

Using GIS to impact lead poisoning risk in Indiana

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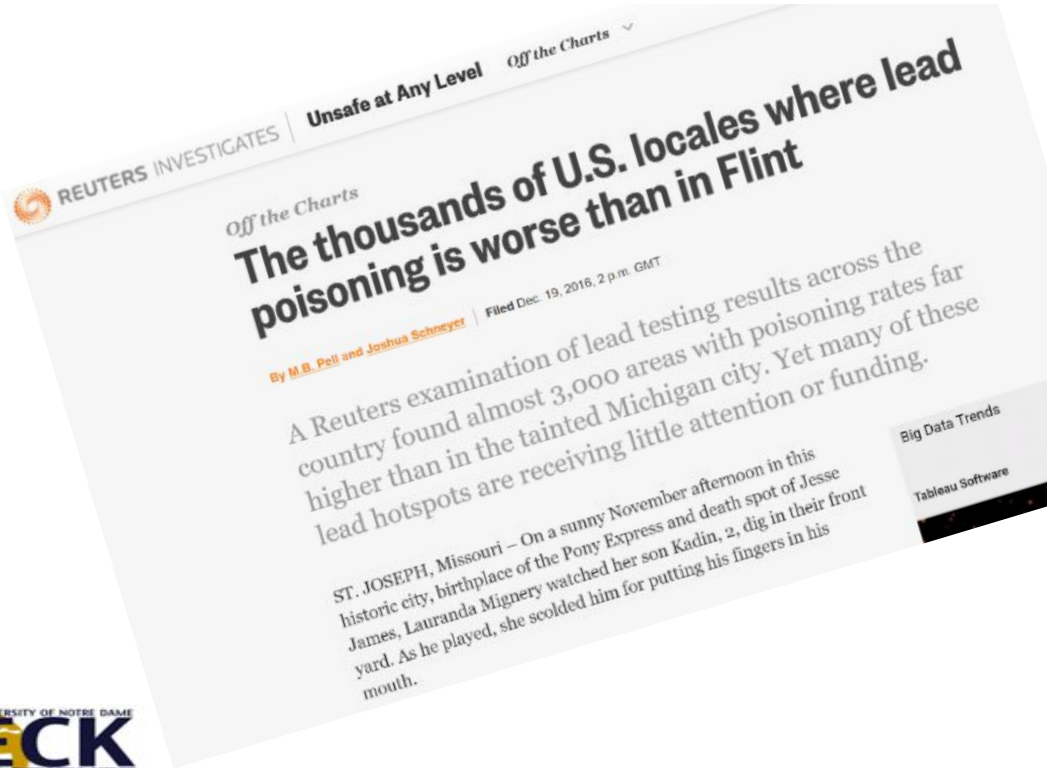
Eck Institute for Global Health

University of Notre Dame

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



History of Lead: Paint

Lead in paint

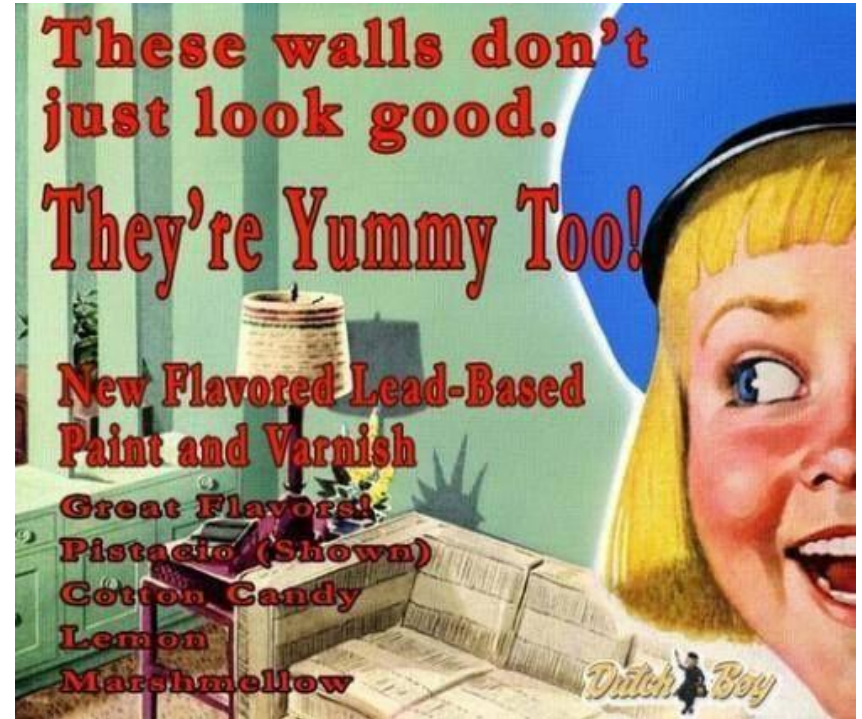
- Accelerated drying time
- Increase durability
- Resist moisture

Limits:

Before 1950: No limit

1950: <5% Pb

1978: <0.06% Pb



History of Lead: Gasoline

Tetraethyl **lead** in gasoline

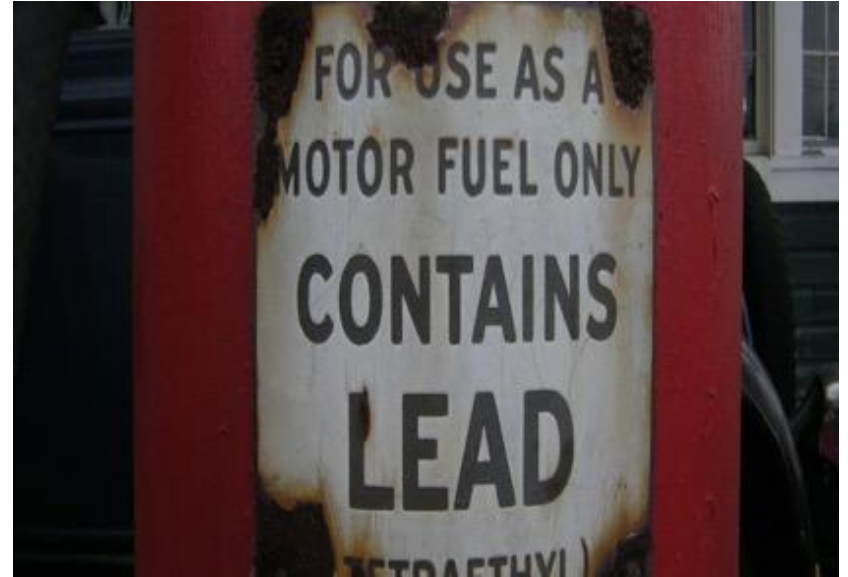
- Reduce engine knocking
- Boost octane ratings
- Prevent corrosion and wear and tear on motor valves

Limits:

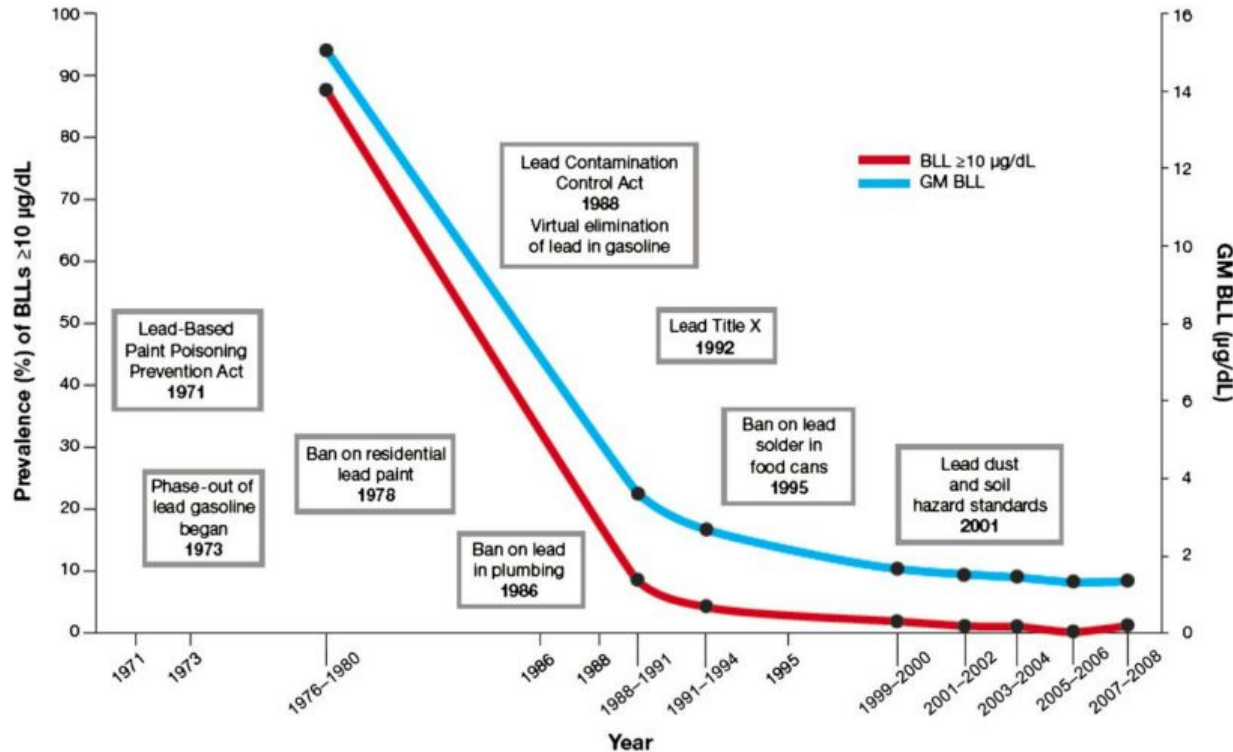
Before 1979: No limit

1980-1988: 80% phase out

1995: Banned



Legacies from leaded paint and gasoline



- Today blood lead levels greater than 5 $\mu\text{g/dL}$ are considered elevated
- Before 2012, greater than 10 $\mu\text{g/dL}$ was considered elevated

Pediatrics

July 2016, VOLUME 138 / ISSUE 1

From the American Academy of Pediatrics
Policy Statement

Biology of Lead

How does it get into the body?

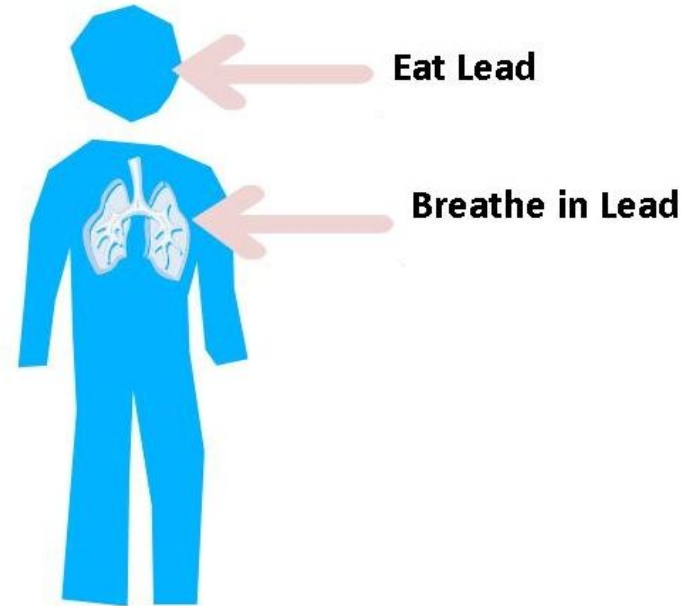
- Ingestion, inhalation primarily
- Most lead is excreted

Where does it go in the body?

- Blood
- Soft tissues
- Mineralizing tissues

Can the body get rid of lead?

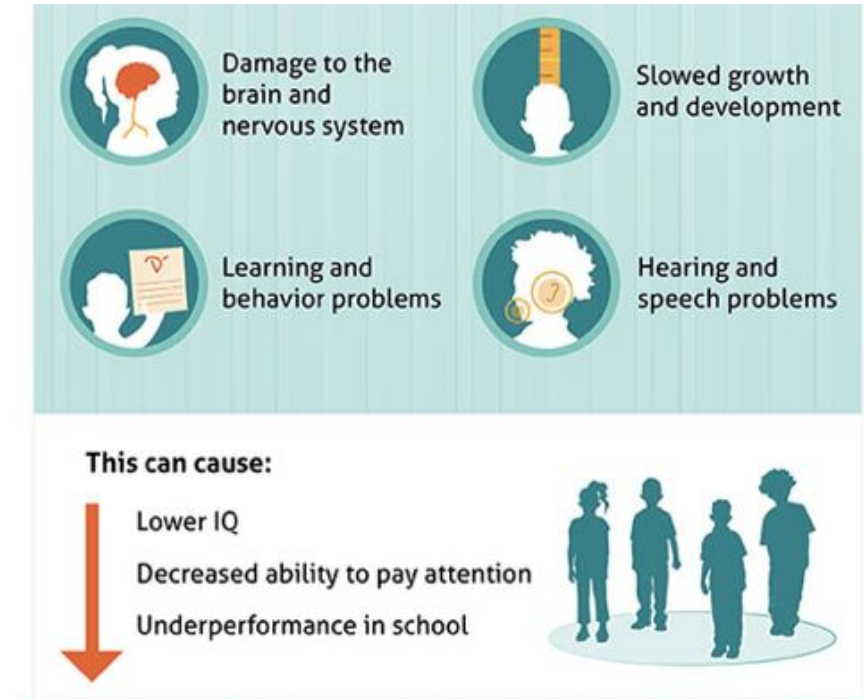
- Half-life in blood: 25 days
- Half-life in soft tissue: 40 days
- Bones: years...



Neurological and Physiological Effects of Lead

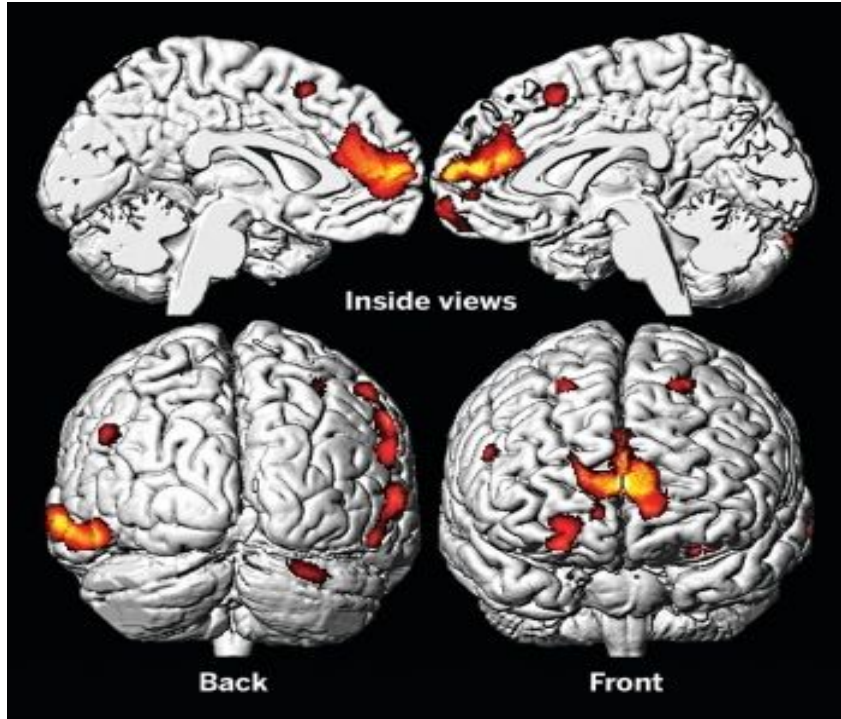
Children are at highest risk:

- Neurologic effects on children documented at levels below 10 $\mu\text{g}/\text{dL}$
 - 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

REUTERS INVESTIGATES | Unsafe at Any Level | Off the Charts

Off the Charts

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

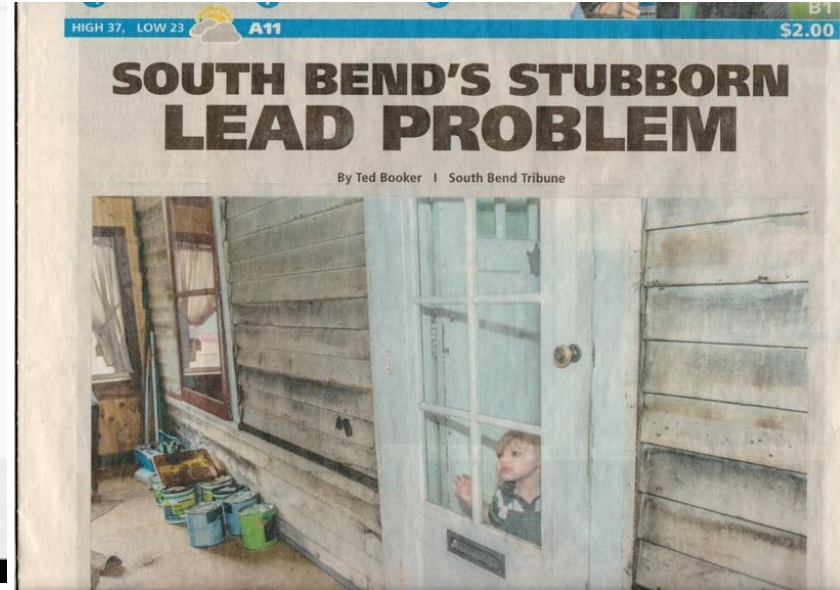
By M.B. Pell and Joshua Schneyer | Filed Dec. 19, 2016, 2 p.m. GMT

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, Lauranda Mignery watched her son Kadin, 2, dig in their front yard. As he played, she scolded him for putting his fingers in his mouth.

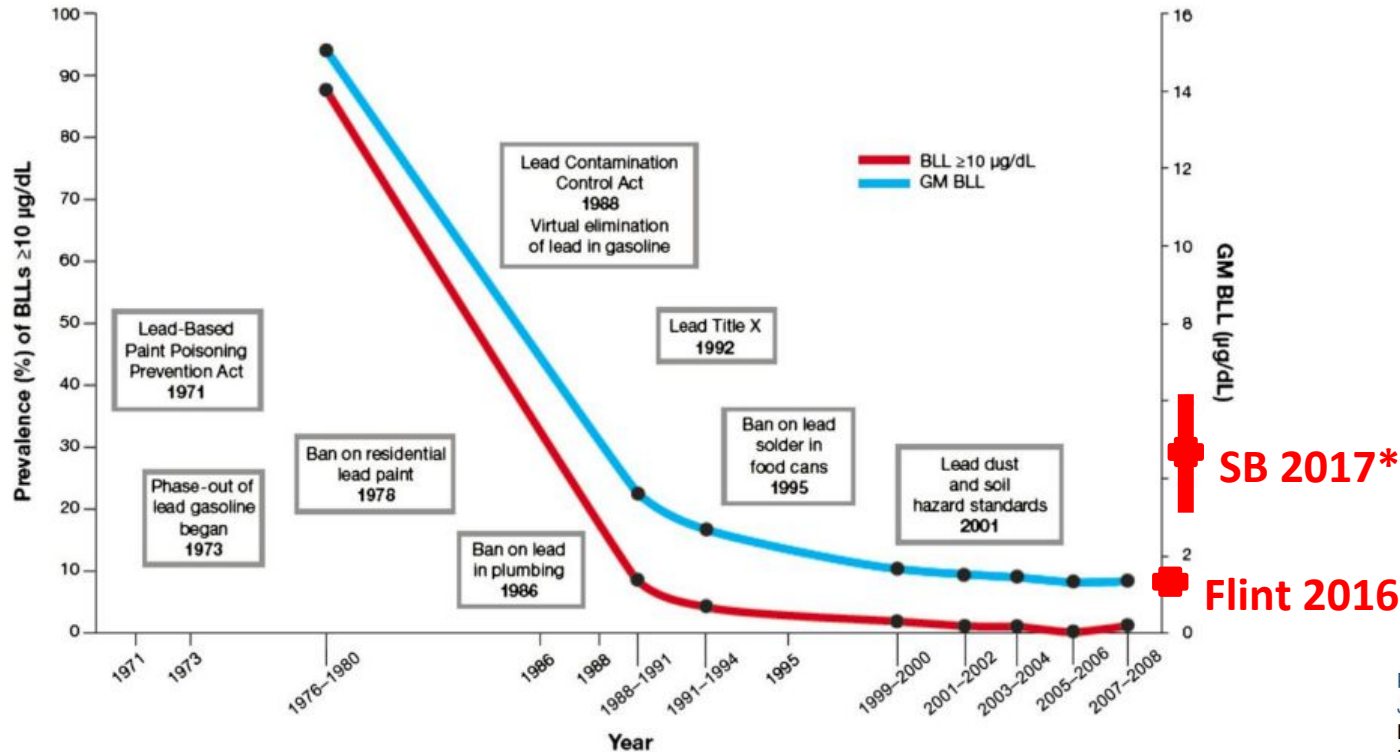
Big Data Trends

Tableau Software



<http://www.reuters.com/investigates/special-report/usa-lead-testing/>

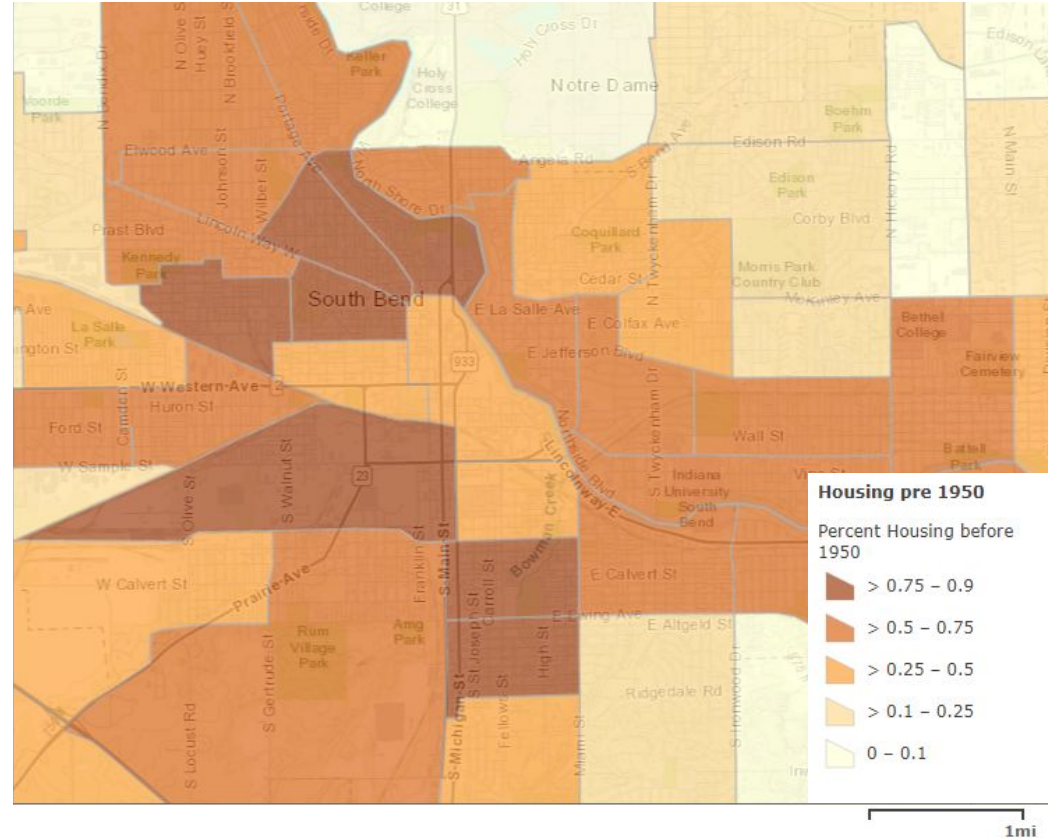
Legacies from leaded paint and gasoline



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South Bend

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



Projects

1. Analysis of lead testing records 2005-2015, and 2016-2017
 - a. Dissemination of results to community
2. Environmental testing around Saint Joseph County
3. Development of a home test kit

1. Analysis of lead testing records 2005-2015, and 2016-2017

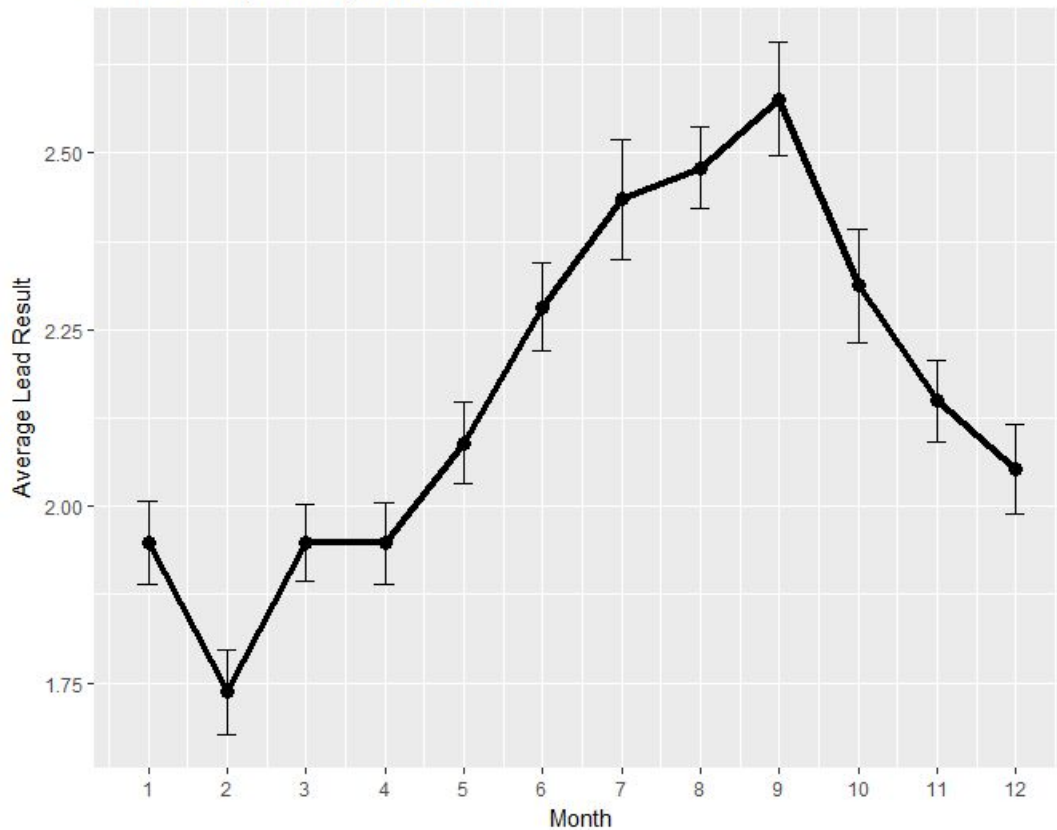
- Data provided by the Saint Joseph County Health Department and the Indiana State Department of Health
- Two different data requests, each with different fields
- Consists of blood-lead levels, age, sex, medicaid status, test type
 - Many other variables present, but lacking consistency
- This lets 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 EBLI $\geq 10\mu\text{g/dL}$
 - 1,589 EBLI 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.

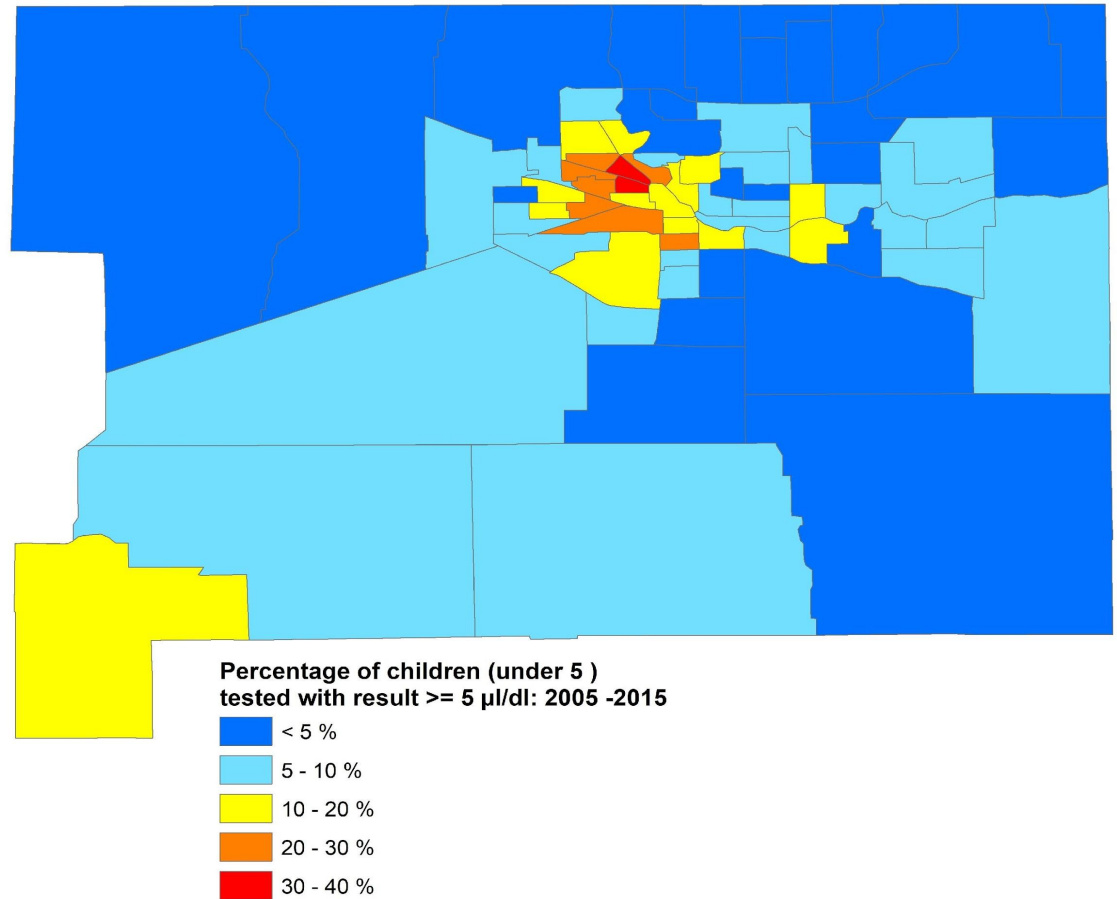
Seasonality

All children (under 5) 2005-2015

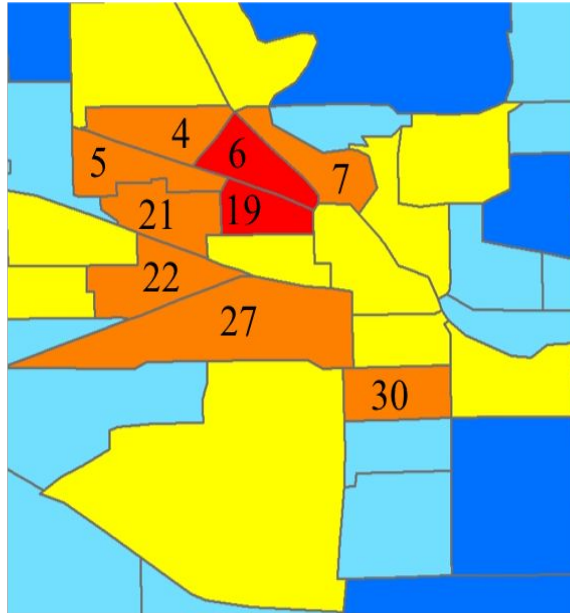


St. Joseph County 2005 - 2015

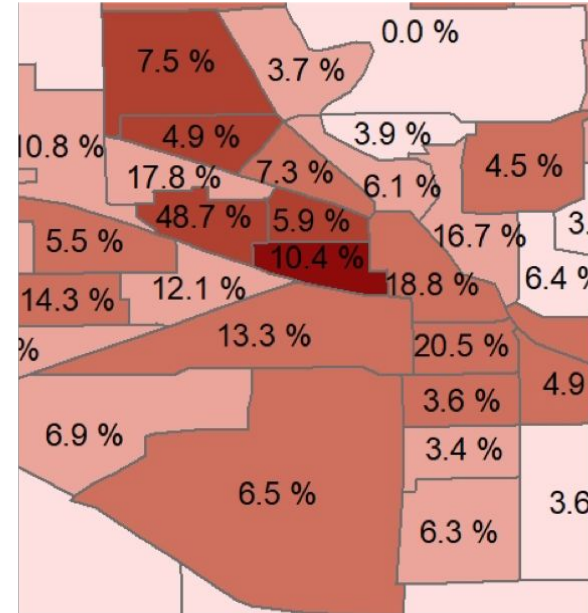
Children Tested with Elevated Blood Lead Levels

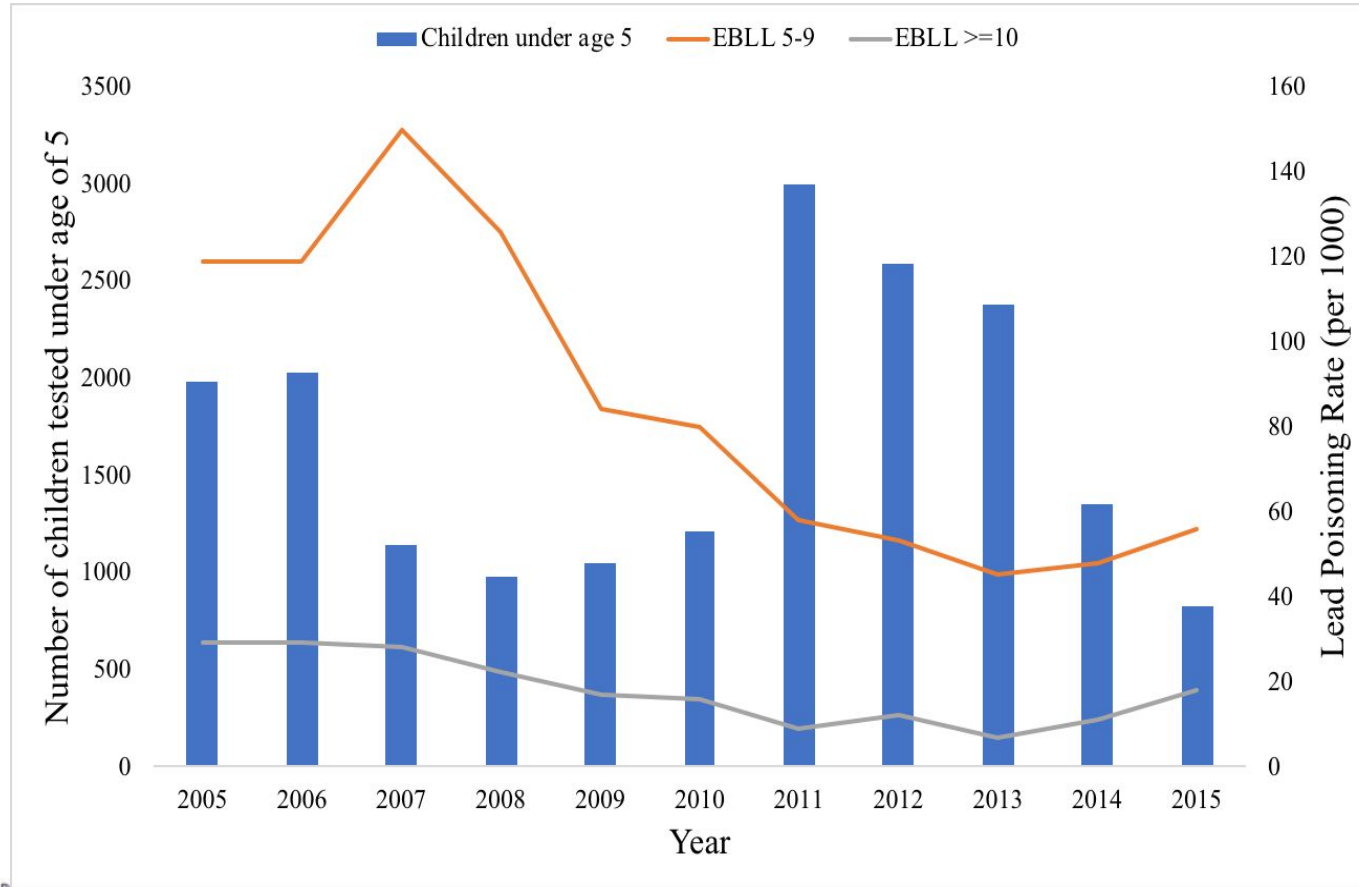


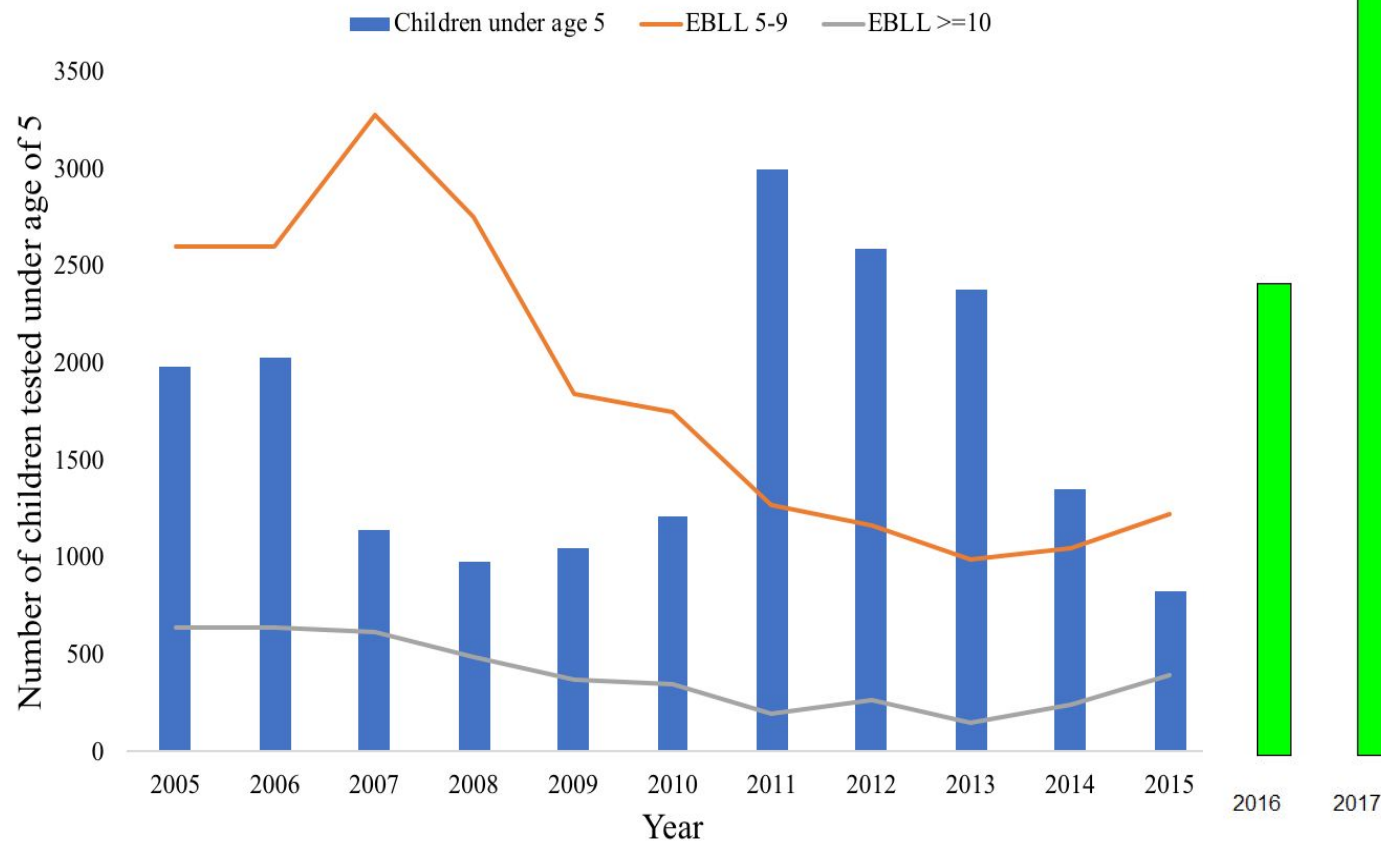
(A)



(B)



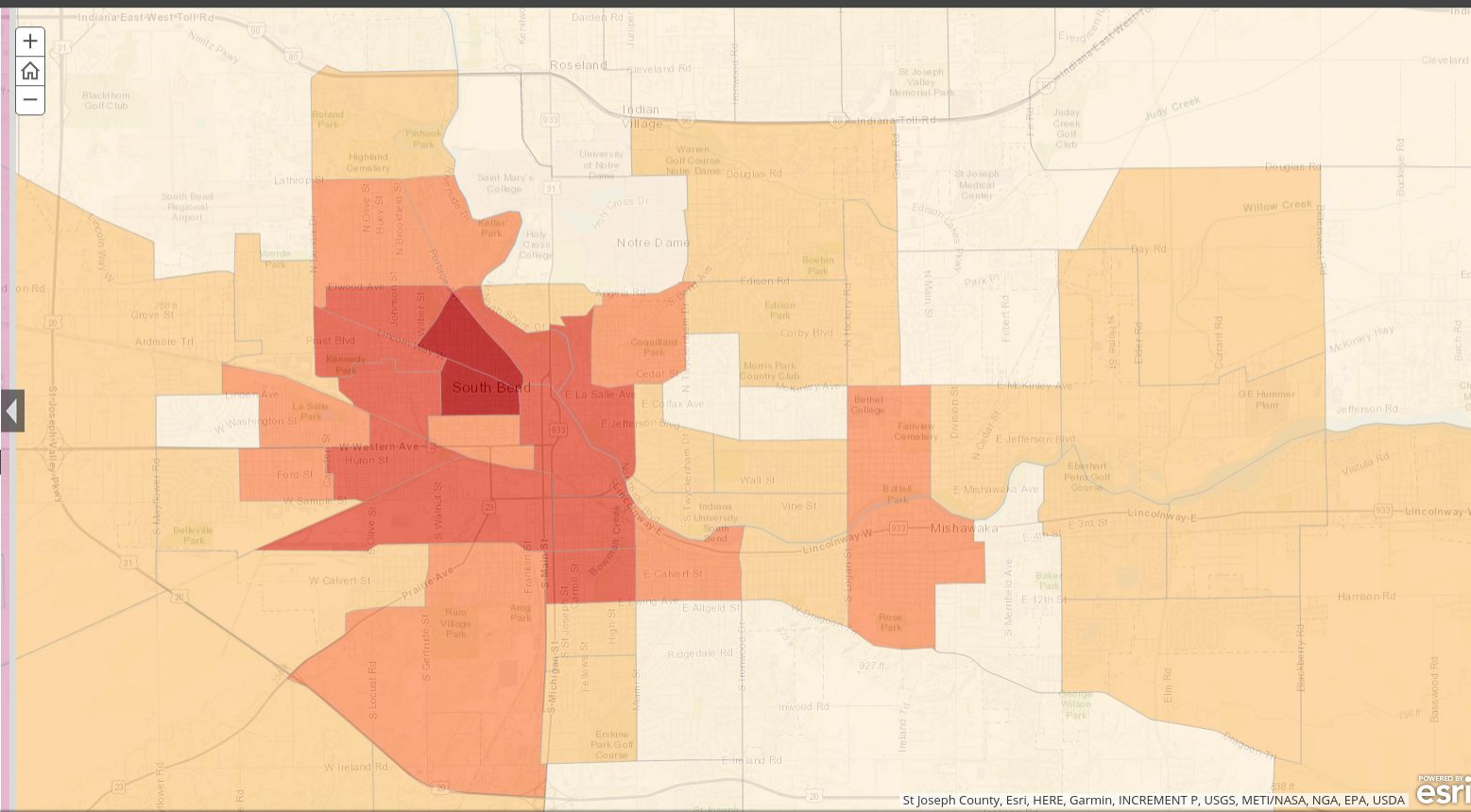




Data from Indiana State Department of Health and the American Community Survey (2011-2015 aggregate)

Legend

Percentage of children tested In 2015	Percentage of children with elevated BLL
m2015 divided by Population Under 5	Percent children elevated BLL
> 0.2 - 0.29	> 0.25 - 0.369
> 0.1 - 0.2	> 0.15 - 0.25
> 0.05 - 0.1	> 0.1 - 0.15
> 0 - 0.05	> 0.05 - 0.1
0 - 0	0 - 0.05



<https://arcg.is/1OW99f>



NAVARI FAMILY CENTER for DIGITAL SCHOLARSHIP

Lead Prediction Map

new

Choose a dataset:

- Actual Recorded BLL
- Model Predicted BLL

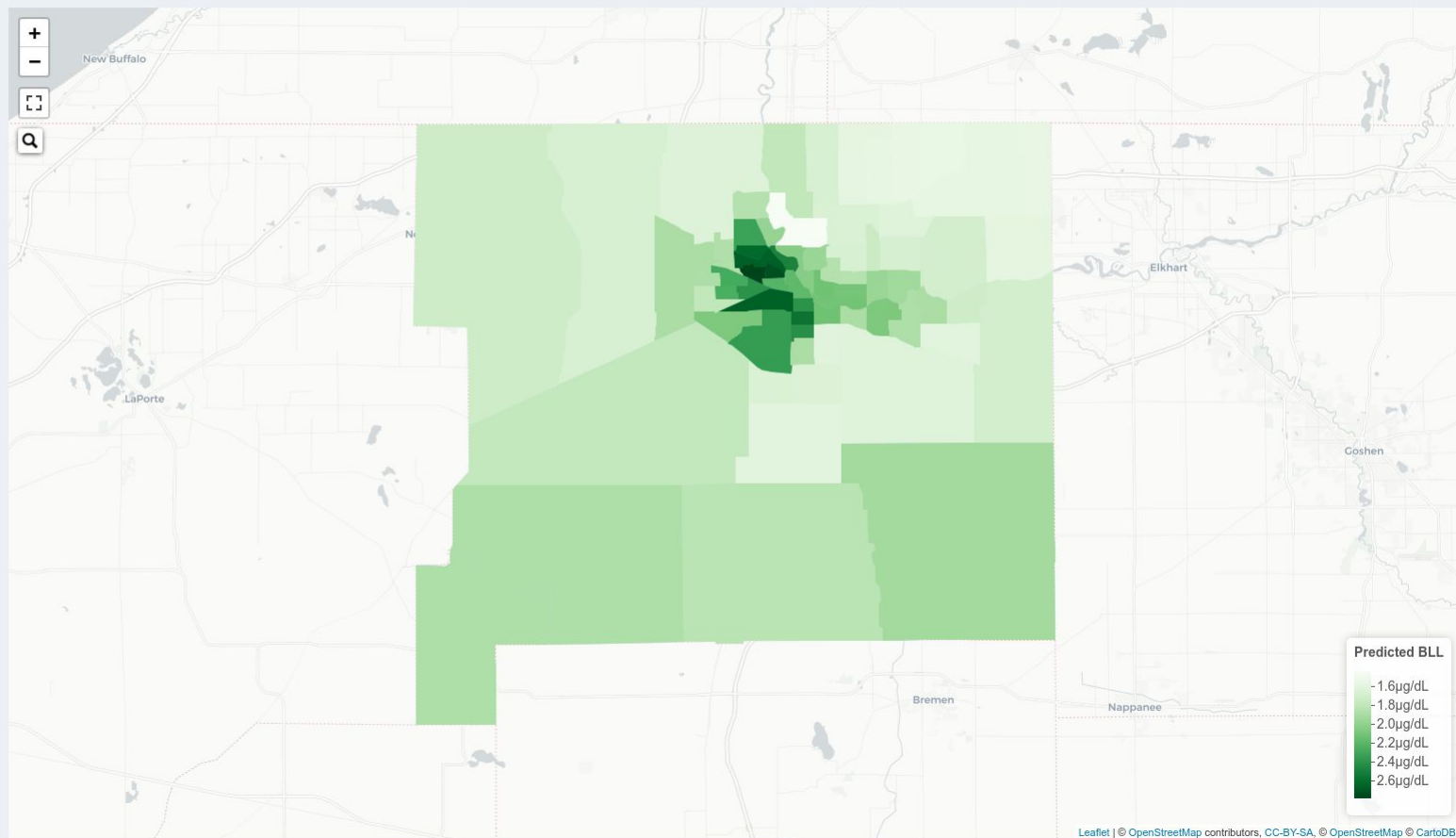
Socioeconomic Factors

Dataset

Methodology

Research Abstract

About



Leaflet | © OpenStreetMap contributors, CC-BY-SA, © OpenStreetMap © CartoDB

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 $\mu\text{g/dL}$
 - Screening and management for pregnant and lactating women

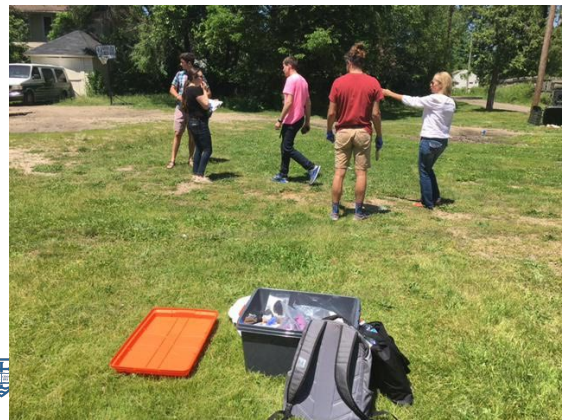
Back to the community

- 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

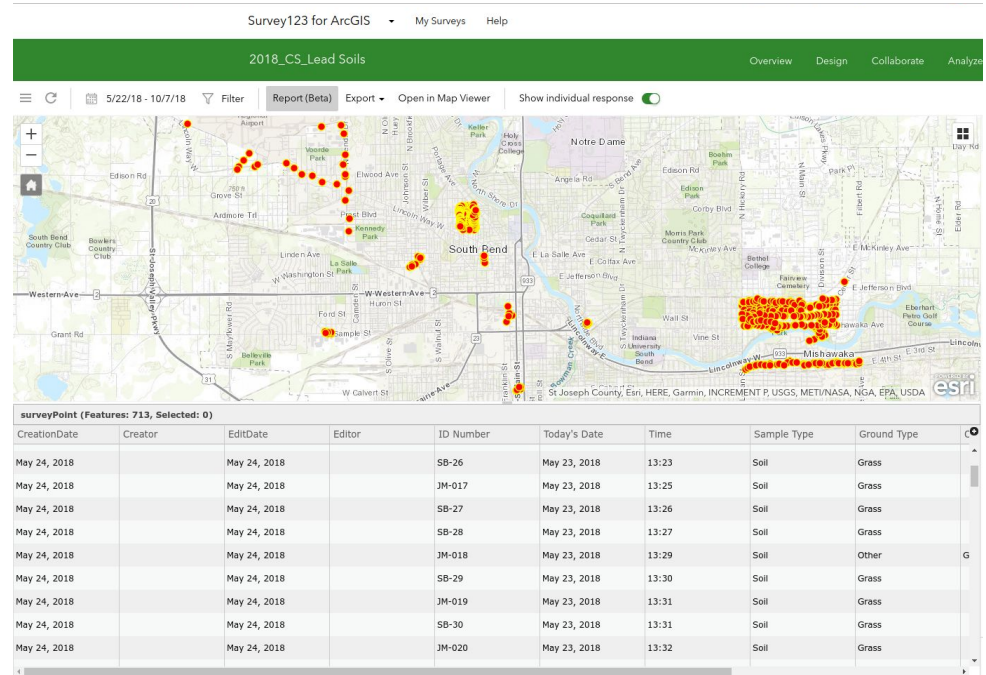
- Intro to GIS
- Chemistry in Service
- Community Based Research
- ~100 students, ~1500 samples

High School and home-schooled students

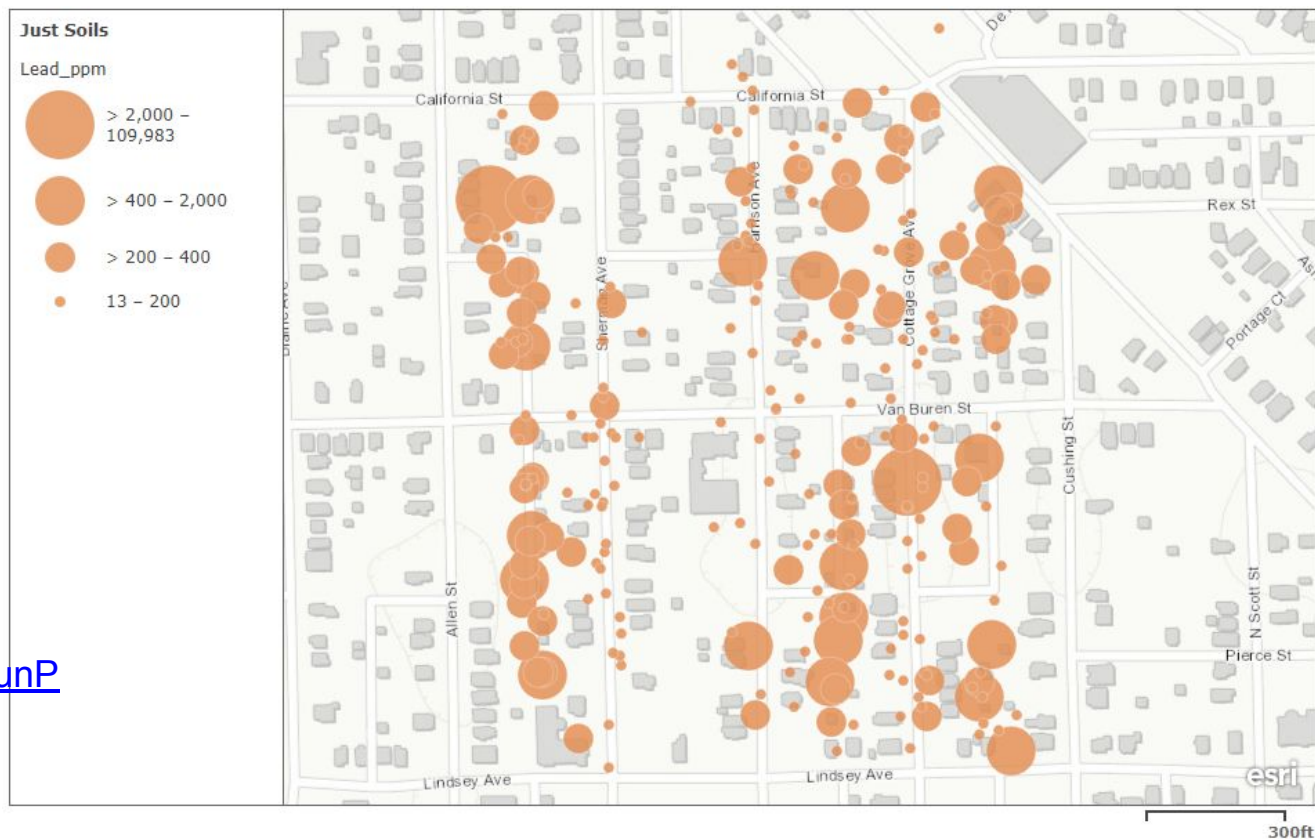
- 5 students, 3 teachers
- ~1000 samples

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

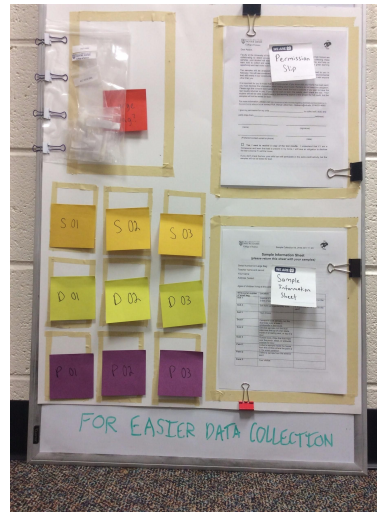


3. Development of a home test kit

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/>

Summary

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

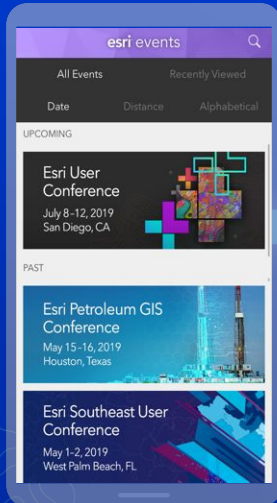
Christopher Knaub, Eck Institute for Global Health

Funding:

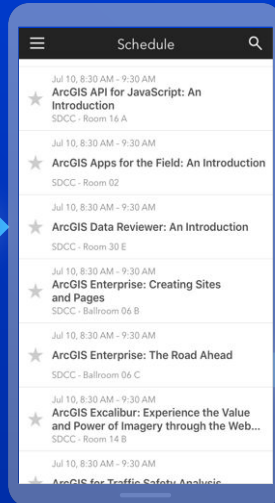
- Indiana Clinical and Translational Sciences Institute
- University of Notre Dame

Please Share Your Feedback in the App

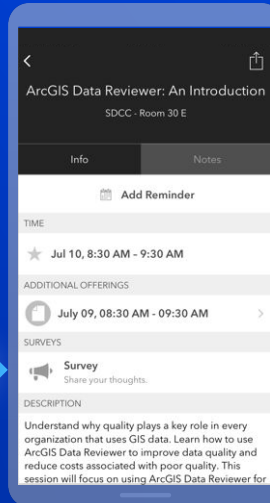
Download the Esri Events app and find your event



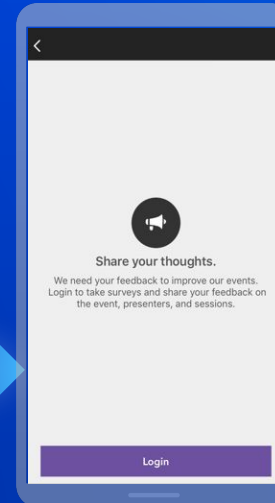
Select the session you attended



Scroll down to "Survey"



Log in to access the survey



Complete the survey and select "Submit"

