Screening for Lead Poisoning
A Geo-spatial Approach to Determine Testing of Children in At-risk Neighborhoods
City of Atlanta 2005

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Objective

To assess lead testing of children at high risk for lead poisoning in the City of Atlanta
Georgia Lead Testing Guidelines

- Risk should be verbally assessed for all children at 12 and 24 months of age.
- Georgia children who should be tested:
  - their verbal assessment indicates risk
  - Medicaid/PeachCare for Kids/WIC eligible
  - reside in homes built before 1978
  - adopted from outside the United States
  - parents may be exposed to lead at work
Focus on Neighborhood

- Risk for lead poisoning varies geographically
- Smaller geographic unit more accurate to assess risk
- Neighborhoods seem an ideal geographic resolution for assessing testing
  - Residents/physicians can easily identify their location by neighborhoods
- Amenable to outreach and interventions
Methods

Lead testing & WIC data (2005)
1. De-duplication of addresses
2. Geocoding

Residential land tax parcel data (2002)
1. Selecting parcels with year structure built
2. Single and multi-family residential parcels

Population data from census (2000)
1. Area-weighted analysis by block groups
2. Children ≤ 3 years

Aggregation

Neighborhood level dataset for analysis
Methods: Neighborhood Risk

- Created priority testing indices
  - To characterize risk by neighborhoods
  - Based on risk factors:
    - % of Pre-1978 housing
    - % of Pre-1950 housing
    - % of WIC children
  - Divided risk factors into quantile groups
  - Developed a scoring scheme to assign value to different quantile ranges of the risk factors
For each neighborhood...

\[ \text{Combined risk} = \text{Housing score (Pre 1978 or Pre1950)} + \text{WIC score (WIC)} \]

Priority Testing Index
Priority Testing Index

• Priority testing indices categorized
  – Low, Low-Medium, Medium, High-Medium, High

• Calculated two priority testing indices
  — Pre 1978 and WIC
  — Pre 1950 and WIC

• Enabled us to prioritize neighborhood risk
  – e.g. the identification of 10% of the highest risk neighborhoods
Methods

Lead testing & WIC data
Residential land tax parcel data
Population data from census

Aggregation

Neighborhood level dataset for analysis

Statistical Analysis
Priority testing Index

SPSS/SAS

Visualization in a GIS
ArcGIS
Results

Demographics

- 236 neighborhoods in the city of Atlanta
- 18,627 children aged (0-3) years
Results

• **Testing and WIC**
  - 2,231 children tested for lead in 2005
  - 23 children had BLL ≥ 10 μg/dL
  - 8,229 children aged (0-3) enrolled in WIC

• **Housing**
  - 84,055 residential parcels with year housing built
  - Of these 75,286 (89.6%) parcels were built before 1978
  - 47,142 (53.5%) residential parcels built before 1950
An estimated 39 children live in each neighborhood.

Of the 18,627 children in the City of Atlanta, 2,231 (11.9%) were tested for lead.

Of children tested, 23 (1%) had elevated BLLs.

Overall low testing.
• Pre 1950 housing concentrated in central Atlanta
• Testing does not match housing risk
Results

Percent of Pre 1978 housing by neighborhood

- 0% - 50%
- 51% - 78%
- 79% - 90%
- 91% - 96%
- 97% - 99%
- 100%

Percent of children aged 0-3 tested by neighborhood -- Tests / Total Children (0-3)

- 0%
- 1% - 2%
- 3% - 8%
- 9% - 17%
- 18% - 34%
- 35% - 100%
Results

- Testing increases as percent of WIC children increases
- Housing risk and testing do not follow clear trend
• Low category virtually non-existent
• High priority neighborhoods located in center of the city
Discussion

• In general, testing reflects the numbers of WIC children and not housing risk
• Creating priority testing indices was an approach to characterize neighborhood risk
• Combining risk factors can improve risk assessment and ultimately testing
Discussion

• Dissemination of information about high risk neighborhoods can be accomplished by community-based organization

• Maps can help communities and providers identify children living in high risk neighborhoods.

• Maps can be generated for specific clinic/hospital service areas on neighborhood risk

• Primary prevention strategies are key for achieving the 2010 goal of eliminating childhood lead poisoning
Strengths and Limitations

• **Strengths**
  – Use of tax parcel data enables accurate assessment of housing risk
  – Smaller geographic units recognized by residents, such as neighborhoods, are better suited for outreach

• **Limitations**
  – Datasets used in our analyses used data covering different times
Next Steps

- Assess testing among children enrolled in Medicaid
- Translate methods of this study into a statewide effort
Conclusion

There is a need to increase testing of children living in old housing and in poor families.
Thank you!!

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Back-up Slides
Methods: Datasets

• Childhood blood lead, 2005
  – Aggregated, de-identified information by neighborhoods
    • number of children tested for lead
    • number of children with elevated BLLs for children ≤ 3 years of age

• WIC, 2005
  – WIC data used as proxy for poverty
  – Aggregated, de-identified information by neighborhoods
    • number of children ≤ 3 years of age enrolled in WIC

• Population, 2000
  – Number of children ≤ 3 years of age from US Census
Methods: Datasets (continued)

• Residential land parcel data
  – Can have one or more housing units depending on type of property
  – Provided by Center for GIS, Georgia Tech.
  – Includes structure construction date, appraised value, land use information etc.
## Scoring Scheme for Priority Testing Index

<table>
<thead>
<tr>
<th>Percent of Neighborhoods with Risk Factors</th>
<th>Percentile Groups</th>
<th>Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-1978 housing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-50 %</td>
<td>0-10&lt;sup&gt;th&lt;/sup&gt;</td>
<td>1</td>
</tr>
<tr>
<td>51-90 %</td>
<td>11&lt;sup&gt;th&lt;/sup&gt;-50&lt;sup&gt;th&lt;/sup&gt;</td>
<td>2</td>
</tr>
<tr>
<td>91-99 %</td>
<td>51&lt;sup&gt;th&lt;/sup&gt;-90&lt;sup&gt;th&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>100 %</td>
<td>91&lt;sup&gt;th&lt;/sup&gt;-100&lt;sup&gt;th&lt;/sup&gt;</td>
<td>4</td>
</tr>
<tr>
<td>Pre-1950 housing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-30 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31-83 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>84-100 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children in WIC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-35 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-100 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Scoring Scheme for Priority Testing Index

<table>
<thead>
<tr>
<th>Score</th>
<th>Quantile</th>
<th>Pre-1978 housing %</th>
<th>Pre-1950 housing %</th>
<th>WIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0&lt;sup&gt;th&lt;/sup&gt; -10&lt;sup&gt;th&lt;/sup&gt;</td>
<td>0-50%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>2</td>
<td>11&lt;sup&gt;th&lt;/sup&gt; -25&lt;sup&gt;th&lt;/sup&gt;</td>
<td>51-78%</td>
<td>1-6%</td>
<td>1-5%</td>
</tr>
<tr>
<td>3</td>
<td>26&lt;sup&gt;th&lt;/sup&gt; -50&lt;sup&gt;th&lt;/sup&gt;</td>
<td>79 - 90%</td>
<td>7 - 30%</td>
<td>6 - 35%</td>
</tr>
<tr>
<td>4</td>
<td>51&lt;sup&gt;st&lt;/sup&gt; -90&lt;sup&gt;th&lt;/sup&gt;</td>
<td>91-99%</td>
<td>31-83%</td>
<td>36-100%</td>
</tr>
<tr>
<td>5</td>
<td>76&lt;sup&gt;th&lt;/sup&gt; -90&lt;sup&gt;th&lt;/sup&gt;</td>
<td>97 - 99%</td>
<td>73 - 83%</td>
<td>68 - 100%</td>
</tr>
<tr>
<td>6</td>
<td>91&lt;sup&gt;st&lt;/sup&gt; -100&lt;sup&gt;th&lt;/sup&gt;</td>
<td>100%</td>
<td>84-100%</td>
<td>100+%*</td>
</tr>
</tbody>
</table>
Fact Sheet: Bedford Pine Neighborhood

Lead screening
Number of screens in 2005: 73
Cases with elevated Blood lead level (BLL >= 10 ug/dL): 1
Blood lead screening rate: 30.41%

Demographic and Housing Information
# of children aged (0-3) years: 172
# of children enrolled in
Women Infant and Children (WIC): 133
Size of neighborhood: 0.4 sq. mile
Total # of residential parcels: 187
# of Pre 1978 residential parcels: 133

Community information
Organizations:
1. Atlanta Downtown Neighborhood Assoc.
2. Central Atlanta Neighbors
# of Pediatricians: 2
# of Family Practioners: 1
Processing housing data

- Append parcel databases
Why Housing data?

• Housing value
  – Condition of the house tied to housing value
  – Identifying neighborhoods with substandard housing
Why Housing data?

• Identify year of construction of a house
  – Proxy for presence of lead paint
  – Pre 1950 houses had high levels for lead
  – 1978 lead in paint was banned

• Housing value
Housing data from US Census

- Census data resolution
  - Blocks → Blockgroups → Tracts → City → County → State

- Available housing attributes
  - Total housing units
  - Occupancy (renter/owner)
  - Median year structure was built
  - Age of housing: dis-aggregated by every ten years, e.g., Built 1940-1949, Built 1939 or earlier
Housing data from US Census

Limitations

• Housing data by blocks do not have all the afore-mentioned attributes
• Converting housing data from a census resolution to other non-census geographies involves some approximation
• Census boundaries are not easily recognized by residents
Tax Parcel Data

- Tax parcel is a unit of land
- Collected to assess the value and improvement on the land
- Information available from CAMA files
  - Computer Aided Mass Appraisal
  - Electronically available
- Usually, data available from the County tax assessor’s office
Tabular data

CAMA files

Spatial data

County Survey Records

GIS Visualization
Tax Parcel Data

• Information available on
  – Age of construction of the structure
  – Year structure was remodeled
  – Land use code, e.g., residential, commercial, etc
  – # of housing units per residential parcel
  – Built-up area
  – Improvement value of the house
  – Assessed grade of the house e.g., A- excellent condition; F- poor condition
Assessing housing risk

Select residential parcels

Multiply by # of housing units / parcel

Year built < 1978

Yes

Remodeled recently (2002-2006)

Yes

Housing risk present

No

Remodeled between 1978 and 2001

No

Remodeled recently (2002-2006)

Yes

No housing risk

No

Check for condition of housing
Assessing housing risk

Two ways to assess condition of housing

Option 1

Housing risk present

Calculate Improvement value/sq.ft for all housing units

From distribution, select a cut-off value. Say median, 25th percentile, etc

Improvement value/sq.ft of a house < cut-off

Yes

No

Housing in good condition

Substandard Housing

Option 2

Housing risk present

Obtain Grade Value for the house

A: excellent condition
B, C: good condition
D, E, E: poor condition

Yes

Grade Value = D, E, F

No

Housing in good condition
GIS methods

Parcel layer in a GIS

Creating parcel centroid
Resolution for analysis

• Parcel level
  – Datasets with address information
  – Analyzing individual level data

• Aggregated
  – Resolution: Census or non-traditional geographies like neighborhoods, NPU, etc
  – Ecologic approach
Housing based risk factors

Aggregated level data

• Calculating risk factors for housing
  • % of Pre-1978 residential parcels
    # of parcels with structures built before 1978
    Total # of residential parcels
  • % of Pre-1950 residential parcels
    # of parcels with structures built before 1950
    Total # of residential parcels
• Pre 1950 housing concentrated in central Atlanta
• Testing does not match housing risk
Mapping housing risk

Other approaches: Spatial interpolation
- Housing risk and testing do not follow clear trend
Discussion

Utility of Tax parcel data

• Improving geocoding of addresses
• Disaggregated age of housing data suited for advanced techniques
  – Spatial interpolation of housing risk
  – Bayesian techniques
• Information on condition of housing
  – Stratifying housing risk by condition of housing important for targeted testing
Assessment of parcel data in the US

- Federal Geographic Data Committee
  - Cadastral survey sub-committee
  - Assessing status of parcel conversion to a GIS format in the US
- Some states have a centralized parcel management program
- Counties primarily responsible for collecting and managing parcel data
Assessment of parcel data in the US

• 144.3 million parcels in the US
• 68% of parcels converted into GIS format
• Counties with population over 150,000 have GIS parcel layer
• Parcel conversion to GIS is taking place rapidly in urban areas
Limitations

• Lack of metadata
• Issues with projection and datum conflict
• No standard naming convention for fields in the tax assessors database across US
• Not available from all counties, especially in rural areas
Discussion

• Testing does not reflect housing risk
• Maps can help communities and providers identify children living in high risk neighborhoods
• Primary prevention strategies are key for achieving the 2010 goal of eliminating childhood lead poisoning
Strengths and Limitations

• Strengths
  – Use of tax parcel data enables accurate assessment of housing risk
  – Smaller geographic units recognized by residents, such as neighborhoods, are better suited for outreach

• Limitations
  – Datasets used in our analyses had data covering different times
Conclusion

Housing based primary prevention important for childhood lead poisoning prevention and accessing residential tax parcel data when available will improve housing risk assessment.
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