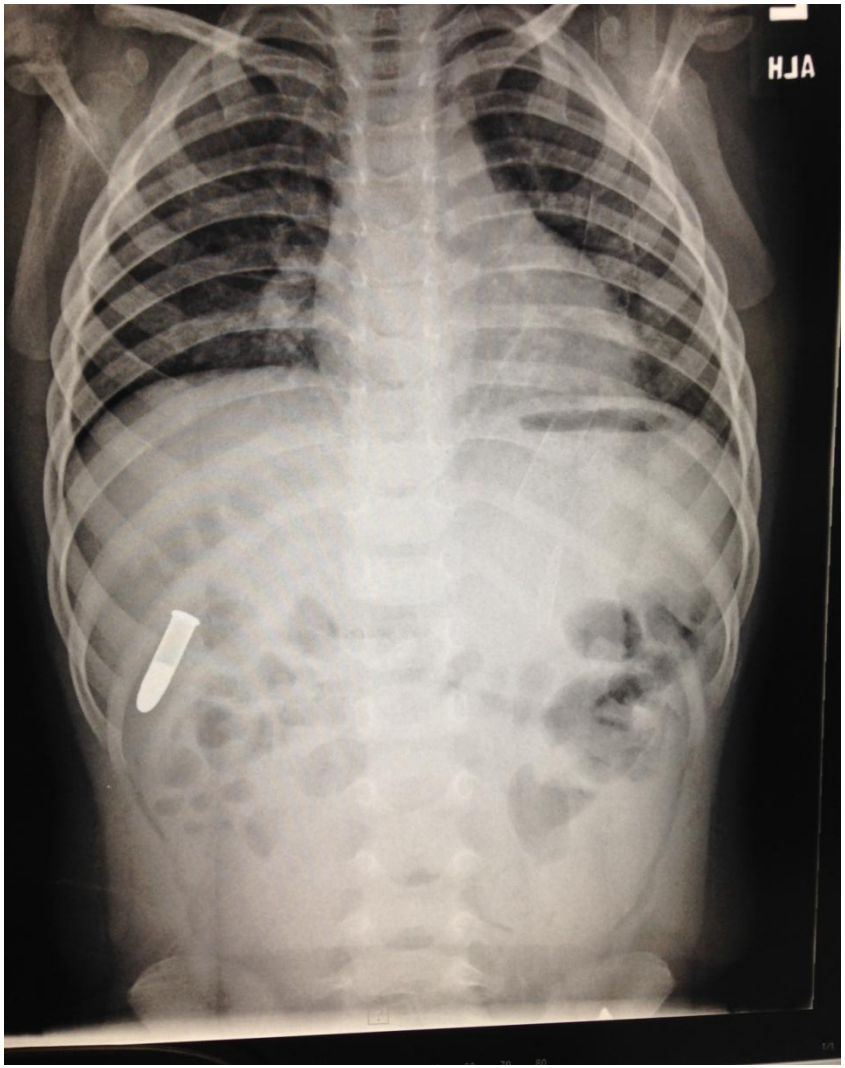
Lead Screening and Testing

Deborah Bieging MD, FAAP
Leslie Herrmann MD, FAAP

Objectives

- To understand the rationale for current recommendations for lead screening
- To know which type of test to order at YKHC
- To understand long-term effects of elevated blood lead levels and how to counsel families
- To understand how a serum lead level resembles a small bird

First, this…



We’ll come back to that.

Screening tests

- Substantial morbidity/mortality
- Prevalence warrants testing in apparently healthy population
  - Universal
  - Selective
- Preclinical detection provides some benefit

Lead sources

- Leaded gas
- Paint
- Game shot with lead bullets
- Water flowing through lead pipes and/or copper pipes with lead fittings
- Welding
- Toys, pottery, cosmetics, vitamins or canned food from outside the US

State of Alaska Epidemiology **Bulletin**

Dept. of Health & Social Services
Karleen Jackson, Commissioner

3601 C Street, Ste. 540
PO Box 240249
Anchorage, AK 99524-0249

Division of Public Health
Richard Mandsager, MD, Director

Local (907) 269-8000
24 Hour Emergency No. 1-800-478-0084
http://www.epi.Alaska.gov

Editors
Jay C. Butler, MD
Joe McLaughlin, MD, MPH

Bulletin No. 17
August 11, 2006

Unsafe Concentrations of Lead in Children's Toys Distributed by Libraries—Summer 2006

Background

Bendable dog and cat toys given away at many public libraries this summer might contain unsafe levels of lead. The toys were distributed as part of a statewide summer reading program at public libraries throughout Alaska, and in at least 30 other states nationwide. A library in Indiana discovered the problem during the first week of August after a librarian attended a lead-testing event at a local hospital and decided to have the toys tested.

Approximately 72 Alaska libraries obtained about 2,400 toys this summer. It is currently not known how many toys were given away to children. The rubbery toys are roughly four

The main risk posed by these toys is the possibility that children might chew on them or swallow part of the toy, and thereby absorb unsafe amounts of lead into the bloodstream. The toys are not hazardous to touch.

Children are more vulnerable to lead poisoning than adults and exposure is especially dangerous for younger children. A child who swallows large amounts of lead may develop anemia, abdominal cramps, muscle weakness, and brain damage. Even at much lower levels of exposure, lead can affect a child's mental and physical growth. Due to these risks to children, parents have been encouraged to consult with a health-care provider if they think their child

Figure. Bendable rubber toys distributed to children by approximately 72 Alaska public libraries—Summer 2006.*

*Photo courtesy of Ryan Fagan, MD, MPH.

Lead metabolism

Lead metabolism?

- Directly absorbed, distributed, and excreted.
- Inhaled or ingested
  - Blood 30 day ½ life
  - Soft tissue 40 day ½ life
  - Mineralizing tissue 25 YEARS!
- Children absorb up to 70% of ingested lead and retain up to 50%
- Adults absorb 20%, retain 1%

Lead is bad for people

Interferes with interactions of divalent cations an sulfhydryl groups

(Lots of biochemistry)

Damage to CNS, Blood, Kidneys

Central Nervous system

- Dose dependent negative effects on IQ, reading ability, psychomotor development, HS graduation rates, low level criminal behaviour.
- Some studies show some reversibility if levels are brought down but many studies show persistent negative effects even after treatment.
- No safe lower limit
- Encephalopathy at high levels (100-150).

Renal

- Mild effect on renal function at low levels
- Lead nephropathy and later HTN associated with higher levels

Hematologic

- Rarely causes anemia at low levels
- Higher levels cause decreased hgb synthesis and hemolysis – not microcytic anemia
- Strong association with iron deficiency.
  - ?pica

A little history…….

- Environmental lead increased dramatically in the 50's primarily because of leaded gasoline and paint.
- Definition of an abnormal lead level has decreased from <60 in the 1970s, to the present level of <5.
- No "safe" lead level

Targeted screening

Administered by: _____ Date: ____/____/____

Childhood Lead Risk Questionnaire

Used to identify children who should be tested for lead exposure

Instructions: 1. Ask the child's parent or guardian the following questions and mark their responses.

2. If guardian answers YES or Don't Know (D/K) to any question, test the child for lead as soon as possible.

Child's Name: _____

Date of Birth: ____/____/____ Age: ____ years

Gender (circle one): MALE FEMALE

Provider's Name: _____

Please answer YES, Don't Know (D/K) or NO to the following questions:

	YES	D/K	NO
1. Does your child live in or visit homes, day care centers or other buildings built before 1978?	☐	☐	☐
2. Does your child live in or visit homes, day care centers or other buildings with recent repairs or remodeling	☐	☐	☐
3. Does your child eat or chew on non-food substances such as paint chips or dirt?	☐	☐	☐
4. Has anyone who lives in the same home as your child previously had an elevated blood lead level?	☐	☐	☐
5. Is your child a foreign adoptee, refugee or has your child recently traveled internationally?	☐	☐	☐
6. Does your child eat wild game such as moose, caribou or waterfowl that has been shot with lead bullets?	☐	☐	☐
7. Does your child come in contact with a person whose job or hobby includes any of the following:	☐	☐	☐

- Chemical preparation
- Valve and pipe fittings
- Brass/Copper foundry
- Refining furniture
- Making fishing weights
- Lead smelting
- Welding
- House construction or repair
- Battery manufacturing or repair
- Burning lead-painted wood
- Automotive repair shop or junk yard
- Going to a firing range or reloading bullets
- Radiator repairs
- Pottery making

8. Does your family use foreign or traditional products such as imported pottery, health remedies, skin care creams, spices, or foods? These include: ☐ ☐ ☐

- Cosmetics such as kohl, surma, and sindor
- Imported or glazed pottery, imported candy, and imported nutritional pills or vitamins
- Traditional medicines such as ayurvedic, greta, azarcon, alarcon, alkohl, bali goli, coral, ghasard, liga, pay-loo-ah and rueda
- Foods canned or packaged outside the U.S.

For more information, please contact:

Environmental Public Health Program, AKDHSS

(907) 269-8000

2008 State Epi Bulletin

- 1,141 children aged <6 years were tested between 1995-2006
  - 17 had BLL ≥10 µg/dL
  - Exposure sources included foreign/adoptee from abroad for 6 (35%), playing with air gun pellets for 2 (12%), pica (eating non-nutritive substances) for 2 (12%) and unknown for 7 (41%)
- "Across all age groups, the majority (81%) of known non-occupational elevated lead exposures involved people exposed on indoor firing ranges, followed by children who were born or adopted abroad (10%), and people casting lead as a hobby (3.4%)."

2008 State Epi Bulletin

Recommendations:

"Health care providers should assess lead exposure risk among their patients, test patients who are at risk for lead toxicity, and report elevated BLLs to the Alaska Section of Epidemiology."

After 2008…

Cutoff for concerning lead level was lowered from 10 microgram/dL to 5 microgram/dL.

2014 State Epi Bulletin

Data were reanalyzed…

- Alaska had lower rates of elevated levels than the national rate.
  - Alaska: 23 cases per 100,000 persons
  - USA: 565 cases per 100,000 persons
- However, the Southwest region had a higher prevalence of elevated levels.

Table. Median and Elevated (≥5 µg/dL) BLLs among Children Aged <18 Years, by Region — Alaska, 2007–2012

Region	% Pop.[7] Tested (#)	Median BLL in µg/dL (Range)	Elevated BLL Rate per 100,000[7] (#)
Anch/Mat-Su	1.6% (1631)	3.0 (0–14)	66 (67)
Gulf Coast	0.8% (165)	1.9 (0.3–10.3)	31 (6)
Interior	3.3% (961)	2.0 (0–26.7)	73 (21)
Northern	1.6% (134)	1.8 (0.4–5.3)	12 (1)
Southeast	4.3% (726)	2.0 (0–33.2)	84 (14)
Southwest	7.9% (1008)	1.6 (0.3–19.6)	281 (36)
Unknown	410	2.0 (0.1–36.9)	19 (35)
Total	2.7% (5035)	3.0 (0–36.9)	96 (180)

2014 State Epi Bulletin

Why was the Southwest worse?

Possibly…

- Higher routine screening rates
- "…more frequent use of bullets containing lead shot for hunting game."

2014 State Epi Bulletin

Recommendations:

"Health care providers should assess all children aged <18 years, particularly those <6 years, for potential exposures to lead and offer blood lead testing to those with ≥1 risk factor; a lead exposure tool is on the EPHP website."

National Recommendations for Lead Screening

Then there was Flint, MI

- In 2015, Dr. Mona Hanna-Atisha noted doubling of # children with elevated lead levels
- Approx 40% of homes and many schools were noted to have markedly elevated lead levels in the water. (Highest recorded was 13,200ppb which compares with <15ppb as the recommended safe level and >5000ppb which is classified as hazardous waste)

Screening tests

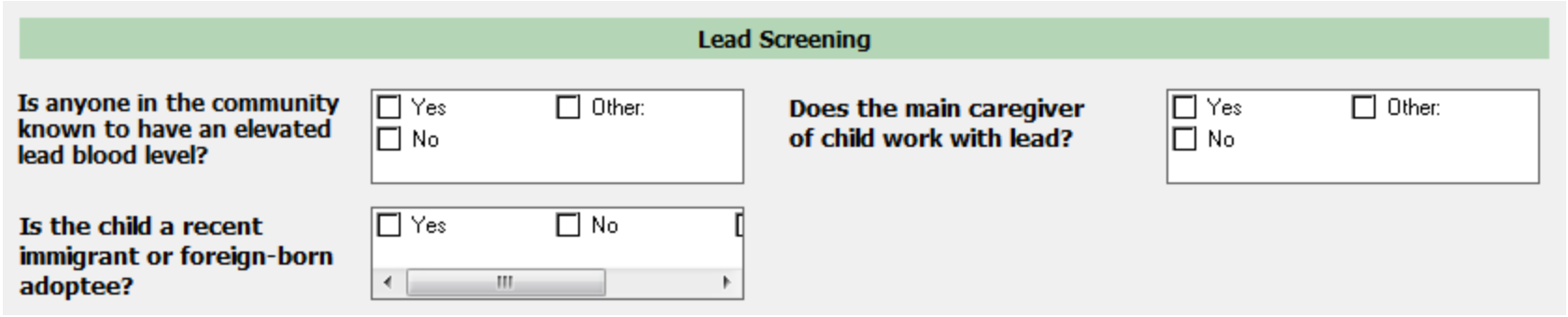
- Substantial morbidity/mortality
- Prevalence warrants testing in apparently healthy population
  - Universal
  - Selective
- Preclinical detection provides some benefit
  - Serum lead screening the canary in the coal mine?

Previous Local/Regional Practices

- HUGE variability!
- Current practices include:
  - Screening at 12 and 24 month WCC…
  - Targeted screening using some/all questions…
  - Sending a blood lead level if there is another reason to poke the child…
  - Sending a blood lead level if doing an anemia work-up…
  - Not ever checking because “we don’t have lead here.”

Village Screening

- Could not find any reference to lead in eCHAM
- The RAVEN form for WCC includes:



Ch-ch-ch-changes!

2017 State Epi Bulletin

"In the wake of the Flint, Michigan water crisis, the Centers for Medicare and Medicaid Services (CMS) informed DHSS in September 2016 that every state receiving CMS funding must have a MEC lead screening policy that complies with federal Medicaid Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) mandates. The EPSDT program requires blood lead screening on all MEC at ages 12 and 24 months, or before 72 months if the child has not previously been screened."

2017 State Epi Bulletin

Table. Screening among Children with Medicaid Coverage Under 72 Months of Age — Alaska, 2011–2015

Region	Number screened	Estimated number of children with Medicaid coverage (95% CI)	Estimated proportion screened (95% CI)
Anchorage	283	7678 (7069–8288)	3.7% (3.4–4.0%)
Gulf Coast	125	1840 (1490–2190)	6.8% (5.7–8.4%)
Interior	151	2910 (2394–3426)	5.2% (4.4–6.3%)
Mat-Su	286	2818 (2582–3055)	10.1% (9.4–11.1%)
Northern	53	1797 (1656–1937)	3.0% (2.7–3.2%)
Southeast	253	1663 (1263–2062)	15.2% (12.3–20.0%)
Southwest	1258	3026 (2832–3230)	41.6% (38.9–44.6%)
Total	2409	24,827 (21,925–27,728)	9.7% (8.7–11.0%)

2017 State Epi Bulletin

We got a (somewhat-accurate) shout-out!

"In our review, there was considerable variation of screening practices by region. Notably, the screening rate was substantially higher in the Yukon-Kuskokwim Delta (YKD) region than any other region. There are at least three reasons why the YKD region has such success with screening: 1) providers have been visiting villages every fall (since 2010) to offer lead screening to Head Start children, 2) children in Bethel receive a well-child check (which often includes BLL testing) during the community's annual "Kindergarten Roundup", and 3) the Yukon-Kuskokwim Health Corporation has increased their efforts to offer BLL screening to all children at age 12 and 24 months both in their Bethel hospital and their five sub-regional clinics."

Report from the State

- Leslie received a call from someone at the state…basically, she wanted to know what we were doing that our numbers were so much higher than the rest of the state!
- Summary: state-wide testing is “abysmal;” we’re merely “bad”
- ☺

State Epidemiology Bulletin Recommendations

1. Health care providers should test all MEC for lead exposure at ages 12 and 24 months, or before 72 months if the child has not previously been screened.
2. Health care providers should continue to assess *all children aged <18 years, particularly those aged <72 months, for exposure to lead and offer blood lead testing to those with any risk factors. A lead exposure tool is available on the EPHP website.*
3. Clinical specimens should be processed by the providers' routine testing service. Alternatively, the Alaska State Public Health Laboratory is also available to process specimens (use the RAM Scientific [800-535-6734] Safe-T-Fill 200 µL EDTA collection device).
4. Per 7 AAC 27.014, laboratories are required to report all BLLs to SOE, and health care providers are required to report all EBLLs (≥5 µg/dL for children aged <18 years and ≥10 µg/dL for adults). See: http://dhss.alaska.gov/dph/Epi/Documents/pubs/conditions/frmHeavyMetals.pdf.

Tests Available at YKHC

- State lead screen → Lead, State
  Lead, State Blood, Routine collect, T;N, Lab Collect
  Lead, State Blood, Routine collect, T;N, Nurse collect
  - Advantages
    - Capillary
    - 100 microliters of blood
    - Cheaper
  - Drawbacks
    - Variable turnaround time – can take >1 week
    - Risk of artificial elevation due to skin contamination
  - When to order
    - Screening
- LabCorps lead test → Lead Level, Blood Peds
  Lead Level, Blood Peds Blood, Routine collect, T;N, Nurse collect
  Lead Level, Blood Peds Blood, Routine collect, T;N, Lab Collect
  - Advantages
    - Possibly more accurate
    - Often quicker turnaround time
  - Drawbacks
    - Venous sample
    - 1-3 mL of blood
    - More expensive
  - When to order
    - Confirmation/suspected exposure

State Testing

Courtesy of David Verbrugge, Manager of Analytical Toxicology at the State of Alaska Public Health Lab:

"Blood Lead screening requires 100 uL of free flowing blood. A blade lancet must be used to get the proper sample flow. The tubes we provide are 200 uL "end to end" fills. EDTA is in both the collection straw and vial. After collection, several inversions are required to ensure a good fluid sample. Samples are stable at room temperature for at least 2 months, at room temp. Shipping does not require cold packs.

However, as a practical matter samples should be submitted for testing as soon as possible. Elevated blood lead levels are rare, but in those circumstances we would like to follow-up near to collection time.

The current level for follow-up is 5 ug/dL. This level is subject to revision by CDC, as their goal is to continue to see reduction in Children's Blood Pb. The next revision has been suggested to be 3.5 ug/dL - this may occur during 2017.

…Budgets are tight and our federal grant support is a bit nebulous at the moment. As long as I can keep the hardware running, we'll be running tests."

Who to test and when

- All children at 12 months and 24 months
- Any child under 5 who has risk

Power Plans!

AMB Well Child (12 Months) (Initiated Pending)	
Patient Care	
Apply fluoride varnish	T;N, Once
Medications	
In Office Meds	
diphtheria/hepB/pertussis,acel/polio/tetanus (Pediari...	0.5 mL, Intramuscular, form: Injection, Once
High Alert pneumococcal 13-valent conjugate vac...	0.5 mL, Intramuscular, form: Injection, Once
measles/mumps/rubella virus vaccine (MMR Vaccine)	0.5 mL, Subcutaneous, form: Injection, Once
varicella virus vaccine (Varicella Vaccine)	0.5 mL, Subcutaneous, form: Injection, Once
hepatitis A pediatric vaccine (Hepatitis A peds/adol V...	0.5 mL, Intramuscular, form: Injection, Once
hepatitis B pediatric vaccine (Hepatitis B peds/adol Va...	0.5 mL, Intramuscular, form: Injection, Once
haemophilus b conjugate (PRP-OMP) vaccine (Pedva...	0.5 mL, Intramuscular, form: Injection, Once
diphtheria/tetanus/pertussis (DTaP) ped (Dtap Vaccine)	0.5 mL, Intramuscular, form: Injection, Once
poliovirus vaccine, inactivated (IPV Vaccine)	0.5 mL, Intramuscular, form: Injection, Once
tuberculin purified protein derivative (tuberculin purif...	0.1 mL, Intradermal, form: Injection, Once
Flu (Influenza) Immunizations	
acetaminophen (acetaminophen 160 mg/5 mL oral li...	15 mg/kg, Oral, Once
ibuprofen (ibuprofen 100 mg/5 mL oral suspension C...	10 mg/kg, Oral, Once
Pharmacy	
ferrous sulfate (ferrous sulfate (as elemental iron) 15 ...	2 mg/kg, Oral, BID, #1 bottle(s), 3 Refill(s)
acetaminophen (acetaminophen 160 mg/5 mL oral su...	15 mg/kg, Oral, q4h PRN for pain, #120 mL
ibuprofen (ibuprofen 100 mg/5 mL oral suspension)	10 mg/kg =, Oral, q6h PRN for pain, #120 mL
Laboratory	
CBC w/Diff	Blood, Routine collect, T;N, Lab Collect
Lead, State	Blood, Routine collect, T;N, Lab Collect
SRC Labs	
SRC Laboratory	Not available for the facility of the active encounter
Consults	
If pediatric consult needed, please page the on-call pediatrician.	
Miscellaneous	
Refer to Audiology Internal	
Refer to Dentistry Internal	
Refer to Family, Infant, Toddler Program Internal	
Refer to Optometry Internal	
Refer to Dentistry Internal	Requested Start Date/Time T;N, Reason for Referral 12 month well visit, Priority Routine

Village Testing

- State lead level can be sent from the village.
- We're working on getting it added to the Regional Guidelines (the standing orders for the health aides) so this happens routinely.
- This talk will be converted to a HealthStream module for health aides so they have training on the importance of lead screening.
- Lead screening at 12 and 24 months will be added to the CHAM revision currently in progress.

What to do if high?

- Confirm (LabCorps venous test)
- History: screen for Sx of toxicity, potential sources, pica
- PE: delays in language or other neurobehavioral abnormalities
- Screen for iron deficiency: CBC, iron levels, ferritin
- Consider screening other children in the household.
- Report to the state if >5 in a child.
  - http://dhss.alaska.gov/dph/Epi/Documents/pubs/conditions/frmHeavyMetals.pdf
- YK Office of Environmental Health & Engineering can do in-home investigation.
  - Email Jennifer_Dobson@ykhc.org if interested.

Confidential Heavy Metal and Toxic Exposure Report Form
State of Alaska, Section of Epidemiology

Health care providers may use this form for making Heavy Metal reports. This includes heavy metals such as arsenic, cadmium, cobalt, lead, and mercury. Forms may be found at http://dhss.alaska.gov/dph/Epi/Pages/pubs/conditions/crforms.aspx.

Patient Information

Last Name _____ **First Name** _____ **MI** _____

Date of birth ___/___/_____ (mm/dd/yyyy) **Sex:** ☐ Female ☐ Male ☐ Transgender **Pregnant:** ☐ No ☐ Yes; # of weeks _____ ☐ Unknown

Race: ☐ White ☐ Black ☐ Alaska Native/American Indian ☐ Native Hawaiian/Pacific Islander ☐ Asian ☐ Unknown ☐ Other _____

Ethnicity: ☐ Hispanic ☐ Non-Hispanic ☐ Unknown

Physical Address _____ **PO Box** _____

City _____ **State** _____ **Zip Code** _____

Phones (home) _____ **(cell)** _____ **(work)** _____

Heavy Metal and Toxic Exposure Information

METAL	SPECIMEN	SPECIMEN COLLECTION DATE	TEST RESULT	NOTE SPECIES IF APPLICABLE (*e.g. organic/inorganic*)
☐ **ARSENIC**	☐ Urine ☐ Blood ☐ Serum ☐ Other Specimen: _____	___/___/___		
☐ **CADMIUM**	☐ Urine ☐ Blood ☐ Serum ☐ Other Specimen: _____	___/___/___		
☐ **COBALT**	☐ Urine ☐ Blood ☐ Serum ☐ Other Specimen: _____	___/___/___		
☐ **LEAD**	☐ Urine ☐ Blood ☐ Serum ☐ Other Specimen: _____	___/___/___		
☐ **MERCURY**	☐ Urine ☐ Blood ☐ Serum ☐ Other Specimen: _____	___/___/___		
☐ **OTHER**	☐ Urine ☐ Blood ☐ Serum ☐ Other Specimen: _____	___/___/___		

Patient hospitalization time if applicable: _____ **Name of Medical Facility** _____

Attending health care provider _____ **Phone** _____

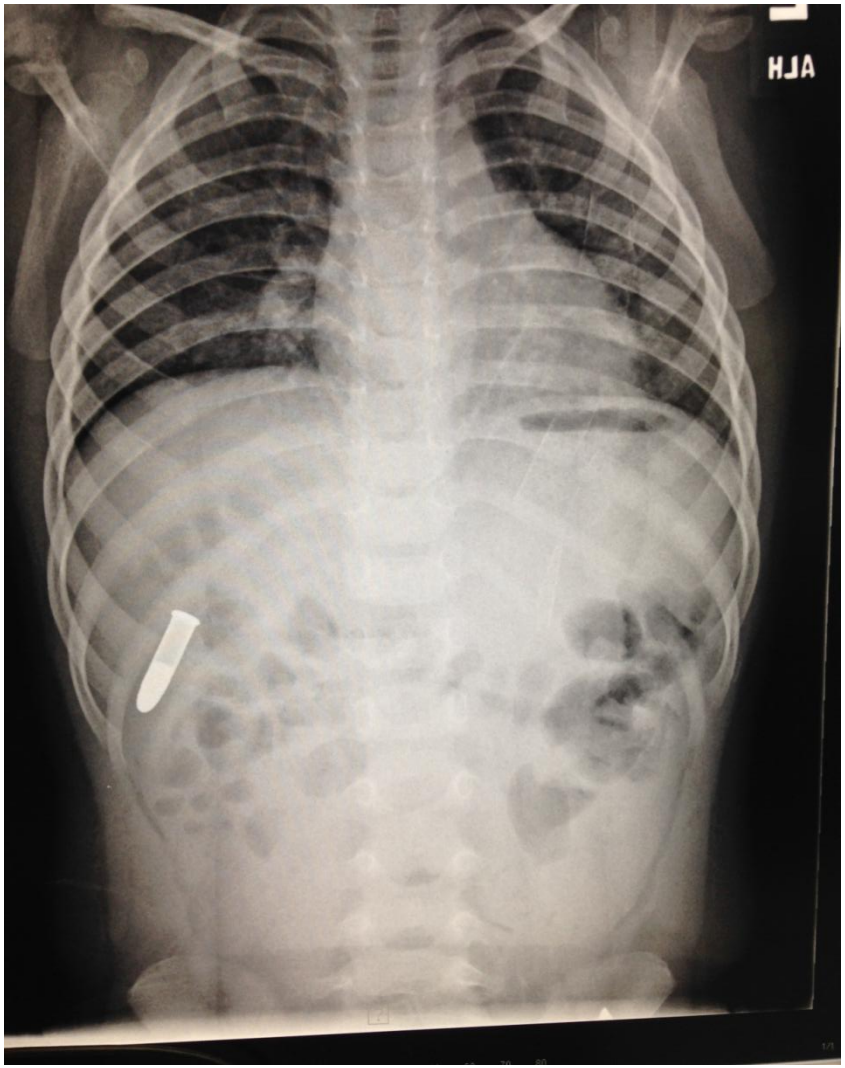
Laboratory Name (*if known*) _____

Notes (e.g., symptoms or suspected exposure source): Toxic symptoms if applicable:

Russian Mission, 2016

- Lead in the water – background
- What was done about it
- Results
  - 33 children screened
  - The highest level found was 4.4.

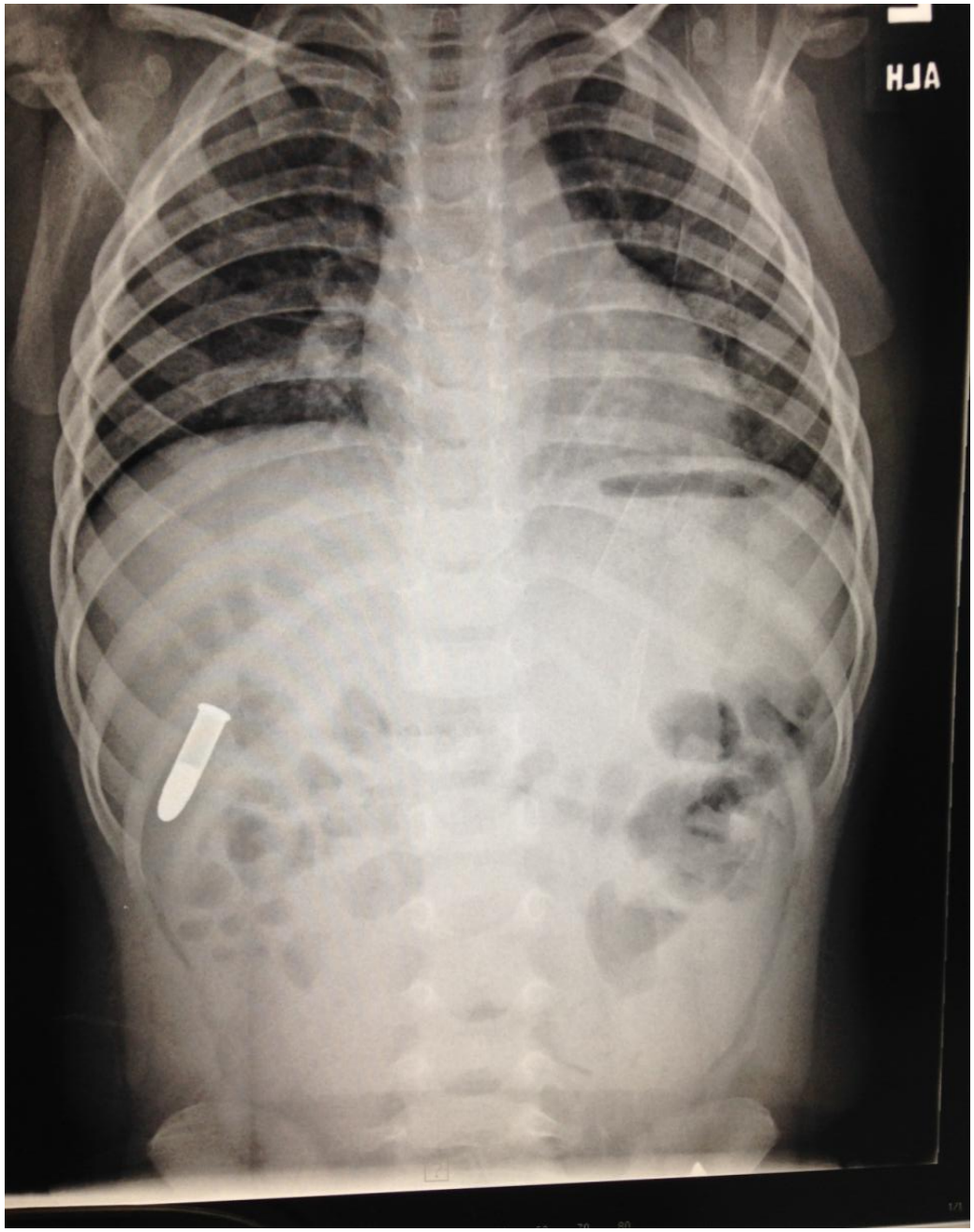
And now, back to…



Case Example

2 year old boy with h/o CPT-1a deficiency and speech delay presented to the ER for fever and barky cough.

CXR obtained in triage due to history.


HJA

Case Example

More history was obtained.

No known history of ingestion.

Child often in the care of his grandparents. In their home, they have many different kinds of ammo, including .22 bullets of different varieties – some are lead-tipped.

Lead level sent.

Family instructed to check diapers for passage of bullet and to follow-up in one week

Case Example

Family did not come to follow-up appointment.

Lead level returned 10 days later at 44.

Case manager tracked down family and got them to come in for follow-up appointment 11 days later.

Case Example

Abdominal X-ray revealed: bullet still present.

Patient given Fleet enema, and RN manually removed bullet.

Peds hematology consulted.

CBC with H/H 11.6/35 with MCV 76 and essentially reassuring iron studies.

Repeat lead level sent and resulted two weeks later at 40.3.

Plan was to repeat level in one week to ensure it is still coming down.

Case Example

Family again lost to follow-up.

They next presented to the ER almost three months later for a dog bite and rabies PPX.

Lead level repeated at that time was 15.

Family again lost to follow-up (for both lead and rabies PPX series).

Learning Points from this Example

- Who knows how long the bullet was in there?
  - If he had had routine screening, there's a chance it could have been found earlier, possibly reducing his overall exposure.
- The state lead level took a long time to result.
  - For testing (when there is a suspicion for exposure), venous testing will result faster.
- Follow-up continues to be a challenge in our population.

Future Directions

- Better communication with WIC about hemoglobin
- Point of care hemoglobin and lead testing

Thank you!

Questions?