

# Structural Racism in Adverse Health Outcomes from Childhood Lead Exposure in Philadelphia

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*Abstract: Childhood lead exposure poses a significant risk to health and well-being, adversely affecting brain function, nervous system development, and behavioral patterns. Sources of exposure, including dust, soil, consumer products, and water, contribute to this issue, particularly prevalent in Philadelphia due to lead-based paint in older housing units. This literature review examines the health disparities and inequities associated with childhood lead exposure in Philadelphia, focusing on structural racism and residential segregation as crucial lenses for analysis. By delving into the sociocultural context of lead exposure, this study underscores the imperative of collaborative efforts among stakeholders to safeguard Philadelphia's most vulnerable populations. Healthcare professionals and policymakers play pivotal roles in enhancing funding and prevention strategies. Addressing this issue through the prism of structural racism allows for the identification and rectification of systemic and institutional factors contributing to health disparities. Moreover, this review includes a comprehensive policy analysis of existing legislation targeting this concern in Philadelphia. Through stakeholder collaboration and historical insights, this review aims to offer guidance for shielding the city's most at-risk children from lead exposure. Additionally, it evaluates current policies to inform and steer future endeavors aimed at mitigating childhood lead exposure in Philadelphia.*

## INTRODUCTION

The Centers for Disease Control and Prevention assert that no level of lead in children's blood is considered safe. Regrettably, the persistent "silent epidemic" of childhood lead exposure continues, subjecting children to toxic effects that can inflict enduring damage, impacting their health into adulthood. Lead ingestion, inhalation, and dermal absorption all contribute to its entry into the body, resulting in severe harm to the brain, nervous system, impeded development, stunted growth, and psychosocial impairments.<sup>3</sup> This issue gained widespread attention in 2014 when the water supply in Flint, Michigan, was contaminated with lead, sparking a public health emergency that highlighted health disparities and the urgent need for prevention efforts, especially for the most vulnerable populations.<sup>4</sup> In Philadelphia, Pennsylvania, childhood lead exposure remains a pressing public health concern, yet limited data scrutinizes this issue through the lens of structural racism. Understanding the structural components within society that contribute to adverse health outcomes in specific patient populations is crucial for healthcare professionals. It is imperative that physicians comprehend these societal intricacies to effectively safeguard the health and well-being of the communities they serve.

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## PURPOSE STATEMENT

This literature review aims to provide historical context, and improved understanding of how healthcare professionals and policy stakeholders can work together to eliminate the detrimental effects of childhood lead exposure in the most vulnerable populations. The effects of childhood lead exposure are detrimental, making primary prevention of utmost importance. However, it is important to note that primary prevention can only be effective if the issue is approached through a lens that incorporates a holistic understanding of the issue. This literature review attempts to provide insight into the structural components that contribute to health disparities in childhood lead exposure, as a call to action for policy experts, and health care professionals to work together to alleviate the preventable burden to health that childhood lead exposure presents.

Like most causes of morbidity and mortality in the United State of America, childhood exposure to lead is not present equally across all demographics. Childhood lead exposure is concentrated in areas of our country where poverty is present, and due to historically discriminatory laws and regulations, racial minorities are often the hardest hit.<sup>5</sup> Much of the existing literature on this subject acknowledges the health disparities that exist, however, this review is unique in its attempt to provide a historical and socio-cultural context to the issue while integrating various other systemic issues which can be tackled via the same framework. The intended audience for this literature review are future and current healthcare professionals, as well as policymakers and government officials with the roles and responsibilities to enact systemic change. In the context of healthcare, discussions of discrimination are often limited to individual, person-to-person stressors caused by implicit biases in healthcare. This review aims to expand healthcare providers' knowledge on how structural racism affects the health of the communities they serve. Without this education on structural racism, particularly its relation to childhood lead exposure in Philadelphia, vulnerable populations continue to remain disadvantaged.

## METHODS

*Overview:* A review of current literature was conducted to understand the relationship between childhood lead exposure, structural racism in Philadelphia, and potential solutions to mitigate risk. To assess the literature, a database search was conducted through the Rowan School of Osteopathic Medicine Library. Three databases were used, including SCOPUS, NCBI (National Center for Biotechnology Information), and PubMed.

*Search-Term Strategy:* The following search terms were used in each database to collect data: “Lead Exposure OR Childhood Lead Exposure” AND “Philadelphia Lead Levels” AND “Environmental Racism Philadelphia” AND “Structural Racism” AND “Residential Segregation.” Extra terms were added when necessary.

*Inclusion Criteria:* This study included paper written in English, including primary research, and meta-analyses which assessed childhood lead exposure, environmental racism, and historical consideration relating to these topics in Philadelphia. Some papers which assessed trends in the US were also used.

*Types of Studies:* Primary surveys, meta-analyses, systematic reviews, and review articles were used. We did not have a limit on the types of studies used for this literature review.

*Types of Outcome Measures:* This literature review qualitatively assessed historical and socio-cultural factors that influence childhood lead exposure in Philadelphia.

*Data Extraction:* The studies included in this literature review ranged from 2003 to 2021. Information from the methodology, results, discussion, and conclusions were extracted to establish relationships between the study variables.

*Data Analysis:* Data extracted from the literature will be reviewed and synthesized. Analysis will be included in the following sections of the literature review based on theme.

## STRUCTURAL RACISM

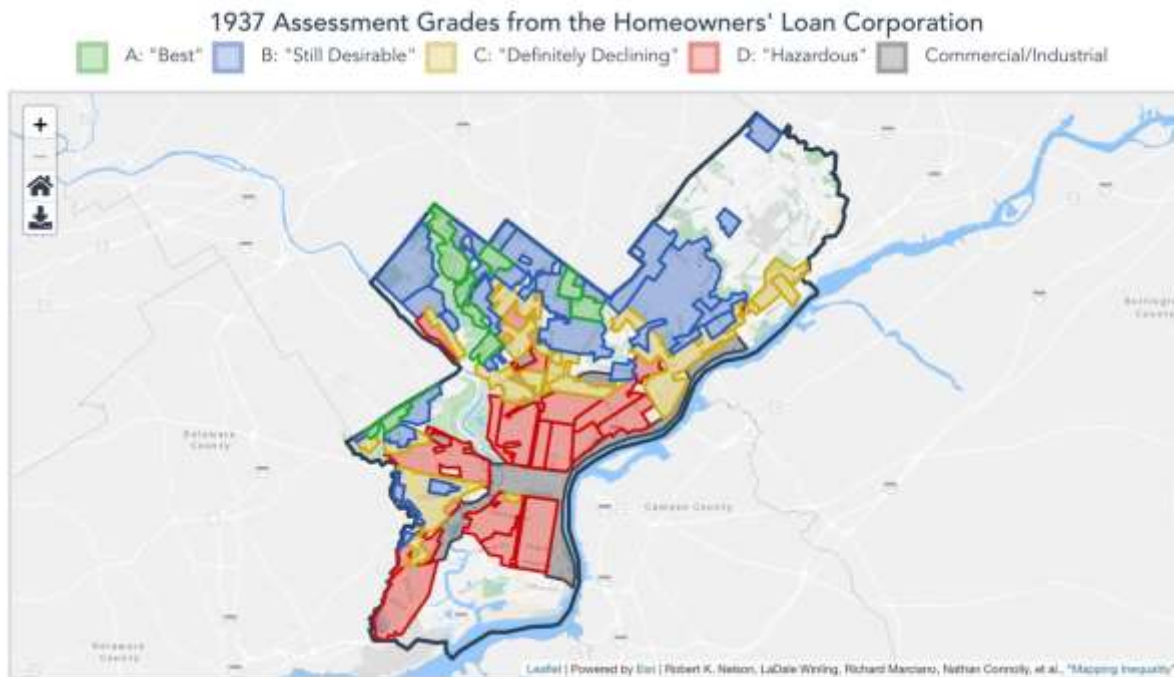
Structural racism embodies societal mechanisms fostering racial discrimination across essential systems, encompassing housing, education, employment, healthcare, and justice.<sup>6,7</sup> The United States has grappled with health inequities rooted in complex histories, predominantly driven by racial disparities. Despite extensive research attributing health inequities to racism, public discourse

often hesitates to acknowledge this reality. Healthcare education predominantly addresses individual experiences of discrimination within healthcare settings, yet fails to encompass broader institutionalized racism's impact on health outcomes.<sup>8</sup> Particularly for Black Americans, historical residential segregation, notably through practices like redlining, has generated enduring and adverse health consequences.<sup>9</sup> Redlining, initiated by the Federal Housing Administration in 1934, deliberately denied mortgages to marginalized groups, perpetuating neighborhood segregation.<sup>9</sup> These discriminatory practices persist, with studies revealing their compounding effects on health outcomes and ongoing segregation. The historical implications of structural racism, especially residential segregation, have curtailed access to healthcare, community resources, education, and social mobility within communities of color.<sup>10</sup>

### *Impact on Childhood Lead Exposure in Philadelphia:*

This literature review contends that residential segregation has profoundly influenced childhood lead exposure in Philadelphia, perpetuating its enduring presence within communities of color. Historical redlining practices illustrate this impact, as evident in the city's neighborhood demarcations. Early in the 20th century, federal and local governments implemented discriminatory practices that barred African American and other minority populations from homeownership.<sup>11</sup> These practices included redlining maps, discriminatory mortgage programs, and racially restrictive deed stipulations, fostering racial segregation and property devaluation, particularly in African American neighborhoods in Philadelphia.<sup>12</sup> Though deemed illegal in 1968, housing discrimination persists today, reflected in higher interest rates and fees charged to African American and Latino homebuyers.<sup>13</sup> Figure 1 illustrates demarcations created by the Homeowners' Loan Corporation in Philadelphia, delineating "Hazardous" and "Definitely Declining" zones that still grapple with concentrated disadvantages and lack of investment. Figures 2 and 3 further depict these regions as socioeconomically disadvantaged, correlating with higher childhood blood lead levels.

*Figure 1. This graph shows the historical redlining practices in Philadelphia. Data sourced from The City of Philadelphia, Office of the Controller.*



## CHILDHOOD LEAD EXPOSURE IN PHILADELPHIA

### *Routes of Exposure:*

Children can encounter lead through multiple sources, including chipping lead-based paints in older homes, soil near aging buildings and roads, drinking water, consumer products, cosmetics, and exposure via parental occupations or hobbies.<sup>14</sup> Predominantly, lead exposure in Philadelphia originates from homes constructed before 1978, where the use of lead-based paint was prevalent.<sup>15</sup> Dust within poorly maintained older homes and historical contamination from lead-emitting industries and leaded gasoline until 1996 further contribute to childhood lead exposure in urban neighborhoods.<sup>16</sup>

### *Vulnerability and Health Impacts:*

Lead exposure, through touch, ingestion, or inhalation, poses significant risks, especially for children under 6 years old. Their developing bodies and behaviors, such as hand-to-mouth contact, increase susceptibility.<sup>15</sup> The CDC reports that there is no safe blood lead level in children, however, the CDC's "level for concern" is at 5 ug/dL. Low levels of lead in the blood have been shown to adversely affect a child's intelligence, academic potential, and ability to stay focused.<sup>17</sup> Irreversible effects of lead poisoning include slowed growth, brain and nervous system damage, learning difficulties, speech impairments, lower IQ, and academic underperformance.<sup>15</sup> Studies also indicate a potential link between lead exposure and increased delinquent behavior, significantly limiting a child's potential and elevating health risks.<sup>18</sup>

### *Detection and Disparities:*

Given its subtle symptoms, screening for lead exposure is crucial for early identification. The Centers for Medicare and Medicaid Services cover the cost of blood lead testing for Medicaid-enrolled children.<sup>15</sup> Unfortunately, lead exposure disproportionately affects communities already grappling with health disparities and limited access to healthcare services.

### *Health Disparities in Childhood Lead Exposure:*

Studies demonstrate stark racial disparities in lead exposure, with non-Hispanic Black children exhibiting the highest rates of elevated blood lead levels (EBLL) compared to other racial groups.<sup>19</sup> Factors contributing to these disparities include socioeconomic status, the construction year of family homes, and race.<sup>20</sup> Gentrification processes, including demolitions of older buildings, elevate the risk of lead exposure, especially in older structures.<sup>21</sup> Historical discriminatory practices, such as redlining by The Home Owners' Loan Corporation in the 1920s and 1930s, have perpetuated a higher risk of lead exposure for Philadelphia's non-Hispanic Black population.<sup>22</sup> Studies reveal strong correlations between EBLL and minority populations, children living in poverty, and non-Hispanic Black communities. Within five zip codes of low-income communities of color in North and West Philadelphia, studies demonstrate that as many as one in 15 children has EBLL.<sup>23</sup> Additionally, studies indicate that children of color in North Philadelphia are 2-2.5 times more likely to suffer from lead poisoning compared to the entire city's children.<sup>24</sup> Race is a significant indicator of risk for lead exposure, as studies have shown that even at the national level, Black children experience 2.8 times higher odds of having blood lead levels higher than 5 ug/dL compared to low-income children who are white and Hispanic.<sup>25</sup> The same study indicated that being Black is the second strongest predictor of having elevated blood lead levels, second only to living in a residence built in 1950.<sup>25</sup> Housing code violations, inadequate funding, and loopholes allowing landlords to evade standards contribute to the persistence of lead in Philadelphia's poorest neighborhoods.<sup>26,27</sup> Many individuals who live in Philadelphia's poorest zip codes are not able to afford the upkeep and renovations in their old homes, which increases the risk of lead exposure. These astounding statistics indicate that the history of racist practices including redlining, poor residence quality, environmental racism, lack of lead law enforcement, and lack of access to equitable healthcare have contributed to stark disparities in Philadelphia. All of these aspects relate back to the concept of structural racism's pervasive effects on health inequality. Figures 1 and 2 show the various disparities in elevated blood lead levels of children in Philadelphia.

Figure 2. This map demonstrates the various zip codes within Philadelphia where EBLL are highest. Data Sources from Philadelphia Department of Health, Childhood Lead Poisoning Surveillance Report, 2022.

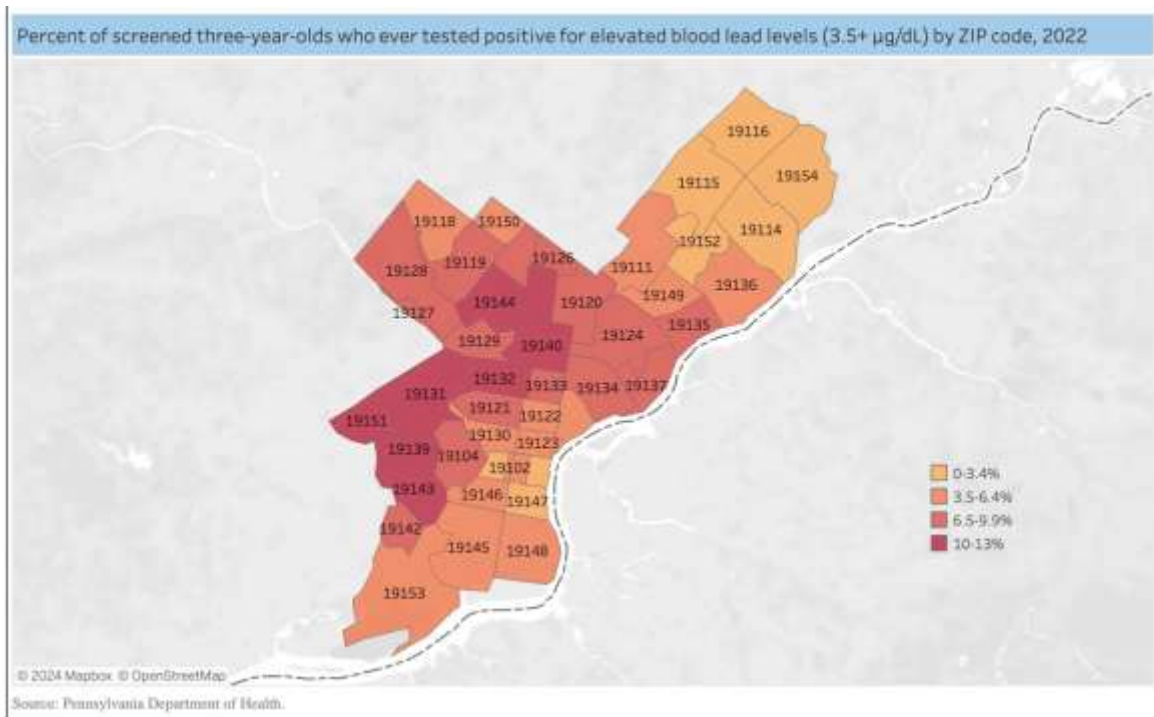
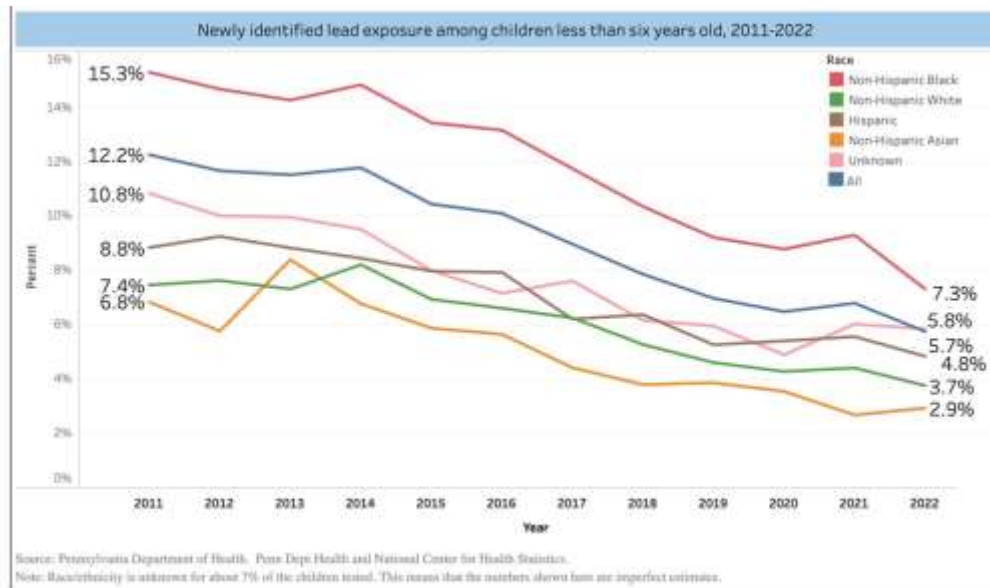


Figure 3. This graph shows the racial disparities which exist for EBLL in Philadelphia. Data Sources from the Pennsylvania Department of Health Lead Surveillance Program.



## *Lessons Learned from Rochester*

Rochester, NY, surpasses the national average for children with elevated blood lead levels, much like Philadelphia. With 87% of housing stock built before 1950, similar to Philadelphia, Rochester poses a significant risk to families moving into these older homes. A majority of Rochester's housing units are rentals, predominantly occupied by low-income families.<sup>28</sup> Increased awareness of elevated blood lead levels led to the formation of the Coalition to Prevent Lead Poisoning (CPLP) in 2000, composed of educators, healthcare providers, and community groups. Their primary aim was to pass a local policy to reduce lead hazards in high-risk housing.<sup>28</sup> The coalition's collaboration with stakeholders and analysis of lead exposure prompted an amendment to the housing code in 2005. This amendment mandated lead inspections of properties built before 1978, the year the United States banned the use of lead paint in residential buildings.<sup>28</sup> By focusing on high-risk areas, with a goal of inspecting rental units by 2010, Rochester managed to conduct 58,177 inspections within the first four years, almost covering all pre-1978 rental properties. Rochester's success stemmed from well-designed legislation, community collaboration, and substantial funding allocation to lead poisoning prevention. The ongoing support from private consultants, academics, government, and community groups facilitated practical analysis and significantly improved lead exposure outcomes.<sup>28,29</sup>

## *Lead Exposure in Philadelphia*

Philadelphia, as one of the oldest U.S. cities, faces a high prevalence of childhood lead exposure, especially in low-income neighborhoods. The primary source of lead exposure is from homes built before the federal ban on lead-based paint in 1978. In 2000, approximately 92% of Philadelphia's housing units were built before 1980, suggesting the persistence of lead-based paint within these homes.<sup>30</sup> Lead exposure in Philadelphia also arises from ingesting lead-contaminated house dust and soil, particularly in older, poorly maintained housing. Historical factors such as lead-emitting industries and leaded gasoline emissions until 1996 further contribute to soil lead contamination in urban neighborhoods.<sup>32</sup> However, lead-based paint remains the primary culprit for lead exposure in older housing units.<sup>33</sup>

## *Philadelphia Laws and Primary Prevention Programs for Lead*

In December of 2016, Mayor Jim Kenny released the Lead-Free Kids program: Preventing Lead Poisoning in Philadelphia. This is a plan to improve the city's efforts to prevent lead poisoning in Philadelphia children.<sup>33</sup> This plan included new commitments by City departments, including the Philadelphia Department of Health and the Department of License and Inspections, to prevent lead exposure and prevent adverse health effects in Philadelphia children. In addition to the program, the mayor created the Childhood Lead Poisoning Prevention Advisory Group to review and analyze Philadelphia's commitments and offer recommendations to reduce lead poisoning in the city.<sup>33</sup> While these initiatives provided primary prevention methods, legislative and programmatic actions are necessary to tackle lead exposure effectively.

Philadelphia has three significant laws focusing on lead-based paint in housing units and testing lead levels in children:

- I. The Lead Paint Disclosure and Certification Law
- II. The Rental Property Lead Certification Law, and
- III. Testing Lead Levels in Children

The Lead Paint Disclosure and Certification Law requires landlords renting housing units built before 1978, where children under the age of six live to have the residence inspected and certified as "lead-safe" or "lead-free." The Rental Property Lead Certification Law was recently passed in October of 2019. It included all rental units to be certified as "lead-safe" or "lead-free" before a rental license is granted, regardless of a child's age. This law targets specific zip codes in Philadelphia for compliance and will establish prioritization until April of 2022. Testing Lead Levels in Children is an ordinance that requires physicians to test any child between 9 to 21 months of age for a blood lead level. Although these laws have been implemented and are expected to reduce lead poisoning in children effectively, compliance is still lacking. According to the City of Philadelphia's 2022 surveillance report, there was a decrease in children with previously unknown lead exposures from 12% in 2011 to 6% in 2022.<sup>34</sup>

To effectively address child lead exposure in Philadelphia, it is imperative to analyze the laws and regulations implemented, assess their feasibility, and provide recommendations to make the laws more impactful. This will be done by looking at the Centers for

Disease Control and Prevention's Policy Analytical Framework. Using this framework, the current laws and regulations on child lead exposure will be analyzed for their efficacy and feasibility. Policy recommendations will then be made to ensure that these laws have 100% compliance and reduce child lead exposure in Philadelphia.<sup>35</sup>

CDC's Policy Analytical Framework included two extensive tables that included framing questions, criteria for the policies, and prioritizing policies based on public health impact, economic impact, and budgetary impact. For each law, specific questions that were in CDC's analytical framework were answered. These questions centered around policy objectives, historical context, how the policy addresses the problem, and gaps in the data. The existing laws on lead exposure and lead-based paint were reviewed and compared to the tables to assess their effectiveness and feasibility. The policy analysis's inclusion criteria were any law within Philadelphia that focused solely on lead-based paint in rental units and testing lead levels within children. The exclusion criteria were any laws outside of Philadelphia and laws that did not focus on lead-based paint or testing in children. The last step of the analysis was strategy and policy development and worked to clarify operational issues and help identify research questions that needed to be addressed.<sup>35</sup>

## POLICY ANALYSIS

### *Lead Paint Disclosure and Certification Law- Bill No. 100011-A*

The Philadelphia Lead Paint Disclosure and Certification Law was passed in December of 2011 and was a significant step in addressing lead exposure. This ordinance was in Chapter 6-800 of the Philadelphia code entitled "Lead Paint Disclosure" and requires landlords to provide certification that their housing units are "lead-safe" or "lead-free." This ordinance applies specifically to residential properties built before March of 1978. However, it excludes the following: dwelling units for an educational institution for occupancy by students, units that are leased for students enrolled in a university degree program, and children over the age of 6 living in dwelling units.<sup>36</sup> This ordinance's primary focus was dwelling units built before March of 1978 because of the prevalence of lead-based paint.

The City of Philadelphia concluded that most housing built before 1978 contains dangerous paint levels and should be remediated before families move into the property. The goal for rental properties containing lead would be that after remediation, the property is certified "lead-free," but due to extra resources that may be required, "lead-safe" is the more feasible goal. "Lead-Free" is defined by the City of Philadelphia as the circumstance in which the interior and exterior of a property do not contain any lead-based paint, and the property contains no lead-contaminated soil or dust. "Lead-safe" is when the property is free of the condition that causes exposure to lead from lead-contaminated dust, soil, lead-based paint, or other threats of lead exposure due to the condition of the housing unit.<sup>36</sup> Before a buyer is obligated under the contract to purchase or lease a housing unit built before 1978, the seller is required to provide the buyer with a lead hazard pamphlet and a valid certification prepared by a certified lead inspector. This certification must state that the property is either lead-safe or lead-free, and the buyer must sign a copy of this certification. The valid certification should state that the inspector determined that the property was free of any deteriorated paint, and the dust samples collected complied with EPA regulations.<sup>36</sup> Failure to comply with the ordinance can result in fines of up to \$2,000 per offense, with each day of non-compliance resulting in a separate offense.<sup>36</sup> Figure 1 shows estimates for progress on compliance with the Lead Paint Disclosure Law as of May 2017. There are about 18,000 properties subject to the law in Philadelphia, and as of 2017, 4,300 have been reached regarding compliance. That is 24% of properties subject to the law. In addition, 2,000 lead-safe or free certificates are on file, which is 11% of all properties subject to the law.<sup>33</sup>

### *Rental Property Lead Certification Law- Bill No. 180936-A*

The Rental Property Lead Certification Law was an ordinance passed on October 2<sup>nd</sup>, 2019, and was in full effect in October of 2020. This ordinance was an amendment within Title 6 of Philadelphia's Health Code and is the newer version of Philadelphia's Lead Paint Disclosure Law to improve compliance with the ordinance. The ordinance focuses on lead paint hazards and other violations of lead safety. Like the Lead Paint Disclosure Law, this ordinance also focuses on rental properties but includes all rental properties, regardless of the year built.<sup>36</sup> In addition, specific zip codes are targeted to assess areas with a high prevalence of children with elevated blood lead levels (EBLLs). As mentioned in the ordinance, for each active zip code in the city, the health department will certify the percent of screened children living in zip codes with a high prevalence of EBLLs during a set time. The department will then post the zip codes in rank order, starting with the zip code with the highest prevalence of children with EBLLs.<sup>36</sup>

The City of Philadelphia established four regions in which the ordinance will take effect. First, the areas of Philadelphia that comprise the eleven highest rank zip codes will be Region I. The following eleven zip codes will be Region II, then the next eleven are Region III, and the remaining zip codes comprise Region IV. The Department of Public Health will assess lead exposure according to the designated regions, post the data on its website, and will file a copy with the Chief Clerk of Council. The four regions will be assessed as follows: October 2020- March 31<sup>st</sup>, 2021 will be Region I. April 1<sup>st</sup> to September 30<sup>th</sup>, 2021 will be Regions I and II, October-March 2022 will be Regions I, II, III, and anything after April of 2022 will be all regions.<sup>36</sup> Failure to comply with the ordinance will result in penalties of no more than \$2,000 per offense, similar to the Lead Paint Disclosure Law.

### *Testing Lead Levels in Children- Bill No. 180937-A*

Testing Lead Levels in Children was an ordinance passed on June 5th, 2019, and was an amendment of Philadelphia's code entitled "Preventative Medicine." This ordinance established requirements for the testing of blood lead levels in children under specific terms and conditions. First, a physician treating a child between 9 to 21 months of age whose blood lead level has not been tested shall test the lead levels at the first practical opportunity. Second, a physician treating a child between 21 to 72 months of age that has not been tested shall be tested at the first practical opportunity.<sup>36</sup> Some exemptions of the ordinance include a) if the testing may be detrimental to the child's health and b) if the parent objects to testing due to religious, moral, ethical, or other grounds.

Despite the passing of the Lead Levels of Children ordinance, rates of lead testing have not shown a significant improvement. According to the 2022 Philadelphia Lead Surveillance report, fewer children were tested for lead exposure in 2022 than before the start of the COVID-19 pandemic. In 2022, it is approximated that only 27% of three-year old children were screened for lead exposure. Although these trends in data may be attributable to the disruptions in healthcare caused by the COVID-19 pandemic, it is important to note that the rates of screenings still have not returned to pre-pandemic levels.

Figure 2 looks at newly identified children with venous BLLs greater than 3.5 ug/dL by zip code in 2022. The findings show the zip codes with the highest percentage of newly identified children are centered primarily in West and North Philadelphia.<sup>34</sup> This data indicates that significant work still needs to be done to address existing health disparities within these districts of Philadelphia, despite the efforts of new bills such as Bill No. 180937-A.

### *Prioritizing Lead Laws in Philadelphia*

Using the CDC's policy analytical framework, the laws were ranked according to their public health impact, feasibility, and economic and budgetary impacts. Table 2 shows the CDC's framework and the law rankings. The laws ranked at the top in its public health impact were the Philadelphia Lead Paint Disclosure and Certification Law and the Rental Property Certification Law. These laws have an extensive reach, effect size, and impact on the population affected by lead exposure in Philadelphia. The laws focus on primary prevention measures and therefore attempt to eliminate the source of the exposure before the child becomes poisoned. Testing lead levels in children is a medium impact solely due to the secondary prevention measure; the child is already exposed to lead, but this law helps identify areas with a high prevalence of child lead exposure.

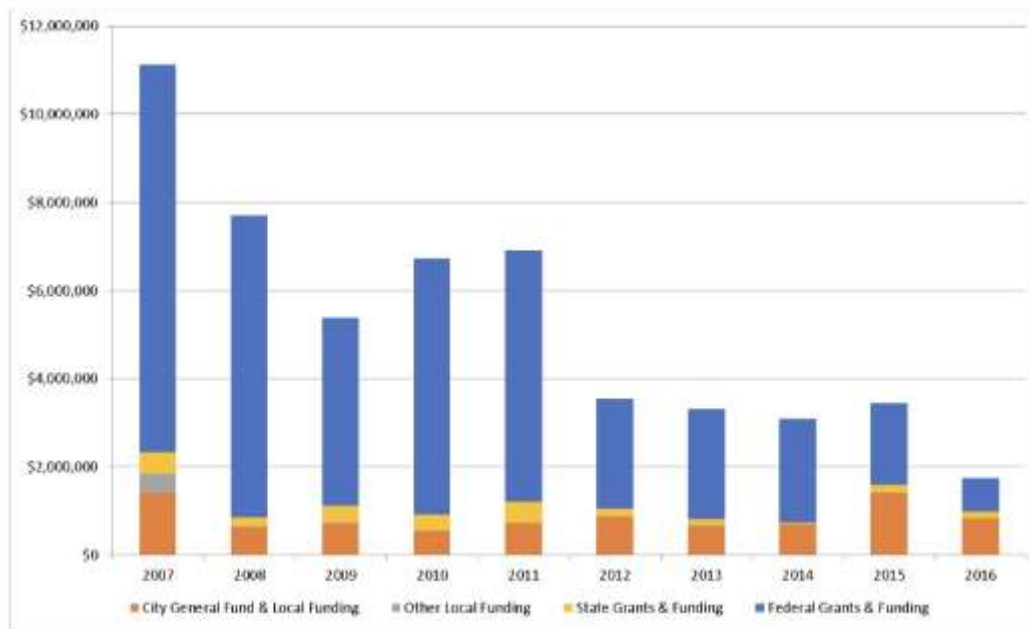
All three laws have been enacted, but the Rental Property Lead Certification law was just recently enacted. Due to its breakup of zip codes according to the year and the emergence of the COVID-19 pandemic, the law's implementation has been delayed. Testing Lead Levels in Children is more favorable in terms of economic and budgetary impact because most insurance companies cover the cost of lead testing. Many private insurance companies and children covered by Medicaid receive free testing services.<sup>37</sup> The least favorable and most costly policy to implement is the Rental Property Lead Certification Law. Because this requires all rental units to certify they are lead-free or safe, this requires additional funding and more resources to implement. A majority of rental units built after 1978 will not have lead-based paint present in the home and will not pose a significant risk to the child. Funding is already lacking in lead primary prevention programs. Therefore, it is more cost-effective to use the funding on the Lead Paint Disclosure Law to improve implementation and compliance and focus more on pre-1978 rental units. The Lead Paint Disclosure Law was favorable in terms of economic and budgetary impacts, and the cost to benefit ratio is desirable. This law is a primary prevention measure that focuses on properties with a significant risk of lead exposure. If provided enough funding, it would be very practical to fully implement in Philadelphia.



Compliance

One major issue with the implementation of the three ordinances for lead exposure was the lack of compliance. The Lead Paint Disclosure and Certification Law was a significant step in the right direction. However, a lack of compliance made the ordinance largely ineffective at reducing lead exposure in the housing units. This is apparent in figure 1- a small percentage of lead-free and safe certifications were provided. The Rental Property Lead Certification Law was passed as an update to improve compliance, but there is no data available because it was just implemented in 2020. A significant reason for the lack of compliance in landlords is the high costs of remediation. Average lead abatement, specifically the mitigation of lead, costs more than \$1,000 per housing unit, including sealing old paint with new paint and covering affected areas with new siding or drywall. This does not eliminate the source of the exposure, and therefore would be done frequently. To create a lead-free environment, elimination would cost approximately \$15,000 or more per unit.<sup>38</sup> Figure 4 illustrates federal and state funding received for lead poisoning prevention programs in Philadelphia from 2007-2016. Funding significantly fell, and as a result, landlords would most likely be paying out of pocket for lead remediation services in their housing units.

Figure 4. This graph shows the funding for lead poisoning prevention at the Philadelphia Department of Public Health between the years 2007 – 2016. Data Sources from the Pennsylvania Department of Health Lead Surveillance Program.



LIMITATIONS AND RECOMMENDATIONS

The policy analysis's major limitation was a lack of data on compliance with the most recent ordinance passed- the Rental Property Lead Certification Law. Implementation of this ordinance would have started in October of 2020, but the pandemic COVID-19 emerged in January of 2020 and most likely pushed implementation from occurring. This made it difficult to assess the Rental Property Lead Certification Law's efficacy at reducing lead exposure in Philadelphia.

To effectively reduce lead exposure in Philadelphia, there must be proper funding, increased collaboration, and better prioritization of zip codes at the greatest risk. First, a funding program must be created on an at-need basis for landlords who cannot afford lead remediation. This will significantly improve compliance with the Lead Paint Disclosure and Certification Law. In addition, the Rental Property Lead Certification Law should remain focused on establishing prioritization of at-risk zip codes but should only focus on pre-1978 rental units because that will likely contain lead-based paint, which is the most significant source of lead exposure in

children. This will be more cost-effective, save time, and ensure that children living in older housing units are protected from the threat of lead poisoning. Also, there must be an increased collaboration with stakeholders, specifically the Pennsylvania Department of Health and Philadelphia Department of Health. Both organizations have separate child lead surveillance reports, and the data on testing lead levels in children both state and county-wide differ. The CDC's child lead exposure screening recommendations should be implemented in both the Pennsylvania and Philadelphia Department of Health to yield consistent results and help to characterize the risk in children.<sup>37</sup>

Lead remediation and policies in Rochester, NY, were successful within four years of implementation because of the ongoing collaboration with several stakeholders determined to reduce lead exposure in the city. Furthermore, Rochester made a conscious effort to increase their resource base, both in training and ensuring there were enough lead contractors to meet the community's needs.<sup>28</sup> Lastly, establishing prioritization of at-risk neighborhoods will effectively address lead poisoning in Philadelphia's most affected zip codes. The Rental Property Lead Certification Law is working towards implementing this in its four region plan and will be crucial to protect the health of Philadelphia children.

This review involved the analysis of a diverse array of studies, however, the generalizability of the results we have accumulated is limited. The data extrapolated to Philadelphia, is assumed to apply to many urban cities in the USA, where there is a history of redlining and residential segregation. However, it is important to note that some cities have been affected by this history more so than others because local governments may have put more funding and effort into alleviating these issues, as compared to Philadelphia. A proposed study idea for a meta-analysis can be a policy review of several US cities comparing lead laws and housing regulations. Future studies should assess which policies have worked in different locations, and which cities have allotted funding towards combating structural issues which contribute to health disparities. Additionally, there are other social determinants of health and comorbidities that should further be examined that are related to structural racism, as it permeates the lives of many individuals.

## CONCLUSION

The literature extensively underscores the pivotal role of a historical perspective in comprehending the roots of health disparity in Philadelphia, particularly concerning childhood lead exposure within the context of racial residential segregation. Structural racism, operating through various channels, significantly impacts community health. Factors such as deteriorating housing conditions in neighborhoods inhabited by people of color, deficient built environment standards, exposure to environmental pollutants, limited educational and employment opportunities, and constrained healthcare access all contribute to this issue.

In Philadelphia, historical practices that fostered residential segregation have notably increased the risk of lead exposure among non-Hispanic Black children. The detrimental repercussions of lead exposure pose an imminent threat of irreversible harm to children, necessitating urgent intervention. The compounded effects of residential segregation on healthcare access further exacerbate these challenges. The City of Philadelphia's reports unequivocally highlight the undeniable disparities in lead exposure. However, addressing these disparities transcends individual efforts due to socioeconomic constraints prevalent in this population. In the next section of this report, we will analyze ongoing efforts across the nation, and within Philadelphia to combat childhood lead exposure.

In Philadelphia specifically, recommendations to address childhood lead exposure must be developed on the institutional level. The entities which contributed to these issues historically, should lead the way in addressing and funding the solutions. Namely, the Federal Housing Commission, as well as local stakeholders within Philadelphia should work to increase funding for the enactment and enforcement of laws and regulations in Philadelphia's most vulnerable neighborhoods to prevent childhood lead exposure. Further research should be conducted, including a policy analysis of the various laws and regulations within Philadelphia pertaining to housing. By conducting a policy analysis, it is possible to evaluate the efficacy of these policies and establish whether they are properly enforced. This research has the potential to save the children of Philadelphia from the adverse effects of the "silent epidemic" of childhood lead exposure.

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