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82 Below:

Visualizing Lead Service Lines and Lead Risk in Chicago

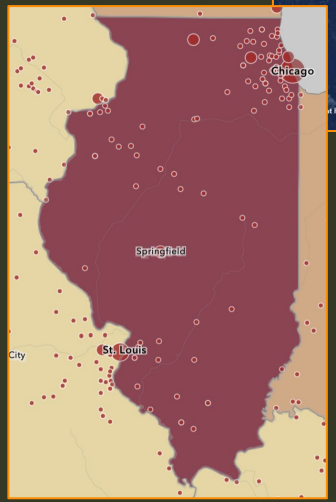
82 Below: **Obaid Bin-Mahfoudh, Sebastian Buzenas, Gavin Coffer, Pranav Kuchibhotla, Thailer Simmons**

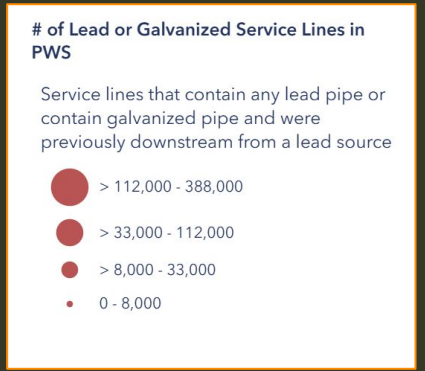
What is Happening in Chicago's Pipes?

The city of Chicago is estimated to contain over 400,000 lead service lines- more than any other city in the U.S.

- Service lines are pipes that connect homes and businesses to the city's water supply via water mains.
- Until 1986, lead was the pipe material mandated by city ordinance for use in service line construction
- Illinois is home to the most lead lines, with Chicago accounting for ~58% of lead lines

Source: NRDC 2024





Lead Toxicity

Lead is a known neurotoxin that accumulates in the body for a person's ***entire lifetime.***

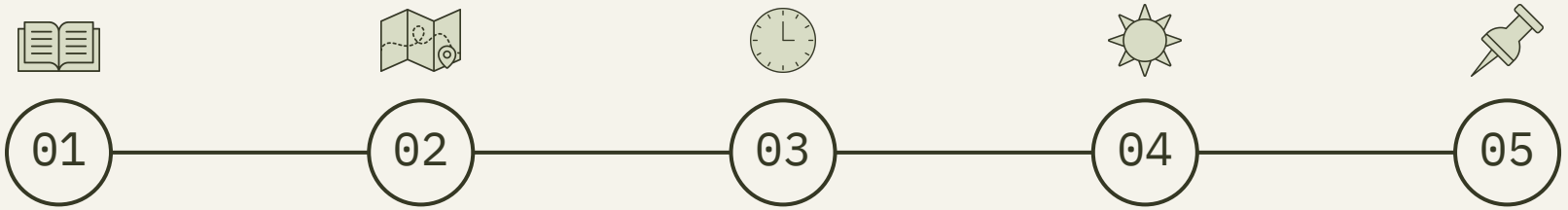
There is no safe lead exposure level. ANY exposure can cause:

- Cognitive impairment/ learning disability
- Behavioral problems
- Lowered IQ
- Anaemia

These issues are most detrimental in children and pregnant people who can leach lead to their fetuses. Due to the cumulative nature of lead poisoning, early onset of poisoning can affect a child's entire lifetime.

Approach

Our approach to understanding lead risk in Chicago consisted of:



01 Data Collection

Data Sources: FOIA Release, US Census Bureau, The Guardian US, EPA , NWS

Factors to consider	Notes
Hotspot analysis	Transparency for lead service lines in Chicago Identify areas for service line replacement to ensure equity and helping our most vulnerable population Identify improvements to lead testing strategies
Risk Model	City of Chicago geometry data: City of Chicago website. Census block group geometries: Census website ADI Score: Neighborhood Atlas Children under 5 data: Census ACS Lead service line data: FOIA Request from City of Chicago.
Lead temperature draws	Risk of lead poisoning to our most vulnerable population and those who cannot adequately respond to lead poisoning.
Benefits of taking action • What are the benefits of making the change?	Ensure transparency to the residents of Chicago. Helping ensure prioritization for our most vulnerable population

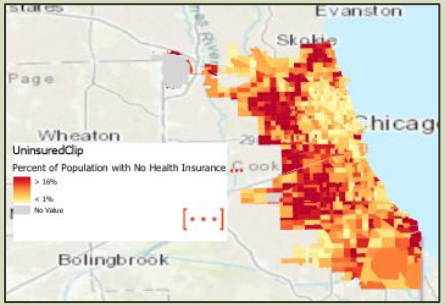
02 Hotspot Lead Risk Analysis

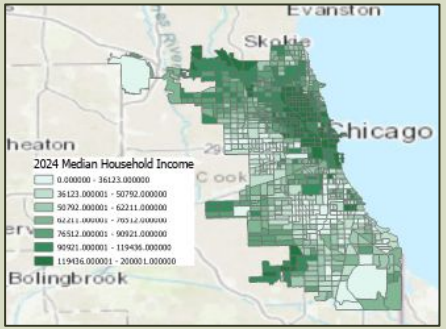
Questions

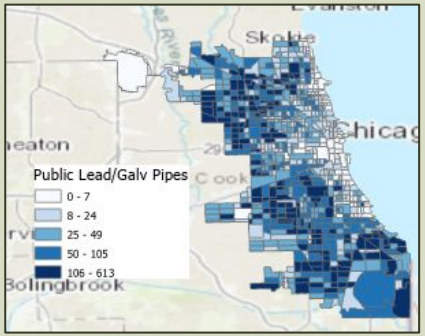
- Where is lead most likely to be within the city?
- Where are people most unprepared to handle lead exposure?
- Where are both of these factors present?

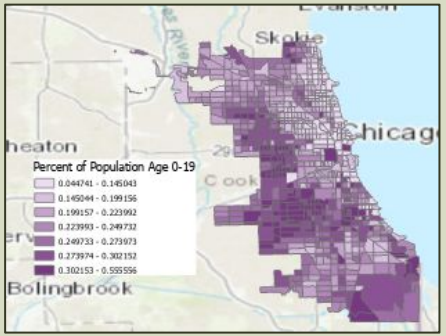
Key Indicators

- Private and Public LSL density
- Census Demographics: Population under 19, Population Uninsured, Median Household Income
- Normalized as percents

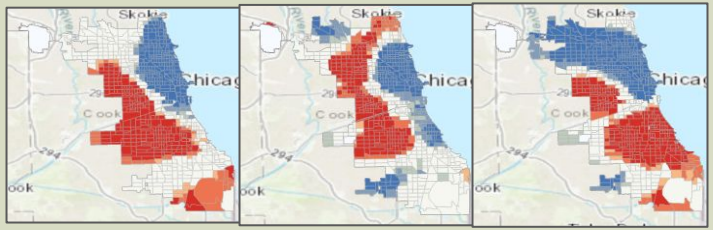




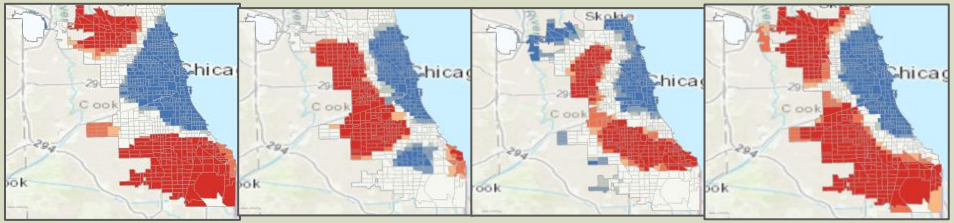




02 Hotspot Lead Risk Analysis



Youth, Uninsured, Inverse Income Hotspots - Demographics

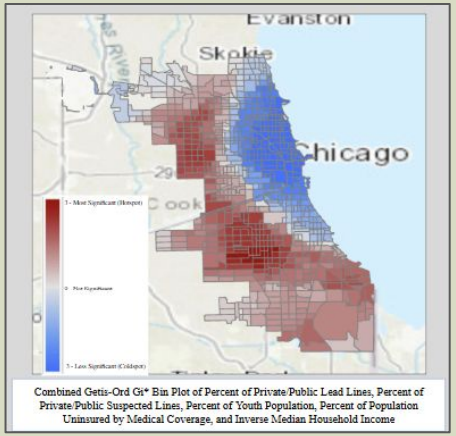


Private/Public Lead and Suspected Lead Hotspots - Lead Presence

Hotspot Methodology

- Where is the statistic unusually high given the statistics surrounding it?
- Use of Gi* Statistic to determine spatial hotspots
- Locating significant hot and cold spots
- Combining hotspot maps

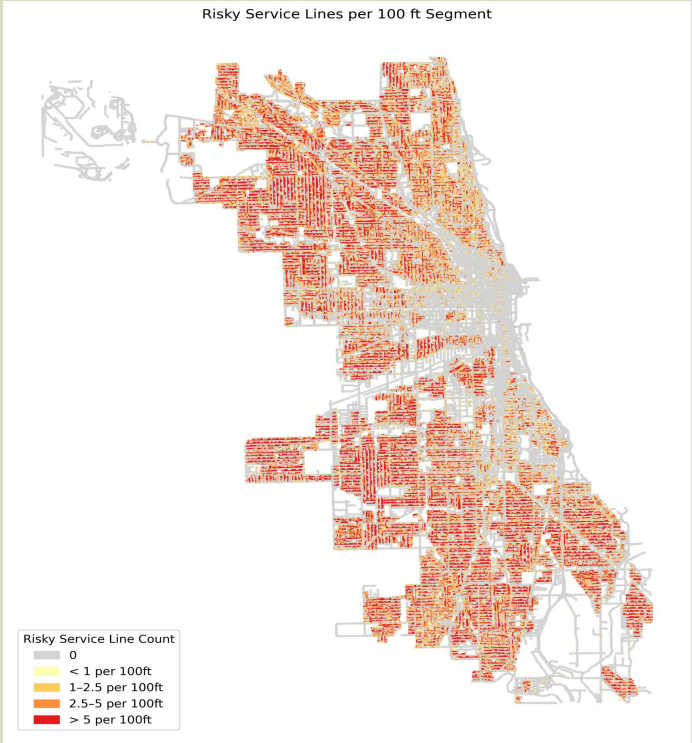
Key Findings



Combined Getis-Ord Gi* Bin Plot of Percent of Private/Public Lead Lines, Percent of Private/Public Suspected Lines, Percent of Youth Population, Percent of Population Uninsured by Medical Coverage, and Inverse Median Household Income

03 More Granular Service line replacement

After setting priorities by block groups we can get more granular and prioritize streets within a block group. This will be done by determining the number of risky service lines per 100 ft.



Partial Service line replacement 2025–2165

Predicted cost:
$7,789,120,000.00

Full Service line replacement 2025–2172

Predicted cost:
$7,413,016,000.00

Assumptions:
Cost of replacement:
$16,000

Annual budget:
53 million

Animated 30-Day Rolling Lead Exposure Levels (ZIP Code-wise)

- This animation shows the 90th percentile of lead levels using a 30-day rolling window for each Chicago ZIP code.
- For each day, it looks at lead samples from the previous 30 days to highlight unusually high contamination levels.
  - **Darker red** = higher lead risk
  - **Grey** = not enough data
  - Lead risk rises in **summer** and drops in **winter**, revealing clear seasonal patterns.
- This helps pinpoint when and where lead exposure risk rises.