

# **Housing Conditions in Providence**

## **Enough to Make You Sick?**

Combating Lead Poisoning and Asthma  
Through the Creation of Healthier Homes

by  
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## **ABSTRACT**

Lead poisoning and asthma affect the quality of life of thousands of residents of Providence. City officials have been working closely with Brown University and the Rhode Island Department of Health (DOH) since early in 1998 to develop more efficient ways of dealing with both health problems. A recent \$4 million grant the City recently received from the Office of Urban Housing and Development (HUD) is likely to bring these endeavors to fruition in upcoming months.

Now, one of the major challenges the City faces is determining where and how the resources will be distributed. My research identifies houses in Providence that deserve resources for remediation. I have identified houses that have been linked to more than one poisoned child, and also houses that have been linked to a poisoned child and an asthmatic. I completed these analyses by identifying addresses at which lead-poisoned children have lived in Providence, from Rhode Island Department of Health data, and addresses at which asthmatics have lived in Providence, from Rhode Island Hospital admissions data.

My study looks at one other challenge housing officials face: creating programs that prevent, rather than only identify, environmental health problems. I describe a series of housing conditions that may be used as indicators for lead poisoning. This means the City can create programs that work to prevent, rather than simply detect, lead poisoning.

## **I. INTRODUCTION AND PURPOSE**

Lead poisoning and asthma are two important environmental health risks associated with housing. A majority of lead-poisoning cases result from exposure to lead-based paint in the home; many asthmatics are sensitive to environmental allergens in the home. Though we continue to improve our understanding of each of these health conditions, there are several obstacles that must be overcome to address them. I have identified four challenges in creating and implementing environmental health programs and policy in Providence. I believe that these challenges are not unique to Providence, and my analysis should be useful for environmental health programs elsewhere.

I begin my discussion of the challenges by explaining the current procedures for dealing with asthma and lead poisoning. There are no public health programs that address asthma in Providence or in Rhode Island, though interest in such programs is building. The Department of Health's (DOH) lead poisoning program, on the other hand, has been in place since the late 1970's. In 1991, a lead law was passed to set standards for lead levels in the housing environment, focusing on prevention. These regulations went into effect in 1993. According to Rhode Island law, all children in the state must be tested for lead poisoning by the time they are six. Every child in the state must be tested once a year until they are three. If they have two negative tests, and haven't changed their living environment, they can discontinue screening

after age 3. If the child is high risk according to the CDC, namely that they live in pre-1978 housing, they would have to be screened more often – as many as four times a year.<sup>1</sup> This testing occurs by analysis of the lead concentrations in blood drawn from the vein or by a finger-stick. The DOH collects the results of all tests. A test of lower than 10 ug/dl is considered acceptable. Families with children who have blood lead levels (blls) of 15 - 19 are educated in lead poisoning prevention, by the Kent County VNA<sup>2</sup> and family physicians are encouraged to monitor the child's blood-lead level (bll). When a community has many kids with blls of 10 and above, the CDC encourages public health agencies to provide public education regarding lead poisoning. Between 15 and 19 µg/dl children are supposed to be tested more frequently, and possibly have their environment investigated. Any test results that are higher than 20µg/dl are noted by the DOH and warrant an inspection of the home where the child was living. The inspector checks to see that the home is in compliance with the state lead regulations.<sup>3</sup> If it is not, a notice of violation is sent to the owner of the property. If an attempt to comply is not made within thirty days, the DOH sends a second notice of violation, posts the property, and turns the case over to the City of Providence's City Solicitor for Prosecution in Providence Housing Court (if the address is in

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<sup>1</sup> Bibeault, Lynn. Personal interview. 13 Apr. 1999.

<sup>2</sup> Simon, Peter. Personal interview. 26 Apr. 1999.

<sup>3</sup> Rules and Regulations for Lead Poisoning Prevention [R 23-24.6-PB] February 1992, Rhode Island Department of Health, Environmental Lead Program. Part III: Lead Inspections, Methods of Measurement, and Standards. Section 4.0 Environmental Lead Inspections.

Providence). At this point, the DOH partners with the City to make sure that the landlord abates the hazard according to the state lead laws; the DOH provides expert testimony in court and necessary re-inspections throughout the court process and the City provides legal representation, subsequent notices to owners and court services. It is important to realize that the discovery of a lead hazard in the home of a poisoned child does not prove that the child was poisoned there; a child may have become lead-poisoned at another address or outside.

**II. CHALLENGES**

Within this system, the following challenges must be addressed before the rates of lead poisoning and asthma in Providence can be expected to decrease substantially.

<b>Challenges</b>
1) Focus on prevention rather than detection of lead poisoning.
2) Restricted access to health records because of confidentiality.
3) Lack of resources to address all environmental health risks efficiently.

1) First of all, the policy and program focus thus far surrounding lead poisoning in RI has dealt mostly with detection rather than prevention of the problems. According to Rhode Island’s Lead Poisoning Prevention Act, “childhood lead poisoning is completely preventable”, but “Rhode Island does not currently have a comprehensive strategy in

<sup>4</sup> This is an important step in defining the problem, but focusing on prevention is crucial. If we can identify which houses are most problematic before they make kids sick, these houses might be one way to prioritize resources.

- 2) There are strict rules regarding confidentiality of medical information in Rhode Island. It is DOH policy not to release addresses connected to lead-poisoned children, except for cases that are "closed", or finished, by DOH. These have either been abated or referred elsewhere, and these closed addresses are available. With this interpretation of the State's confidentiality law, there is no way to direct renovation funding and programs selectively toward houses that were connected with poisonings of 20 µg/dl and higher, or cases still under DOH follow-up, without going through an Internal Review Board process related to confidentiality or using DOH as an intermediary.
- 3) The large number of homes in low-income urban neighborhoods that may pose environmental health hazards often appears to overwhelm the resources available for risk reduction.<sup>5,6</sup> Since it is impossible to

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<sup>4</sup> Title 23, Health and Safety, Chapter 23-24.6 Lead Poisoning Prevention Act, Section 23-24.6-2 Legislative findings.

<sup>5</sup> Title 23, Health and Safety, Chapter 23-24.6 Lead Poisoning Prevention Act, Section 23-24.6-2 Legislative findings.

<sup>6</sup> Title 23, Health and Safety, Chapter 23-24.6 Lead Poisoning Prevention Act, Section 23-24.6-7 Screening by health care providers.

remove all health risks from the Providence housing stock at the same time, priorities must be set for remediation. For example, a house that is connected to several poisoned children might be considered more of a risk than a house that has only been connected to one child. The City might also decide that a house where residents have had multiple environmental health problems, like asthma and lead poisoning, warrants more immediate attention. *Once identified, these houses should be of the highest priority for remediation.*

### **III. BACKGROUND RESEARCH**

#### *CHILDHOOD LEAD POISONING*

During the last two decades, experts have discovered the effects of low levels of lead poisoning on neurological development.<sup>7,8</sup> The most significant source of this poisoning is lead-based paint in the home. Not only are cities and states relying on extensive blood lead screening programs to identify lead poisoning in children, but they also are targeting the risks of exposure in the home environment.<sup>9,10,11,12</sup>

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<sup>7</sup> Chisholm Jr., J.J., Mellits, e.d. and Quaskey, S.A. "The relationship between the level of lead absorption in children and the age, type, and condition of housing." Environmental Research 38 (1985) 31-45.

<sup>8</sup> Lanphear, Bruce P. MD, MPD, Burd, Robert S. MD, MPH, Auinger, Peggy MS and Schaffer, Stanley J. MD, MS. "Community Characteristics Associated With Elevated Blood Lead Levels in Children." Pediatrics 101 (1998) 264-271.

<sup>9</sup> Lanphear, Bruce P. MD, MPD, Burd, Robert S. MD, MPH, Auinger, Peggy MS and Schaffer, Stanley J. MD, MS. "Community Characteristics Associated With Elevated Blood Lead Levels in Children." Pediatrics 101 (1998) 264-271.

<sup>10</sup> Report on the National Survey of Lead-Based Paint in Housing: Base Report, Office of Pollution Prevention and Toxics, April 1995.

<sup>11</sup> Understanding Title X: A Practical Guide to the Residential Lead-Based Paint Hazard Reduction Act of 1992, Alliance to End Childhood Lead Poisoning, January 1993.

<sup>12</sup> Harvey, Birt MD. "The Exposure of Children to Lead." Pediatrics 102 (1998) 227-29.

Lead poisoning can come from several different sources – lead pipes that carry drinking water, food cans, some ceramic glazes, and previously from leaded gasoline. Most poisoning occurs in the home when people, primarily children, inadvertently ingest lead particles from lead-based paint. This sometimes happens in occupational settings or during home renovation, but most often the poisoning is due to prolonged exposure to dust with high lead levels in a home. Lead wears off from painted friction surfaces, such as windows and doors. This lead dust collects on flat surfaces, mainly floors, windowsills and window troughs. Small children ingest the dust when they put their fingers or toys that are contaminated with dust in their mouth. Paint also flakes off in chips, which children sometimes eat because they taste sweet.

The rates of lead poisoning in Providence are higher than in most other US cities. In 1998, the RI Department of Health screened 2,683 children and 9% had blls over 20g/dl, the level that the Center for Disease Control defines as a health risk<sup>13</sup>. (See Figure 4.) In comparison, a national survey done between 1991 and 1994 revealed that only 4.4% of all children in the country had elevated blood-lead levels (EBLs.) Providence's rates are also higher than rates recorded for Boston; where in 1995, 5% of the children were lead-poisoned.

Interest in the issue of lead poisoning has been growing locally and progress has been made. Rhode Island's Department of Health (DOH) has

implemented an aggressive screening program to test children's blood for lead. Among all children born in the first four months of 1996, 65% had been screened by 18 months of age; the screening rate for high-risk children was 73% before that. Among all children born during the first four months of 1994, 59% had been screened by 18 months of age, with 65% of high-risk children screened.<sup>14</sup> These numbers are not adjusted for immigration in either direction, however. In other words, children who migrated out of Rhode Island might be included in the population count, but then are mis-classified as unscreened. Children who migrate into Rhode Island might not show up in the database at all.<sup>15</sup> Additionally, the Mayor of Providence established the Safe Housing Lead Task Force in January of 1998. The Task Force focused its efforts on education, fundraising and housing. Its report formed a foundation for addressing the health problem, and helped to create a funding proposal to HUD of \$4 million dollars to address lead-poisoning risks in Providence. With the grant funds, the City hopes to not only address lead-poisoning risks, but more general environmental health hazards such as asthma triggers.

### *ASTHMA*

Asthmatics experience difficulty breathing due to constriction or obstruction of the airways. The muscles of the bronchi in the lungs

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<sup>13</sup> Centers for Disease Control and Prevention. "Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials." 1997.

<sup>14</sup> Feeley, Sue. <FEEL100W@cdc.gov> "LEAD QUESTION." 9 Feb. 1999. Personal e-mail. (9 Feb. 1999)

become overly sensitized, and contract when exposed to certain triggers. Sometimes the bronchi secrete mucus in response to the irritation. The addition of this sticky substance also affects a person's ability to breathe, especially for a small child. A patient with asthma rarely has difficulty breathing all of the time. The frequency of attacks and also their strength characterize the severity of asthma.

Evidence suggests that asthma has both a genetic component and an environmental component.<sup>16,17</sup> People appear to develop asthma from exposure to certain allergens. Regardless of the cause, many people have asthma attacks when exposed to elements in the environment called triggers. Many triggers are environmental, such as dust mites, cockroach dander, animal dander, pollen, molds, ozone, NO<sub>x</sub>, SO<sub>4</sub>, smoke and particulates, and various chemicals. Other patients have asthma that worsens when they exercise, or when they are exposed to cold air.

Attempts to treat asthma focus on the constriction and obstruction mechanism. Doctors encourage patients to reduce their exposure to whatever triggers their asthma. Also, there are several medications available that greatly increase a patient's lung capacity, some that a patient takes regularly and some that are administered when the patient is exposed to a trigger or at the onset of an asthma attack. These methods

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<sup>15</sup> Feeley, Sue. <FEEL100W@cdc.gov> "Re: LEAD QUESTION." 29 Apr. 1999. Personal e-mail. (29 Apr. 1999)

<sup>16</sup> Barbee, RA, Murphy, S. "The natural history of asthma." *Journal of Allergy and Clinical Immunology*. October 1998; 102:S65-72.

<sup>17</sup> Sutherland, M, Czarny, D, Douglass, J. "Allergy in the Airway." *Austr-Fam-Physician*. August 1998: 27:681-5.

work especially well for people with exercise-induced asthma, or for people who are sensitive to a specific trigger.

Although research into asthma is now substantial, there is still much mystery surrounding the disease. Therefore, it has been difficult to create health policy to deal with asthma specifically, let alone a comprehensive policy that includes lead poisoning and asthma. But as we learn more about the effects of reducing an asthmatic's exposure to triggers, preventative health measures become more of an option.

Asthma rates have been rising around the country for many years.<sup>18</sup> Data provided by the Air Pollution and Respiratory Branch of the National Center for Environmental Health suggest asthma has been on the rise since 1977. In 1960, there were 5,000 deaths in the US due to asthma. This number steadily decreased until 1977, when it hit a low of just less than 2,000. It then began to increase until it reached 5,500 deaths in 1995.<sup>19</sup> In 1979, the prevalence of asthma was recorded at 7,000, and the number had increased to 14,000 in 1994. In urban areas of the country, the disease disproportionately affects African-American children. (See Figure 5.) However, it is thought that this is due largely to socioeconomic status rather than specifically to race<sup>20</sup>. It is interesting that asthma rates have been steadily increasing over a period of time

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<sup>18</sup> Anderson, Henry A. MD, Brown, Clive M. MBBS, MPH, Etzel, Ruth A. MD, PHD. "Asthma: The States' Challenge." U.S. Department of Health and Human Services; Public Health Reports 112 (1997) 198-205.

<sup>19</sup> Redd, Stephen C. MD "Indoor Air Activities", Air Pollution and Respiratory Health Branch, National Center for Environmental Health, 1998.

<sup>20</sup> Lieu, Tracy A., MD, MPH, Quesenberry, Charles P., Jr, PHD, Capra, Angela M., MA, Sorel, Michael E. MPH, Martin, Kathleen E., Mendoza, Guillermo R., MD. "Outpatient Management Practices Associated with Reduced

when asthma treatments have become so much more effective. Doctors in Providence have been noticing an increase in the City as well.<sup>21</sup> Some suspect that this increase is due to poor indoor air quality.

### *HEALTHY HOMES*

It is suspected that the housing conditions that may be contributing to asthma are similar to those that are perpetuating the lead-poisoning problem. We know that peeling and chipping paint contributes to many of lead-poisoning cases. The paint may be coming off at friction surfaces or simply because it is old, but paint also flakes off of walls that have been damaged by water. This water damage, common in houses with faulty roofs or gutter systems, can also contribute to poor indoor air quality, as mold growth is common in these situations and moisture and humidity promotes growth of dust mites.

This connection between housing condition and environmental health problems is being recognized nationally. In 1998, the U.S. Office of Housing and Urban Development (HUD) announced that it intends to provide resources for state and local programs that address environmental health holistically, by dealing with more than one health problem at a time. If lead poisoning and asthma are occurring in the same houses in

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Risk of Pediatric Asthma Hospitalization and Emergency Department Visits." *Pediatrics* 100 (1997) 334.

<sup>21</sup> Block, Stanley, MD. Personal interview. 9 Feb.99.

Providence, the City might benefit from creating a healthy homes strategy to prevent these health conditions.

**IV. CHALLENGES ADDRESSED**

Given the problems that lead poisoning and asthma are creating in the City, it is important to try to overcome the obstacles that prevent us from dealing more effectively and efficiently with them. Listed with the challenges I discussed earlier are the strategies I have developed to address them:

<b>Challenge</b>	<b>Strategy</b>
Focus on prevention rather than detection of lead poisoning.	<i>Identify indicators such that risky houses may be addressed before they poison children.</i>
Confidentiality restrictions regarding access to health records.	<i>Identify houses that pose risks for other reasons.</i>
Lack of resources to address all environmental health risks efficiently.	<i>Create programs that deal with more than one risk at a time or focus on houses with most severe risks.</i>

***Strategy I: Identify indicators such that risky houses may be addressed before they poison children.***

In January of 1998, members of the Mayor’s Policy Office approached the Center for Environmental Studies (CES) at Brown University. These officials were involved with the Safe Housing Lead Task Force, and were looking for assistance with data analysis. They were interested in developing a program that focuses on the prevention of childhood lead poisoning, rather than identification after poisoning. If

they could identify indicators for lead poisoning in Providence’s housing stock, the Mayor’s office could then develop an identification system to address dangerous houses before they poison children.

Professor Harold Ward at CES, along with 8 students, created a list of possible indicators based on existing data. They included housing code violations; environmental violations (issued primarily for illegal trash disposal or rats); property value; owner-occupancy; and Section 8 (a program of federally-subsidized housing that is supposed to be lead-safe.) We compared addresses from each of these categories with addresses at which lead-poisoned children had lived, and found correlation of surprising strength; the risk ratios ranged from 1.3 (CI 1.2 – 1.5) to 1.8 (CI 1.6 – 2.1). These data were included in the City’s grant proposal to HUD as a list of target houses to receive lead abatement attention. The methods used for these calculations can be found in Appendix I.

**Figure 1**

	Odds Ratio	Lower Bound	Upper Bound
Housing Code Violations	1.90	1.55	2.32
Environmental Violations	2.12	1.76	2.55
Section 8	1.45	1.15	1.83
Non-Owner Occupancy	1.35	1.16	1.58
Assessed Value	1.52	1.21	1.89

## **Strategy I: Data**

### *Childhood blood lead data:*

The Rhode Island DOH provided the results of analyses of all blood lead samples drawn from Providence children under age six from 1993 to 1998, together with the address of the child at the time the blood sample was taken. From these data, the highest blood lead level for each child at each address the child was at for each of the 6 years was extracted, leaving us with blood lead levels for 52,829 children, with levels ranging from 0 to 82  $\mu\text{g}/\text{dl}$ . For the analysis of housing conditions as indicators, the blood lead levels from 1997 were used, as the study only had access to data on housing conditions from 1997.

*Housing Code Notices of Violations:* The City of Providence Office of Code Enforcement provided data on housing code violations for the months of January through April. 837 of 2,419 notices of violations are results of complaints.

*Environmental Violations:* The data for environmental violations came from the Department of Public Works and contained records of all violations in 1997. These notices of violation were primarily for improper management of solid waste.

*Section 8 Rental Subsidy:* Privately-owned houses with federal Section 8 rental subsidies effective on March 1998 were identified from data provided by the Providence Housing Authority

*Property Value and Owner-Occupancy:* Tax assessments for all properties

in Providence, current as of approximately October, 1997, were used in two ways – to give the assessed value of housing in which children lived, and as the basis for identifying housing occupied by owners (owner-occupancy). This database tends to overestimate dwelling unit value and the degree of true owner-occupancy. For example, only the assessed value of the entire structure is available and only ranges of the number of units is included. Therefore, for multiple-unit housing, the assessed value/ unit is an overestimate. In addition, to identify owner-occupants, the addresses to which tax bills are sent were matched with the address of the structure. Since owners have been known to give the address of the structure as the billing address, without necessarily living there, this method overestimates the number of owner-occupied units.

### ***Strategy I: Methods***

We categorized “poisoned children” as those who had a bll of 15 and higher. A non-poisoned child was a child with a test of 10 or lower. The tests of 11-14 were not included in the analysis. They were left out in accordance with the procedure of case-control analysis, to increase the strength of the calculation. They were also left out to help insure against overlap between groups, which was a characteristic of the data which the lab reported to us. The list of addresses connected with poisoned and non-poisoned children was matched with each of the five databases of housing conditions. For the case-control analysis for property value,

property values were divided into two categories, high and low. Again, this was done to strengthen the statistical power of the evaluation. The low category included values from \$1,001 to \$49,999; the high ranged from \$100,001 to \$749,999. The middle range of \$50,000 - \$100,000, as well as anything under \$1,000 and greater than or equal to \$750,000, was dropped. I excluded the extreme values in both directions under the assumption that those properties did not have houses on them. In each case, risk ratios with 95% confidence intervals were calculated to determine correlation between lead poisoning and housing condition.

### ***Strategy I: Implications***

This analysis demonstrates that these five housing conditions correlate with lead poisoning and therefore have positive predictive value. A child living in a house with a code violation, for example, statistically has a 90% greater chance of being lead poisoned than a child living in a house without code violations. Houses with these five risky conditions could be targeted for remediation if the City or State is trying to prevent the lead poisoning problem, though they should not be the highest priority. Targeting houses that have already been connected with poisoned children would be a more effective prevention strategy. Then, targeting houses that *might* poison children, such as houses with the housing conditions identified in the following analysis, might be the next prevention tier.

***Strategy II: Identify houses that pose risks for other reasons.***

Strategy II relates directly to Strategy I. Rhode Island's Access to Public Records Law, protects the confidentiality of medical records.<sup>22</sup> Unless a case concerning a lead-poisoned child has been completely dealt with and closed, the DOH has interpreted the law in such a way that it cannot release addresses of houses where lead-poisoned children have lived to outside sources, like the City, neighborhood groups, or advocates. The DOH has agreed to release the addresses to the City for code enforcement, however. It is understandable why the State would want to protect the privacy of families it is dealing with; children could be stigmatized because of their medical condition. But these regulations make it difficult for the City to determine which houses should receive remediation assistance.

It has been suggested, however, that the DOH can release to the City a list of addresses that are problematic for many different reasons. Some places on the list might be connected with lead-poisoning incidents and some might be houses with code violations. The City would therefore not be able to identify which houses on the list are connected to lead-poisoning incidents, and the confidentiality of the patients would be preserved. This is also DOH's rationale for releasing cases that have been

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<sup>22</sup> Title 38, Public Records, Chapter 38-2 Access to Public Records. Section 38-2-1.

closed; the person receiving the information does not know why the address or family was receiving DOH attention.

To create such a composite list, we would have to identify houses that pose lead-poisoning risks based on something other than a previous poisoning. The housing conditions indicators identified in the previous analysis – housing code violations, environmental violations, property value, Section 8, and owner-occupancy – could be used to create such a list of target houses. Since this approach is not based on medical conditions, this list would not be subject to the DOH’s confidentiality restrictions.

***Strategy III: Create programs that focus on houses with most severe risks or that deal with more than one risk at a time.***

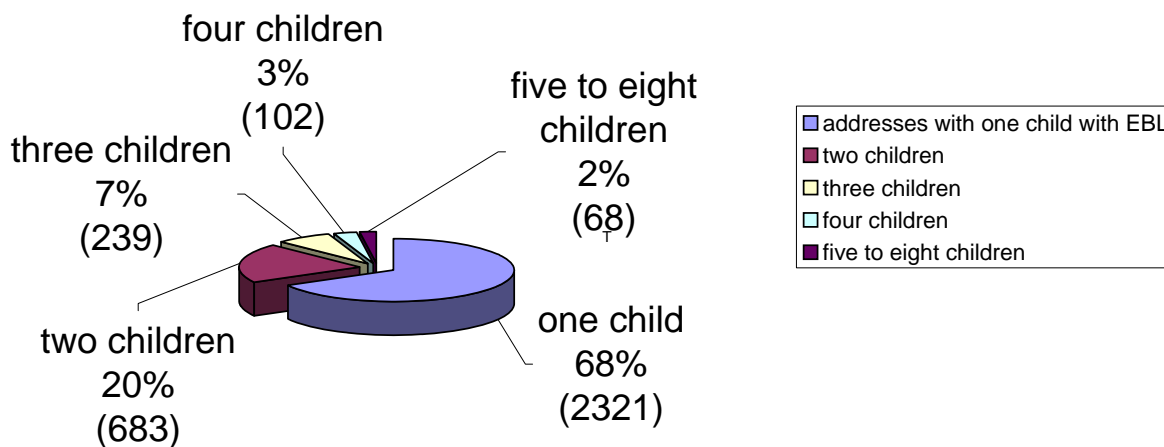
The mobility of children in Providence creates problems for health officials who want to eliminate risks in the home, as it is difficult to determine where the poisoning occurred. But if we could identify houses in the City linked to several poisoned children, the probability is likely to increase that those houses are causing the problem.

When we first began to explore this question of whether or not there were houses linked to several poisoned children, we discovered that people working on lead poisoning prevention had two very different answers to

this question. Some believe that virtually every house in Providence built before 1978 (when lead paint was outlawed) potentially could poison any resident child, while others believe that a relatively small number of houses are responsible for a majority of the poisonings. According to the analysis of the data, the truth lies somewhere between but closer to the latter extreme.

**Figure 2**

**ADDRESSES IN PROVIDENCE WHERE ONE OR MORE POISONED CHILDREN HAVE LIVED**



Total Addresses: 3413

A second way of prioritizing resources would be to focus on houses that are linked with more than one environmental health problem. I chose lead poisoning and asthma as two environmental health problems that

might be linked. Both problems are associated with poor housing condition, and it is suspected that there are types of renovations that would reduce the risk of both problems.<sup>23,24</sup> One example is repairing or replacing a severely leaking roof. Extensive water damage in a home contributes to peeling paint, which is a lead-poisoning risk, and it causes mold growth, which can be very aggravating to asthmatics who are allergic to mold. The following analysis indicates that lead poisoning and asthma occur more often at the same address than expected by random choice.

**Figure 3**

	<b>Houses with Asthmatics</b>	<b>Houses without Asthmatics</b>	<b>TOTAL</b>
<b>Houses with Poisoned Children</b>	353	3231	3584
<b>Houses without Poisoned Children</b>	427	9884	10311
<b>TOTAL</b>	780	13115	13895

**Odds ratio:  $\frac{353 \cdot 9884}{427 \cdot 3231} = 2.5$ , 95% CI = 2.2, 2.9**

The lower extreme of the confidence interval is greater than 1, which demonstrates significance at the 95% confidence level. An odds ratio of 2.5 suggests that statistically a child living in a house where a lead-

<sup>23</sup> Staes, BSN, MPH, Rinehart, Richard, SM, CIH. "Does Residential Lead-Based Paint Hazard Control Work? A Review of the Scientific Evidence." Alliance to End Childhood Lead Poisoning, Scientific and Technical Reports, April 4, 1995.

<sup>24</sup> Wood, Robert A., M.D. Taming Asthma and Allergy by Controlling Your Environment: A Guide for Patients. 1995, Asthma and Allergy Foundation of America, Towson, MD. P. 63.

poisoned child has lived is 2.5 times more likely to have problems with asthma than if that child is living in a house without a lead-poisoned child. However, about 90% of houses with lead-poisoned children did not correspond to houses with hospital visits for asthma. About 50% of houses with asthma visits did not have lead-poisoned children.

### ***Strategy III: Data***

The DOH lead poisoning database was the source of lead data for this analysis. I included the highest test result per child, for every address at which that child had been tested, during the six-year period. I sorted the data according to address, which made it easy to determine the number of children who had tested positive for lead poisoning while living at this address. The houses with only one child are represented by the first category listed in the pie chart above; the houses with five to eight lead-poisoned children are in the fifth category.

To determine which houses in Providence have both lead-poisoned children and asthmatics, I matched the DOH lead-poisoning data with asthma data from the Rhode Island Hospital and from Miriam Hospital. I used the same definition of a poisoned-child in this analysis as I did with the indicators; children with blls of 0-9 were defined as not poisoned, and children with blls of 15 and higher were defined as poisoned. The asthma data were obtained from Steven Reinert and Carolyn Kent at Lifespan, Inc.

They consisted of a list of all people of all ages who were admitted to Rhode Island Hospital or Miriam Hospital between 1993 and 1998, either as an emergency-room patient or an in-patient, with a primary diagnosis of asthma as determined by ICD-9 code. The data set also included the address at which the person was living at the time s/he was admitted. Obviously, this is not a complete listing of all asthmatics in Providence. Since these data include primarily patients with the more extreme cases, they therefore underestimate the prevalence in the City. The nature of the asthma data warrants discussion. It comes from two sources, RI Hospital and Miriam. RI Hospital is located in the middle of the lowest socioeconomic area of Providence. This might explain why there are so many asthma admissions from that area. But there is consensus that patients with emergent cases of asthma are taken by ambulance to the hospital that corresponds with their insurance plan, not the closest one. Additionally, the RI Hospital is known in the community as being most desirable to populations of different cultures; in cases where people are choosing which hospital to visit, they might choose RI Hospital for that reason. Also, all children are taken to the emergency room at Hasbro, which is part of Rhode Island Hospital. This means that all children with severe asthma attacks in the city should be included in this data set. Also, the distribution of the houses identified with asthmatics may be affected by the location of RI Hospital, which is in the middle of the largest asthma cluster. (See Figure 5.)

### ***Strategy III: Limitations and Implications***

Ideally, we would be able to eliminate poor housing conditions and the economic situations that exacerbate them, so that all people are living in healthy environments. But resources are insufficient to upgrade all housing at the same time. Priorities must be set to obtain the greatest risk reduction as efficiently as possible.

There are several ways to do this. The costs and benefits of rehabilitating properties should set priorities. It may not be economically feasible to turn houses with little or no economic value into environments suitable for human habitation because the costs would be too great. In these cases, it might be most efficient to condemn and demolish these houses and focus on those that are more easily renovated. This means focusing on the houses where we can attain the safest conditions for the lowest costs. This would mean focusing on houses that have appreciable market value and are not severely deteriorated, where the cost of remediation can be kept in balance with the property value.

It is also important, in this process of identifying needy houses and reducing their risks, that we don't significantly reduce the amount of affordable housing for the lower socioeconomic groups in the City. Though increasing housing quality is extremely important for improving health conditions, it might lead to gentrification as the remediation raises the property value of the home.

It would seem that the risk of gentrification in this case is low, however. If we are using the most cost-effective measures to remove lead hazards, such as the inexpensive renovations mentioned earlier, the increase in property value should be small. But any changes, even slight ones, in property value in the City will prohibit some groups of people from paying rent. In other words, a safe house is worth more on the market than a house with environmental health risks. It is important to be aware of this situation. As a community, it is crucial that we continue to improve the opportunities for all people to become more economically stable such that they can afford housing that is safe and healthy. The bottom line for policy-creation should be that nobody, no matter how few resources they have, should be forced to sacrifice their health or the health of their family. Families should also not have to choose between unsafe housing and no housing. The community must work toward providing safe housing, along with a system to help families afford such housing such as grants and low-interest loans.

I will start by identifying houses that present the greatest risk based on two different definitions. Then, after investigating these houses, I will determine if the risks can be abated in a cost-effective manner. The first definition of a high-risk house is one with several poisoned children, as was discussed in the previous strategy. The second definition is a house with other environmental hazards.

Perhaps the most important finding of this analysis is that 353 houses had incidents of both asthma and lead poisoning. This suggests that we might be able to eliminate health risks by addressing more than one disease at a time in these homes. This is especially important for programs where home visiting is involved. Home visits, either to work with the family on health issues or to collect information about the housing structure, are resource intensive. It is expensive, in terms of time and money, to gain entrance to a home. Therefore, different types of assessments, such as lead poisoning and indoor air quality, should be done during the same visit to make the system more efficient, rather than having one program for lead poisoning visits and one for asthma visits. If we can streamline these programs, such that inspectors or other visitors are aware of several different diseases exacerbated by housing conditions, we will have a much more effective and efficient system. This observation also suggests the need for the creation of housing codes that pertain to indoor air quality. According to the data, houses with lead-poisoned children are more likely to have some sort of indoor air quality hazard. Lead inspectors could be instructed to check for asthma triggers when in a home of a lead-poisoned child. This could either be part of a new system of codes pertaining to indoor air quality or as a public education effort. In general, the City and State should move toward looking for risks in homes related to both diseases.

There are plans to create public education programs to deal with lead poisoning and asthma. Recently the Health and Education Leadership for Providence (HELP) Lead Safe Center was created to coordinate medical care, social service and housing resources for families of lead-poisoned children. This program, which is responsible for managing all aspects of each family's case, is working to include asthma. The coordinators of HELP want to work with the families in the places where they live to reduce their exposure to lead hazards and environmental allergens.

The Environmental Health Action Project (EHAP) is also working toward this goal. EHAP is a partnership between the Swearer Center for Public Service at Brown University; the HealthCorps Program through the Providence Community Health Centers; and the Center for Environmental Studies at Brown. It brings together students from institutions of higher learning in Providence, including the Brown Medical School, the Rhode Island College Nursing Program, and the Community College of Rhode Island, along with members of the HealthCorps, to conduct home visits with asthmatics from the Providence Community Health Centers. Teams of two – a student and a HealthCorps volunteer - conduct several visits to a patient's home. They cover basic asthma education and prevention, including reduction of triggers in the home environment. The teams also collect data concerning the condition of the homes. They fill out a form that describes most conditions that do or might affect asthma or lead

poisoning. The teams are also being trained to help the families deal with lead poisoning risks if necessary. This type of program is an ideal model for Healthy Homes efforts, as the volunteers are trained to deal with other environmental health problems as they arise in the home visits. As a result, the EHAP program is creating a database of housing conditions of asthmatics in Providence, one that will might be used to help affect policy or as a model for a more extensive database. The scale of these efforts should be increased in the future.

In order for multidisciplinary home visits and inspections to be truly successful, they must be couched within a political and legal framework that ensures funding of these activities, provides incentives for remediating hazards and enforces standards upon those who do not comply. For example, even if lead and indoor air hazards were removed with federal funds, there have to be incentives for the tenants and landlords to keep the houses up to code and safe. Currently, the enforcement of lead laws by the courts in Providence is not a threat to landlords; prosecution is slow. This is especially important when identifying houses that, according to the housing codes, should be demolished completely.

The difficulty in conducting the research reported here reveals a severe lack of data describing the asthma problem in Providence. It took me six months to obtain asthma data for Providence. I knew that the data existed, but institutions that collect it did not want to release it.

Pharmaceutical companies track the sale of inhalers and other types of asthma medication, information often used as surrogates for asthma prevalence. But private companies charge large fees for the use of their data. The data collected by RiteCare program in Rhode Island includes the prevalence of asthma. However, the people in charge of the program were reluctant to release the data for the purposes of this study because the addresses they have for their patients are recorded at the time the patient joins RiteCare; in other words, the addresses might not be current in all cases. But if we want to make any attempts to better understand asthma on a citywide basis, we must start with what we have. No data set is going to be perfect for every analysis; the asthma data used in this study has many limitations. But it is a beginning. RiteCare should reconsider releasing its asthma data to help the City better address the disease.

Along with these important implications come a few limitations to this study, many of which already have been mentioned. This study only measures correlation, not causation. For example, lead poisoning is more likely to occur in a house with code violations than in a house without. But the study does not prove that code violations cause or contribute to lead poisoning.

Reducing childhood exposure to lead means addressing deteriorating lead paint in homes. But once a child is poisoned, it is often difficult to determine where that poisoning occurred. This is because

children in Providence move frequently, and blood lead levels change rapidly as exposure changes. If, for example, a child was tested for lead poisoning a week after moving to a new home, and the test came back positive, it would be difficult to know if lead hazards found by DOH in the new home were the only sources of exposure for this child. DOH inspectors do not have jurisdiction to go into a home where a lead poisoned child used to live, only into a home where the child currently lives. Therefore, targeting the addresses where children lived at the time they were tested does not necessarily mean we are targeting the houses that are contributing to the problem.

However, in the case of houses where 5 or more poisoned children have lived; it is very likely that these houses are contributing to the problem. This analysis is supported by the fact that the DOH has identified hazards and has succeeded in obtaining the abatement of only half, or 35, of these houses. As explained earlier, testing precedes an order to abate, which means that a majority of the houses that have housed several poisoned children also were exposing occupants to lead. It would seem reasonable that houses in which more than one poisoned child has lived should be targeted for lead-poisoning prevention programs.

The data themselves presents several limitations. For the analysis concerning housing conditions as indicators of lead poisoning, the risk ratios concerning data from the Office of Code Enforcement might be confounded. There is speculation by the Office of Code Enforcement that

some of these violations are complaint-driven, from tenants who are trying to turn in their landlords for poor housing conditions, including lead hazards. This speculation is based on the idea that the poisoning of a child triggers the complaint, which triggers the violation. If this were the case, the correlation would not be statistically significant. However, the majority of these violations are not complaint driven. Of the 2,419 notices of violation in our database, only 837 or 34% were results of complaints. This is also demonstrated in the maps of the environmental and code violations. Clearly, the Notices of Code Violations are given out along the same street, as would be expected from a routine inspection, but not from complaints. This clustering is evident from the maps. Further examination might be warranted on this subject, if either of the violation indicators is going to be used as a basis for policy.

## **V. CONCLUSION**

Lead poisoning has been an important priority of health officials in the state for many years. In the case of Providence, it is mostly a disease associated with poverty and poor housing condition. Fixing houses, one by one, that have poisoned children will deal with the problem on a small scale. But it will not be eliminated on a larger scale until housing conditions in general are improved. As the City makes efforts to revitalize Providence, we should work to see that the improvements make it to the parts of Providence that need them the most. Then, we will see true

victories in the battles against lead poisoning.

Until we reach that point, the Lead Hazard Reduction grant monies are an excellent place to start. Members of the Providence community are currently trying to figure out which houses should receive funds from the \$4 million HUD grant the City recently received. This study will hopefully help the Mayor's Office direct the funds where they are most needed, by addressing the confidentiality restrictions, difficulties in linking houses to poisoned children, and identifying the most risky houses in the City. It also lays the groundwork for more holistic environmental health programs that focus on not only detection and treatment of problems, but prevention as well.

The Lead Hazard Control grant will provide resources to three different tiers of housing, identified according to severity of risk. The houses with **cases of multiple poisonings** should be put into the top tier, along with the **houses with asthmatics and lead-poisoned children**. **Houses with the indicators associated with poisonings** might go into the third tier, to examine whether or not addressing these houses before they poison children is effective. All of these addresses should be released by DOH, to the people in charge of implementing the grant in any of the following ways:

- 1) Directly. The DOH has waived its confidentiality interpretations before. Releasing them in this case would allow for important progress to be made in the battle against lead poisoning, which

- 2) As part of a composite list of houses, including the highest risk houses and the indicator houses.
- 3) The DOH could also volunteer to contact the houses for the grant staff. This way, no one would have access to the addresses except for DOH, which is within the confidentiality restrictions.

These funds, along with long-term efforts to revitalize the neighborhoods of Providence, will hopefully begin to make our lead poisoning trend a thing of the past.

## Appendix I

To calculate the odds ratio in each analysis, I created a 2x2 table. The population was divided up into four categories, depending on the conditions I was studying. In each case, two of the groups were children who were lead poisoned, with blls of 15 or greater. Two of the groups consisted of children with blls of 0-9. These two groups were divided further, into a group of children living at the addresses being studied and children who were not. These addresses were either those with the housing conditions discussed in the Strategy I, or addresses with asthmatics. In this explanation, these four groups will be referred to as a, b, c and d.

The odds ratio for each analysis is equal to  $a*c / b*d$ . To calculate a 95% confidence interval, I created a lower and upper bound based on the following formula.

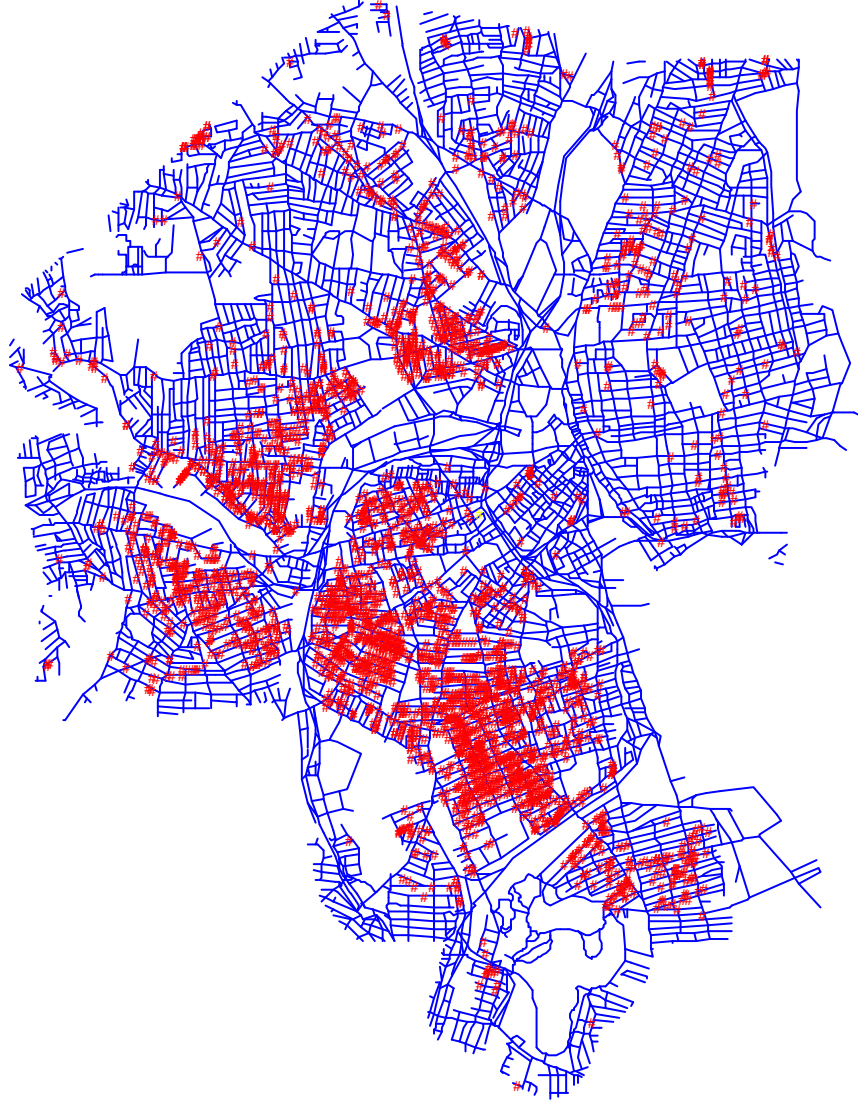
Lower bound:  $e^{\ln(RR) - 1.96\sqrt{\text{var}[\ln(RR)]}}$

Upper bound:  $e^{\ln(RR) + 1.96\sqrt{\text{var}[\ln(RR)]}}$

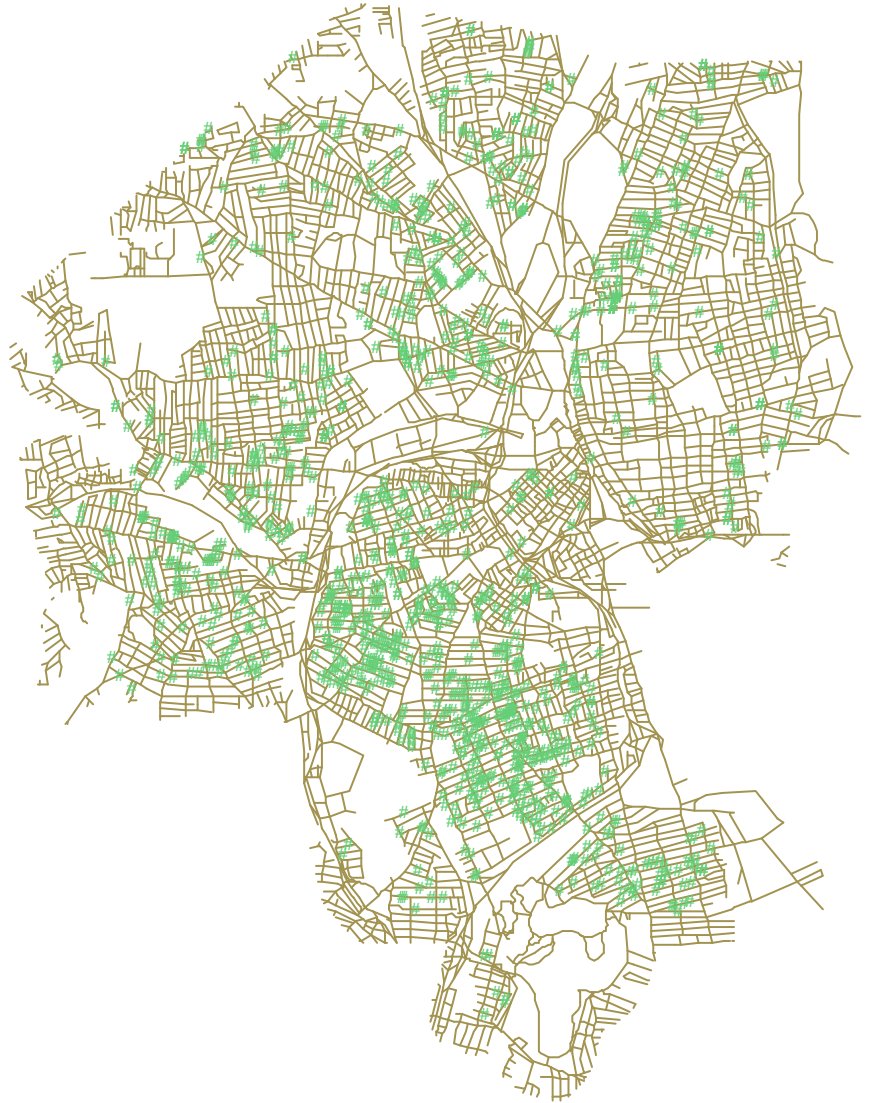
$\text{var}[\ln(RR)] = 1/a + 1/b + 1/c + 1/d$

**FIGURE 4**

**MAP OF ADDRESSES WITH CASES OF LEAD POISONING IN PROVIDENCE**

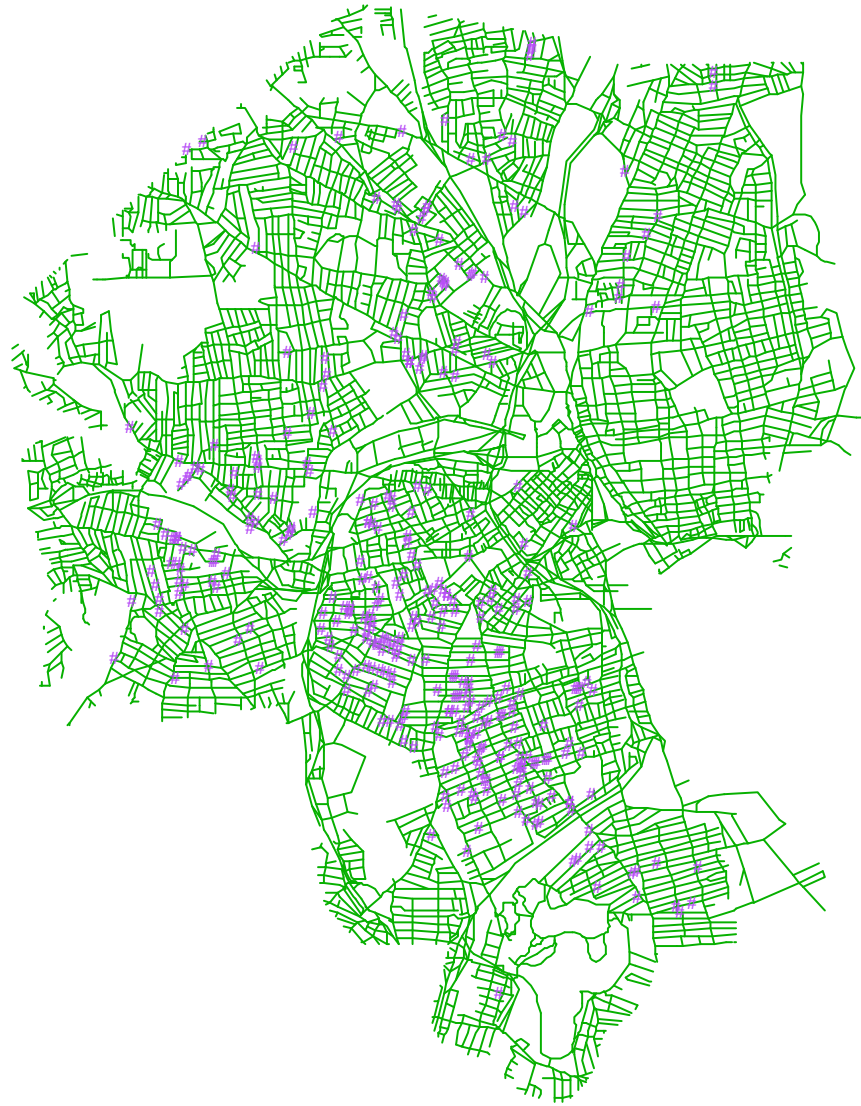


**Figure 5**  
MAP OF ADDRESSES WITH CASES OF ASTHMA IN PROVIDENCE



**Figure 6**

MAP OF ADDRESSES WITH CASES OF LEAD POISONING AND ASTHMA  
IN PROVIDENCE



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