

ASTHO 2015 State-to-State Peer Fellowship Program

Indiana Lead Risks Maps
Environmental Public Health Tracking
ASTHO Fellowship Report

Submitted by

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Introduction

The Centers for Disease Control and Prevention (CDC) National Environmental Public Health Tracking Network (EPHTN) is “a web-based surveillance system that involves the ongoing collection, integration, analysis, and interpretation of environmental hazards and exposure data with data on health illnesses possibly linked to the environment.”

Since its launch, EPHTN has allowed state, local and federal agencies to rapidly detect emerging public health threats, implement and evaluate the efficacy of control strategies, and develop actions that improve public health. Currently, the CDC funds an EPHTN in 25 states and one city. Indiana is not one of the funded states.

In 2009, the Association for State and Territorial Health Officials (ASTHO), in collaboration with the CDC, launched its Environmental Public Health Tracking: State-to-State Peer Fellowship Program to provide guidance and capacity of non-grantee states and territories by providing opportunities to:

- Develop a pilot project that would advance EPHT in their states.
- Gain first-hand tracking experience from CDC state grantee mentors.
- Improve communication and collaboration between funded and non-funded states.

In 2015, the Indiana State Department of Health (ISDH)’s Environmental Epidemiologist was accepted into ASTHO’s 2015 Environmental Public Health Tracking: State-to-State Fellowship Program. The State of Maine selected Indiana for the fellowship project, based on commonalities between the two programs and Indiana’s effort to create lead risks maps. The site visit with the host state took place in May 2016.

The pilot project by Indiana created lead risk maps developed through ArcMap 10.3.1 software. The maps will be used to target outreach and education of the Indiana Lead & Healthy Homes Program. The maps will identify high-lead-risk areas by mapping contributing factors of lead poisoning, specifically older housing (homes built before 1960), and poverty data from the 2010 Census data mapped at the Census Tract Level.

Report on Tracking Activities

I. Host-state visit, May 16-18, 2016

The May 16-18 visit to the Maine Centers for Disease Control and Prevention, in Augusta, Maine, allowed the ASTHO fellow to participate in a Maine Environmental Public Health Tracking (EPHT) meeting and additional program meetings. These additional meetings provide support to the fellow’s program in their home state through discussions on methodologies, data uploading, and the grant application process.



Figure 1: Site Visit in Augusta, Maine

A tour of the Environmental Section at the Maine CDC, along with staff introductions, initiated the tracking-site visit. Immediately following the tour and introductions, the tracking meeting began. The tracking meeting jumped into discussions about preparations for the launch of their new blood-lead surveillance at 5µg/dL and above.

Blood lead surveillance at the 5-9 µg/dL level is presented as both estimated lead results and confirmed results in the lead tracking maps for Maine. This is one of the obstacles that Indiana faces regarding lead surveillance. According to the Indiana State Rules, retesting and case management is provided for results of $\geq 10\mu\text{g/dL}$. For some counties that may have the resources, they may provide case management at 5-9 µg/dL. This is not the case for most counties in Indiana (there are 92 counties in Indiana) and confirmatory testing at 5-9 is not routine. In order to develop an understanding of potential lead exposures and risks, Indiana derives the lead poisoning estimates from unconfirmed testing at $\geq 5\mu\text{g/dL}$.

Important Lessons from Tracking Meeting. Maine's Tracking Network Data Portal encompasses environmental health topics such as; lead poisoning, carbon monoxide, and Lyme disease (which encompasses their most frequent site visits). The Lead Poisoning page offers displays in the format of tables, charts, trend charts, and maps. There is also an introduction and an "about the data" section. The data viewer can display the data using many customizations of the different indicators (lead poisoning, screening, and risk factors). These customizations include geographical boundaries based on public health districts, counties, and townships, how to measure the data (as a percent or number), the year, age of children, and the data scale. Most importantly, the maps offer a side-by-side view for comparisons. For example, data viewers can visualize lead poisoning as compared to the older housing in Maine. This is especially beneficial to program managers, public health partners, internal partners, and other staff. This data will be able to reach outside of the usual epidemiologists working on the data to explore new hypotheses or confirm old ones.

The importance of the Tracking Network for the State of Maine includes the highly skilled staffing and team environment. All staff involved in the tracking network, have the skills to appropriately review one another's work and review the content to be published to the public. This includes reviewing how the data is displayed, the accuracy of the data, and wording of the content to be published on the website. Interestingly, to examine the lead screening rates among children in Maine, the state uses a denominator based on birth cohort figures from Vital Records. This is something that the State of Indiana would like to look into. Lead results for the state of Maine are all reported to their state laboratory, which assists with processing lead results.

One of the biggest goals of the tracking network, specifically related to the lead mapping, is to provide local partners with the data they need and to ultimately guide public health actions. To assist with this process of using the data and working with local health partners, Maine holds portal trainings and focus groups to get feedback about their partners' needs and concerns. Their partners can then impact public health through change, increasing awareness, or by removing lead exposures.

Comparing lead programs: The greatest opportunity from the fellowship meeting is to understand the differences and similarities in the two states' lead programs, and to identify methods used by Maine that can be adapted to Indiana to assist with improving certain processes, methodology, and creating impactful maps and outreach to initiate public health actions.

State Lead Programs. Some of the outstanding differences of Maine and Indiana are the geographic size, population size, funding sources, public health authority, and degree of confirmatory testing. According to the Census Estimate for 2015, Indiana's population is about 6.6 million people within 92 counties throughout Indiana, including Marion County (Indianapolis) with 14 percent of the state population. Indiana is a home rule state, where the local health departments (93) have the public health authority. For the lead program, the county health departments have the primary responsibility of lead testing, lead case management, and lead risk assessments. However, if the local health department needs assistance, the State Health Department can provide assistance for some of those services. Additionally, Medicaid children are required to be screened for lead poisoning. According to Indiana State Rules, confirmatory testing is initiated at a lead level of $\geq 10\mu\text{g/dL}$. Additionally, ISDH recommends local health departments do confirmatory testing at $\geq 5\mu\text{g/dL}$. Confirmatory testing at 5-9 $\mu\text{g/dL}$ varies by county. Therefore, for surveillance purposes and to understand lead poisoning we use both initial screenings and confirmed cases in our lead surveillance reporting and targeting.

When comparing Maine to Indiana, the population size is smaller, with 1.3 million people in Maine, according to the 2015 Census Estimate. The state is divided into eight public health districts without county health departments. The state relies heavily on local partners and organizations to assist with outreach, education, and lead removal initiatives. With the detailed information on locations of lead poisoning, they are able to effectively remediate and remove lead hazards to prevent future lead poisonings.

Interestingly, the State of Maine was able to pass legislation to obtain a portion of the sales from 1 gallon paint purchases to use for their lead program. This funding has assisted the state with reaching and targeting vulnerable populations to lead hazards. With funded outreach in vulnerable/susceptible areas, the advance methodology for reporting, and



¹
Figure 2: Indiana County Map

advanced visualizations on the tracking network, combined with focus groups and feedback from local partners, their efforts in the high-risk areas have made these areas match the lead poisoning rates with the other Maine public health districts. This is a substantial lead program/tracking network success story. This further supports the mapping and targeting of high-risk/ high-lead poisoning areas to make substantial differences in lead poisoning program efforts in Indiana.

In Indiana, some Indiana County Lead Programs have substantially decreased resources to test children or never had the capacity. ISDH hopes to increase testing in those counties to understand the true lead poisoning rates and potential exposures. The lead poisoning rates for the census tracts used in targeting for outreach and education help provide more information to counties with limited resources, to both allocate resources effectively and to tests areas that were not being tested historically. The lead poisoning data is also added to the maps as another variable to understand the relationship between older housing and poverty to childhood lead poisoning.

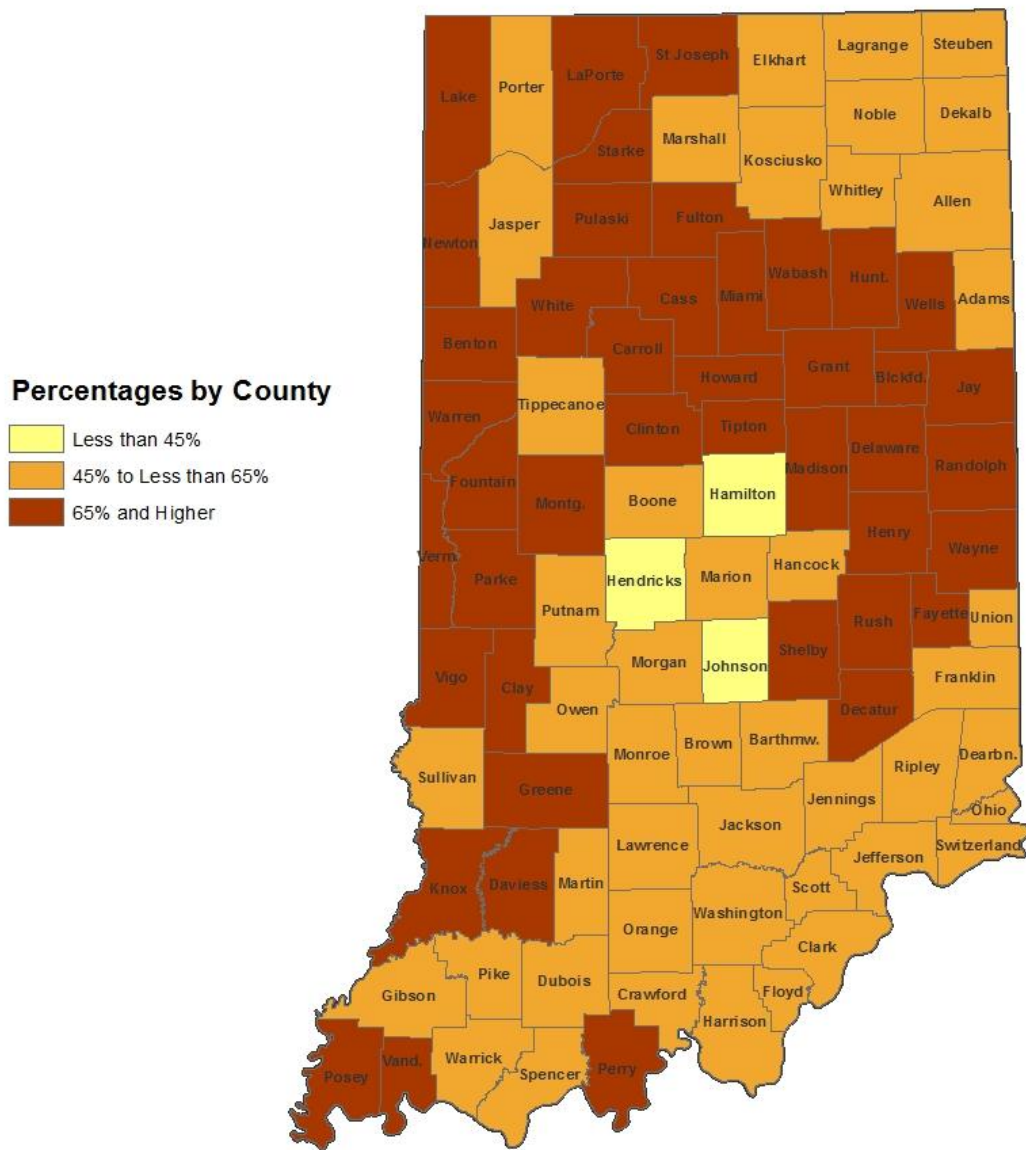
Lastly, the Environmental Public Health Tracking Network has been able to develop formal procedures/guidelines for submitting and presenting data on various health topics such as carbon monoxide, water quality, and lead poisoning. These guidelines and procedures will assist in dealing with the large datasets from the lead testing data, offering new denominators to display screening rates and differences in lead poisoning estimates with unconfirmed data. These methodology documents will be used in the future to submit data to the Tracking Network. Indiana plans to build the capacity to submit and use the data to consistently report to the National Tracking Network.

II. Fellowship Project- **Targeting High Risk Areas for Childhood Lead Poisoning Maps**

The fellowship project selected by Indiana is the development of maps to support the Indiana State Department of Health's (ISDH) Lead & Healthy Homes Program to target high-risk areas for childhood lead poisoning. The variables selected for this project to be represented in the maps are older housing and childhood poverty based on previous ISDH projects and established risk factors by the Centers for Disease Control & Prevention (CDC).

Background. In 2014, the older housing map was created for the Indiana Lead Program and includes the percentage of homes built pre-1980 (lead-based paint ban in 1978) by county. This data was helpful in determining the relationship between the percentage of older housing in a county and the lead poisoning rates for a county. However, with the current project, the analysis can go further with the census tract data. By narrowing our boundaries to the census tract level,

Indiana Housing Built Before 1980 by County (Census 2010)



Environmental Public Health Division 3.14.16

6 **Figure 3: Previous Older Housing Map for Indiana created for the Indiana Lead & Healthy Home Program**

county health departments can target specific areas of the county, to increase screening and outreach.

Methods and Data. Using data from the Census.gov resource, specifically “Housing Census American Community Survey 2013 5-Year Estimatesⁱ”, it lists the number of homes built during certain decades. First, due to housing’s significant impact on lead, housing maps were developed for pre-1940s housing and housing built from 1940s-1960s. Selection of the year ranges are based on EPA’s percentage for the likelihood of homes having lead in themⁱⁱ.

An additional risk factor for childhood lead poisoning is living in poverty, which is measured by childhood poverty status. Poverty, according to the Census Bureau, is a set of money income thresholds that vary by family size and composition to determine who is in poverty. If a family’s total income is less than a family’s threshold, then that family and every individual is considered in poverty.ⁱⁱⁱ This data is also collected from the American Community Survey 2014 5-year Poverty Status by Age. Using the Census estimates for childhood poverty for children ages 6 and under, we created a map for displaying poverty percentages at the census tract level. Using the census tract poverty data and the census tract older housing data, the map represents multiple lead risks and therefore would identify census tracts that are the most vulnerable in the state to lead poisoning from those risk factors.

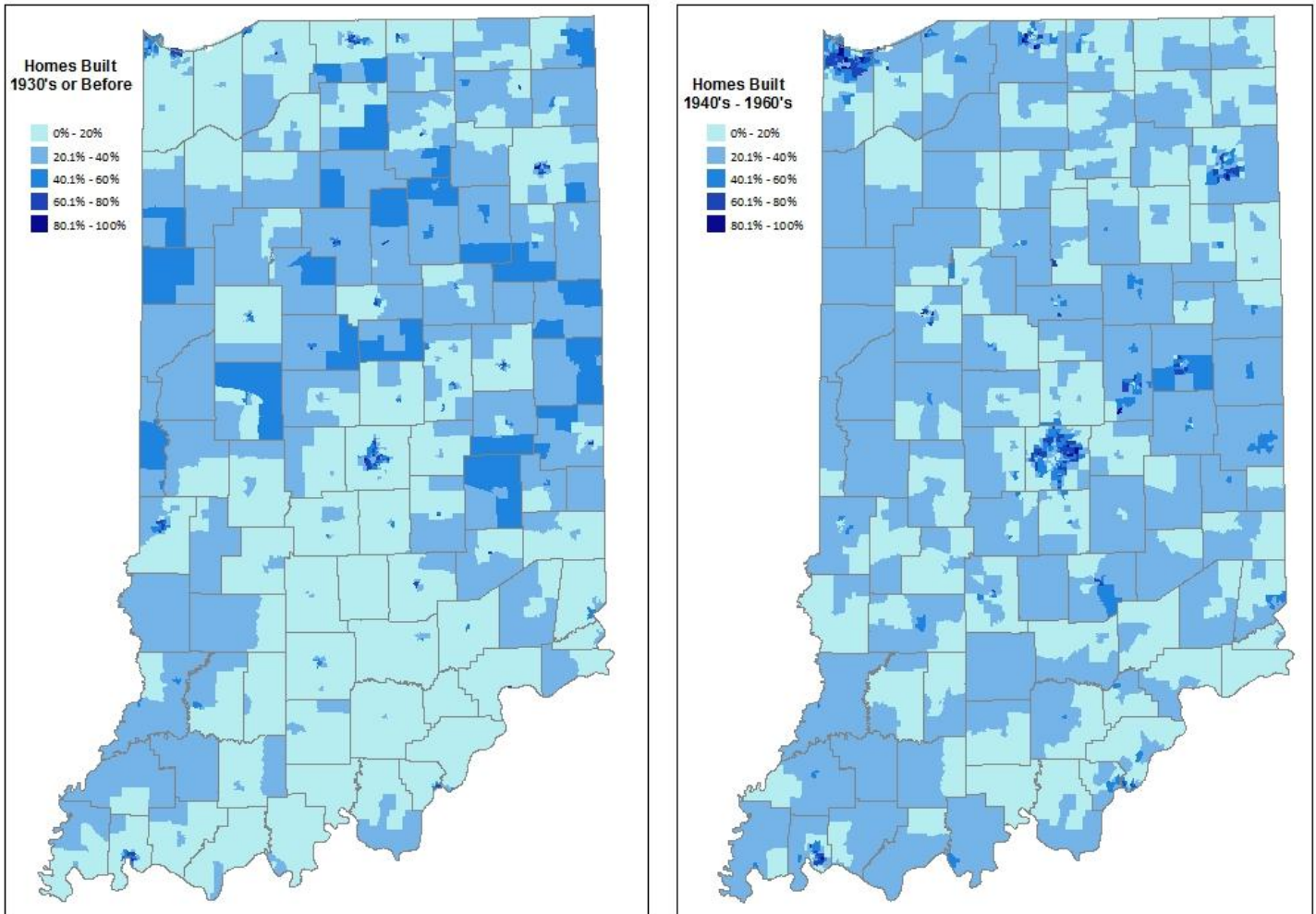
Various phases of the map are created/will be created to capture other contributing factors of high- and low-lead poisoning rates such as lack of testing, weighting of certain risks from geoprocessing analyses, and ranking the top elevated lead result ($\geq 5\mu\text{g/dL}$) percentages within the census tracts to set these areas for top priority targeting. The maps for this specific project will assist with understanding areas where there has not been much testing historically but there is a high risk due to the lead poisoning risk factors. When adding the lead poisoning data to the map, we can actually determine a relationship between lead poisoning and lead risks. Lead results from 2005-2015 are added as an additional piece to confirm the relationship between older housing and poverty to lead poisoning. The data in the maps include 1,507 census tracts for Indiana and 509,917 address points for geocoded and matched lead results ($\geq 0\mu\text{g/dL}$) for Indiana from 2005-2015. Some of the geocoded and matched results may be only a zip code point that falls within the 1,507 census tracts used for census tract analysis.

Lead results from 2005-2015 are processed and deduplicated every year for the annual report. The lead results used are the currently available deduplicated lead data from the Lead Data Flow system for the Lead & Healthy Homes Program.

The lead poisoning rates will not be too heavily relied on, due to lack of testing in some high-risk areas. With over 62 percent of Indiana’s housing being built before 1980 (1978 lead-based paint ban) more than half of Indiana’s homes could pose a lead risk. Drilling down to the Census Tract level can provide the Indiana Lead & Healthy Homes Program with more specific areas for targeting outreach efforts for testing, local health department education, and educational materials for the physicians’ offices and the public.

Figure 4: Current Older Housing Census Tract Level Map from the ASTHO Project 2016

Indiana Lead Risks Housing Map, 2010 Census Estimates

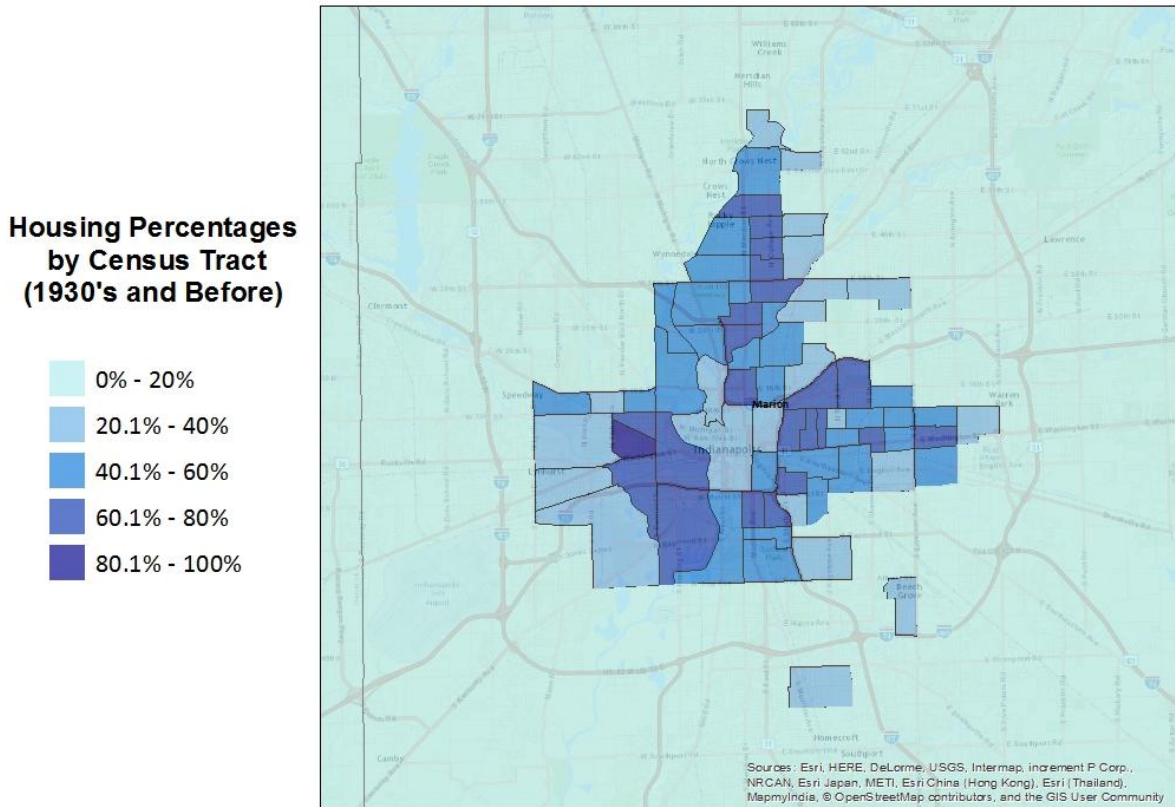


Mapping Results. The level of detail in the Census maps allow us, with limited resources, to educate and target the most at risk areas for childhood lead poisoning. We can provide direction to local health departments that have limited staffing or funds to screen and educate children in their counties. Visually at the state level, these maps don't offer much detail, but when working within ArcGIS, the maps can be manipulated to zoom in and zoom out.

For example, at the county level, the maps provide more detail than the statewide map. Marion County (Figure 5) is the location of Indianapolis, which has the largest population of Hoosier residents in the state. Within this large county, we can identify one census tract with the highest percentage of older housing (1930s and before) and about 20 census tracts with the second highest tier of older housing.

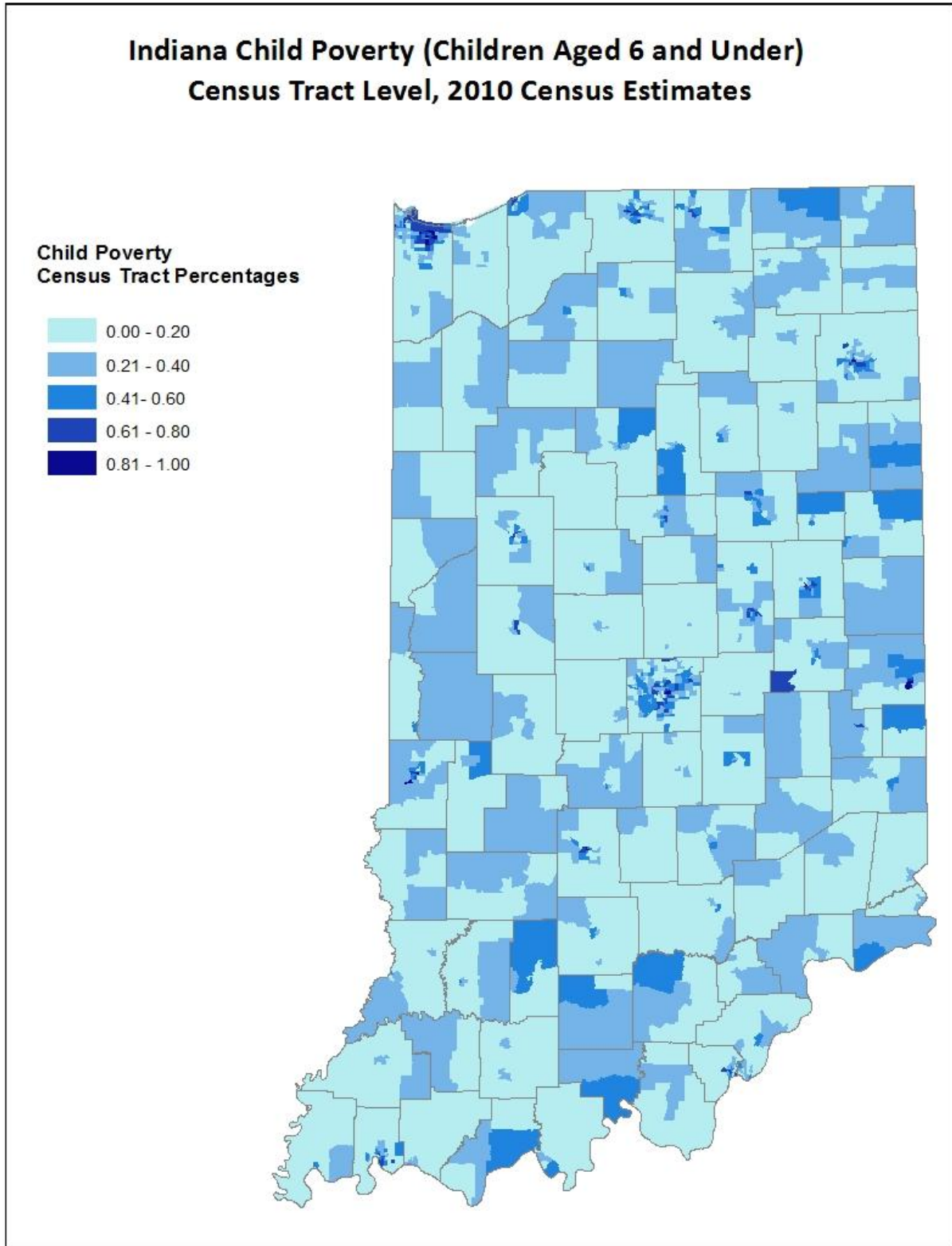
Figure 5: Marion County, Indiana Current Older Housing Map from ASTHO 2016 Project

Lead Housing Risks, Homes Built 1930's and Before (Marion County, Indiana)



In Indiana, with 92 counties, it would be difficult to predict poverty status of a child with county data only. Census tract poverty data enhances the ability to estimate risk factors for children living in census tracts within a community. This is especially important for physicians to understand in order to screen at risk children for lead poisoning. Using census estimates for childhood poverty, Figure 6 provides five increments of poverty percentages, with the darkest color blue indicating the highest percentage of childhood poverty within a census tract. With a county level map of the census tracts, further information can be collected for certain susceptible areas.

Figure 6: Statewide Census Tract Level Poverty Map from the ASTHO 2016 Project

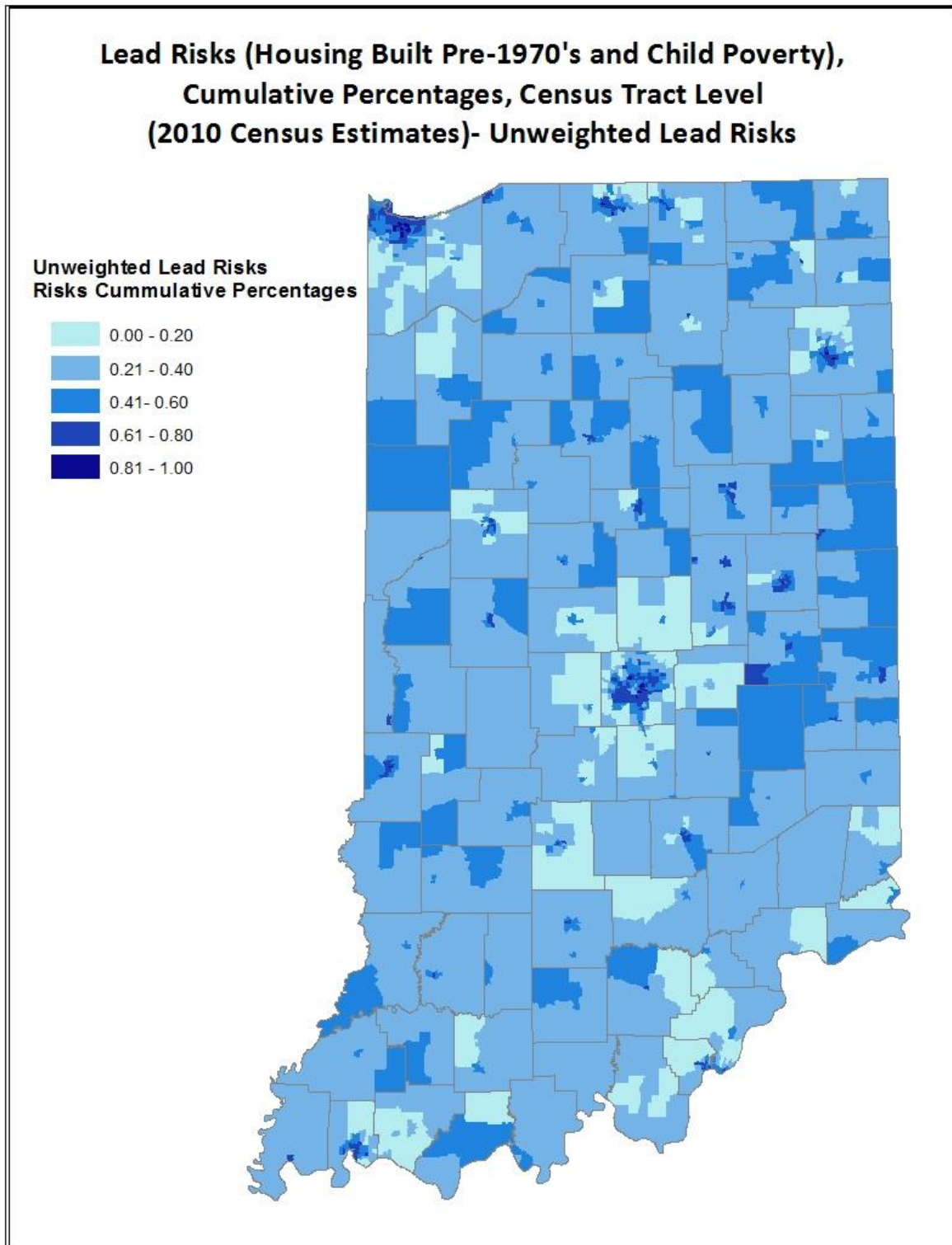


Combining the percentages at the census tract level for both child poverty and older housing gives a combined percentage for examining multiples risks (Figure 7).

Childhood Poverty + Older Housing Pre-1970s = Combined Percentage for Lead Risks

A risks-only map should be considered in order to target outreach and education to these especially susceptible geographic areas that may not have childhood-lead testing. This map is useful in that it can display areas with many risks, without much lead testing. It is anticipated that many of the high-risk areas may not have been tested in before, and through targeting efforts for screening, newly identified lead poisoned children may emerge. The development of county maps with census tract level data will be useful for assessing risks by physicians and nurses for their communities. For example, it is the federal requirement to test children at certain age periods, and then to test based on risks determined by the physician. Physicians may not have previously had time to research the risks for lead poisoning and this can be another tool supplied by Indiana State Department of Health.

Figure 7: Multiple Risks Map, Older Housing and Child Poverty, Census Tract Level-Unweighted Map, ASTHO Project 2016



Additionally, to conduct further analyses to understand how the lead testing results compare to the lead risks, the last map was created to display weighted lead risks. Lead testing data is used to represent a possible lead exposure geographically. Using initial elevated lead tests (results $\geq 4.5\mu\text{g/dL}$) weights can be added to the risks data based on statistical calculations comparing the relationship between older housing and childhood poverty to childhood lead poisoning at the census tract level. The elevated lead results used in the mapping are only children with an address provided, which is used in the geocoding processes of ArcGIS.

Comparatively, the lead poisoning data is added to the combined risk percentage of older housing and child poverty to understand the impact of these risks on childhood lead poisoning in Indiana. Therefore, we are adding a weight determined by the relationship between child poverty, older housing (pre-1940's housing), older housing (1940s-1960s), and childhood lead poisoning data. Another variable was also added (pre-1940s housing) based on the analyses of these factors with lead poisoning data. The weighted risks map helps us further determine how much certain lead risk factors may influence childhood lead poisoning. The largest weight is due to housing built pre-1940's, which matches the EPA housing with lead risks diagram mentioned previously in the methods section. This helps us control for certain factors such as census tracts that have a high percentage of poverty with newer housing, where we may not find lead. However, the weighted map should not be the only tool used due to low testing in many areas in Indiana.

Childhood Poverty (Given Weight) + Older Housing 1940s-1960s (Given Weight) + Older Housing Pre-1940s (Given Weight) = Weighted Combined Percentage for Lead Risks

Figure 8 helps the Lead & Healthy Homes Program understand the impact of the risk factors; older housing and poverty on childhood lead poisoning in the state. It helps us measure particular risk factors, to be able to target even narrower populations such as those census tracts with a high percentage of housing pre-1940s.

**Lead Risks (Housing Built 1940's-1960's,
Housing Built Pre-1940's, Child Poverty),
Cumulative Percentages, Census Tract Level
(2010 Census Estimates)- Weighted Lead Risks**

**Weighted Lead Risks
Risks Cummulative Percentages**

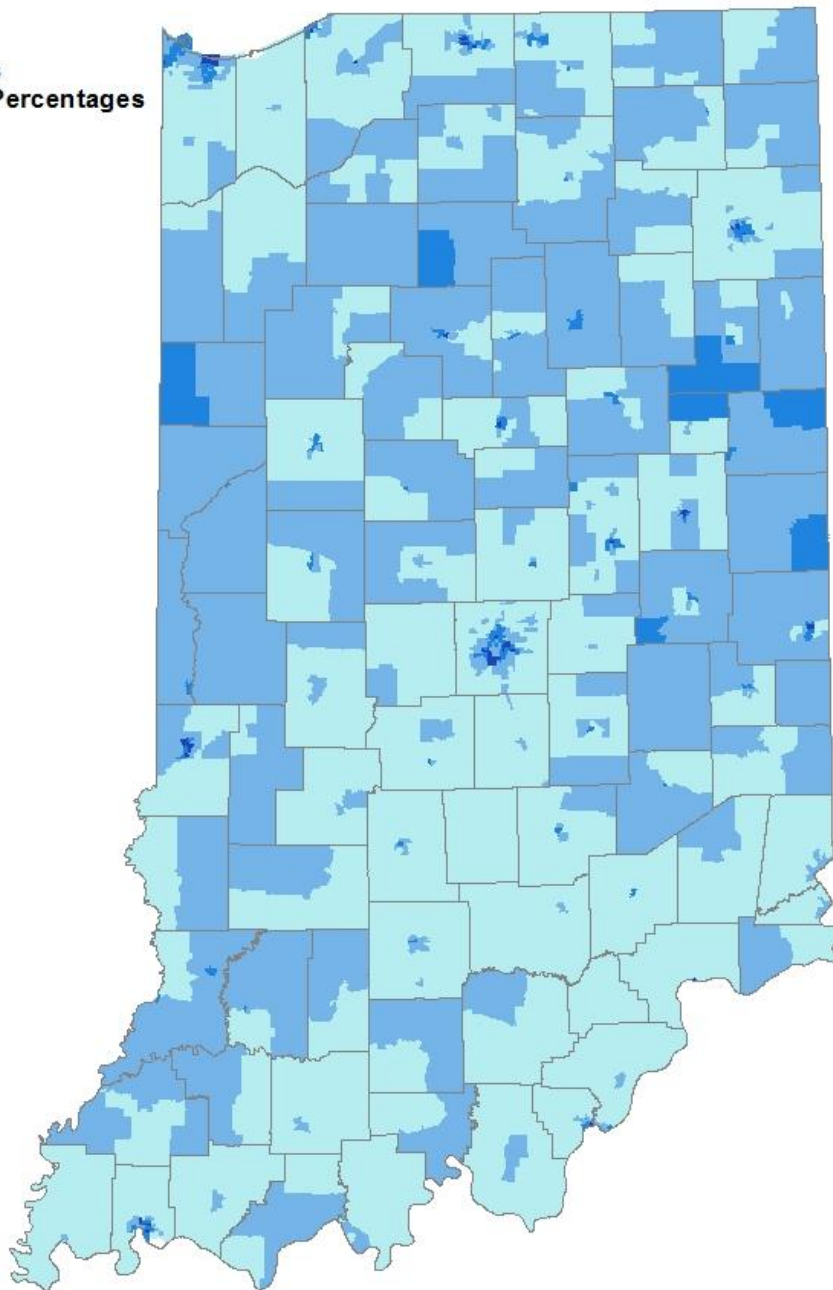
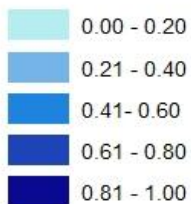


Figure 8: Multiple Risks Map, Older Housing and Child Poverty, Census Tract Level-Weighted Map, ASTHO Project 2016

Weights given from running the r^2 for the three risk variables supplies the following equation:

$$\text{Childhood Poverty (.271535)} + \text{Older Housing 1940s-1960s (.009345)} + \text{Older Housing Pre-1940s (.492697)} = \text{Weighted Combined Percentage for Lead Risks per Census Tract}$$

Another result from the analyses not included in this map that demonstrates a large weight when compared to the lead poisoning data is the distance (square mileage) between lead poisoned children. The hypothesis for this result is siblings, temporary housing, urban settlement in Indiana, testing locations, and unmitigated housing can all be potential confounding factors. Further analyses will be conducted to understand this.

Follow up Actions. County maps will be created for the county health departments upon request and as an educational piece with the county health department lead trainings. It is anticipated that screenings and lead poisoning rates will increase in the high-risk areas for childhood lead for 2016-2017 with the use of these maps. Assumably, with targeted screenings in high-risk areas, the data would change statewide to seem like the lead poisoning rate in Indiana is increasing. However, in the next decade, the lead poisoning rates would be anticipated to decrease by the increased screening and education within those high-risk areas.

Also using the census tract data available in this map will be very valuable for determining lead exposures in Indiana. Other factors will be added and analyzed in the map. Census tracts with the largest percentage of lead poisoning children will be contacted to understand the situation within the identified census tracts. This should be a valuable tool for local health departments and partners working on lead issues.

Conclusions. The information provided in these maps will be very valuable for investigations, outreach and education, public health actions, screenings, and much more. With the guidelines provided by Maine's Tracking Network and the CDC Tracking Network, demonstrations and discussions from the site visits and webinars, and as funding becomes available, Indiana State Department of Health, Environmental Public Health Division will be well-prepared to submit, analyze, and understand what is expected when applying for Tracking Network funding. Until the funding becomes available, the Lead & Healthy Homes Program plans to proceed in using these maps to understand and investigate childhood lead poisoning in Indiana with additional data, further analyses, and working to provide these to local health departments.

Limitations of the Data and Project:

The data included in this project is address data linked with a lead result. Lead results that do not provide address information could not be used for this project. The data for this project helps the ISDH LHHP target outreach and education in Indiana. Lead testing varies from year to year and therefore 10 years of lead data helps us understand potential lead exposures in certain geographic units. Using preliminary lead results of $\geq 5\mu\text{g/dL}$ assists in capturing more data within a geographic unit. Since confirmed testing is mostly at the $\geq 10\mu\text{g/dL}$ level then potential lead exposures may not be captured if only confirmed cases were used. With the size of the lead testing ($\geq 5\mu\text{g/dL}$) data set and the analyses conducted, the impact of certain variables display associations with the lower unconfirmed lead levels.

Data collected from the Census are census estimates, which population and housing may change over time or may not be provided for certain census tracts and therefore the risk level would be 0. This information is used to help allocate testing and educational resources and additionally to estimate lead risks within particular communities with the data that is available.

Acknowledgments:

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Additional assistance was provided by:

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ⁱCensus.gov <http://www.census.gov/quickfacts/table/PST045215/23>

<http://www.census.gov/topics/income-poverty/poverty/guidance/poverty-measures.html>

ⁱⁱEPA.gov <https://www.epa.gov/lead/protect-your-family-exposures-lead>

ⁱⁱⁱ Census.gov <http://www.census.gov/topics/income-poverty/poverty/guidance/poverty-measures.html>