A proposal to the Tennessee General Assembly
By Rashad Taylor

Reducing Childhood Lead Poisoning in Tennessee: An Analysis of Policy Alternatives

Executive Summary

Lead poisoning is one of the most insidious environmental health hazards in the nation, especially for young children. Being exposed to lead at a young age has serious physical, cognitive, and behavioral impacts. No amount of lead in blood is considered safe, but a consistent portion of Tennessee children have been testing at the especially dangerous levels of 10 ug/dL and above. This analysis proposes three options to reduce the proportion of Tennessee children testing at high levels. These policies include mandating that high-risk Tennessee municipalities apply for HUD Lead Hazard Reduction grant funding; requiring a portion of Tennessee's Drinking Water State Revolving Fund program funds go towards lead service line replacement; and requiring lead screening universally for children at 1 and 2 years of age. Since most lead poisoning nationwide is linked to lead-based paint and due to its estimated outcome effect, I propose the HUD grant mandate be made a priority by the state government. However, all of these policies could be implemented together to have the greatest impact in protecting our children.

Background

Lead poisoning is one of the most threatening environmental health risks in this country. Young children are at increased risk for lead poisoning for behavioral and physiological reasons. The toxin endangers their physical, behavioral, and neurological development. Lead poisoning in

children has been found to cause hearing & speech problems, slow growth & development, reduced IQ, learning issues, and attention deficit disorders. Adults can also become lead poisoned and suffer reproductive, circulatory, and neurological effects. As is the case for most other environmental health hazards, low-income and minority communities are at increased risk of encountering lead hazards. Sources of lead exposure include lead-based paint on older structures; lead in water pipes; lead in soil from paint, vehicles, or industrial sources; lead in spices and foodstuffs, toys, or jewelry.

Childhood lead poisoning has been linked to reduced IQ and ADHD (Braun, 2006), an increased need for special education (Schwartz, 1994), and increased rates of arrests and violent crimes (Needleman, 1996). Children with problematic blood-lead levels have been found to be disproportionately male, Hispanic or Black, and residing in homes earning below 200% of the federal poverty line (Doctors, 2010).

The human capital, social and health care costs of childhood lead poisoning are immense. Estimations from Elise Gould's 2009 National Institute of Health publication include $165-$233 billion in lifetime earnings lost due to lead-poisoning IQ-reduction for children (6 years of age or less) in 2006 (Gould, 2009). Gould estimated a range of 39,526 to 194,227 lead poisoned children 6 years of age or less with a blood-lead level of 10 ug/dL or more in 2006. This same cohort's medical treatment costs were estimated to be between $10.8 and $53.1 million.

Given these staggering costs, it is not surprising that reducing lead hazards can pay big dividends. With lead-based paint being the leading cause of childhood lead poisoning, addressing such hazards has a large economic impact. Pre-1978 housing with lead painted

components presents a variety of potential hazards to occupants. Deteriorating paint results in lead dust in soil and on floors where children play. Children also tend to ingest paint chips directly or chew/gnaw on painted components. Lead-based paint abatement and hazard reduction activities involve removing such components, encapsulating them, or rendering them inaccessible. It was found that each dollar invested in lead paint hazard control sees a return of $17-$221 in 1996 dollars (Gould, 2009). This return includes recouping lost earnings and tax revenue; reducing crime; and avoiding treatment and special education costs.

Childhood Lead Poisoning in Tennessee

For this analysis I will focus on children 6 years of age and younger. Even though no amount of lead is considered safe and the CDC reference value for lead in blood is currently 3.5 ug/dL, I will use 10 ug/dL to indicate lead poisoned children due to most literature and economic analysis being done with that level. I will refer to levels equal to or above 10 ug/dL as the subject blood-lead level or SBLL.

According to data from the Tennessee Department of Health's Childhood Lead Poisoning Prevention Program (TNCLPPP), the rate of screened children in Tennessee with blood-lead levels (BLL) above or equal to 10 ug/dL was consistently at 0.3% from 2013 to 2020. In 2019 (prior to COVID19 induced declines in screening), 91,863 children 6 years of age and younger were screened in Tennessee. All Tennessee children are recommended to be screened before 72 months of age. However, due to inconsistent uptake and execution of the program many children go unscreened, or their data are not entered. For 2013-2019, an estimated average of 17.9% of Tennessee children ≤ 6 years of age were screened each year. The Centers for Disease Control and Prevention (CDC) also collects this data as part of its National Childhood Blood Lead

Surveillance program. For its 2018 Tennessee blood-lead data, CDC used an estimation of 488,652 children being 6 years of age or younger in Tennessee. Combining this estimation with the trend of 0.3% of screened children testing at the SBLL, at least 1,466 children can be expected to have a blood-lead level at or above 10 ug/dL currently in Tennessee - although the actual number is likely to be higher.

Policy Proposals

The main goal of these policy proposals will be to reduce the 0.3% of screened children testing at the SBLL after 5 years. Each of these policy proposals are intended to make use of extant funding sources to reduce hazards from common sources of lead poisoning.

1. Mandate high-risk Tennessee counties and metro housing authorities apply for Department of Housing and Urban Development (HUD) Lead Hazard Reduction grant funding.
2. Require a portion of Tennessee's Drinking Water State Revolving Fund program (DWSRF) monies to go towards lead service line replacement
3. Require lead screening universally for children at 1 and 2 years of age.

Policy Alternative #1: Mandate high-risk Tennessee counties and metro areas apply for HUD Lead Hazard Reduction Grant funding

The Lead Hazard Reduction (LHR) Grant Program is overseen by HUD's Office of Lead Hazard Control and Healthy Homes (OLHCHH). This grant program awards funds to local governments and some states or tribal entities to identify and control lead-based paint hazards in privately owned housing. The FY22 Round 2 version of the grant program made over $400,000,000 available nationwide, with a maximum award of $8,000,000 to a single awardee

and a minimum of $1,000,000. For context, the City of Philadelphia (population: 1.576 million) received the maximum $8,000,000 in 2022. The City of Memphis (population: 628,000) received $5,600,000 in 2019. The City of Clarksville (population: 171,000) received $2,879,918 in 2022. The grant periods primarily run for 42 – 48 months. Once an entity receives the funding, they establish a system to evaluate hazards in pre-1978 housing and bid out the lead hazard reduction work to certified contractors. With the $400,000,000 available, the OLHCHH expected to make 90 awards for this grant round. The OLHCHH has indicated the following average costs per unit addressed:

OLHCHH Lead Hazard Control Per-Housing Unit Cost				
2018	2019	2020	2021	**2022**
$8,046	$11,442	$17,319	$12,724	**$14,053**
				HUD FY22 Agency Financial Report

Assuming an average cost of $14,053 per housing unit, about 71 units could be addressed for every $1,000,000 received in grant funding. The State of Tennessee could make use of this existing stream of funding to reduce the lead burden on its child population. This will be an executive order or legislative action to mandate that certain high-risk counties or localities apply for the Lead Hazard Reduction Grant whenever eligible (HUD generally precludes entities that have had an LHR grant within the recent past). Determining high risk counties or cities can be based on child screening results, housing stock that is pre-1960, socioeconomic, and demographic factors. Several national entities identify especially vulnerable communities such as EPA's Environmental Justice mapping tool (*EPA (EJScreen)* 2023), or the *Small,*

Underserved, and Disadvantaged Community designations within the Safe Drinking Water Act regulations (*EPA (SUDC)* 2021).

These grant applicants will, of course, be competing against public entities across the country and funding will not be guaranteed. However, HUD has been left with remaining funds in previous grant rounds and has shown a desire to meet any additional demand with more funding. For localities in Tennessee since 2013, only Shelby County, City of Memphis, City of Knoxville, and City of Clarksville have received Lead Hazard Reduction Program grant funds. Many more counties and cities in Tennessee could potentially receive this funding and greatly reduce lead hazards in homes state-wide.

Policy Alternative #1 Costs Estimation

Lead hazard reduction work is already regulated in Tennessee through the Tennessee Department of Environment and Conservation's Toxic Substances Program (TSP). The need to oversee the new program and additional regulatory workload may require an additional 3 staff members at an average salary of $55,000 per year. Staff will have training costs which may include various certification classes and accreditations in necessary disciplines for an average of $1000 per new employee. Costs of benefits will be about $21,400 per employee each year. Other marginal costs of adding additional employees to an already-large state department would be negligible. The mandate program will require outreach/education to affected counties and localities. $1000 per year should be allotted for the costs of producing and communicating such material. To aid in implementation and rollout, personnel from affected counties and localities should be trained on federal grant processes. Travel and materials for biannual grant workshops will be around $1400 per year.

Estimate of Program Costs for Policy Alternative #1 (over 5 years)		
Item	1st year Cost	5-year Cost
Additional Staff Salary	$165,000	$825,000
Staff benefits	$64,200	$321,000
Staff training	$3000	$3000
Outreach/promotion of new mandate program	$1000	$5000
Training of county/city personnel on grant writing/planning	$1400	$7000
Total	**$234,600**	**$1,161,000**
		Estimations based on current TSP budget items

Policy Alternative #1 Outcome Estimation

To estimate an outcome effect of this policy based on historical grant award data, I will assume that in the first 5 years of this policy four additional localities (that otherwise would not have applied) will use grant funds averaging $3,500,000 each for a total of $14,000,000 in funding used. This $14,000,000 will address 994 units of housing with lead-based paint hazards. Prior literature is limited as to the effect of lead paint hazard reduction work on community blood-lead levels. Studies by Caes et al., and Leighton et al found a remediation effect close to 20% for the reduction in children's blood-lead level a few months after their homes underwent lead hazard reduction. However, these studies look at the effects on specific children in a short time frame after lead paint hazard reduction work is done. A community-based Chicago, IL study found an impact of 2.5 lead poisoning cases averted for every unit of housing remediated (Jones, 2011). I will choose a more conservative effect to estimate the impact of this policy on statewide blood-lead level screening results, I will assume that every 5 units addressed in the high-risk areas results in 1 fewer child testing at the SBLL. The estimate of 994 additional units

being addressed in 5 years would lead to 199 fewer children testing at the SBLL. A reduction of 199 to the 1466 baseline of SBLL children (assuming no effect from population growth) reduces the SBLL rate to 0.26%.

Policy Alternative #2: Require a portion of Tennessee's Drinking Water State Revolving Fund program (DWSRF) monies to go towards lead service line replacement (LSLR)

Another option to combat lead poisoning is to reduce the chance of lead leaching into drinking water. According to EPA, 50-75% of lead in drinking water comes from lead service lines (Sandvig, 2008). These are pipes that carry water from public water system storage to households. Different parts of the piping system may contain lead that can leach into drinking water under certain conditions. Many states have taken steps to identify and remove such service lines, often with the assistance of Drinking Water State Revolving Fund Program loans.

The Drinking Water State Revolving Fund program is a federal-state partnership scheme with the aim of improving the nation's water infrastructure and drinking water quality. The program offers low or no-interest loans to water systems for projects such as line replacement, treatment plant upgrades, storage tanks, and efficiency initiatives. Small or especially vulnerable communities receive extra financial help such as subsidies or even principal forgiveness on these loans. Replacing old lead pipes to prevent lead-poisoning falls within the aims and capacities of this program. The state of Tennessee receives an allotment of funding each year from EPA and must add a 20% state match. For context, In 2021 the state received $19,125,000 for a total of $22,950,000 after the state match. In 2022 the state received $19,284,000 for a total of $23,140,800 after the state match. Water systems of cities, counties, or other

municipalities apply for funding on a specific project and the state ranks applications into a priority list. Loan repayments and interest revenue go back into the fund and grow the base fund over time, along with EPA allotments and state matching. Total DWSRF loan program project funds available have grown from $69,377,478 in 2021 to $138,265,400 in 2023. Portions of the fund are dedicated to staffing, technical assistance initiatives and other administrative/management costs (TDEC IUP (2022)).

For reducing childhood lead poisoning in Tennessee, I propose that a portion of the state DWSRF go to replacement projects for lead service lines each year. Certain percentages of the fund are already set aside for specific uses or users such as green projects or small communities. I propose another set-aside for lead-related replacement projects. This set-aside would go to helping design, plan, and fund the removal of lead service lines (LSL). For this policy to maintain its effectiveness, the state should help communities apply and make sure there are enough applicable LSLR projects each year to use all the set-aside funding.

Policy Alternative #2 Costs Estimation

This policy alternative will incur no additional costs to the state as it will use funds already in the State of Tennessee DWSRF. The tradeoffs present include less funding for non-lead-related projects, but the impact of this should be negligible.

Based on financing data from past LSLR projects around the country, I will assume a cost of $5500 per lead service line replaced (LSLR Financing Case Studies, EPA & Marcus, 2023). This proposal will be to use $5.5 million per year over the first 5 years specifically to conduct LSLR in at-risk areas through the DWSRF. The State of Tennessee, Division of Water Resources personnel that currently oversee the DWSRF should be adequate to implement this policy, but I will

propose one additional employee at $55,000 per year. This position will aid in identifying high-risk communities and making sure applications are submitted. As with Policy Proposal #1, efforts should be made to perform outreach to eligible communities and provide training. Resources for communities to identify LSLs in their water systems are already available through other channels.

Estimate of Program Costs for Policy Alternative #2 (over 5 years)		
Item	1st year Cost	5-year Cost
Additional Staff Salary	$55,000	$275,000
Staff benefits	$21,400	$107,000
Staff training	$1000	$1000
Outreach/promotion of new mandate program	$1000	$5000
Training of community water system personnel on grants/ project budgets	$1400	$7000
Total	**$79,800**	**$395,000**

Policy Alternative #2 Outcomes Estimation

The impact of LSLR on community rates of child lead poisoning has not been extensively studied but there is recent evidence of LSLR impacts. A study of LSLR impact on blood lead levels in Rhode Island (Marcus, 2023 (working paper)) found that children whose homes were affected by the LSLR saw a reduction of 0.4 ug/dL or 13% in mean blood-lead levels. For this analysis, I will assume an impact of a 10% reduction in the rate of children testing at the SBLL. This drops 0.3% to 0.27%. Since less children are purportedly poisoned by lead in drinking water than by lead paint hazards, I expect there to be less value in this proposal in terms of reducing the rate of SBLL children. It is also expected that addressing water line issues has less of an impact on children with levels ≥ 10 ug/dL than on those at lower levels. In Rhode Island, $55

million was used to replace 10,000 LSLs. Since this proposal calls for $55 million to be used in the first 5 years, it is estimated that 10,000 lines will be replaced within that period.

Policy Alternative #3: Require lead screening universally for children at 1 and 2 years of age.

Currently in Tennessee, it is not mandated by law for children to be screened for lead. It is only recommended state-wide and required by certain insurers and other child programs. This patchwork approach to screening children has resulted in an inadequate screening rate. From 2013 to 2029, an average of only 17.9% of children 6 and younger had results reported. According to a 2017 report by *Safer Chemicals-Healthy Families,* Tennessee is one of 27 states with formal recommendations only at the state level. Ten states and D.C. have required Univeral testing. Screening a higher number of children will lead to more identified cases of EBLLs. This will lead to more widespread treatment and intervention. Over time, a reduction in the number of children testing at the SBLL should be seen.

This proposal calls for a state law requiring providers to screen for lead at age 1 and 2 checkups. If a child's screening history cannot be determined up to age 6, the provider shall conduct it. Aiming the policy at ages 1 and 2 allows for earlier detection of issues and earlier intervention (this is modeled on the recently enacted Indiana House Bill 1313). The law would make use of existing reporting networks. Impact on provider workloads/flows should be minimal as young children already have many routine checkups at which this work will be performed.

Policy Alternative #3 Costs Estimation

The increased screening data and case management will flow through TNCLPPP. For this, I propose an additional 2 staff members for TNCLPPP to aid in data support and case

management at an average salary of $62,000 per employee plus training and benefits. Outreach efforts should be made to ensure pediatric providers know of their responsibilities. TNCLPPP already disseminates materials to providers on how to properly test children and how to report results.

Estimate of Program Costs for Policy Alternative #3 (over 5 years)		
Item	1st year Cost	5-year Cost
Additional Staff Salary	$124,000	$620,000
Staff benefits	$42,800	$214,000
Staff training	$1000	$1000
Outreach/promotion of new mandate program	$1000	$5000
Total	**$168,800**	**$840,000**

Policy Alternative #3 Outcomes Estimation

The impact of screening mandates on blood lead levels has not been well examined. According to the 2017 *Safer Chemicals-Healthy Families* report, the 10 states that had universal screening requirements screened an average of 29.5% of the children under 72 months of age per year (including D.C.). Using this average, I will assume screening rates in Tennessee will rise from 17.9% to 29.5% after implementation of this policy (Dickman, 2017). I do not believe the benefits of this policy change will be borne out within the 5-year outlook period. However, the proposal is certainly worth consideration and will help more Tennessee children in the long term. The rate of children at the SBLL will likely remain the same in the short term.

Conclusion and Discussion

While all these policies should be pursued in concert to have the most impact on reducing childhood lead poisoning, I propose policy alternative #1 as the priority approach. Most lead poisoning results from lead-based paint in older housing and this policy makes use of

federal funding to remediate those hazards. This policy also has the highest estimated outcome effect of reducing the SBLL rate to 0.26% in 5 years.

Policy Comparison Matrix				
	Description	5-year cost	5-year outcome effect	SBLL rate
Baseline	Present trends continue	$0	0	0.3%
Policy Alternative #1	HUD LHR grant mandate	$1,161,000	-0.04%	0.26%
Policy Alternative #2	DWSRF LSLR Policy	$395,000	-0.03%	0.27%
Policy Alternative #3	Universal screening law	$840,000	0	0.3%

References

Braun, J. M., Kahn, R. S., Froehlich, T., Auinger, P., & Lanphear, B. P. (2006). Exposures to environmental toxicants and attention deficit hyperactivity disorder in U.S. children. *Environmental health perspectives*, *114*(12), 1904–1909. https://doi.org/10.1289/ehp.9478

Centers for Disease Control and Prevention. (2022, September 2). *Health effects of lead exposure*. Retrieved February 20, 2023, from https://www.cdc.gov/nceh/lead/prevention/health-effects.htm

Centers for Disease Control and Prevention. (2022, September 23). *CDC - National Childhood Blood Lead Surveillance Data*. Retrieved February 20, 2023, from https://www.cdc.gov/nceh/lead/data/national.htm

Department of Environment & Conservation. (2022, November). *Drinking water intended use plan*. Tennessee State Government - TN.gov. Retrieved March 8, 2023, from https://www.tn.gov/environment/program-areas/wr-water-resources/srfp/srf-home/drinking-water-state-revolving-fund/drinking-water-intended-use-plan.html

Dickman, J. (2017, January) *Children at Risk: Gaps in State Lead Screening Policies. Safer Chemicals – Healthy Families*. Retrieved March 8, 2023 from https://toxicfreefuture.org/wp-content/uploads/2017/01/saferchemicals.org_children-at-risk-report.pdf

Doctors, J., & Weiss, E. (2010, February). *Cutting lead poisoning and public costs*. pewtrusts.org. Retrieved February 15, 2023, from https://www.pewtrusts.org/~/media/assets/2010/02/22/063_10_paes-costs-of-lead-poisoning-brief_web.pdf

Gould, E. (2009, July). *Childhood lead poisoning: Conservative estimates of the social and economic benefits of lead hazard control*. Environmental health perspectives. Retrieved February 20, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2717145/

Jones, D. J., (2011, June 30). *Primary prevention and health outcomes: Treatment of residential lead-based paint hazards and the prevalence of childhood lead poisoning*. Journal of Urban Economics. Retrieved March 11, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0094119011000349

Leighton, J., Klitzman, S., Sedlar, S., Matte, T., & Cohen, N. L. (2003). The effect of lead-based paint hazard remediation on blood lead levels of lead poisoned children in New York City. *Environmental research*, *92*(3), 182–190. https://doi.org/10.1016/s0013-9351(03)00036-7

Marcus, M. (2023, February). *Burying the Lead: Effects of Public Lead Service Line Replacements on Blood Lead Levels and Property Values*. National Bureau of Economic Research. Retrieved March 13, 2023, from https://conference.nber.org/conf_papers/f177420.pdf

Needleman HL, Riess JA, Tobin MJ, Biesecker GE, Greenhouse JB. Bone lead levels and delinquent behavior. J Am Med Assoc. 1996;275:363–369. [PubMed]

Sandvig, A. et al. (2008). Contribution of Service Line and Plumbing Fixtures to Lead and Copper Rule Compliance Issues. epa.gov. Retrieved March 9, 2023, from https://archive.epa.gov/region03/dclead/web/pdf/91229.pdf

Schwartz J. (1994). Societal benefits of reducing lead exposure. *Environmental research*, *66*(1), 105–124. https://doi.org/10.1006/enrs.1994.1048

Staes, C., Matte, T., Copley, C. G., Flanders, D., & Binder, S. (1994). Retrospective study of the impact of lead-based paint hazard remediation on children's blood lead levels in St. Louis, Missouri. *American journal of epidemiology*, *139*(10), 1016–1026. https://doi.org/10.1093/oxfordjournals.aje.a116941

Tennessee Childhood Lead Poisoning Prevention Program. (2021, October). *LEAD POISONING BURDEN AND SCREENING*. Tennessee Department of Health. Retrieved February 18, 2023, from https://www.tn.gov/content/dam/tn/health/program-areas/lead/2021-TN-CLPPP-Fact-Sheet-Final.pdf

United States Department of Housing and Urban Development. (2022). (rep.). *Fiscal Year 2022 Agency Financial Report*. Retrieved February 20, 2023, from https://www.hud.gov/sites/dfiles/CFO/documents/afr2022.pdf.

United States Environmental Protection Agency. (2021, December). *Small, Underserved, and Disadvantaged Communities (SUDC) Grant Program Grant Implementation Document* . epa.gov. Retrieved February 21, 2023, from https://www.epa.gov/system/files/documents/2021-08/updated_sudc_implementation_document_508-compliant.pdf

United States Environmental Protection Agency. (2023, January). *EJScreen: Environmental Justice Screening and Mapping Tool*. epa.gov. Retrieved February 21, 2023, from https://www.epa.gov/ejscreen