economic benefit of preventing lead poisoning: *If* $80 billion invested in preventing lead exposure, return would be $83.9 billion in societal savings and savings would increase over time

Central Nervous System Toxicity

At high levels of lead exposure

- **Peripheral neuropathy**
- **Tremor**
- **Seizures**
- **Ataxia**
- **Delirium**
- **Coma**
- **Death**

How much lead is too much?

1960s ≥ 60 µg/dL

1971 ≥ 40 µg/dL

1975 ≥ 30 µg/dL

1985 ≥ 25 µg/dL

1991 ≥ 10 µg/dL

2012 ≥ 5 µg/dL

2012 CDC Publication

Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention

Report of the

Advisory Committee on Childhood Lead Poisoning Prevention

of the Centers for Disease Control and Prevention

January 4, 2012

Key recommendations:

1. Stop use of phrase *"level of concern"*

2. Use *reference level* that is 97.5% of population blood lead level in children aged 1-5 years from NHANES data

Reference level = 5 mcg/dL

Some assumptions of earlier research

1. **No symptoms = No lead poisoning**

2. **Affected children without encephalopathy would recover completely**

Higher prevalence of lead-exposed children before regulatory action (1970s- present) reduced lead in air, paint and water. Harder to find unexposed controls.

American Journal of Diseases of Children

VOLUME 66 NOVEMBER 1943 NUMBER 5

LATE EFFECTS OF LEAD POISONING ON MENTAL DEVELOPMENT

RANDOLPH K. BYERS, M.D.
AND
ELIZABETH E. LORD, PH.D.
BOSTON

FOREWORD

The sudden tragic death of Dr. Lord on Jan. 10, 1943 occurred before the completion of the final draft of this paper. It was she who first felt that the minor deviations found on psychologic examination of these children with lead poisoning might be of important significance for the future. It was she who maintained the file of cases, studying them from the psychologic point of view, without encouragement from any one for the first several years.

That lead poisoning occurring in early life usually has a disastrous effect on mental development has not been generally recognized, though the subject of lead poisoning in children has been discussed by many observers. The manifestations of acute involvement of the nervous system have been adequately described, and the gross destructive lesions in the brain consequent to acute lead encephalopathy accompanied by cerebral edema and high intracranial pressure have been recognized. On the other hand, McKhann,[1] for instance, stated: "The neurologic manifestations of lead poisoning usually subside without serious consequences if the ingestion of lead is stopped and the removal of lead from the circulation and its deposition in inert form in the bones can be hastened, as described, by the use of a diet high in calcium together with the administration of cod liver oil or viosterol to accelerate the laying down of new bone."

Cognitive Effects at Low Lead Levels

- Canfield et al. 2003 studied BLLs from children (n=172) at 6,12,18,24,36,48,60 months
- Stanford-Binet IQ test at age 3 and 5 years
- Each BLL increase of 10 µg/dL associated with 4.6 decrease in IQ.

Canfield RL, Henderson CR,Jr, Cory-Slechta DA, et al. Intellectual impairment in children with blood lead concentrations below 10 microg per deciliter. N Engl J Med. 2003

What to do next?

NORTH CAROLINA DIVISION OF PUBLIC HEALTH
FOLLOW-UP SCHEDULE FOR DIAGNOSTIC / CONFIRMED BLOOD LEAD LEVELS
FOR CHILDREN UNDER THE AGE OF SIX

Blood Lead Level	Response
	Clinical and environmental follow-up is based on the *truncated* test result. Example: Actual result= 4.79; Actions based on truncated value= 4
	All diagnostic (i.e., confirmation) tests should be performed as soon as possible within specified time periods. ➢ Diagnostic tests should be venous; however, capillary tests are accepted if a venous cannot be obtained. ➢ Follow-up testing can be capillary. ➢ CDC protocol for capillary sampling of blood lead should be followed. (See Resources) ➢ If diagnostic test result falls into a lower category - follow response for the lower risk category. ➢ If diagnostic or follow-up test result falls into a **higher category** – conduct another diagnostic test to confirm the higher risk category. Follow guidelines for higher risk category, after confirmation. ➢ Point of care (POC) lead analyzers (i.e., LeadCare) should **NOT** be used for diagnostic tests. ➢ Diagnostic tests must be sent to an outside reference laboratory.
<5 µg/dL	• Report blood lead test result to parents and document notification • Educate family about lead sources and prevention of lead exposure **Retest at age 2, earlier if risk of exposure increases**

5-9 µg/dL (Perform diagnostic test **within 3 months**)	**Take same actions as above -AND- if diagnostic test result is 5-9 µg/dL:** • Provide clinical management • Conduct nutritional assessment and refer child to the WIC Program • Take environmental history to identify lead sources (DHHS 3651 Form) • Refer to local health department to offer an environmental investigation • Test other children under the age of six in same household **Follow-up testing: Every 3 months until 2 consecutive tests are <5 µg/dL (based on the *truncated* test result)**
10-44 µg/dL (Perform diagnostic test **within 1 month** at 10-19 µg/dL; **within 1 week** at 20-44 µg/dL)	**Take same actions as above -AND- if diagnostic test result is 10-44 µg/dL:** • Refer to local health department for required environmental investigation and remediation enforcement if hazards are identified • Refer child to CDSA* Early Intervention or CC4C** as appropriate • Refer to Social Services as needed for housing or additional assistance **Follow-up testing:** • **10-24 µg/dL: every 1-3 months until 2 consecutive tests are <5 µg/dL** • **25-44 µg/dL: every 2 weeks to 1 month until 2 consecutive tests are <5 µg/dL (based on the *truncated* test result)**

Case 2: North Carolina, 2018

12-month-old girl taken for routine screening

- **No symptoms of concern, but history of constipation**
- ***Confirmed* BLL of 65.9 µg/dL**

45-69 µg/dL (Perform diagnostic test **within 48 hours** at 45-59 µg/dL; **24 hours** at 60-69 µg/dL)	**Take same actions as above -AND- if diagnostic test result is 45-69 µg/dL:** • Consult with Carolinas Poison Center (1-800-222-1222) for advice on chelation and/or hospitalization • Consider an abdominal x-ray check for an ingested object • Alert NC CLPPP by calling 919-707-5950 **Follow-up testing: 45-69 µg/dL: every 2 weeks to 1 month until 2 consecutive tests are <5 µg/dL (based on the *truncated* test result)**
≥70 µg/dL (Perform emergency diagnostic test **immediately**)	**Take same actions as above -AND- if diagnostic test result is ≥70 µg/dL:** • Hospitalize child and begin medical treatment immediately **Follow-up testing: Same as 45-69 µg/dL category**

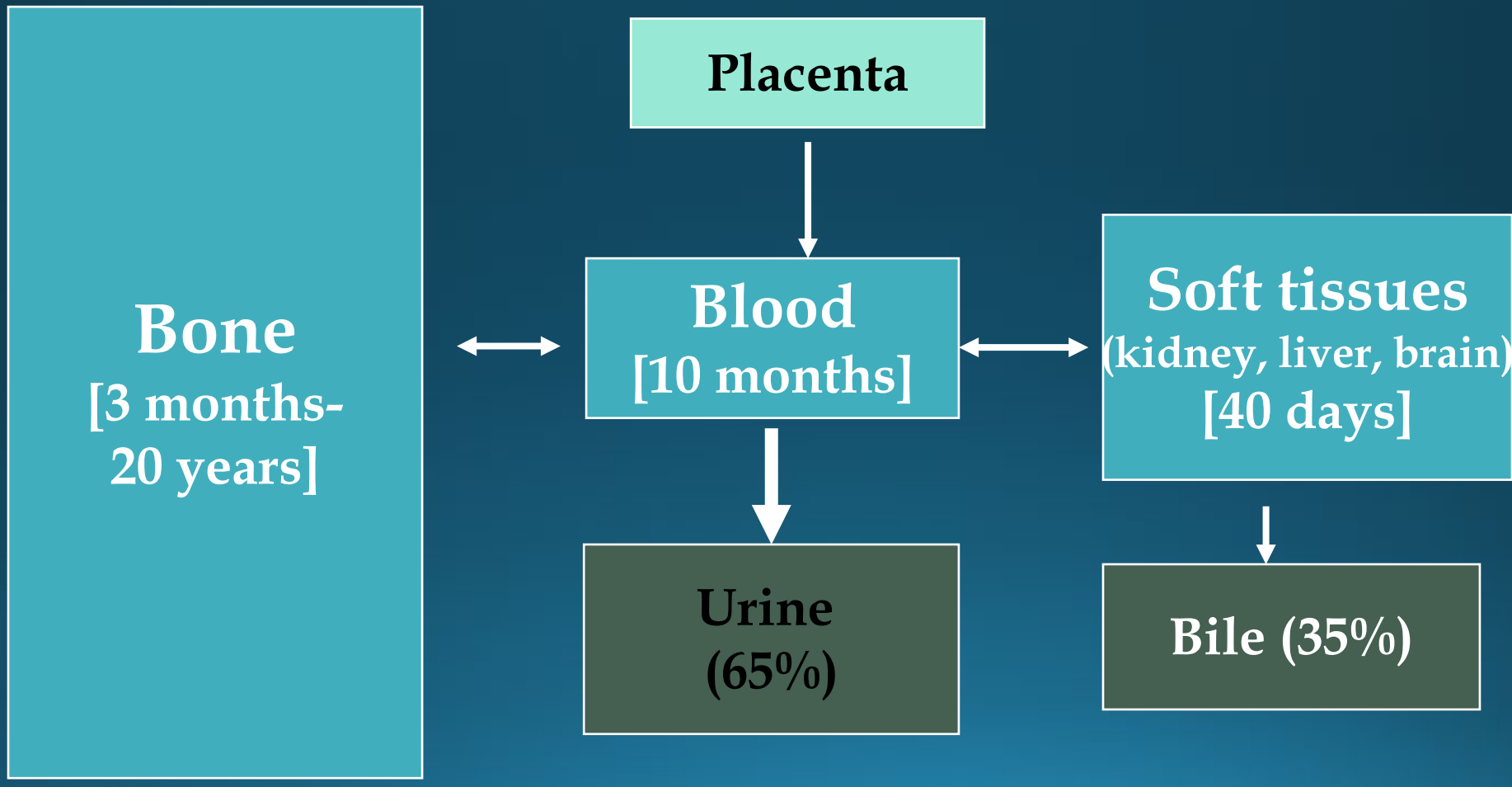
Case 2: Management

- Referred for hospital admission
- Abdominal xray--no foreign body
- Labs: mildly decreased hemoglobin = anemia
- Admitted for chelation with succimer (DMSA)
- History obtained of spending increasing amounts of time in a shooting range owned by a family member
- Older sibling also confirmed to have lead poisoning (test other kids!)

Case patient BLLs: January = 66 → chelation
June = 47
August = 42

Slow decrease in blood lead level... why??

Most absorbed lead is stored in bone



Bone-to-Blood Lead Transfer

- ✓Bone lead maintains blood lead levels long after exposure occurs

- ✓Increased transfer from bone to blood with growth, pregnancy, lactation, menopause, physiologic stress, chronic disease, hyperthyroidism, kidney disease, broken bones, advanced age, and calcium deficiency

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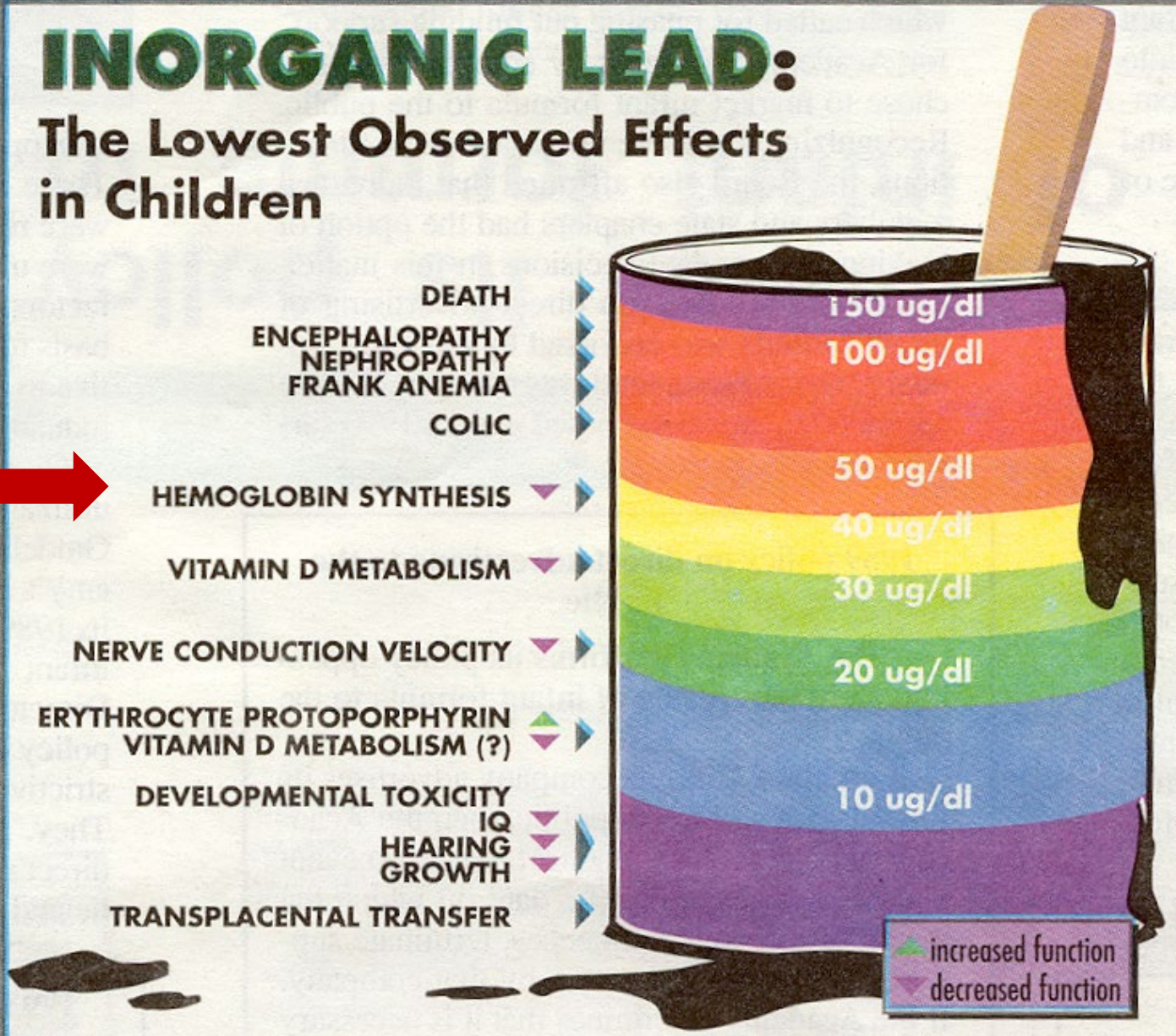
The Lowest Observed Effects in Children



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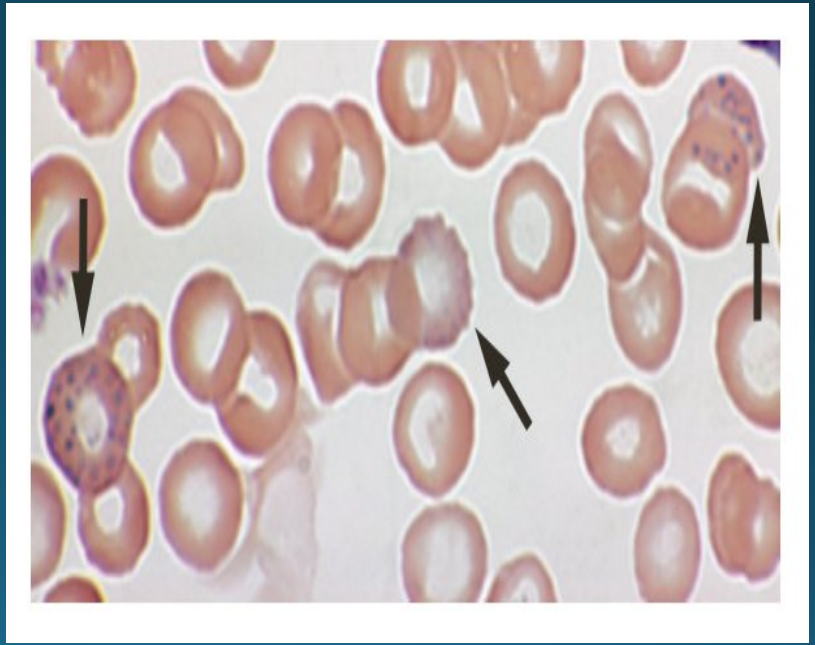
Source: ATSDR, 1990.

Brelund Graphics

How lead causes anemia

- Inhibits enzymes required for red blood cell (rbc) formation
- Decreases erythropoietin production in the kidney
- Decreases the life span of a rbc by making the cell membrane more fragile
- Pale, small rbcs (microcytosis, hypochromia)



Case 3: New Hampshire, 2000

- **2-year-old girl presented to a community hospital ED with low grade fever and vomiting x 1 day**
- **Lab findings:**
  - **microcytic anemia – hemoglobin 7.6g/dL (normal >11.4)**
  - **Basophilic stippling of red blood cells noted**
  - **Throat swab rapid strep test – Positive**

https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5022a1.htm

Case 3: New Hampshire, 2000

- 19 days later, admitted to same hospital for worsening vomiting
- Transferred the next day to a tertiary care hospital
- She developed hypotension and respiratory distress and became unresponsive
- Intubated and ventilated
- CT scan showed diffuse cerebral edema (swelling of the brain)

Case 3: New Hampshire, 2000

- **A BLL drawn 1 day earlier = 391 µg/dL**
- **Chelation therapy started with british antilewisite (BAL) and calcium ethylenediaminetetraacetic acid (CaN_2EDTA)**
- **BLL decreased to 72 µg/dL**
- **Surgical treatment of increased intracranial pressure**
- **Coma persisted. Patient removed from life support two days after transfer and died.**
- **Lead paint in the family's NH apartment (pre-1950) matched the lead isotope in the patient's blood.**

MMWR
Weekly
June 08, 2001 / 50(22);457-9

Fatal Pediatric Lead Poisoning --- New Hampshire, 2000

Fatal pediatric lead poisoning is rare in the United States because of multiple public health measures that have reduced blood lead levels (BLLs) in the population. However, the risk for elevated BLLs among children remains high in some neighborhoods and populations, including children living in older housing with deteriorated leaded paint. This report describes the investigation of the first reported death of a child from lead poisoning since 1990 (*1*). The investigation implicated leaded paint and dust in a home environment as the most likely source of the poisoning. Lead poisoning can be prevented by correcting lead hazards, especially in older housing, and by screening children at risk according to established guidelines (*2*).

On March 29, 2000, a 2-year-old girl was seen at a community hospital emergency department with a low-grade fever and vomiting of approximately 1 day's duration. The child

Fatal pediatric lead poisoning Wisconsin, 1990

CDC Home | Search | Health Topics A-Z

MMWR

Weekly

March 29, 1991 / 40(12);193-195

Persons using assistive technology might not be able to fully access information in this file. For assistance, please send e-mail to: mmwrq@cdc.gov. Type 508 Accommodation and the title of the report in the subject line of e-mail.

Epidemiologic Notes and Reports Fatal Pediatric Poisoning from Leaded Paint -- Wisconsin, 1990

Although fatal lead poisoning among children occurs rarely in the United States, it represents a medical and public health emergency. This report summarizes the investigation of a child who died from poisoning associated with ingestion of leadbased paint.

On September 12, 1990, a 28-month-old Wisconsin boy was admitted to a hospital with a 4-day history of lethargy and reduced appetite. Although the child had no known past medical problems, his parents reported that he had eaten flaking paint. On initial neurologic examination, the child had extreme lethargy with facial palsy and gasping respirations, consistent with lead encephalopathy; laboratory results revealed severe lead toxicity and hematologic abnormalities (blood lead level (BLL) 144 ug divided by L; erythrocyte protoporphyrin level 593 ug divided by L; hemoglobin 8.1; and basophilic stippling). Despite chelation therapy with British antilewisite and calcium disodium edetate (CaNa 2-EDTA), the child developed seizures, became comatose, and died 26 hours after admission. An autopsy showed massive cerebral edema with uncal herniation. The intestines contained multiple roundworms (Ascaris lumbricoides) and flake-like material consistent with paint chips. Radiographs revealed prominent epiphyseal lines in the lower extremities, consistent with chronic lead exposure.

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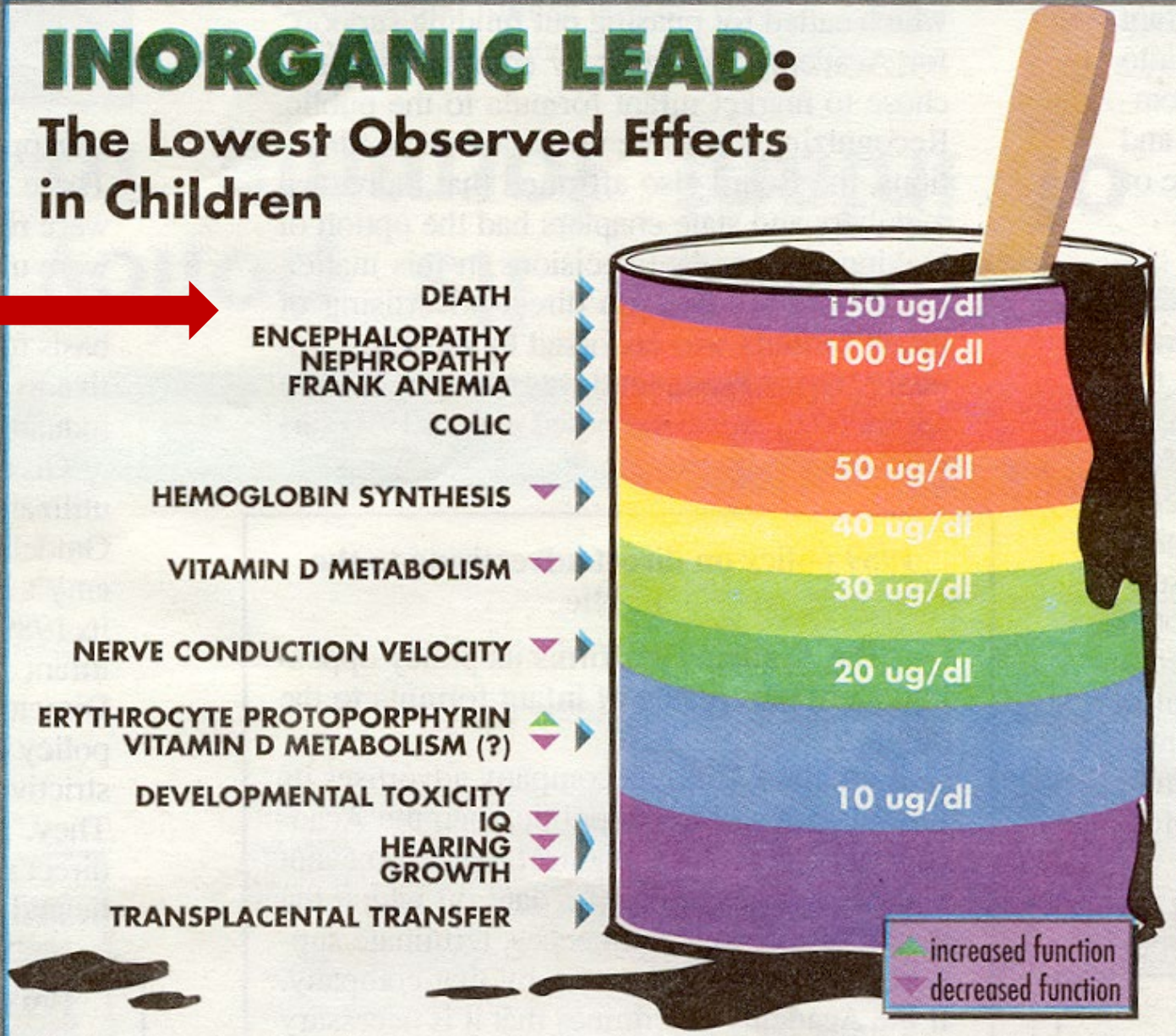
The Lowest Observed Effects in Children



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Source: ATSDR, 1990.

Brelund Graphics

Acute lead encephalopathy

- Typical BLL >70-100 µg/dL
- Nerve palsies (cranial nerves)
- Seizures
- Bizarre behavior
- Ataxia (imbalance)
- Loss of developmental skills
- Cerebral edema/increased intracranial pressure (persistent vomiting, headache)
- Coma

Lead Effects on the Brain

- Affects the function of neurotransmitters
- Increases permeability of blood vessels in the brain – bleeding and swelling may occur
- Increased intracranial pressure may cause death
- Early symptoms are non-specific: Irritability, poor attention span, developmental regression, lethargy, nausea and vomiting

Chelation Therapy

Intramuscular/Intravenous

- British antilewisite (BAL)
- Calcium ethylene-diaminetetraacetic acid (CaNa2EDTA)

Oral

- Succimer
- [D-penicillamine]
  - -rarely used

When is chelation indicated?

- ✓ **Lead encephalopathy**
- ✓ **BLL ≥ 70 µg/dL / mild or no symptoms**
- **?** **BLL 45-70 µg/dL / no symptoms ?**
- **X** **BLL 20-44 µg/dL /no symptoms**
- **X** **BLL 10-19 µg/dL**

Critical steps in treatment

1. REMOVAL FROM FURTHER EXPOSURE
    - Must be in a lead-free environment during chelation
2. Optimize nutrition: treat iron deficiency, ?calcium
3. Chelation
    - Multiple treatments may be required
    - Total body content of heavy metal decreased by 1-2%
    - BLL decreased by ~75% after 48-72 hours of BAL/$CaNa_2EDTA$
    - +/- GI decontamination e.g., whole bowel irrigation

Why don't we chelate all cases?

- Rogan et al. 2001: Study of Outcomes after chelation
- Randomized, double-blinded, placebo-controlled succimer (up to three courses) vs. placebo. All received standard environmental investigation and attempts at remediation/prevention
- Children (n=780), age 12-33 months
- BLL's starting 20-44 µg/dL

- Rogan WJ, Dietrich KN, Ware JH, et al. The effect of chelation therapy with succimer on neuropsychological development in children exposed to lead. N Engl J Med. 2001 May 10;344(19):1421-6.

Treatment Outcomes

- Children followed over 36 months
- Serial BLL's and neurocognitive, psychological, behavioral testing on both groups
- BLL's decreased more quickly with succimer
- Levels *same* in both groups after one year
- No improvement in any testing with succimer
- Authors recommended no chelation in children with BLL <45 µg/dL

- Rogan WJ, Dietrich KN, Ware JH, et al. The effect of chelation therapy with succimer on neuropsychological development in children exposed to lead. N Engl J Med. 2001 May 10;344(19):1421-6.

Nutritional supplements as part of treatment

Iron

- Biological plausibility – the divalent metal transporter (DMT1) is used for gut absorption of iron *and* lead
- Yeast cells incubated with lead increased absorption of lead with low iron
- RCTs of iron supplementation for children with BLL ≥ 10 µg/dL: decrease in BLLs, with most benefit in those with moderate-severe iron deficiency

Vitamin C

- Ascorbic acid increases absorption of non-heme iron by converting it from ferric to ferrous (DMT1)
- Animal studies suggest that ascorbic acid supplementation decreases blood lead; need human studies
- NHANES: children with highest serum ascorbic acid had lower likelihood of elevated BLL; not a linear relationship

Nutritional supplements as part of treatment

Calcium

- Biological plausibility – calcium and lead compete for intestinal absorption. The calcium transport protein has high affinity for lead
- Mixed evidence of no effect to benefit in studies
- Study of calcium supplementation for Nigerian children with elevated BLLs=no effect compared to placebo after one year

Zinc

- Also a metal, but does not appear to compete with lead for absorption
- Rat studies have shown lower lead levels with higher doses of zinc, but doses used possibly toxic for humans
- Cross-sectional study of Mexican children: no significant difference in blood lead levels between zinc-deficient and zinc-sufficient in 2-year-olds

Role of nutrition

- Good evidence for iron supplementation *if iron deficient*
- Non-heme (plant-based) iron or heme (meat-based) iron with ascorbic acid
- Evidence not as strong for supplementing with calcium, Vitamin C or Zinc—not routinely recommended
- Many reasons for children to have sufficient food with high-quality calories
- Prevention includes :
  - Growing food with *lead-free* soil and water
  - Using *lead-free* cookware and dishes

And, hand washing before eating!

Photo courtesy of CDC.gov public image library

Summary: Health Effects

- There is no “safe” level of lead in the body
- Lead poisoning can be present even if there are no obvious symptoms
- The diagnosis of lead poisoning is made by the blood lead level
- Symptoms can be vague and non-specific(e.g. fatigue, irritability)
- Children are more susceptible to lead poisoning than adults
- Lead affects every system in the body
- The blood lead level (BLL) may not reflect the total body lead burden

THE BEST MEDICINE = PREVENTION

Who should get screened?

Health Check (Medicaid), Health Choice and WIC recipients: Required

- Capillary Blood Lead Level (BLL) at **12 months AND at 24 months**
- Once at 25-72 months (if never screened before)

Other patients:

- Any child with any positive answer on risk assessment (DHHS form or verbal history)/known risk factor
- Neonates with mothers with lead exposure (cord blood)
- Children with a family member/sibling with an elevated BLL

- NC Childhood Lead Testing and Follow-Up Manual (Updated March 2016) Retrieved from http://ehs.ncpublichealth.com/hhccehb/cehu/lead/docs/2016ClinicalTrainingManualFINAL042116.pdf ***Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention*. Report of the Advisory Committee on Childhood Lead Poisoning Prevention** *of the Centers for Disease Control and Prevention (2012).* Retrieved from https://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf

Special Populations

Refugees (age 6 months –16 years)

Test at first visit *and* again 3-6 months later if age <6 years, *regardless of initial result*

Internationally adopted children – at first visit and then at ages 12 and 24 months (CDC screening recommendation)

Immigrant children – at first visit and 3-6 months later, then per routine screening

Pregnancy: Testing and Management

- American College of Obstetricians and Gynecologists (ACOG) recommendation – test if a risk factor for lead exposure is identified.
- If a pregnant woman has a confirmed blood lead level **≥ 5 µg/dL**
  - **Follow the recommendations in Ch. 5 of the NC CLPPP clinical manual**
  - **Refer to local environmental public health for a home lead inspection**
  - **Correct iron deficiency, if present, and assess calcium intake (RDA 2,000mg/d)**
- **If chelation is considered for a BLL ≥ 45 µg/dL, consult with a toxicologist and high-risk obstetrics specialist**
- **Order a cord blood lead level on an infant born to an exposed mother**

Lactation: Testing and Management

- **Maternal lead can be present in breastmilk (~3% of BLL)**
- **“Pump and Dump” recommended if mother’s BLL is ≥ 40 micrograms/deciliter (µg/dL)**
- **Monitoring the baby’s BLL recommended if mother’s BLL is 5-39 and breastfeeding. If maternal BLL > 20 µg/dL and infant’s BLL ≥ 5 µg/dL and no other source if identified, stop breastfeeding.**

Types of Preventive Activities

- Primary Prevention – intervening before exposure. Removal of lead from the environment before a child is exposed.

- Secondary prevention – early detection of lead exposure to mitigate the effects by screening with blood lead tests. May lead to primary prevention for other children (source identification and removal).

Primary prevention is the goal!

Screening Recommendations

NC CLPPP – universal screening at age 12 and 24 months

CDC – risk-based or universal screening at age 12 and 24 months

USPSTF – "the current evidence is insufficient to assess the balance of benefits and harms of screening for elevated blood lead levels in asymptomatic children."

AAP – screen at 12 and 24 months for high-prevalence areas/children with Medicaid (Bright Futures), +risk

AAFP – follows USPSTF

ACOG – risk-based

NC DHHS Risk Assessment Questionnaire (nchealthyhomes.com/lead)

Date:	Age:	Residential Zip Code:
1.	Receive Women, Infants, and Children (WIC) Program Services or is your child enrolled in Medicaid (Health Check) or Health Choice?	
2.	Live in or regularly visit a house that was built before 1950, including home child care centers or homes of relatives?	
3.	Live in or regularly visit a house that was built before 1978, with recent or ongoing renovations or remodeling (within the last 6 months)?	
4.	Live in or regularly visit a house that contains vinyl miniblinds?	
5.	Have a brother, sister, other relative, housemate or playmate who has or has had a high blood lead level?	
6.	Is your child a refugee, immigrant or adopted from another country?	

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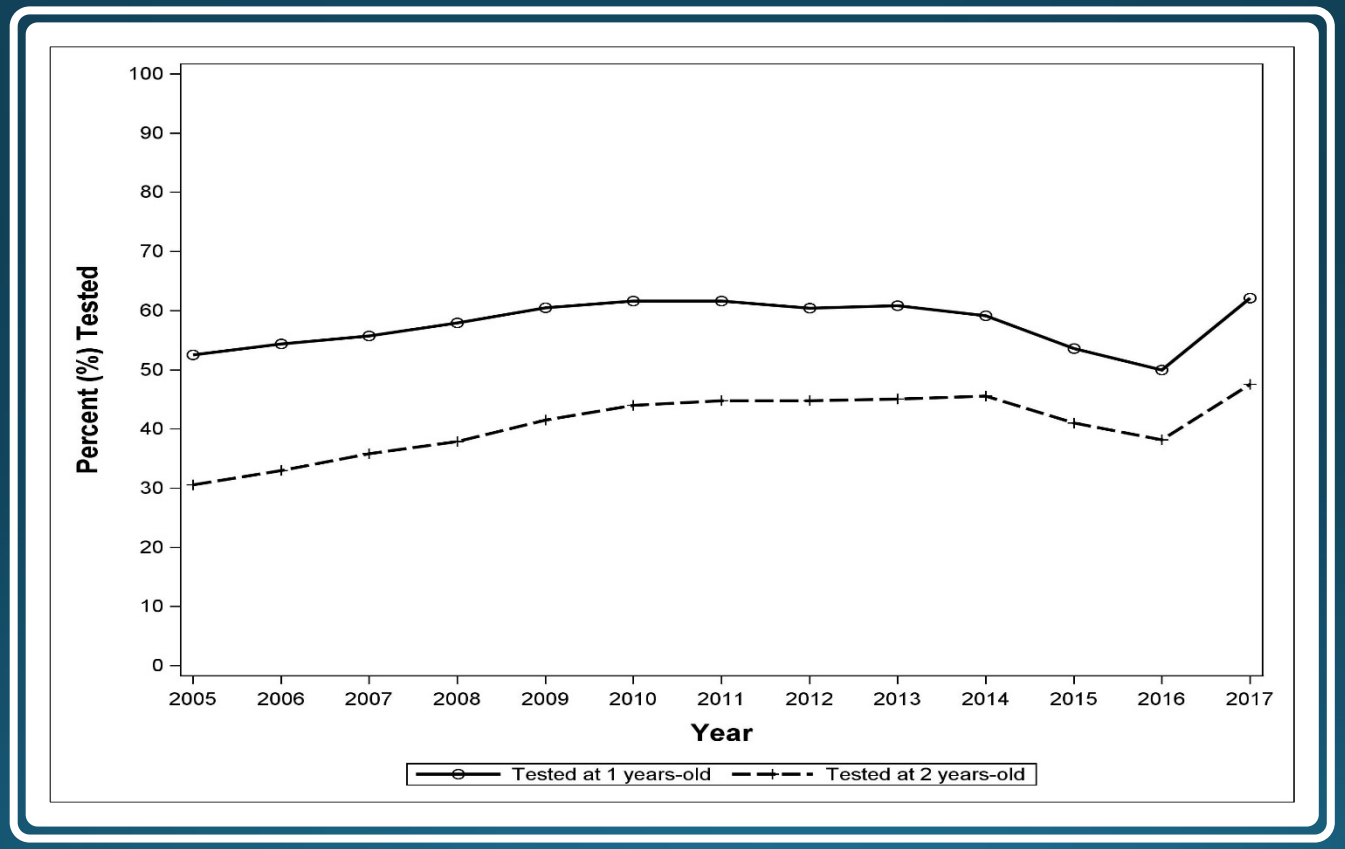
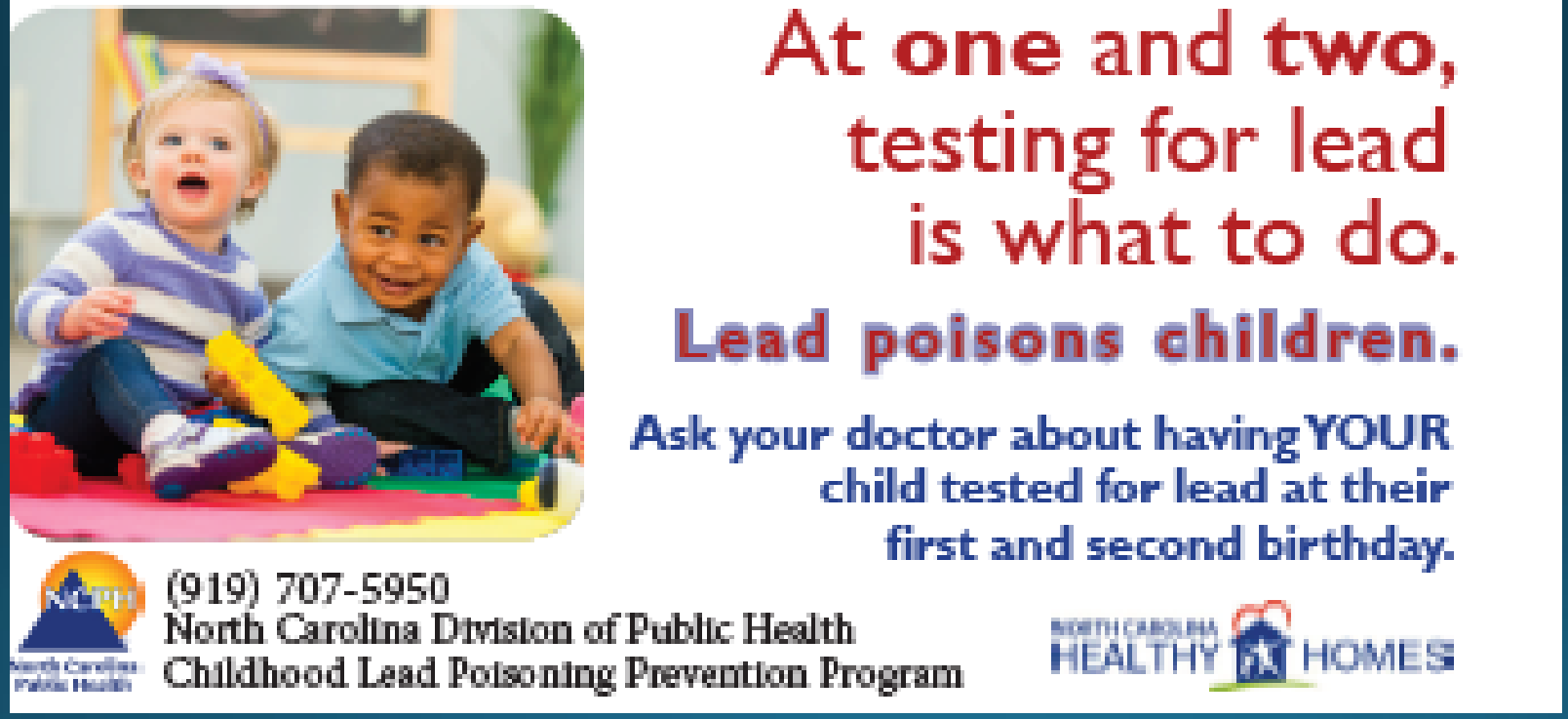
EHS 3958 (Revised 04/12)
Environmental Health Section (Review 04/13)

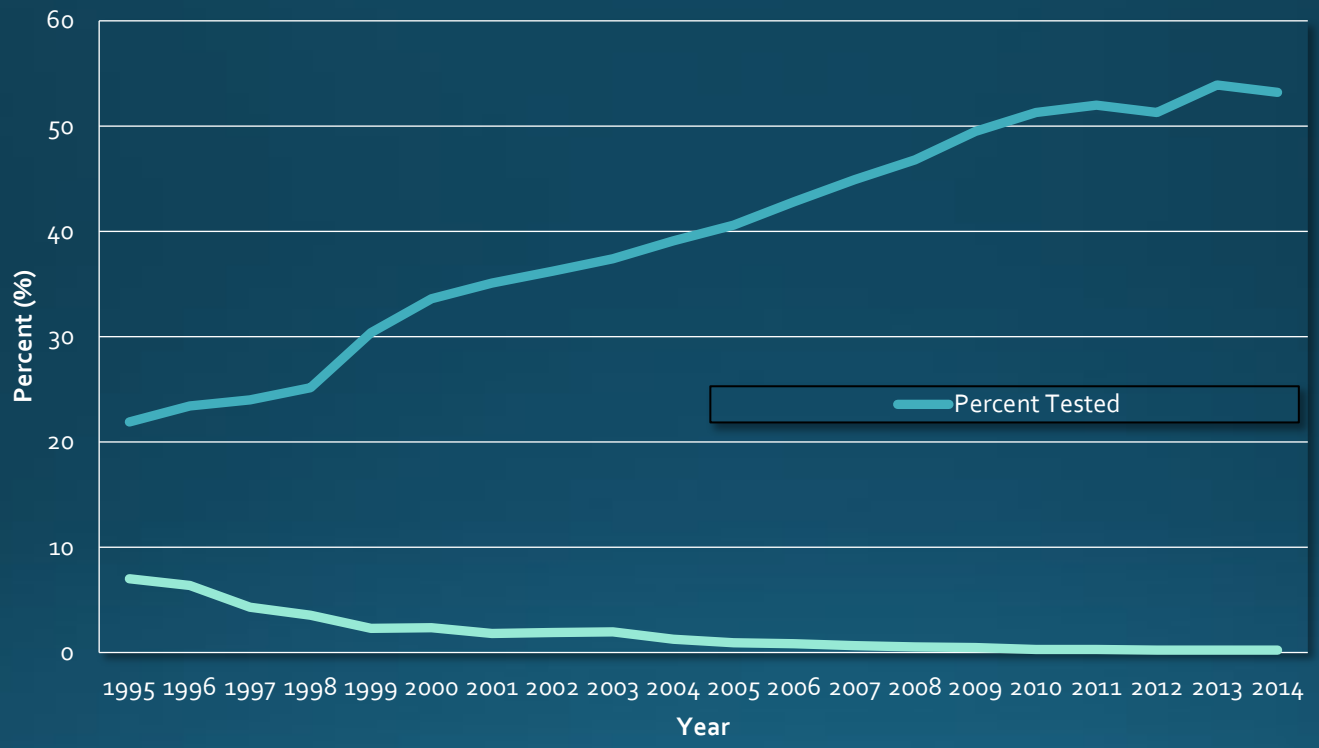
Fewer children are tested at age 2 compared to age 1, but the risk of lead poisoning is highest at age 2



Universal Testing Recommendation



Percent of NC Children Tested for Lead Poisoning, 1 and 2 Year-olds



Data source: NCLEAD Surveillance System

Screening : Key Points

- A blood lead test at ages 12 and 24 months is *recommended* for all NC children. This is required for children with Medicaid, Health Choice and WIC
- Refugee children 6 months to 16 years should be tested at entry into the U.S. *and* 3-6 months after placement.
- Testing consists of an initial capillary sample (can be done with point-of-care analyzers) followed by a diagnostic (preferably venous) sample.
- For capillary samples, wash the child's hands well with soap and water to get a more accurate sample. Diagnostic samples must be sent to an outside reference laboratory for analysis, regardless of sample type.
- Offices using POC analyzers are considered laboratories and are required by law to report blood lead results for children < age 6 years to NC CLPPP.

NORTH CAROLINA DIVISION OF PUBLIC HEALTH
FOLLOW-UP SCHEDULE FOR DIAGNOSTIC / CONFIRMED BLOOD LEAD LEVELS
FOR CHILDREN UNDER THE AGE OF SIX

Blood Lead Level	Response
	Clinical and environmental follow-up is based on the *truncated* test result. Example: Actual result= 4.79; Actions based on truncated value= 4
	All diagnostic (i.e., confirmation) tests should be performed as soon as possible within specified time periods. ➢ Diagnostic tests should be venous; however, capillary tests are accepted if a venous cannot be obtained. ➢ Follow-up testing can be capillary. ➢ CDC protocol for capillary sampling of blood lead should be followed. (See Resources) ➢ If diagnostic test result falls into a lower category - follow response for the lower risk category. ➢ If diagnostic or follow-up test result falls into a **higher category** – conduct another diagnostic test to confirm the higher risk category. Follow guidelines for higher risk category, after confirmation. ➢ Point of care (POC) lead analyzers (i.e., LeadCare) should **NOT** be used for diagnostic tests. ➢ Diagnostic tests must be sent to an outside reference laboratory.
<5 µg/dL	• Report blood lead test result to parents and document notification • Educate family about lead sources and prevention of lead exposure **Retest at age 2, earlier if risk of exposure increases**

Legally required reporting in NC

- Blood lead test results – report ALL
- Child's identifiers: Full name, Date of Birth, primary address including zip code, age , gender, race/ethnicity and Medicaid #
- Point-of-care test results (e.g. LeadCare) are lab results and reporting is required (Contact NC CLPPP for instructions)
- Commercial labs report data to NC Public Health

County-specific data from NC LEAD

- Percent of 1 and 2-year-olds in North Carolina Tested for Lead in 2017: **54.6%**
- Percent of 1 and 2-year-olds in MECKLENBURG County Tested for Lead in 2017: **32.7%**
- This county is BELOW the NC Testing Rate for Lead in 2017 (Rank: **98** out of 100 counties).

100 counties in North Carolina: screening rates from %-% in 2017

Clinical Resources

- Your local health department
- http://nchealthyhomes.com/lead-poisoning/
- https://ehs.ncpublichealth.com/hhccehb/cehu/lead/
- https://www.cdc.gov/nceh/lead/
- https://www.pehsu.net/region4.html (AAP/PEHSU collaboration)

NC Childhood Lead Poisoning Prevention Program (NC CLPPP): Contact Information

- **919-707-5950 or (888) 774-0071** or call the main number for Environmental Health, **(888)251-5543** and ask to speak with someone from the Childhood Lead Poisoning Prevention Program
- https://ehs.ncpublichealth.com/hhccehb/cehu/lead/
- ann.chelminski@dhhs.nc.gov
- (919)707-5953 or (919) 815-0141

Thank you

Photo courtesy of the UNC Institute for the Environment

Questions???