Reducing Childhood Asthma Complications and Lead Poisoning through Equitable Housing in St. Louis City: Recommendations for a Municipal Program

Laura McNulty
Capstone for Masters Degree in Public Health
Brown School at Washington University in St. Louis
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Executive Summary

In the City of St. Louis, rates of childhood asthma complications and lead poisoning exceed state and national averages, with Black children disproportionately affected relative to white children. Despite progress due to prevention and treatment strategies such as high-risk asthma screening and clinical linkage, parental education programs, blood lead testing, and residential property lead remediation, both problems have endured. These public health concerns are shaped by multiple systemic forces, including poverty, structural racism, housing and environmental law and policy, and access to health care and public health services. Poor quality housing is a common risk factor for both asthma complications and childhood lead poisoning, but an equitable housing program has not yet been attempted in St. Louis to address both conditions in an integrated manner. The City of St. Louis Department of Health is already working to address this complex problem, and is positioned to enhance its leadership role as a backbone organization for collective impact efforts. The proposed program is grounded in social ecological theory and principles of environmental justice and health equity. The program incorporates evidence-based public health interventions, leverages existing resources, and is modeled on established healthy homes programs. The program intervention will target residential property owners, parents of children ages 19 years and younger, and housing and health providers serving selected zip codes in the City of St. Louis. The program is estimated to cost $11.4 million over four years, and to result in 75% reductions in the prevalence of lead poisoning and emergency department visits due to asthma within this time period. In partnership with stakeholders, including the newly formed STL Healthy Homes + Energy Efficiency Coalition, the City of St. Louis Department of Health is positioned to address root causes of this critical health equity issue by aligning system design to intended impact.

Public Health Issue: Childhood Asthma and Lead Poisoning in St. Louis

The issues of childhood asthma and lead poisoning lie at the intersection of health equity and environmental justice. A shared understanding of both concepts is essential to guide both the definition of the problem and the development of solutions. The Robert Wood Johnson Foundation states: “Health equity means that everyone has a fair and just opportunity to be as healthy as possible. This requires removing obstacles to health such as poverty, discrimination, and their consequences, including powerlessness and lack of access to good jobs with fair pay, quality education and housing, safe environments, and health care.”[1] The National Academies of Science, Engineering, and Medicine defines health equity as “the state in which everyone has the opportunity to attain full health potential and no one is disadvantaged from achieving this

potential because of social position or any other socially defined circumstance," and highlights the need to "confront historical and contemporary injustices" that perpetuate disparities.[2] The Principles of Environmental Justice, as adopted in 1991 by the First National People of Color Environmental Leadership Summit, affirm that the burden of environmental harms should not merely be redistributed more equally between groups, but eliminated altogether.[3] The Energy Justice Network points out that environmental justice is necessary to contend with the existence of environmental racism, defined as "the disproportionate impact of environmental hazards on people of color."[4] Health equity and environmental justice cannot be achieved without explicitly naming the impact of institutional racism and the distribution of power and resources. Likewise, the burden of childhood asthma and lead poisoning cannot be eliminated without solutions that are grounded in commitment to racial equity and social justice.

Asthma and lead poisoning can have life-long consequences for children. Asthma complications can lead to emergency room visits, hospitalizations, and missed school days, with consequences for academic achievement. Unmanaged asthma can interfere with sleep, causing fatigue and poor performance in school, as well as with play and physical activity, with consequences for obesity and overall health.[5] While asthma can be controlled with medication, lack of access to a regular source of health care is associated with increased emergency room visits due to asthma.[6] In St. Louis City, 11.2% of children are estimated to have asthma, compared to a national prevalence of 8.4%.[7] Furthermore, the rate of emergency room visits for asthma-related complications is more than ten times higher for Black children age 19 or younger (42.4 visits per 1,000 population) compared to white children (3.9 visits per 1,000 population).[8]

Elevated blood lead levels (BLL) in children are associated with serious health effects, including learning disabilities, behavioral problems, delayed growth and development, and reduced cognitive function. Infants and young children are especially vulnerable to lead exposure, as their developmentally normal exploratory behavior can lead to ingestion of environmental toxins. Children's developing nervous systems are highly susceptible to lead toxicity, and their gastrointestinal tracts more easily absorb lead, particularly if the child is iron deficient.[9,10] While no level of lead is considered safe, the Centers for Disease Control and Prevention has established 5 µg/dL as the threshold requiring follow-up services, which was reduced from 10 µg/dL in 2012.[11] In St. Louis City in 2015, 8.5% of children under age 6 who were screened for lead poisoning were confirmed to have a blood lead level (BLL) 5 µg/dL or greater, and 1.7% had a BLL 10 µg/dL or greater. In comparison, the rates in Missouri overall were 3.8% and 0.65%, respectively, among children screened. Black children in St. Louis City

were found to be 2.4 times more likely to test positive for lead than white children, accounting for over 70% of all cases of elevated BLL.[12]

There is substantial overlap in the root causes of risk factors for childhood lead poisoning and asthma-related complications, including exposure to high concentrations of air pollution, poor quality deteriorating housing, and low socioeconomic status. To disentangle the upstream and downstream factors, social ecological theory offers a lens for understanding health outcomes as the product of interacting forces across multiple contextual levels.[13] A causal framework illustrating the pathways leading to these adverse outcomes across individual, interpersonal, institutional, community, and policy levels is presented in Appendix A.

Policy and Community Context

Across the United States, discriminatory housing and urban planning policies have concentrated Black and low-income families in neighborhoods zoned in the vicinity of polluting industries, with poorly maintained housing and high vacancy rates, and with few opportunities for economic advancement.[14] In St. Louis, the legacy and continued existence of residential segregation and the resulting health and economic inequities are well documented.[15,16] Further, St. Louis is one of the oldest cities in the county, state, and nation in terms of housing stock, with nearly 90% of residences built before 1980 and 55% built in the 1930s or earlier.[12] Drawing from social ecological theory, residential segregation, income and wealth inequality, and older housing stock may be considered elements of the policy and community context that influence health outcomes. Indeed, neighborhoods that have the highest proportions of Black and low-income residents, public housing developments, and vacant properties are the same neighborhoods where elevated lead levels and rates of asthma-related emergency room visits are disproportionately found among children.[6,12,15,17]

These structural elements, however, do not inevitably lead to hazardous home environment conditions. The relationship to chipping paint, structural deterioration, and poor ventilation systems is modified by weak enforcement of housing policies. In St. Louis City, all properties that are located in the unified Housing Conversation District (which now covers 98% of all residences) must obtain a city inspection and be issued a Certificate of Inspection prior to occupancy of a residential unit, which generally pertains both to rentals and sales.[18] The city ordinance that was established (and amended) to streamline the regulations necessary to preserve and improve the city's aging housing stock explained its intent that "requirements of the Certificate of Inspection for occupancy will serve as a valuable tool toward enforcing the minimum housing standards and securing the health and safety of all residents of the City of St.

Louis."[19] Ordinance No. 69202 did not specifically require environmental sampling for lead or other hazards, though it did define minimum criteria for visual inspection pertaining to sanitation, structural conditions, safety features, water damage and leaks, and pest infestations, all of which can create conditions that exacerbate asthma and contribute to chipping of lead-based paint. However, in practice, inspection criteria are limited to checking for minimal interior building code violations and adherence to minimum exterior standards, and the certificate explicitly does not guarantee the overall condition of the property.[18] Without strengthening and enforcing inspection criteria to resolve disconnects between the city ordinance and actual practice, low-income families are easily permitted to move into properties that may adversely affect their health and safety.

These hazardous home conditions can reinforce and exacerbate one another, resulting in exposed lead-based paint and dust, rodent and pest infestations, and mold growth, among other hazards. Again, this relationship is modified by weak housing policies that give renter households little recourse when property owners refuse or neglect to make necessary repairs and improvements. Since 1973, the state of Missouri has recognized the implied warranty of habitability, which requires landlords to keep their property fit for living, even if the lease does specifically require them to make repairs.[20,21] While the warranty is generally interpreted to allow tenants to withhold rent if a landlord refuses to make repairs, a 2018 Missouri Supreme Court decision allows trial courts to decide whether a tenant must deposit withheld rent with the court in order to assert the implied warranty of habitability. This discretion can put tenants at risk of eviction for non-payment of rent, with little legal recourse.[21] Furthermore, this implied warranty of habitability is one of few legal tools available to low-income tenants in Missouri to hold landlords accountable to maintaining safe and healthy residential properties.[22]

Institutional, Interpersonal, and Individual Context

In general, children can be exposed to lead from a variety of sources, including industrial air emissions; soil contamination from housing demolition and settling of lead-containing emissions; direct inhalation, ingestion, or dermal absorption of lead-based paint or dust; or drinking water contaminated by lead service lines.[12,23] Children can develop asthma from chronic exposure to allergens and respiratory irritants, which are also implicated in exacerbation and complications of existing asthma. Sources include vehicular and industrial source pollution; inadequate indoor ventilation; and the presence of mold, cockroaches, tobacco smoke, and other indoor air pollutants in housing.[6] There is substantial overlap in root causes related to housing exposures. Further, there is evidence that stress can modify the magnitude of the

individual immune response to toxins, putting children facing the stress of unsafe living conditions, poverty, and racism at further risk.

Once children have been exposed to lead or have mounted an immune response to asthma triggers, the relationship to elevated blood lead levels and asthma exacerbation is modified by local institutional capacity for blood lead screening, home assessment and inspection for environmental toxins, and remediation of hazards. Local capacity in St. Louis is shaped by the regulatory environment, particularly in its implications for funding and resource availability. At the federal level, the Residential Lead-Based Paint Hazard Reduction Act of 1992 and its implementing regulations require property owners to disclose any known presence of lead based paint prior to selling or renting residential units, but the regulations do not require proactive evaluation nor remediation to take place.[24] On the other hand, public housing and units rented under the federally subsidized Housing Choice Voucher Program require inspection and abatement or interim controls prior to occupancy.[24] At the state level, Missouri law requires lead inspection of private property only in cases where a child under the age of 6 years has already tested positive for elevated blood lead levels; the law requires abatement if lead is found, and offers some protection from eviction.[25] For mold and other common indoor air pollutants and asthma triggers, there are no state or federal laws that set standards regarding acceptable types or levels of exposure in private property.[26]

In terms of institutional resources to address lead in St. Louis, federal, state, and municipal funding for prevention and remediation have declined in the last ten years.[12,27] This followed a surge of funding in the 1990s and early 2000s from the U.S. Department of Housing and Urban Development (HUD), CDC's Childhood Lead Poisoning Prevention Program (CLPPP), Missouri Foundation for Health, and the City of St. Louis municipal budget, which all supported programs that resulted in significant declines in childhood lead poisoning due to housing exposures.[28] Lead poisoning had already been declining in St. Louis since the late 1970s, following national trends, as the elimination of leaded gasoline, restrictions on allowable levels of lead in paint, the ban on lead in plumbing, and rulings on lead in drinking water all contributed to a 95% reduction in median BLL among children ages 1 to 5 years between 1976-1980 and 2013-2014.[29]

Without national and local leadership focused on the persistence of lead in high-risk neighborhoods, however, resources are now more limited for screening, inspection, and abatement programs. Although all of St. Louis City is considered a high-risk area requiring universal testing by the Missouri Department of Health and Senior Services, and annual blood lead testing is available free of charge for pregnant women and children under age 6 at the City

of St. Louis Department of Health (and is required for children receiving Medicaid between 12 and 24 months of age), screening rates in St. Louis City have stagnated at less than 50%.[12,30] Similarly, while the City of St. Louis offers free lead inspection of homes where children under age 6 or pregnant women reside, and limited financial assistance is still available for property owners who qualify, the number of homes undergoing inspection and full remediation has also declined, from nearly 800 in 2009 to only 81 in 2018.[31]

In terms of resources for addressing asthma trigger remediation, without regulatory drivers in place, most programs in the City of St. Louis originate in school systems or in hospital-based education, clinical linkage, and treatment programs with limited budgets, rather than in housing programs.[7,32–34] In social ecological theory, such programs operate at the institutional level, proximal to the community and policy levels. Without greater resource capacity, children who are exposed to lead or respiratory triggers are likely to experience elevated blood lead levels or asthma exacerbation.

The final set of causal links to lead poisoning and emergency department visits due to asthma is modified by access to health care. When children lack access to treatment by a primary care physician or specialist, they may not receive appropriate follow-up care for elevated blood lead levels, which can range from re-screening or venous testing, to nutrition and therapeutic intervention, to chelation therapy or hospitalization, depending on acuity. Similarly, without access to asthma control medication, rescue inhalers, and continuity of follow-up, children with asthma may experience asthma attacks requiring emergency care. As demonstrated by the causal framework, the demographic patterns of lead poisoning and asthma complications are not random; they reflect the outcomes of a system undergirded by structural racism and weak regulations that fail to protect vulnerable and low-income families, leading to a disproportionate burden of both conditions on Black children in St. Louis City.

Target Population and Catchment Area: Parents, Property Owners, and Providers

In 2019, the Interdisciplinary Environmental Clinic (IEC) at Washington University School of Law released a report titled *Environmental Racism in St. Louis,* in collaboration with clients Action St. Louis, Arch City Defenders, Dutchtown South Community Corporation, and Sierra Club. The report highlighted environmental factors that disproportionately harm Black residents' health and well-being, including mold, air pollution, high energy bills, limited access to nutritious food, illegal trash dumping, and vacant properties, along with lead poisoning and asthma.[17] While this was the first report that consolidated in a single document the variety of environmental risks facing Black residents and neighborhoods, it built on previous work and

lived experience. Most recently, *For the Sake of All* (2014), *Segregation in St. Louis: Dismantling the Divide* (2018), and the City of St. Louis's *Equity Indicators: Baseline Report* (2019) have called attention to these issues. It is important that next steps are likewise grounded in community context and history.

The target population for this intervention includes the parents and caregivers of children under the age of 6 living in six zip codes (63120, 63115, 63107, 63147, 63113, and 63118), the owners of properties where these families live (both owner-occupied and rental), and housing and health care professionals who work in these neighborhoods. These zip codes are burdened by a confluence of three major risk factors: high rates of severe health-related housing violations, high concentrations (third or fourth quartile) of children with BLLs greater than 5 µg/dL, and high or moderate clustering of high childhood asthma rates. These zip codes also overlap with census tracts with a high concentration of houses built before 1980, a high percentage of families living below the poverty level, and low median earnings.[6,12] This program seeks to target those households most at risk; however, as there are additional zip codes that have one or two of the above three risk factors, but not all three, will not exclude families in other zip codes who seek program services. Importantly, several non-included zip codes have high clustering of high childhood asthma rates that are partly attributed to outdoor air pollution from proximity to highways and polluting industry,[6] which would not be directly addressed through this program.

Based on the most recent data from the Missouri Environmental Public Health Tracking (EPHT) program, in 2015 there were 949 emergency room visits due to asthma among children ages 19 and under living in the catchment area. These 949 visits represented 46% of all emergency room visits due to asthma among children in St. Louis, although only an estimated[*] 36% of the city's 19-and-under population resides in these zip codes. Furthermore, 894 (94%) of these emergency room visits were by Black children. The estimated incidence rate among all children ages 19 years and under in the catchment area, based on population projections for 2015, was 36.6 visits per 1,000 population. In terms of lead poisoning, in 2018 there were 282 children ages 5 and under with elevated BLL (5 µg/dL or higher) living in the catchment area. These represented 49% of all cases of elevated BLL among children in St. Louis, although only

[*] Population estimates by age group are publicly available via Missouri Information for Community Assessment (MICA) at the zip code level from the 2010 Census. Estimates by age group are available at the city level for subsequent years via MICA from the US Census Bureau in partnership with the Federal State Cooperative Program for Population Estimates and the National Center for Health Statistics. City level population change for the 0-19 age group was calculated as -8.6% from 2010 to 2015, and for the 0-5 age group as -10.7% from 2010 to 2018. The same rates of decline were applied to 2010 Census data to estimate population by age group for the selected zip codes in 2015 and 2018.

33% of the city's 5-and-under population resides in these zip codes. The estimated prevalence of elevated BLL in 2018 was 3.9% all children ages 5 and under in the catchment area, and 9.1% of all children ages 5 and under who were screened (43% screening rate). Furthermore, 241 (85%) of the children with elevated BLL were Black.

With these baseline values, it is important to keep in mind that St. Louis is residentially segregated by race, so the fact that Black children make up the majority of cases of elevated BLL and emergency room visits due to asthma in the catchment area is partly explained by the racial demographics of these neighborhoods. Black households make up between 86.0% (in 63017) and 97.9% (in 63115) of all households; the exception is 63118, where Black households make up only 48.6% of the total.[12] Since close to half of all cases of both outcomes of interest in the city are found in these six zip codes, targeting efforts to these neighborhoods is hypothesized to also reduce racial disparities overall.

Program Model: Strengthening Capacity to Promote Healthy Homes

Several programs in St. Louis have sought to target lead and asthma prevention and intervention strategies in high-risk neighborhoods and toward vulnerable children. To date, none have combined efforts to address both health outcomes simultaneously. In 2019, the City of St. Louis Department of Health spearheaded the formation of a new Healthy Homes Coalition, together with the County Department of Health, aimed at addressing indoor environmental conditions such as moisture, ventilation, pests and other contaminants, temperature, and structural safety.[35] As of early 2020, the coalition has refined its mission and is moving forward as the STL Healthy Homes + Energy Efficiency Coalition, counting cross-sector agencies and community groups among its members. The coalition is well-positioned to advance collective efforts to strengthen the city's capacity to promote healthy homes and cohesively integrate existing efforts to address disparities in both asthma and lead outcomes, taking into account the specific regulatory environment and distribution of causal factors in St. Louis.

The Lead Safe St. Louis program, under former Mayor Francis Slay's administration, reduced the percentage of children ages 6 to 72 months with BLL 10 µg/dL or greater from 13.6% in 2004 (42.3% screening rate) to 1.5% in 2016 (48% screening rate).[12,28] Lead Safe St. Louis was a large-scale collaborative involving city agencies, schools, health care providers, and community-based groups, funded by a combination of municipal department budgets, state and federal grants, and foundation grants, up to nearly $8 million annually at the height of its operations. The program focused on universal blood lead testing for children and prioritizing proactive inspections of residential and certain commercial and public properties. Lead

abatement services were offered as a primary prevention strategy to inspect and remove lead from homes before children or pregnant women were ever exposed, and as a secondary prevention strategy following an elevated blood lead test to prevent re-exposure.[28]

The gains from Lead Safe St. Louis are at risk of being lost without renewed leadership. At the updated 5 µg/dL threshold, 8.5% of children screened in 2015 were found to have elevated BLL, reflecting a hidden at-risk group of children.[12] At the same time, demolition of vacant properties has increased substantially since 2016,[36] which has been associated with significantly higher blood lead levels in children living in the same census block as demolition activity.[37] Lastly, although proactive inspection and removal of lead from the homes of at-risk pregnant women resulted in significantly lower BLL results in children at 18 months compared to controls, less than one-third of women who consented to receive a home inspection actually ended up receiving one.[38] There are several possible explanations for this substantial loss to follow-up, including mistrust of city inspectors or inefficiencies in communication across city departments. The proposed program aims to address these gaps.

Asthma treatment and intervention strategies in the City of St. Louis have historically been operated independently by a number of different agencies. The City of St. Louis Department of Health manages a program called Asthma Friendly, which conducts home environmental assessments of asthma triggers, provides education to parents and youth, and connects at-risk individuals to health care providers.[7] The Asthma and Allergy Foundation of America - St. Louis Chapter (AAFA-STL) operates a program to provide children who lack regular access to health care with asthma medications, and to provide schools with nebulizers and training on asthma treatment.[32] Health care providers in St. Louis City also operate asthma clinics, including at St. Louis Children's Hospital, and coalitions like the St. Louis Regional Clean Air Partnership work to advocate for air pollution reduction efforts.[39] However, treatment and intervention strategies are not coordinated across these various entities, and their individual reach and resources are limited. Research on the burden of asthma in St. Louis has not been able to quantify an impact of these programmatic approaches, with rates of emergency room visits due to asthma complications among children largely unchanged since 2003.[6,7,40] The proposed program aims to bring these efforts together under a shared framework.

Interviews with local experts (see Appendix B) emphasize the structural and regulatory issues that impede addressing housing as a root cause. If housing risk factors are left unaddressed or it is difficult to enforce compliance, this limits the impact of strategies like high-risk asthma screening and clinical linkage, parental education programs, blood lead testing, and residential property lead remediation. They also emphasize the importance of community

engagement and organizing. If parents feel unsupported or vulnerable in negotiating with their landlords, or if they lack confidence that home inspection and assessment will yield tangible solutions, social norms and power dynamics that perpetuate unsafe housing conditions are likely to continue. The proposed program aims to streamline and strengthen current efforts while also directly targeting structural barriers and community engagement.

Program Goal and Objectives

GOAL: The goal of the proposed program is to achieve health equity with regard to childhood asthma and lead poisoning by engaging municipal officials, health care providers, residential property owners, and parents in targeting poor quality housing as a root cause of the burden in St. Louis. The problems of childhood asthma and lead poisoning are shaped by multiple systemic forces, including poverty, structural racism, housing and environmental law and policy, and access to health care and public health services. The solution therefore requires more than treating children who are suffering – it requires addressing social, economic, environmental, and political forces. Social ecological theory understands health outcomes as the product of interacting forces at multiple levels: individual, interpersonal, institutional, community, and policy.[13] A program that intentionally seeks to further environmental justice and racial equity is therefore well suited for this model. The proposed program aims to leverage existing resources within the city and partner organizations, addressing the root causes of this critical health equity issue by aligning system design to intended impact.

PROCESS OBJECTIVES

- Information and referral system development completed by end Year 1
- Train 50 Healthy Homes Specialists and 50 medical providers by end Year 1
- Reach 500 property owners by end Year 1, and 1,000 by end Year 2
- Reach 500 parents/caregivers by end Year 1, and 1,000 by end Year 2
- Assess 2,000 properties and remediate 1,000 by end Year 3
- Achieve 90% case resolution rate by end Year 4

OUTCOME OBJECTIVES

- Reduce annual prevalence of lead poisoning (BLL $\geq$ 5 µg/dL) to 2% among children ($\leq$ 5 years old) screened in catchment area by end Year 4 (>75% reduction), at 60% screening rate

- Reduce annual incidence rate of emergency department visits due to asthma complications to 9 per 1,000 among children (≤ 19 years old) in catchment area by end Year 4 (>75% reduction)
- Improve average Healthy Home Rating System (HHRS) scores by 75% in catchment area by end Year 4

Strategies and Activities

The overarching strategy of the program is a collective impact approach that engages organizations and community groups across sectors and levels of power to achieve shared goals. The program is organized around eight categories of activities. A logic model is presented in Appendix C, and a workplan calendar in Appendix D.

The first component of the program revolves around developing the process and infrastructure for information management and referral. The STL Healthy Homes + Energy Efficiency Coalition has identified a software called One Touch that is designed to connect health, housing, and energy home visiting and repair programs, enabling referral and communication across providers.[41] After finalizing the necessary contracts and memoranda of understanding between coalition partners and One Touch, a working group will develop the specifications for a custom build-out of the software to align with actual workflows. Articulating protocols for referral, case management, and follow-up will be necessary to ensure system design is aligned to desired impact. Further, the software has the capacity to adjust criteria to guide inspection and remediation procedures. While Missouri has established evidence-based procedures for blood lead testing, home inspection, and lead abatement based on guidelines from the U.S. Centers for Disease Control and Prevention, U.S. Department of Housing and Urban Development, and U.S. Environmental Protection Agency ,[42,43] there are no such agreed protocols for asthma screening or trigger removal. The working group will integrate clinical criteria and existing standards into a comprehensive assessment protocol and manual. There are numerous guides to assessing residential property for health-related hazards,[44] including the evidence-based Housing-Related Health and Safety Hazard Assessment, part of HUD's Healthy Homes Program Guidance Manual.[45] This comprehensive set of guidelines is supplemented by detailed technical protocols and sample data collection tools,[46] and can be adapted to the St. Louis context for both assessment and remediation.

The second program component is to recruit and train Healthy Homes Specialists (HHSs). The role of the HHS is to conduct targeted home assessments, following the comprehensive protocol, and to coordinate follow-up and case management. Recruitment will

focus on residents and workers in the target zip codes, aiming to build local capacity and provide professional development and job opportunities. St. Louis has a robust Community Health Worker (CHW) Coalition, counting among its members CHWs who are based at federally qualified health centers, social service organizations, hospitals, and other community organizations. The City of St. Louis already employs Building Inspectors, and non-profit organizations such as the Community Action Agency of St. Louis County and the EarthWays Center at the Missouri Botanical Gardens, offer healthy home assessment services. St. Louis Community College offers an Environmental Remediation Technician (ERT) program to prepare and certify specialists to work for municipal and private contractors. By partnering under the coalition infrastructure and drawing from these sources of potential HHSs, as well as unaffiliated residents, the program will leverage existing skills, resources, and networks. The training series will be tiered to accommodate people with different levels of previous experience, and will incorporate training on the One Touch interface.

Third, medical providers serving residents from the catchment area will be trained as key partners in the program. Primary care providers, emergency providers, asthma and allergy specialists, and women's health providers (including obstetricians and gynecologists, doulas, and midwives) will be recruited for a workshop series. Their role in the program will be to identify parents and children who are eligible to receive a healthy home assessment, based on clinical and demographic criteria as outlined in the comprehensive assessment protocol, and refer them to the program. It will be important to work with each partner agency to build the eligibility criteria into existing workflows and integrate referrals with One Touch prior to training. Partner agencies and providers will be able to access implementation support services from the coalition working group and from One Touch, and will have opportunities to provide feedback to the coalition to ensure their continued engagement in the program.

The fourth component is to engage and educate residential property owners in the catchment area. Without changes to local ordinances or stronger housing laws, the property owner engagement strategy will focus on supports and incentives available to remediate in-home environmental hazards. A working group of the coalition will be established to curate all available resources. For example, the Healthy Home Repair Program is targeted to low- and moderate-income homeowners, and is administered by the city's Community Development Administration (CDA). While funded by a variety of sources, including Community Development Block Grants, HOME, Affordable Housing Trust Funds, HUD Lead Grants, Federal Home Loan Bank, and special purpose funds from non-profit partners, the waiting list tends to be long and eligibility criteria are strict.[47,48] The city's Lead Remediation Fund pays for free lead inspections

and offers financial assistance for remediation for property owners who qualify; however, while 60% of occupancy permit fees are allocated to the fund,[19] it is largely dependent on grant funding and municipal budget priorities.[49] The working group will therefore also explore opportunities for leveraging other funding and financing mechanisms, such as tax abatements, tax increment financing (TIF) district set-asides, or linkage fees for new real estate development ear-marked for healthy home inspection and remediation. Engaging property owners as stakeholders in this process will be essential to building support and buy-in.

Fifth, parents and caregivers will be engaged and educated. Community meetings and door-to-door outreach will be conducted by coalition members to inform families of the program, how to access services, and to offer training on landlord-tenant rights and resources. Engagement will be tailored both to renter and owner households in the catchment area. Ensuring that parents and caregivers have awareness and trust in the program will be essential, so the selection of coalition members and organizations charged with outreach and engagement will be done in alignment with their existing services and relationships in the community. Offering space for parents to come together to learn and organize around healthy homes concerns will facilitate engagement and mobilization.

Once these foundational components are completed or in progress, the sixth component is to conduct targeted outreach, screening, and referral. Eligible households will be identified via screening questionnaires and established protocols at health centers, emergency rooms, community events and meetings, and outreach through other venues where residents already gather. Referral to the program will take place through the One Touch system. If not already documented through the screening process, intake will include baseline blood lead level testing of children ages 5 or under, and baseline asthma management evaluation for children ages 19 or under. Once completed, the family will be assigned to a Healthy Homes Specialist.

The seventh component involves conducting in-home assessment and remediation. The HHS will conduct the initial assessment, including visual inspection and environmental sampling if indicated, and determine appropriate next steps. HHSs who are also certified as ERTs will be authorized to develop a remediation plan, and submit it for approval to the Building Division and Health Department; if the HHS is not also certified as an ERT, an appropriate referral will be made. The remediation plan will then be implemented.

Finally, the eighth component of the program is to ensure case management and follow-up services. The HHS assigned to each family will be responsible for monitoring the remediation plan, facilitating communication and action steps across providers, and supporting collaborative problem-solving. Education and outreach in the community will continue to maintain awareness

of the program and respond proactively to challenges and feedback. At the St. Louis Healthy Homes + Energy Efficiency Coalition quarterly meetings, program status and priority issues will be presented and discussed.

Program maintenance and support will rely on the collective infrastructure of the St. Louis Healthy Homes + Energy Efficiency Coalition and its members, including the coalition's capacity for organizing, strategic planning, and leveraging resources and networks. The City of St. Louis Department of Health will play a backbone coordination role. Working groups will be established to develop and assure the information and referral process and infrastructure, including technical manuals, guidelines, and partner-specific workflows; to develop and implement training curricula; and to develop and implement the community engagement strategy (both property owners and parents/caregivers). Finally, a Healthy Homes Specialist Coordinator will be hired at the Department of Health to manage intake and assignment of families each HHS.

Formative Evaluation

The purpose of the formative evaluation is to gauge acceptability of the program in the City of St. Louis, to test the feasibility of the intervention strategies, and to lay the foundation for sustained engagement. Findings will be used to modify strategies and the scope of program activities. The formative evaluation will be conducted using interviews, focus groups, and landscape analyses. Coalition members will conduct interviews with representatives of the partner organizations envisioned to be involved to present the program objectives and methods, ask for feedback, and consider adjustments to enable their support and involvement. Focus groups will be held with parents and caregivers who have sought to access home assessment and remediation services, or whose children have experienced lead poisoning or asthma complications, to share the program goals and draft language for outreach and education. Separate focus groups will be held with property owners. Feedback from parents/caregivers and property owners will inform adjustments to program activities and materials.

Process Evaluation and Performance Monitoring Plan

The purpose of the process evaluation is to document how the program is delivered and received. It enables coalition members to assess methodology adherence and to interpret impact evaluation results, providing a basis for replication. Performance monitoring enables the coalition to track progress and make adjustments to improve implementation quality or respond to challenges in real time. Evaluation and monitoring include both quantitative and qualitative

methods, including documenting activities conducted, quantifying resources procured and utilized, and collecting data and feedback from stakeholders. In most cases, coalition members will be responsible for collecting and analyzing information. Other stakeholders and partners will be responsible for providing source information where required.

An indicator table is provided in Appendix E. The process evaluation and performance monitoring plan will cover the Inputs and Activities & Outputs components of the logic model. As listed under Inputs, human resources will be tracked based on coalition meeting minutes. Baseline material resources will be assessed through an initial inventory review by participating partners, with results documented and analyzed by a coalition working group. As the program continues, material resources will be tracked through partners' existing inventory management systems, and utilization projections will be provided based on One Touch data. Resource acquisition will rely on existing supply chains and distribution channels for blood lead testing equipment, asthma screening supplies, home assessment supplies for visual inspection and environmental sampling, and home remediation supplies for lead abatement and interim controls as well as asthma trigger removal and controls. Knowledge resources will be monitored as the coalition working group develops tailored protocols for program referral, case management, home assessment, and home remediation. Protocols will be documented in print and electronic manuals and incorporated into training agendas to ensure accessibility, dissemination, and implementation. Partnerships will be monitored by a coalition log. Financial resources will be monitored through expenditure logs and budget reports by partner agencies.

Indicators for the main strategies detailed in Activities & Outputs revolve around tracking the development of the information and referral infrastructure (including number of memoranda of understanding with partner agencies, number of custom integrations of the One Touch software, and user adoption rates of One Touch), the reach of recruitment and training (including training satisfaction scores among HHSs and providers), the number of contacts with property owners and parents/caregivers to educate them about the program, and the reach of lead and asthma screening, clinical testing, home assessment, and home remediation interventions. One Touch records, partner agency logs, and coalition logs and meeting minutes again serve as important data sources. In addition, the coalition will track the resolution rate of open cases as well as the time (days) to resolution, to ensure the program is responding in a timely and efficient manner. The coalition will also administer surveys to parents and caregivers to assess quantitative satisfaction rates and to gauge qualitative feedback on the program. Analyzing this information on a monthly or quarterly basis, depending on the indicator, will help

to identify areas for further training, outreach, and protocol improvement, and to ensure progress towards targets.

Impact Evaluation Plan

The purpose of the impact evaluation is to quantify the degree to which changes in the outcomes of interest may be attributed to the program, as opposed to other factors. The City of St. Louis may use these results to decide whether to modify the program, to demonstrate to the community and to potential funders the value of the approach, and to engage more property owners, parents, and other stakeholders in the healthy homes movement. The impact evaluation plan will cover the Outcomes and Impact components of the logic model.

For the Outcomes indicators that measure rates of childhood lead poisoning and rates of emergency room visits due to asthma complications, the main priority is to be able to assess whether there were changes in the annual prevalence of lead poisoning and the annual incidence rate of asthma-related ER visits at 1) the zip-code level and 2) among participating children, over the course of the program. A longitudinal baseline/end-line study design will be used to evaluate change and progress to target. This study design allows for an adequacy level of inference, which is sufficient for the coalition to assess and communicate health indicator changes in the target population and catchment area. However, the limitation of this design is that causality cannot be inferred. While there is already strong evidence that home environment remediation reduces risk of lead poisoning and asthma complications, it may be valuable to assess whether the program's proactive, primary prevention approach is an effective strategy above and beyond other influencing factors.

To achieve a plausibility level of inference, a quasi-experimental study design will be used to evaluate whether the extent of change in certain indicators is significant in comparison to a counterfactual. A set of other zip codes in St. Louis City and County, matched to the intervention catchment area zip codes in terms of demographic factors and high prevalence of childhood lead poisoning and/or asthma complications, will be used as a comparison group. The same zip-code level indicators will be assessed among these areas using Environmental Public Health Tracking (EPHT) program data, over the same time period. Difference-in-difference analyses will be conducted to determine whether changes in the intervention group are significantly different from what would be expected based on changes in the comparison group. There are internal validity risks to this study design, so results must be interpreted with caution. For example, spillover effects could occur if providers refer children who reside in other zip codes to the program, and contamination effects could occur from healthy homes interventions

run by St. Louis County or other non-profits in the comparison zip codes. Given coalition members' budgets, existing effectiveness evidence, the main audiences for the program, and the purposes of this evaluation, a randomized controlled trial is neither feasible nor necessary, but causal conclusions must be interpreted in context of these limitations.

For the Outcomes indicators related to housing quality and coalition network engagement, an adequacy level of inference is sufficient to demonstrate improvements and progress to targets. The Healthy Home Rating System (HHRS) is an evidence-based, standardized assessment of common home hazards that incorporates level of risk to occupants.[45,46] HHSs will implement the HHRS as part of their initial assessment, and repeat the assessment at case resolution. Results will inform analysis of change at the zip-code level from baseline to end-line. Given the importance of the coalition infrastructure to this program and the centrality of the equity lens, it is also essential to ensure that coalition members are representative of community stakeholders and cross-sector partners. Further, tracking meeting attendance rates is important to ensure that members' voices are actually involved and heard at planning and decision-making tables.

The indicators measuring environmental justice and health equity, property owner accountability for health hazards, and the sustainability of a municipal healthy homes program in St. Louis City aim to evaluate the longer-term impact of the program. Since the population of the program's catchment area is predominantly Black, it may be difficult to interpret race-stratified changes in the annual prevalence of childhood lead poisoning and annual incidence of ER visits due to asthma among program participants or among the target zip codes. However, measuring race-stratified changes in these indicators at the city level will provide evidence of the program's impact on reducing racial disparities. As with the corresponding outcomes indicators, both longitudinal baseline/end-line analyses and quasi-experimental difference-in-difference analyses can be conducted to evaluate race-stratified changes. These results will provide evidence for the coalition to make the case for expanding the program to other neighborhoods and for continuing it in the pilot catchment area beyond four years. Given the program's efforts to engage property owners as partners in resolving housing-related risk factors, longitudinal change in the number of severe health-related housing code violations reported in city records will also be evaluated as an important indicator of longer-term impact. Lastly, in order to sustain the program at the city level in future years, the coalition will need to develop a revenue model, which will be evaluated based on identifying and securing future-year funding sources.

As with the process evaluation and performance monitoring indicators, One Touch records and coalition logs and meeting minutes will again be used as data sources. Having

clear workflows, comprehensive assessment protocols, data quality assurance processes, and overall program supervision and oversight will be important to ensure the integrity and reliability of these indicators. Additional data sources will include the publicly available Missouri Environmental Public Health Tracking (EPHT) program and City of St. Louis records of housing code violations.

Economic Evaluation

A program budget is provided in Appendix F. The total cost of the project is estimated to be $11.4 million over four years. There are important caveats with this estimate, as it is built on assumptions that ought to be adjusted by the coalition based on internal data. The estimated cost of the One Touch system is based on estimated costs of other data management technology tools, but specific pricing was not available for One Touch. The costs of clinical screening and treatment may be covered by Medicaid and private health insurers, so a significant portion of this line item may be indirect.[12,50] The costs of home assessment and remediation are based on general estimates, and actual costs may differ in St. Louis due to local market trends and existing city and partner resources. The average per-home cost of a visual inspection and environmental sampling is estimated at $500. The average per-home cost of complete lead remediation is estimated at $10,000,[51] and the average per-home cost of complete asthma trigger removal is estimated at 7,600;[52] to allow for variation in the degree of remediation required, a distribution was estimated with 60% of inspected homes requiring complete lead remediation and complete asthma trigger removal. For perspective, the annual cost of asthma in Missouri that can be attributed to the environment is estimated at $34.2 million, and the lifetime cost of childhood lead poisoning in Missouri is estimated at $61.6 million.[50] Grants and new financing tools, including the Environmental Justice Collaborative Problem-Solving (EJCPS) Cooperative Agreement Program, innovative uses of the Low Income Housing Tax Credit (LIHTC) and local tax financing mechanisms, St. Louis City's Affordable Housing Trust Fund, hospital Community Benefits dollars, and more, can be explored for securing the necessary revenue.[53]

A cost analysis will be conducted to calculate per child costs and direct and indirect benefits. This will enable an assessment of the return on investment as far as property values, jobs generated, the estimated monetary value of averted childhood lead poisoning cases over the life course, and the monetary value of averted emergency room visits due to asthma. Because the program is embedded within existing systems and not being compared to other interventions, a basic cost analysis is sufficient, rather than cost-effectiveness or cost-benefit.

Conclusion

Solving the interconnected problems of childhood asthma complications and lead poisoning in St. Louis demands a collective action approach that addresses poor quality housing as a root cause. The STL Healthy Homes + Energy Efficiency Coalition and the City of St. Louis Department of Health are positioned to make critically needed progress on this public health issue. By bringing a racial equity lens and a systems approach that acknowledges the impact of poverty, structural racism, housing and environmental law and policy, and access to health care and public health services, this program aims to leverage existing infrastructure, knowledge, and capacity to further environmental justice and racial equity in health. For children and families in St. Louis City, the proposed program will result in near- and long-term benefits for health and well-being, and will build socioeconomic and environmental resilience for the future. The City of St. Louis has the opportunity to adopt a comprehensive, upstream strategy that reflects its commitment to redressing the health injustices faced by Black residents, and that will help children, families, and communities to thrive.

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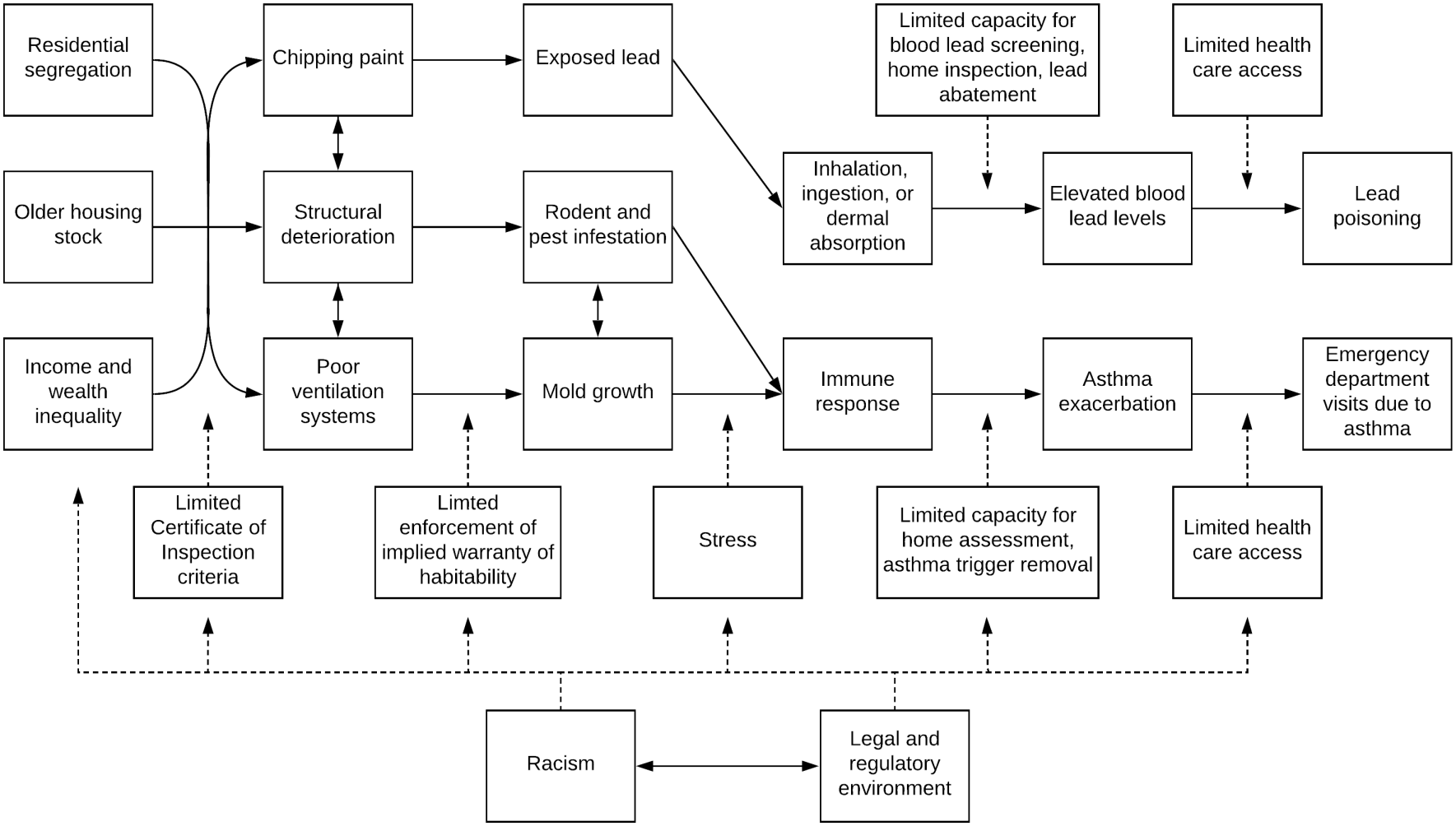
Appendix A: Causal Framework



Appendix B: Local Expert Interviews

- Michele Bildner, Health Administrator, City of St. Louis Department of Health, November 25, 2019
- Inez Bordeaux, Manager of Community Collaborations, Arch City Defenders: November 19, 2019
- Leah Clyburn, Organizer, Sierra Club: November 26, 2019
- David Habif, Physician and current Graduate Student, Washington University School of Law: February 4, 2020
- Bomin Kim, Nico Petrozz, and Morgen Siem, Graduate Students, Interdisciplinary Environmental Clinic, November 19, 2019
- Myisha Johnson, Tenant Rights Coordinator, Dutchtown South Community Corporation: November 19, 2019
- Molly Metzger, Professor of Practice, Brown School at Washington University in St. Louis: March 2, 2020
- Ken Miller, Environmental Scientists, Interdisciplinary Environmental Clinic: October 25, 2019
- Tara Rocque, Assistant Director, Interdisciplinary Environmental Clinic: October 2, 2019
- Sarah Watkins, Administrative Assistant, Action St. Louis: December 10, 2019

Appendix C: Logic Model

INPUTS	ACTIVITIES	OUTPUTS	OUTCOMES	IMPACT
Human Resources: • Community Health Workers (CHWs) • Environmental Remediation Technicians (ERTs) • Building Inspectors (BIs) • Healthy Homes Specialists (HHSs) • Medical providers Material Resources: • Blood lead testing • Asthma screening • Home assessment • Home remediation Knowledge Resources: • Healthy homes guidelines • Information + referral system process and infrastructure Partnerships: • STL Healthy Homes + Energy Efficiency Coalition • St. Louis Community College • CHW Coalition • FQHCs, Hospitals • City Building Division Financial: • Training, materials, transport, database, compensation, remediation costs	Develop I+R process and infrastructure: • Develop OneTouch build-out and protocols • Map referral, case management, follow-up processes Recruit & train Healthy Homes Specialists: • Identify CHWs, ERTs, BIs with interest in HHS certification and capacity • Hire HHS Coordinator at Health Department • Develop and conduct tiered training series Recruit & train medical providers: • Identify PCPs, Ob/Gyns, doulas, midwives, ER providers serving catchment area • Develop and conduct training • Disseminate provider education materials Educate property owners: • Hold community meetings to describe program, including remediation funding opportunities • Develop and distribute education materials Educate parents/caregivers: • Hold community meetings to describe program, including training on rights and resources • Develop education materials Conduct targeted outreach, screening, referral: • Identify eligible households via health center appointments, ER visits, community meetings, outreach • Refer to HHS Coordinator • Providers conduct baseline blood lead testing and asthma management screening • HHS Coordinator assigns to HHS Conduct home assessment and remediation: • HHS conducts home visit and determines next steps • ERT develops and gets approval for remediation plan from Building Division and Health Department • ERT executes remediation plan Provide case management and follow-up services: • HHS monitors remediation plan • STL HH+EE Coalition meets quarterly	Near-Term: • Information + referral system established • 50 Healthy Homes Specialists trained • 50 Medical providers trained • 1,000 Property owners reached • 1,000 Parents reached Medium-Term: • Residential properties assessed • Residential properties remediated • Blood lead testing rates, asthma management screening rates • Case resolution rates	• Reduced rates of childhood lead poisoning (overall + stratified) • Reduced rates of ER visits due to asthma (overall + stratified) • Improved housing quality • Engaged network of coalition members	• Environmental justice and health equity • Property owner accountability for health hazards • Sustainable municipal program

Assumptions

1. Ability to recruit sufficient numbers of HHSs within existing partner agencies and limited new hires.
2. Ability to leverage financing tools for new remediation funding, without changes to local ordinances concerning housing.

Appendix D: Workplan Calendar

Activities	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Formative Evaluation																
Hold interviews and focus groups	X															
Incorporate feedback into project plan and materials	X															
Coalition building and partnership development	X	X	X													
Process and Infrastructure Development																
Establish working groups	X															
Develop guidelines and protocols	X	X	X													
Build out One Touch platform and custom integrations		X	X	X												
Recruitment and Training																
Recruit HHSs			X	X												
Recruit medical providers			X	X					X	X						
Create HHS and provider training curricula			X	X	X											
Conduct trainings					X	X					X	X				
Community Engagement																
Develop outreach materials		X	X													
Plan and conduct outreach activities			X	X		X		X		X		X				
Hold community meetings				X	X		X		X		X					
Intervention Activities																
Outreach, screening, and referral						X	X	X								
Home assessments conducted								X	X	X	X	X	X	X	X	
Home remediation services delivered									X	X	X	X	X	X	X	
Monitoring and Evaluation																
Prepare necessary data collection forms and systems	X	X														
Establish baseline for relevant indicators		X	X													
Collect data on monthly/quarterly indicators			X	X	X	X	X	X	X	X	X	X	X	X	X	
Complete annual and final impact evaluations								X				X				X

Appendix E: Indicator Table

Indicators in italics are for performance monitoring only and do not have targets associated.

Logic Model Component	Indicators	Data sources	Time point	Target
INPUTS				
Human resources	- *Coalition members*	- Meeting minutes	Quarterly	- n/a
Material resources	*Supply and equipment inventory quantities for:* - *Blood lead testing* - *Asthma screening* - *Home assessment* - *Home remediation*	- One Touch projections and documentation - Partner inventory logs	Monthly	- n/a
Knowledge resources	- *Completed healthy homes guidelines and training materials* - *Established referral & management process*	- Manuals - Training agendas	Quarterly	- n/a
Partnerships	- Number of institutional partners	- Partner logs	Quarterly	- 10 by end Q1 - 20 by end Q3
Financial resources	- Budget vs. actuals by line item - *Per household spend (by level of remediation required)*	- Expenditure logs - Budget reports	Monthly Quarterly Annually	- Within 10% month to month - Within 5% quarterly - On budget annually
ACTIVITIES & OUTPUTS				
Develop I+R process and infrastructure	- Number of MOUs in place - Number of custom integrations in place - OneTouch user adoption rate	- Partner logs - Build-out documentation - One Touch utilization reports	Monthly	- MOUs established with 20 institutions by end Q3 - Custom integrations in place with 10 institutions by end Q3; 20 by end Year 1 - 90% user adoption by end Year 2
Recruit and train HHSs	- Number of HHSs - HHS training satisfaction rate	- Staffing logs - Partner logs - Attendance logs	Monthly	- 50 HHSs (all types) - 90% training satisfaction rate
Recruit and train medical providers	- Number of medical providers - Provider training satisfaction rate	- Partner logs - Attendance logs	Monthly	- 50 providers (all types) - 90% training satisfaction rate

Logic Model Component	Indicators	Data sources	Time point	Target
Engage and educate property owners and parents/caregivers	- Number of property owners and parents reached - Number of community meetings held	- Outreach reports - Attendance logs	Quarterly	- 10 community meetings held by end Year 1 - 500 property owners by end Year 1; 1000 by end Year 2 - 500 parents by end Year 1; 1000 by end Year 2
Conduct targeted outreach, screening, referral	- Number of children screened for eligibility - Number of blood lead tests administered - Number of asthma screenings administered - Number of program intakes	- One Touch records	Quarterly	- 5,000 children screened for eligibility by end Year 2 - 5,000 blood lead tests administered by end Year 2 (60% screening rate) - 3,000 asthma screenings administered by end Year 2 - 2,000 intakes by end Year 2
Conduct home assessments and remediation	- Number of properties assessed - Number of properties remediated	- One Touch records	Quarterly	- 2,000 properties assessed by end Year 3 - 1,000 properties remediated by end Year 3
Provide case management and follow-up services	- Case resolution rate - Time to resolution - Parent/caregiver satisfaction	- One Touch records - Parent/caregiver survey	Quarterly	- 90% case resolution rate by end Year 4 - 6-month average time to resolution by end Year 4 - 80% satisfaction rate
OUTCOMES				
Reduced rates of childhood lead poisoning	- Reduction in annual prevalence of lead poisoning (≥ 5 µg/dL) among children ≤ 5 years (zip code level) - Reduction in prevalence of elevated BLL among children in program (individual level)	- EPHT data - One Touch records	Annually	- 2% elevated BLL among children screened (>75% reduction) at 60% screening rate at zip code level by end Year 4 - 1% elevated BLL in population (75% reduction) at zip code level by end Year 4 - 75% reduction in prevalence of elevated BLL among children in program at 6 months post-case resolution by end Year 4
Reduced rates of ER visits due to asthma	- Reduction in annual incidence rate of ER visits due to asthma	- EPHT data - One Touch records	Annually	- 9 visits per 1000 population (75% reduction) at zip code level by end Year 4

Logic Model Component	Indicators	Data sources	Time point	Target
	complications among children ≤ 19 years (zip code level) - Reduction in annual incidence of ER visits among children in program (individual level)			- 75% reduction in annual incidence of ER visits among children in program at 6 months post-case resolution by end Year 4
Improved housing quality	- Healthy Home Rating System (HHRS) (adapted) score	- One Touch records	Annually	- 75% improvement in average HHRS scores by zip code by end Year 4
Engaged network of coalition members	- Percent of members attending coalition meetings - Relative representation of community and sectors in coalition	- Meeting minutes	Annually	- 80% average attendance - 1:5 ratio of community representatives to all other sectors - All other sectors includes housing, health, building, workforce representation
IMPACT				
Environmental justice and health equity	- Reduction in race-stratified annual prevalence rates of lead poisoning (≥ 5 µg/dL) among children ≤ 5 years (city level) - Reduction in race stratified annual incidence rates of ER visits due to asthma complications among children ≤ 19 years (city level)	- EPHT data	Annually	- 75% reduction in lead poisoning rates for Black children and 25% reduction in rates for white children by end Year 4 - 50% reduction in rates of ER visits due to asthma among Black children and 25% for white children by end Year 4
Property owner accountability for health hazards	- Reduction in severe health-related housing code violations	- City records	Annually	- 50% reduction in violations by end Year 4
Sustainable healthy homes municipal program	- Secured funding for expansion to other zip codes	- Revenue model	Annually	- 75% of funds secured for expansion by end Year 4

Appendix F: Budget

Expenses	Year 1	Year 2	Year 3	Year 4	Notes
Payroll (new)	60,000	60,000	60,000	60,000	HHS Coordinator (1 FTE)
Infrastructure	10,000	2,000	2,000	2,000	One Touch software and maintenance
Recruitment and training	2,500	1,000	1,000	1,000	Printing, materials, and refreshments for training 100 ppl (2-day workshop in Y1 plus annual refresher trainings)
Outreach and education	2,000	2,000	500	500	Printing, marketing, and events to reach 2,000 people by Y2
Screening and clinical treatment	25,000	50,000	25,000	0	Assuming 5,000 children screened for lead over 2 years, and 3,000 for asthma, with varying levels of treatment required
Home assessment	100,000	450,000	450,000	0	Visual assessment and environmental sampling of 2,000 properties by end Y3
Home remediation	0	6,000,000	4,000,000	0	Remediation of 1,000 properties by end Y3
Coalition meetings	500	500	500	500	Printing, materials, and refreshments for quarterly meetings
Total Expenses	**$ 200,000**	**$ 6,565,500**	**$ 4,539,000**	**$ 64,000**	
TOTAL BUDGET	**$11,368,500**				