ENVIRONMENTAL PUBLIC HEALTH TRACKING ASTHO FELLOWSHIP REPORT

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Submitted to

Association of State and Territorial Health Officials
Environmental Public Health Tracking: State-to-State Peer Fellowship Program
2231 Crystal Drive, Suite 450
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June 2013

INTRODUCTION

In 2013, the Tennessee Department of Health's (TDH's) Environmental Epidemiology Program (EEP) participated in the Association of State and Territorial Health Officials' (ASTHO) Environmental Public Health Tracking (EPHT) State-to-State Fellowship Program.

As part of the Communicable and Environmental Diseases & Emergency Preparedness (CEDEP) program, the EEP has been Tennessee's environmental public health response agency since 1982. EEP has investigated many different environmental exposure scenarios and, in response, implemented action plans to protect public health. EEP has provided assistance to the Agency for Toxic Substances and Disease Registry (ATSDR), the Environmental Protection Agency (EPA), our state regulatory agency the Tennessee Department of Environment and Conservation (TDEC), the Tennessee Department of Agriculture (TDA), as well as to concerned citizens, local governments, and legislative officials. EEP maintains a surveillance system as part of the National Toxic Substance Incidents Program (NTSIP). NTSIP records acute chemical releases to develop prevention and outreach activities.

In the past, TDH was awarded a grant from the Centers for Disease Control and Prevention (CDC) to develop a statewide program to target children at risk for lead poisoning. The Tennessee Childhood Lead Poisoning Prevention Program (CLPPP) screens children's blood lead levels and educates parents about the dangers of lead poisoning. TDH's CLPPP provides all the necessary components to meet the Healthy People 2020 objective of eliminating elevated blood lead levels (EBLLs) and reducing the mean blood lead levels (BLLs) in children.

REPORT ON TRACKING ACTIVITIES

I. **Visit Host State from April 23 & 24, 2013**

Over April 22-24, 2013, Dr. Sutapa Mukhopadhyay, the principal investigator (PI) visited the Missouri Department of Health and Senior Services' (MDHSS) well-recognized EPHT program. TDH EEP is extremely grateful to Missouri's (MO's) EPHT program for their hospitality as well as sharing their knowledge and expertise. EEP is also grateful to Ms. Ify Mordi of ASTHO for making the fellowship possible.

Accomplishments
Prior to the visit, TDH EEP reviewed the MO EPHT portal. Tennessee (TN) was very interested in how MO developed and implemented their portal. Dr. Mukhopadhyay spent 2 days in MO with the host state staff. The visit was well planned by the MDHSS Environmental Public Health Tracking Program and Ify Mordi of ASTHO. Roger W. Gibson, MPH, Program Manager of MO EPHT, welcomed the PI and introduced her to other members of the EPHT program staff. All aspects of MO's EPHT Program were shared and discussed. On the first day, Dr. Mukhopadhyay gave an overview of her pilot project. MO EPHT staff and their collaborators presented various topics. On the first day, the following topics were covered by MO EPHT program (Appendix 1):

- MO's lead program
- Lead regulations

- Childhood lead
- Adult lead

The second day covered:
- MO’s web portal demonstration
- Overview of EPHT in MO
- Mapping applications
- Public versus secure portal
- Data structure
- Staffing and organization
- Building partnerships
- Budget
- Plans
- Wrap up Q&A

During the site visit, TDH EEP developed a good working relationship with MO. MO’s EPHT staff explained their online, interactive, and queriable EPHT portal. Dr. Mukhopadhyay learned the strengths of a good EPHT portal as well as some pitfalls to avoid.

Learning Experience
One learning objective for TDH EEP was to study about MO’s EPHT program. A second objective was to learn about MO’s lead poisoning prevention program. Another objective was to get guidance on how to implement TN’s EPHT pilot project. Lessons learned are summarized below:
- The site visit allowed TDH to understand MO’s EPHT network in greater detail.
- Tracking is a partnership program. Data must be acquired from a variety of partners. Building a partnership with the appropriate data stewards is the first step of data acquisition.
- Information technology (IT) is the foundation of tracking. The technical aspects of the portal demonstration, IT infrastructure, and GIS capabilities are imperative to the success of a tracking program.
- Communication is a key component to disseminate information to different audiences such as the general public, academia, and government as well as to guide policy makers and decision makers.

The MO EPHT staff’s knowledge and the materials they shared were outstanding. Their EPHT is well developed and contains a large amount of information. Several times during the visit, challenges and solutions were discussed in context of portal development and data use/sharing. These discussions were of great value. It became evident that different skill sets such as database management, programming, and marketing were all required to bring an EPHT portal online and maintain it.

Application
For TDH EEP, to implementing a complete EPHT portal will be a challenge. TDH is not integrated with its environmental regulatory agency. TDEC monitors the condition of TN’s air, land, and water. Though TDH and TDEC have an excellent working relationship, it will take

time to establish both health and environmental databases. Informal discussions of a future TN EPHT Program have taken place. A lack of funding is a major obstacle to our development of a portal.

TDH EEP will share the information gathered during the host site visit widely. After completing this fellowship, we plan a shift to strategic planning and development. The recruitment of data partners will be a new focus. Dr. Mukhopadhyay plans to initiate the formation of a Tennessee Environmental Public Health Tracking workgroup. This workgroup will consist of representatives from all potential data stewards related to the Nationally Consistent Data and Measures (NCDM).

II. **Small Project**

Project Title: Lead Poisoning and Social Vulnerability Index (SVI) Data in Tennessee

Abstract
Lead poisoning is considered to be one of the most serious environmental threats to children's health. Evidence shows that the most common source of lead exposure for children is lead-based paint in older housing and the contaminated dust and soil it generates. Throughout their early childhood development, it is recommended children be screened for lead exposure risk factors and/or children be tested for lead poisoning. Adolescents and adults are tested as needed if they have risk factors. TN requires that all blood lead level (BLL) tests results be reported to the Department of Health. Several years of reporting has created a good quality dataset of BLLs. Using our LeadTRK database from 2010-2012, we examined early childhood elevated blood lead levels (EBLLs) and correlated that information with housing data and Social Vulnerability Index (SVI) characteristics.

Introduction
Protecting children from exposure to lead is important to lifelong health. Lead can cause neurological changes and developmental delays even at low levels in young children. At high levels, lead can cause coma, convulsions, and even death. There is no "safe" level of lead for children. The harmful health effects of lead cannot be corrected [1].

The most common source of lead exposure for children is lead-based paint in older housing and the contaminated dust and soil it generates. Although all children living in older housing are at risk, statistics show that low-income and minority children are much more likely to be exposed to lead hazards [2]. More than a quarter of the very young children in TN live in poverty [3]. Therefore, eliminating lead-based paint hazards from old and low-income housing is essential if childhood lead poisoning is to be eradicated.

Until recently, CDC had used a test level of 10 or more micrograms lead per deciliter of blood (µg/dL) to identify children with concerning blood lead levels. CDC is now using the reference value to identify children who have been exposed to lead and who require case management. A reference level of 5 µg/dL has now been recommended by CDC to identify children with BLLs that are much higher than most children's levels [1, 4]. At this level, CDC recommends public health action to be initiated.

In the past, BLL tests below 10 µg/dL may, or may not, have been reported to parents. The new reference level (5 µg/dL) means that more children will be identified as having lead exposure. This will allow parents, doctors, public health officials, and communities to focus on primary prevention.

Social vulnerability refers to the socioeconomic and demographic factors that affect a community's resilience [5]. Socially vulnerable people are probably at risk for lead exposure. Addressing this issue will help mitigating risk of lead exposure effectively.

Specific Aims
The goal of this project was to identify the interconnectivity between EBLLs, age of housing, and social vulnerabilities. Our ultimate project goal is to identify TN's high risk populations for exposure to lead as determined by social factors and geographic areas. The specific aims of this project were to:

- evaluate the geographic distribution of EBLLs among census tracts,
- analyze SVI and home age among census tracts where children had EBLLs, and
- compare the dispersion of EBLLs with TDH's lead testing criteria.

Benefits and Significance to the State of TN
The geographic information system (GIS) implementation process identified and plotted pre 1980 housing stocks, SVI data, and EBLLs to show the specific areas with the highest vulnerability. An expected outcome of this project was to identify TN's high risk populations for exposure to lead as determined by social factors and geographic areas.

Looking for interconnectivity between EBLLs and social vulnerabilities can aim targeted health promotion and increased lead testing surveillance. Surveillance data will help identify health disparities among the youngest Tennesseans. This will help public health officials allocate resources where they are most needed. TDH's mission is for all Tennesseans to live in safe homes within safe communities.

Research Design/Methods
Data for this pilot project was collected from various sources:

- Lead data was provided by the Tennessee Childhood Lead Poisoning Prevention Program (LeadTRK database)
- Social Vulnerability Index (SVI) data was provided by ATSDR's Geographic Research, Analysis and Services Program (GRASP)
- Population data was provided by US Census Bureau, 2010
- Housing data was provided by American Community Survey, 2006-2010

Data were cleaned using SAS v9.3 software. The project reviewed BLL cases identified for the period of 2010-2012 and examined early childhood (from 0-5 years) EBLLs (≥ 5 µg/dL) data. Only venous BLLs were examined. When multiple tests were linked to the same patient, only the highest BLL was used. Age-specific incidence rates were calculated according to the 2010 US census data.
The vulnerability index included a percentile ranking of all the census tracts. The data were from the 2010 US census of population and housing at the census tract level. SVI 2010 included both 2010 census of population and housing 100% counts (SF1 data for minority

status, age 17 and under, age 65 and older, those living in group quarters, and single parent households) and 2006-2010 American Community Survey estimates (remaining variables). This index was based on four themes:

1. Socioeconomic status - Comprising income, poverty, employment, and education variables
2. Household composition - Comprising age, single parenting (household composition was defined to include dependent children less than 18 years of age, persons aged 65 years and older and single-parent households)
3. Minority status and language - Comprising race, ethnicity, and English-language proficiency variables
4. Housing and transportation - Comprising housing structure, crowding, and vehicle access variables

Data were mapped using ESRI's ArcGIS Desktop 10.1. All the addresses were geocoded. Addresses outside TN and PO Box addresses were not considered for analysis. Addresses without a street name were removed. Individual cases were aggregated by census tract. Age-specific incidence rates per 1,000 populations were calculated according to the 2010 US census data. The incidence rate map was then overlaid on a census tract level map of the SVI value. A third map layer displayed % housing built before 1980. This was done to identify the areas that were experiencing a significant prevalence of EBLL.

A lead risk map for TN was created based on the SVI value. Vulnerabilities were defined as low (0.00-0.33), medium (0.33 – 0.67), and high (0.67-1.00). The value > 0.95 were defined as very high vulnerabilities. Housing data were classified as lowest third (0.0-33.5%), middle third (33.5 –66.7%), and highest third (66.7-100%).

Results

The Figure 1 visualizes lead poisoning and vulnerability data across the state. The map depicts age-specific incidence rate per 1,000 populations. The map also depicts vulnerable areas and housing for lead poisoning. The lead risk map provides information at the census tract level.

A total of 823 children with EBLLs were identified during the three year period from 2010-2012. Of this number, 620 (75.3%) cases had BLL in between 5 and 10 µg/dL. A total of 169 (21%) cases had BLL between 10 and 20 µg/dL. 34 (4.1%) cases had BLL values above 20 µg/dL (Table 1).

Table 1: No of children with elevated blood lead levels (EBLLs) in Tennessee from 2010 - 2012

Blood Lead Level (µg/dL)	No. of Cases	% of Total No of Cases
5 ≥ PbB ≤ 10	620	75.3
10 > PbB ≤ 20	169	20.5
PbB > 20	34	4.1

PbB = Blood lead level

TN's two big metropolitan counties, Shelby (26.6%) and Davidson (19.3%), were identified as the highest number of children with EBLLs (Table 2).

Table 2: Top 10 counties with highest no of children with elevated blood lead levels (EBLLs) in Tennessee from 2010 - 2012

County	Count	% of Total Count
Shelby	219	26.6
Davidson	159	19.3
Sullivan	36	4.4
Hamilton	35	4.3
Rutherford	21	2.6
Washington	18	2.2
Robertson	15	1.8
Montgomery	15	1.8
Henry	12	1.5
Williamson	12	1.5

Vulnerable children at risk for exposure to lead were identified (Figures 1 & 2a). The most frequent category of the SVI for cases was high vulnerability. The incidence of very high vulnerability (>0.95) was also present in total state-wide percentile rankings. High vulnerability was observed for all the individual domains (Figure 2a). Of the 486 census tracts with cases, 229 (47.1%) tracts were located within the most vulnerable area of population. A total of 167 (34.4%) census tracts were in the middle SVI category, and the remaining 90 (18.5%) were in the low SVI category (Figure 2b).

Tracts with percent housing data built before 1980 where lead poisoning occurred were also identified (Figures 1 & 3). According to the housing data for the tracts with cases, 195 tracts out of 486 were located within the highest third category, 225 were in the middle third, and 66 were in the lowest third category.

To visualize the cases in two metropolitan counties in conjunction with the SVI and housing data, age-specific incidence rates were first mapped. The incidence rate map was then overlaid on a census tract level map of the SVI value. A third map layer displayed % housing built before 1980 (Figures 4 & 5). Of the 486 tracts with cases, 98 were located in Shelby County. Of the 98 tracts with cases, 76 (77.6%) tracts were located within the most vulnerable area of population. A total of 13 (13.3%) tracts were in the middle SVI category. The remaining 9 (9.2%) census tracts were in the low SVI value category (Figure 2b). According to the pre-1980 housing data, a majority of the tracts (76 tracts) were located within the highest third category, 15 were in the middle third, and 7 were in the lowest third category for Shelby County (Figure 3).

Davidson County had 76 tracts with cases. Of these tracts, 32 (42.1%) tracts were located within the most vulnerable area of population. A total of 23 (30.3%) tracts were in the middle

SVI category. The remaining 21 (27.6%) census tracts were in the low SVI value category (Figure 2b). Based on the housing data, 44 tracts were located within the highest third category, 17 were in the middle third, and 15 were in the lowest third category in Davidson County (Figure 3).

Discussions

This project illustrates the disparities of EBLLs among highly vulnerable populations. When looked at geographically, health disparities among children with high EBLLs are also established.

This project builds a method to demonstrate the importance of the blood lead data in comparison to SVI. This project also provides a method to compare all the data sets to evaluate effectiveness of blood lead data.

The new lower value (5 µg/dL) of blood lead level indicates that more children can be identified as having lead exposure. This will allow parents, doctors, public health officials, and communities to take action to reduce the children's exposure to lead.

After collecting and analyzing the data, the socioeconomically challenged areas in Shelby County are likely to be more affected by lead poisoning due to root causes, such as extreme poverty, unemployment, and the percentage of high school completion. Since we know that the socioeconomically challenged populations are more affected, we can use the socioeconomic component of the SVI to identify where to focus future intervention and response activities. The overall social vulnerability of Shelby County is a key indicator of the community's susceptibility to lead poisoning. By identifying these vulnerable areas of the county, the methods to mitigate public health consequences can be developed effectively.

Limitations

- Addresses for children tested were not always complete.
- Race and ethnicity were not always captured.
- Information on renovation of pre-1980 housing was not available.
- The number of houses that had lead abated were not available.
- Address level information on the year the housing was built was not available.
- Age-specific population count may be underrepresented (In evaluating census age structures for population counts we calculated age groups for 0-4 years. The 4 year old category included children up to and greater than 4 years of age but less than exactly 5 years of age (0 – 59 months). If we use population counts for children ages 0-5 years, the population could have been overestimated because we would have included children aged 61 -71 months).

Conclusions

- Shelby County was identified as the highest risk area for childhood lead poisoning.
- Old housing stocks in Shelby County were likely to be a risk factor.
- Social vulnerability was likely to be a risk factor for lead poisoning.

Future Directions
Our next step will be to develop a strategic goal to implement EPHT in TN. Our long-term objective is to build a tracking portal to provide comprehensive environmental and public health data.

Benefits for Implementing EPHT in TN
Implementing EPHT to TN will help integrate environmental and health data. This will provide a tool to monitor health and environmental data and guide public health actions. Also, EPHT will provide a better understanding of how the environment can affect people's health.

References

1. Centers for Disease Control and Prevention (2012). What Do Parents Need to Know to Protect Their Children? Atlanta, GA: *US Department of Health and Human Services*. Available at: http://www.cdc.gov/nceh/lead/ACCLPP/blood_lead_levels.htm
2. Centers for Disease Control and Prevention (2013). Blood Lead Levels in Children Aged 1–5 Years - United States, 1999-2010. *MMWR*; 62: 245-8.
3. Macartney, Suzanne (2011). Child Poverty in the United States 2009 and 2010: Selected Race Groups and Hispanic Origin. American Community Survey Briefs. *US Census Bureau*. Available at: http://www.census.gov/prod/2011pubs/acsbr10-05.pdf.
4. Centers for Disease Control and Prevention Advisory Committee on Childhood Lead Poisoning Prevention (2012). Low level lead exposure harms children: a renewed call for primary prevention. Atlanta, GA: *US Department of Health and Human Services*. Available at: http://www.cdc.gov/nceh/lead/ACCLPP/Final_Document_030712.pdf.
5. Flanagan, Barry E.; Gregory, Edward W.; Hallisey, Elaine J.; Heitgerd, Janet L.; and Lewis, Brian (2011). A Social Vulnerability Index for Disaster Management, *Journal of Homeland Security and Emergency Management*: Vol. 8: Iss. 1, Article 3.

Figure 1: Overlay age-specific incidence rate of childhood elevated blood lead levels (EBLLs) data on the social vulnerability index (SVI) value and housing data in Tennessee from 2010-2012.

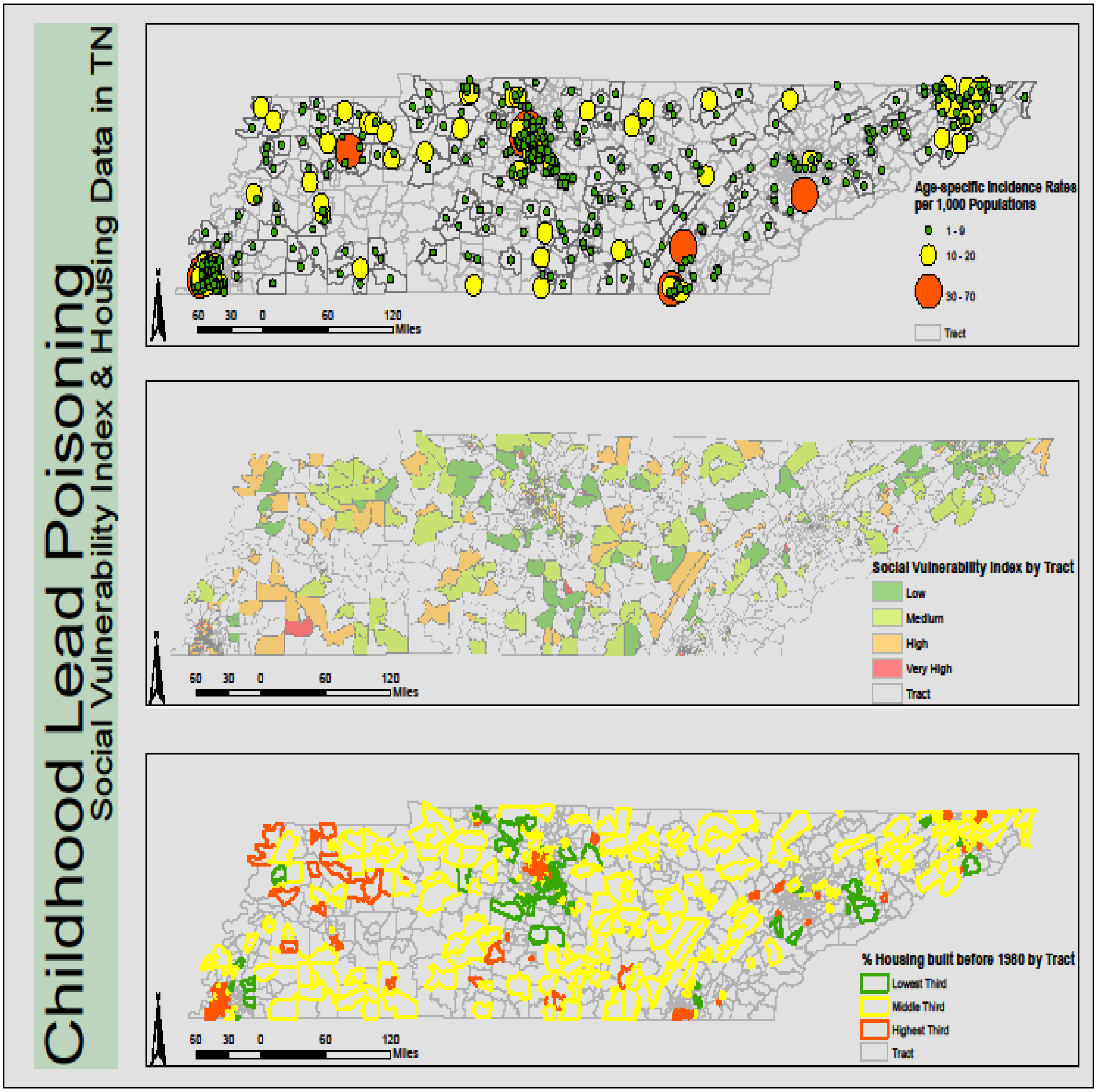


Figure 2a: % of children with elevated blood lead levels (EBLLs) by social vulnerability index (SVI) in Tennessee from 2010-2012.

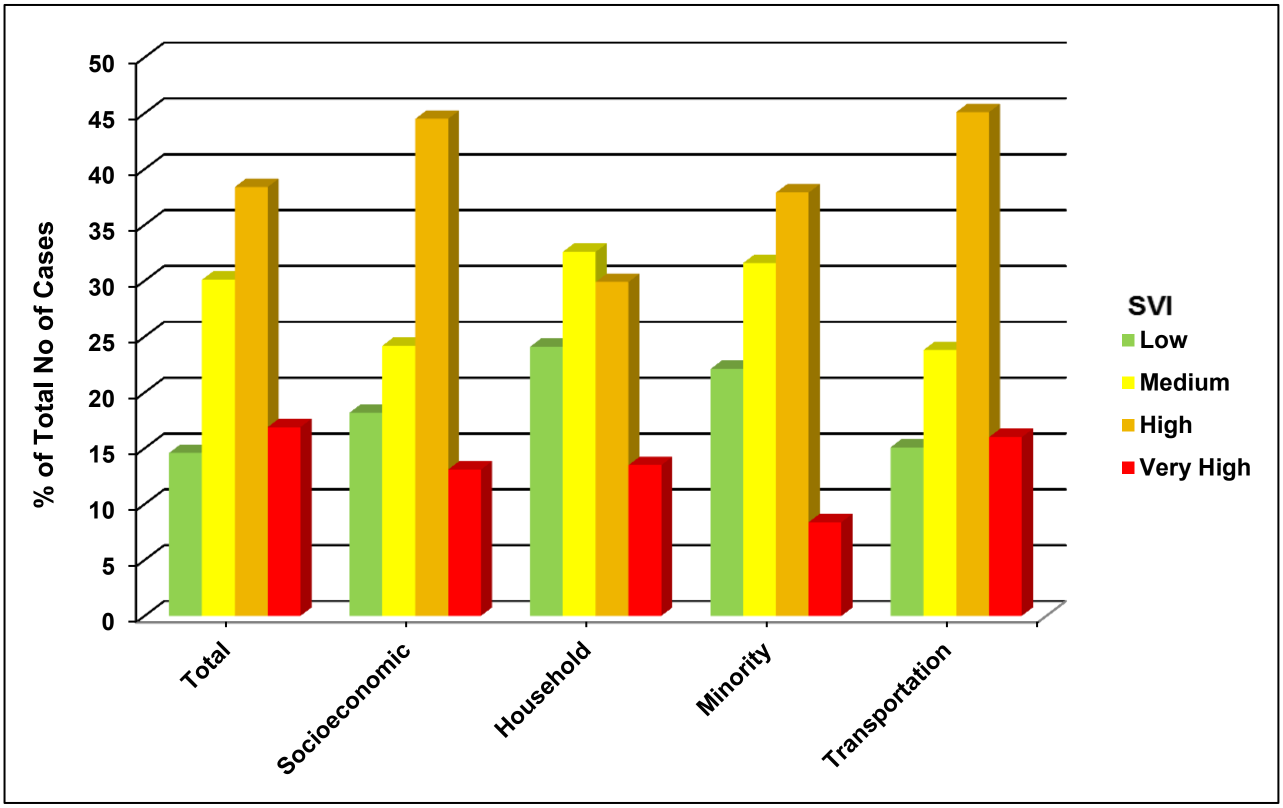


Figure 2b: Number of tracts with cases of childhood elevated blood lead levels (EBLLs) by social vulnerability index in Tennessee from 2010-2012.

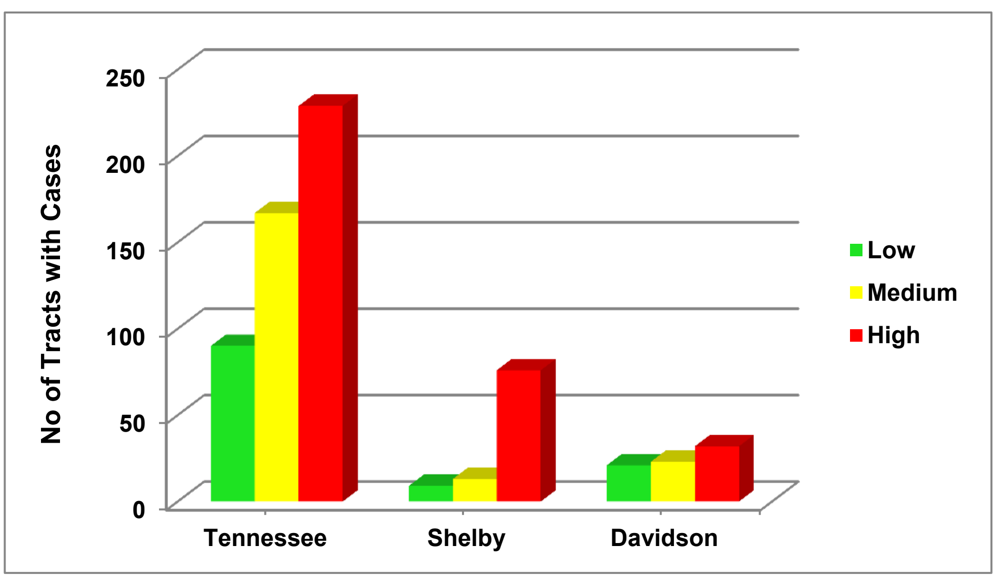


Figure 3: No of tracts with cases of childhood elevated blood lead levels (EBLLs) for % housing data built before 1980 in Tennessee from 2010-2012.

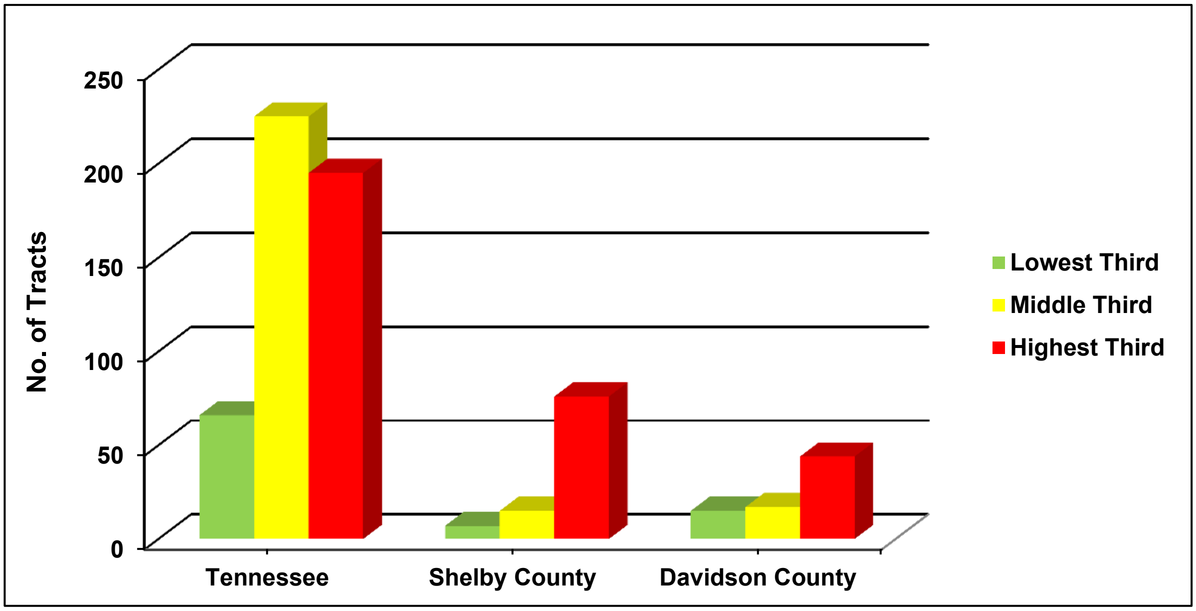


Figure 4: Overlay age-specific incidence rate of childhood elevated blood lead levels (EBLLs) data on the social vulnerability index (SVI) value, and housing data for Shelby County, Tennessee from 2010-2012

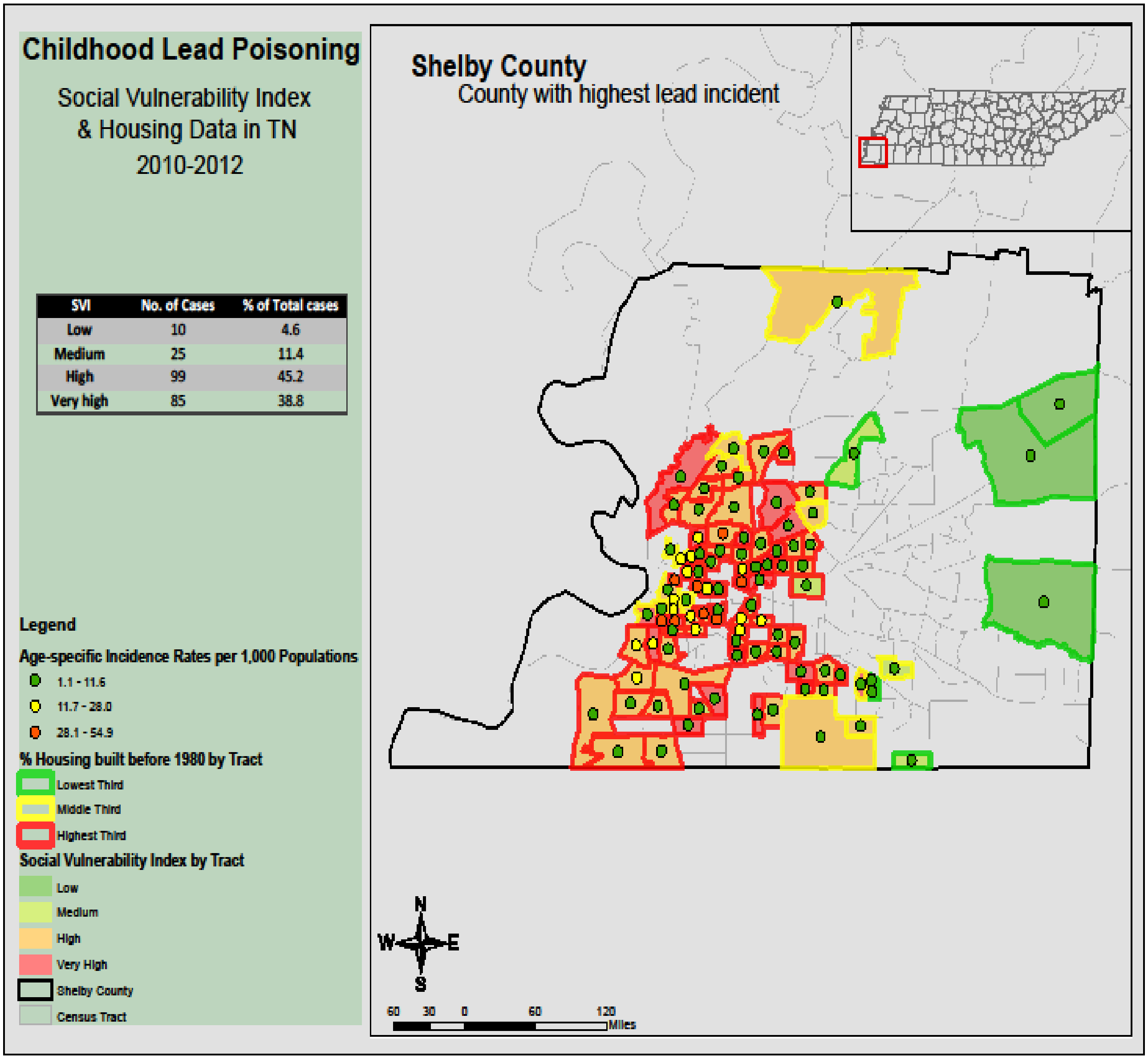
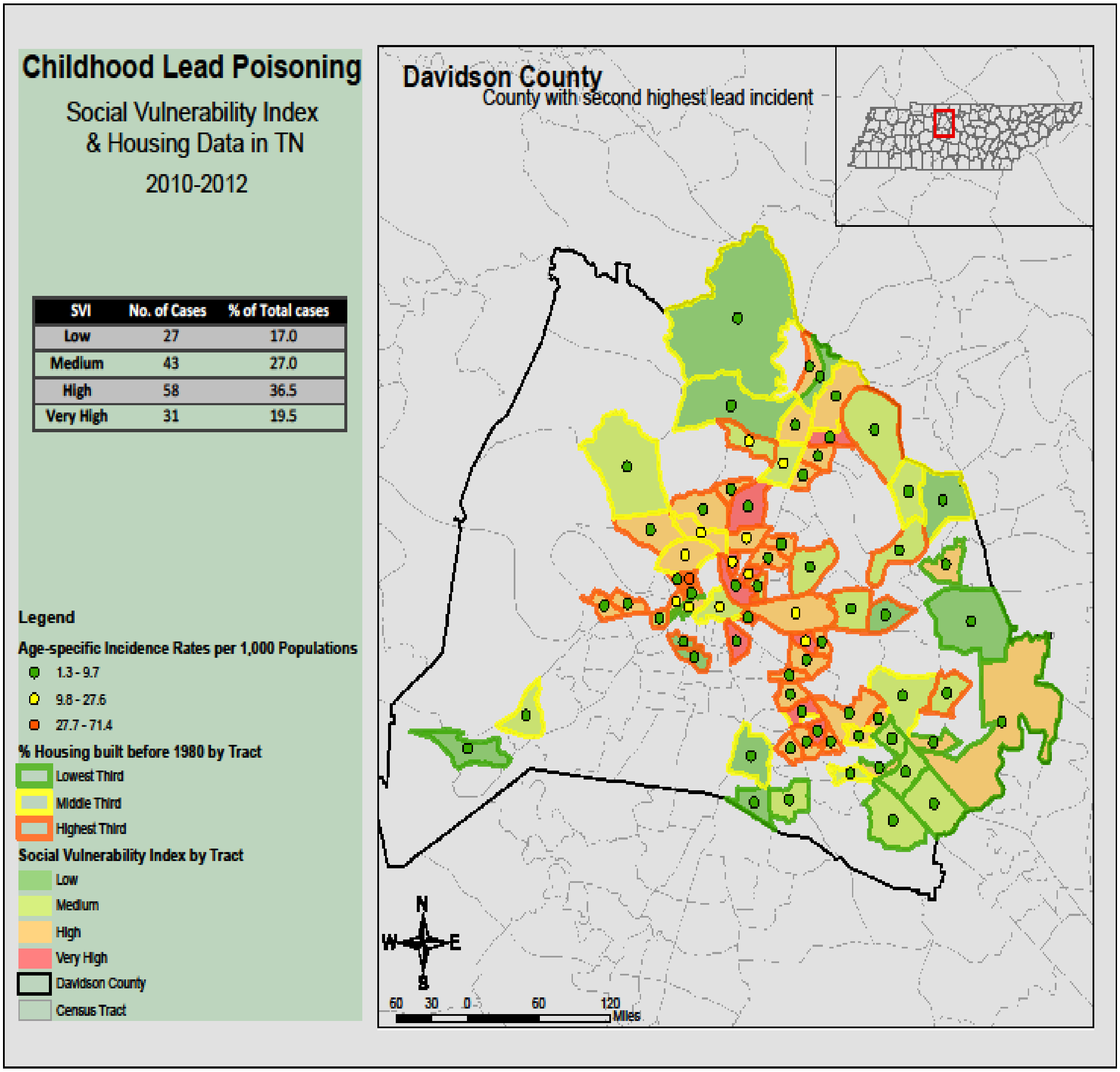


Figure 5: Overlay age-specific incidence rate on childhood elevated blood lead levels (EBLLs) data on the social vulnerability index (SVI) value, and housing data for Davidson County, Tennessee from 2010-2012



Appendix 1:

Environmental Public Health Tracking:
Peer-to-Peer Fellowship Program
Site Visit Agenda

April 23 – 24, 2013

Day 1

	Time	Loc.
I. Meet and Greet: Missouri Tracking Project Team • **Introductions and review of agenda** **II. Overview of Tennessee's tracking project and discussion of goals** TN Site Visit Expectations.docx TN Revised Project Proposal.pdf ○ Lead Poisoning (LeadTRK database) and Social Vulnerability Index (SVI) Data **Tennessee Group Call In/ReadyTalk** Audio login: 866-740-1260; Access Code: 9320993 Web login, click to Join Meeting	8:30 am	DCPH
Lunch	11:30	
III. Tennessee's Tracking Project Continued	1:00 pm	Oak A
IV. Lead Activities • Joyce L – Lead Program • Chris S (Steve) - Regulations • Scott Patterson – Childhood Lead • Carol B – Adult Lead		Oak A

Day 2

		Time	Loc.
I.	**Web Portal Demonstration** • Key Features: Portal standards and functioning • Mapping applications – making data available at a fine geographic level and (Lead Map) • Public versus secure portal • Google Analytics **Tennessee Group Call In/GoToMeeting**	8:30 am	DCPH
	Break		
II.	**Data Structure with Kris & Jennifer**	10:30 am	
	Lunch	12:00	
III.	**Data Structure Continuation**	1:30 pm	Oak B
IV.	**Overview of EPHT in Missouri** • Staffing and organization • Building Partnerships • Budget • Plans (Strategic, Risk Communication, Outreach, and Data & Statistical Guide)		Oak B
V.	**Q&A – Wrap Up: Making the Connections** • Review of Tennessee's plans and next steps		Oak B