Using GIS to impact lead poisoning risk in Indiana

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Outline

1. Why is lead a problem?
2. Notre Dame’s response
3. Projects
   i. Mapping
   ii. Citizen Science
Lead exposure is still a problem all over the US

The thousands of U.S. locales where lead poisoning is worse than in Flint

A Reuters examination of lead testing results across the country found almost 3,000 areas with poisoning rates far higher than in the tainted Michigan city. Yet many of these lead hotspots are receiving little attention or funding.

ST. JOSEPH, Missouri – On a stormy November afternoon in this historic city, birthplace of the Pony Express and birthplace of Jesse James, Lorraine Murphy watched her son Kadyn, 2, dig in their front yard. As he played, she scolded him for putting his fingers in his mouth.

© CBS News
History of Lead: Paint

**Lead** in paint
- Accelerated drying time
- Increase durability
- Resist moisture

**Limits:**
- Before 1950: No limit
- 1950: <5% Pb
- 1978: <0.06% Pb
History of Lead: Gasoline

Tetraethyl lead in gasoline
• Reduce engine knocking
• Boost octane ratings
• Prevent corrosion and wear and tear on motor valves

Limits:
  Before 1979: No limit
  1980-1988: 80% phase out
  1995: Banned
Legacies from leaded paint and gasoline

- Today blood lead levels greater than 5 μg/dl are considered elevated
- Before 2012, greater than 10 μg/dl was considered elevated
Biology of Lead

How does it get into the body?
- Ingestion, inhalation primarily
- Most lead is excreted

Where does it go in the body?
- Blood
- Soft tissues
- Mineralizing tissues

Can the body get rid of lead?
- Half-life in blood: 25 days
- Half-life in soft tissue: 40 days
- Bones: years...
Children are at highest risk:

- Neurologic effects on children documented at levels below 10 μg/dL
  - no safe level
- High exposure effects: irritability, convulsions, coma, or death
- Developmental neurologic effects
- Causes decrease in:
  - Academic achievement
  - Socioeconomic achievement
  - Correlation to criminality

https://www.cdc.gov/nceh/lead/infographic.htm
Lead’s effects on the brain

- Childhood exposure to lead causes gray matter loss (orange areas), especially in frontal areas of the brain.
  - *Cincinnati Lead Study* (Dietrich et. al., 1979)

- Average blood-lead levels during childhood also correlated with arrest rate, Dietrich’s team found
  - Dietrich et. al., 2008

https://cen.acs.org/articles/92/i5/Crimes-Lead.html
Sources of Exposure

- Dust
- Paint chips
- Water
- Soil
- Some toys or other items (keys)
- Some occupations or hobbies

**Home renovations can create more hazards if not done properly!
Solutions

• Full remediation
  – Thousands of dollars, intrusive
• Cover it up
  – Repaint deteriorating surfaces
  – Plant grass or place mulch over soils
• Run water before drinking
• Dust frequently
• Remove shoes
South Bend has a major problem

Off the Charts

The thousands of U.S. locales where lead poisoning is worse than in Flint

By M.B. Poit and Joshua Schneyer  |  Filed Dec. 19, 2019, 2 p.m. GMT

A Reuters examination of lead testing results across the country found almost 3,000 areas with poisoning rates far higher than in the tainted Michigan city. Yet many of these lead hotspots are receiving little attention or funding.

ST. JOSEPH, Missouri – On a sunny November afternoon in this historic city, birthplace of the Pony Express and death spot of Jesse James, Laurinda Mignery watched her son Kaeth, 2, dig in their front yard. As he played, she shook him for putting his fingers in his mouth.

http://www.reuters.com/investigates/special-report/usa-lead-testing/
Legacies from leaded paint and gasoline
South Bend

- Old housing stock
  - Deteriorating paint
- Many areas with high poverty
- Historic industry
Projects

   a. Dissemination of results to community

2. Environmental testing around Saint Joseph County

3. Development of a home test kit

- Data provided by the Saint Joseph County Health Department and the Indiana State Department of Health

- Two different data requests, each with different fields

- Consists of blood-lead levels, age, sex, medicaid status, test type
  - Many other variables present, but lacking consistency

- This lets us understand the the problem as is exists now
  - Areas of concern, testing rates
St. Joseph County Lead Data Report

- 9,941 children tested
  - 333 EBLL ≥ 10μg/dL
  - 1,589 EBLL between 5 – 9.9

- Lead testing rates in SJC are very low
  - Less than 10% of all eligible children.

- If CDC guidelines were implemented, the county faces a five-fold increase in case management.

- Nine census tracts with more than 20% of children with an elevated blood lead level

- Only four women accurately identified as pregnant.

- The quality of data collection was very poor;
  - Over one-third of all variables with a null, unknown or data entry error.
Seasonality
St. Joseph County
2005 - 2015

Children Tested with Elevated Blood Lead Levels

Percentage of children (under 5) tested with result >= 5 µg/dL: 2005 - 2015
- < 5 %
- 5 - 10 %
- 10 - 20 %
- 20 - 30 %
- 30 - 40 %
Recommendations made to the St. Joseph County Health Department

- Improve testing rates significantly
  - 2016-2017 rates have improved
- Improve data collection
  - To assess individual providers/insurers
- Implement the CDC guidelines
  - Open case management on levels above 5 µg/dL
  - Screening and management for pregnant and lactating women
Back to the community

- 7 outreach events
  - Free lead testing
- City and county council meetings
- High school events
- StoryMap
- Editorial in local paper
- University public relations and marketing
  - https://www.nd.edu/features/when-work-becomes-personal/
  - https://www.nd.edu/features/homemade-poison/
2. Environmental testing around Saint Joseph County

- Exposure from contaminated soils is a significant problem
- We have tested soils throughout South Bend and Mishawaka
  - Focused mainly on Census Tract 6: The NNN
- > 10,000 soil samples
- Preliminary results:
  - There are many areas of high lead in soil throughout the county
  - Mostly associated with residential drip-lines
  - Some higher levels in alleys
- Data collection in ongoing
- Collection in ArcGIS Survey123
Community Engagement

Notre Dame Students
- Intro to GIS
- Chemistry in Service
- Community Based Research
- ~100 students, ~1500 samples

High School and home-schooled students
- 5 students, 3 teachers
- ~1000 samples

Neighborhood Organizations
- Near Northwest Neighborhood
- Southeast Area Residents
2. Environmental testing around Saint Joseph County

http://arcg.is/19uunP
Mulch Madness

- Community event to distribute mulch to residents
- 15 blocks
- 85 properties got mulch
  - 70% of houses in area
  - 17 additional residents declined
- 120 volunteers
  - Largely college students,
  - Local high school
  - Community members.
- 24 truckloads
  - About 130 cubic yards
3. Development of a home test kit

• Current model uses children’s bodies to find lead
• Using a citizen-science model to collect dust, soil and paint samples
  – Samples analyzed using X-Ray Fluorometers (XRF)
• Helps residents determine if there is a risk before a child is affected
• Validation on 50 homes
  – High accuracy
• Plan to make these available throughout the year
3. Development of a home test kit

Goal:
To develop a reliable, low-cost home lead test kit so that families will no longer have to rely on their child’s/children’s blood lead test before taking preventive measures and finding lead in their home. Through citizen science and a home lead test kit, this approach will put families in the driver’s seat of prevention, knowledge and action.

- Metadata processing
- Product design
- Analysis automation
Video content

- Background to the problem
- DIY Solutions
- How to take samples
- Where to find more information
Home Test Kits
3. Development of a home test kit

• Nearly all houses built before 1950 have interior lead risks
  – ~60% of South Bend houses

• Soils are often high near the dripline of houses
• Some newer houses have exterior risks

Website with DIY remediation and further information
• https://leadinfo.nd.edu/information-about-lead/
Lead is significantly affecting our children; long-lasting, debilitating effects; increase testing for children; less than 10% tested.

Academic & Community Partnerships are a catalyst to generate leadership, awareness, coordination and resources; become a partner.

Reduce our children’s exposure to lead; increase resources for homeowners and renters to remediate lead.
ND-LIT:

Heidi Beidinger, Assistant Professor, Eck Institute for Global Health
Matthew Sisk, Assistant Librarian, Navari Family Center for Digital Scholarship
Marya Lieberman, Professor: Department of Chemistry
Graham Peaslee, Professor: Department of Physics
Meghanne Tighe, Graduate Student: Department of Chemistry
Christopher Knaub, Eck Institute for Global Health

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