Case Study 5: Lead

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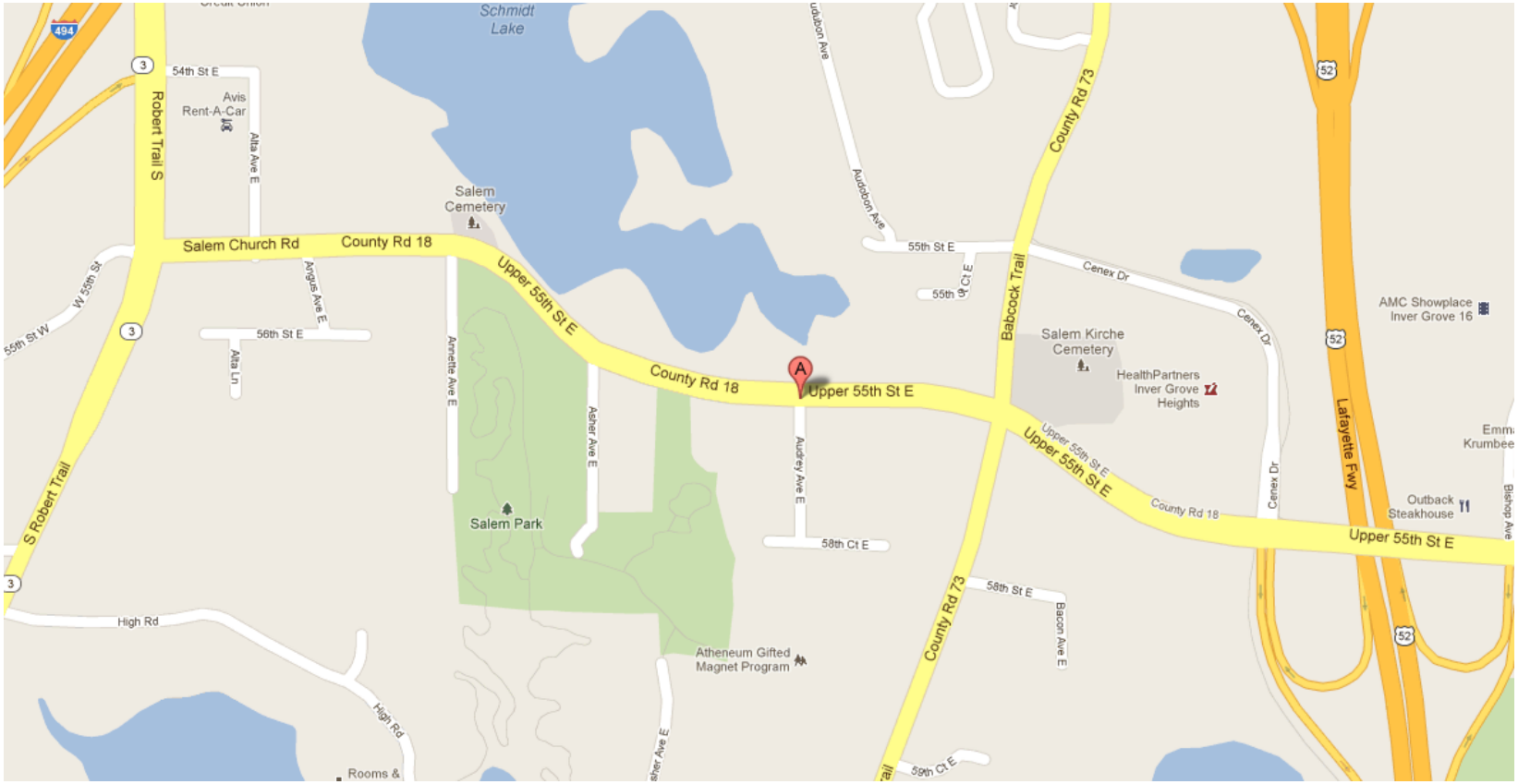
Source(s) of Lead?

- Lead poisoning is a serious health risk
  - It is toxic to various organs and tissues (e.g. heart, bones, kidneys, etc.)
  - Symptoms may be relative benign (e.g. headache) or severe (e.g. death)
  - It interferes with the development of the nervous system
- Sources of lead include:
  - Occupational exposure
  - Paint
  - Soil (from pesticides, gasoline, paint breaking down)
  - Water
  - Products (e.g. children's toys)
  - Lead bullets (i.e. hunting)

Present Study

- The community is concerned about children eating soil that is contaminated by lead
- We want to sue those that are culpable
- But we need to figure out the source of the lead contaminants in the soil
- They believe the lead is from car exhaust and lead paint.

Study Site


Schmidt Lake
494
54th St E
Avis Rent-A-Car
Robert Trail S
Alta Ave E
Salem Cemetery
Salem Church Rd
County Rd 18
Upper 55th St E
55th St W
Argus Ave E
56th St E
Alta Ln
Annette Ave E
Asher Ave E
Salem Park
S Robert Trail
High Rd
Atheneum Gifted Magnet Program
Rooms &
Audubon Ave
55th St E
55th Ct E
Cenex Dr
Babcock Trail
County Rd 73
Salem Kirche Cemetery
HealthPartners Inver Grove Heights
AMC Showplace Inver Grove 16
Lafayette Fwy
Audrey Ave E
58th Ct E
58th St E
Bacon Ave E
59th Ct E
Outback Steakhouse
Bishop Ave
52
3

Sampling Schemes

- Stratified Random Sampling
  - Divide study site into various strata based on landscape features (e.g. freeways, schools, shops, parks, homes with yards, etc.)
  - This will ensure that we adequately sample all representative landscape types
  - Could be either proportional or optimal allocation
- Simple Random Sampling
  - We randomly sample throughout the study site irrespective of landscape features
  - Justification: There may be no areas in the study without an anthropogenic disturbance
- Simple Random Sampling - Children Only
  - If we're only considered about the children then perhaps we should sample only where the children play/spend time

Additional Information from the Community

- Are these the only two possible sources of lead in the community?
- Has anyone in the area actually had lead poisoning? Where were they exposed to the lead?
- Are you interested in knowing if lead occurs more frequently in certain locations (e.g. schools) or just solely the source?
- How large is your budget? Can be used to determine the power for the sample size we can afford
- How old are the homes?

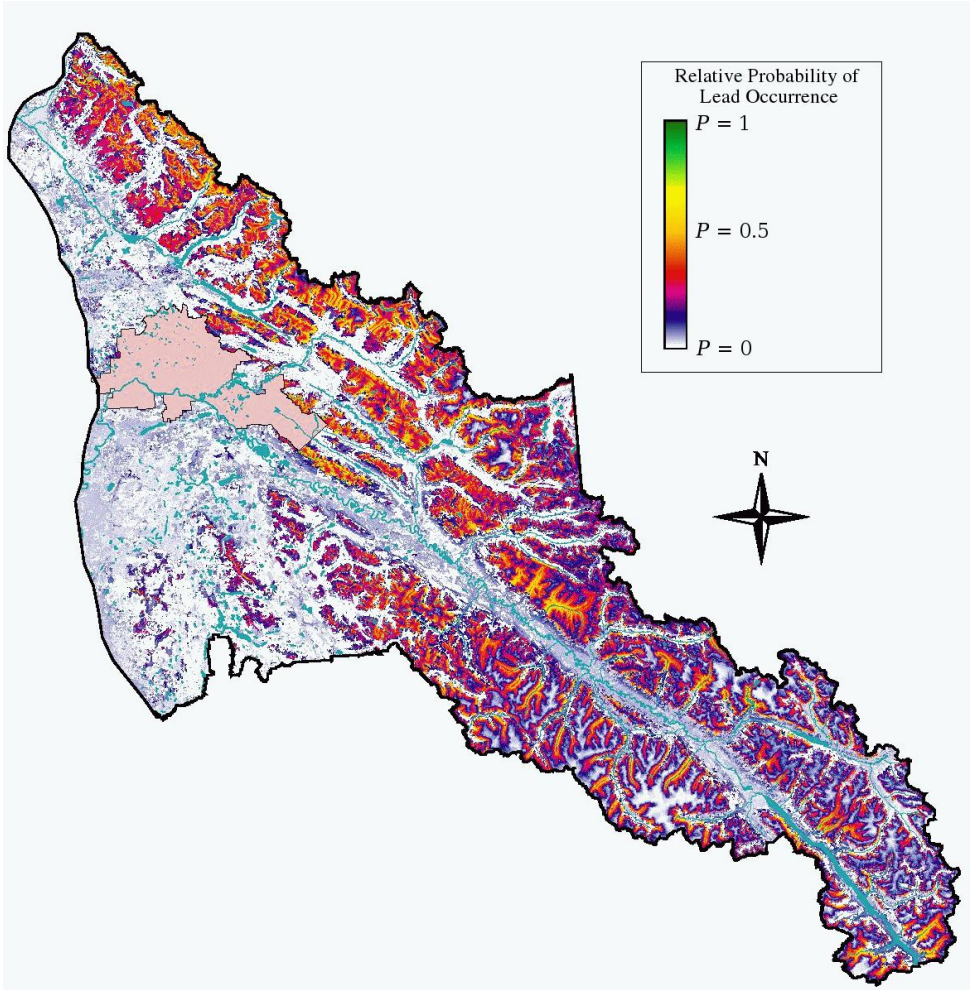
Questions for Lead Experts

- How far can lead travel from car exhaust?
- Are the different isotopes of lead found in paint and car exhaust?
- Are there different elements or compounds that associate with lead depending upon the source?
- Is there any naturally occurring lead in soil?

Spatial Logistic Model

- Create several different spatial covariates
  - Using ArcGIS or R, create circular buffers of various scales around each sample
  - Then calculate:
    - Distance to nearest road & distance to home with lead paint
    - Proportion of buffer that is road & proportion of buffer that has homes with lead paint
    - Proportion of buffer that is water
    - Other covariates that are of interest
- Assume that lead is either present (1) or absent (0), run a logistic regression & create a spatial map (like a resource selection function)
- See if the covariates associated with roads or homes are significant
- Could control for spatial autocorrelation

Resource Selection Function



Chi-Square Test

- After randomly selecting a site, measure occurrence of lead at an arbitrary series of distance from roads & houses with lead paint
- If the lead is from the roads then lead concentration should decrease as you move away from the roads (similarly for houses with lead paint)
- Use a Chi-Square test to test for this association
- Could be confounded with distance to other roads & distance to houses with lead paint