Strategies to Minimize Lead Exposure and Ensure Early Detection of Elevated Lead Levels in Children Less than 5 years of Age

Stephanie Massey
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By

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B.S.N Drexel University, 2015

A Synthesis Paper

Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Nursing (Independent- Public Health)

School of Nursing

The University of Maine

May 2024

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Abstract

Exposure to lead in children can have serious long-term health implications, including cognitive and developmental delays. This systematic literature review identifies evidence-based strategies to prevent lead exposure and ensure early detection of elevated lead levels in children less than 5 years of age. The purpose of this review is to determine reliable and valid methods to prevent and screen for lead exposure in children less than 5 years of age to inform practice, research, and policy.

Keywords: lead prevention, lead screening, blood lead levels in children, lead exposure, elevated lead levels, lead screening guidelines, early detection of elevated lead levels, risks of lead exposure
Lead is a naturally occurring metal found in the earth's crust. In the past, it has been used in many industrial and consumer products, such as paint, pipes, cosmetics, jewelry, car and truck batteries, ammunition, and stained glass. Currently, it can be found in contaminated food, soil, water, and dust. Lead exposure is a public health problem in the United States (US) that can adversely affect the health of children and adults. Lead exposure in children and women of childbearing age are of particular concern because of increased vulnerability to adverse long-term health outcomes (World Health Organization, 2023). During pregnancy, lead in the blood can transfer to the fetus causing neurologic consequences and impaired fetal growth in utero. For the mother, elevated lead levels in the blood can contribute to preterm birth and hypertensive complications in pregnancy (Johnson et al., 2022). Hypertensive complications place women at increased risk for life-long hypertension and associated health consequences (Sbab et al., 2023).

Young children, aged 6 months to 6 years old, absorb 4-5 times more lead than adults because curiosity and age-appropriate behavior such as mouthing toys and other objects contaminated with lead places them at increased risk for lead ingestion. Exposure to lead can cause severe, irreversible health consequences in children. High serum lead levels affect primarily the brain, skeletal, and cardiovascular systems resulting in coma, seizures, and possible death. There is concern that over time these deficits can worsen and increase one's risk of cardiovascular disease and dementia later in life (McFarland, 2021). Deficits in cognitive function, fine motor skills, and emotional regulation can also occur. Low levels of lead exposure often do not cause obvious symptoms but do affect brain development, resulting in decreased intelligence and behavioral problems. In Ontario between 2008 and 2016, drinking water in schools was tested for lead. It was reported that in schools with elevated lead levels in drinking water math, reading, and writing scores were decreased (Buajitti et al., 2021). Research has
determined that no level of lead in the blood is considered safe (World Health Organization, 2023).

The toxic effects of lead exposure in American children were first detected and documented in medical literature as far back as the late 1800’s. Unfortunately, these cases were not identified until severe symptoms, such as seizures, coma, and death, had occurred. As time went on, doctors were more prepared to recognize the early signs of lead toxicity, but because those symptoms (e.g. vomiting, colic, abdominal pain, and irritability) are very similar to other medical conditions, being misdiagnosed or undiagnosed was common (Allwood et. al., 2022). It was not until the 1940s that lead toxicity was identified as a public health problem by both the medical community and the lead industry (Allwood, 2022). There are approximately 170 million Americans alive today who were exposed to toxic lead levels in early childhood, which we know is detrimental to the healthy development of the body (Allwood, 2022).

There are several different areas and products in which lead can be found. Toys, spices, herbal remedies, industrial admissions, and soil can be contaminated with lead, but the largest contributor seems to be from old housing. Children who come from low-income households and/or grow up in housing built before 1978 are at even greater risk of lead exposure. Housing built before 1978 contains lead-based paint and is more likely to have pipes, faucets, and plumbing fixtures containing lead (CDC, 2022). Data collected between 1970 and 2016 from the National Health and Nutrition Examination Surveys (NHANES) and the American Healthy Homes Survey (AHHS) show racial and other disparities, such as socioeconomic status, and lack of access to healthcare providers, have a significant impact on which populations have a higher risk of exposure to lead and higher blood lead levels (Jacobs, 2023).
The lead industry began reducing the amount of lead used in paint, and in 1978, the use of lead in paint was banned altogether. Lead in gasoline from car, truck, motorcycle, and airplane emissions is another source contaminating the environment and causing lead toxicity. Lead in gasoline started to be phased out for use in cars in 1973, with a total ban being implemented in 1996 resulting in an approximate 78% decline in blood lead levels from 1976-1991 (Allwood, 2022).

Despite the ongoing public health efforts over the last several decades, 590,000 US children aged 1-5 were found to have an elevated blood lead level of 3.5 ug/dL and greater in 2016, and 4.3 million children resided in homes with lead paint in 2019 (Jacobs, 2023). Testing for lead in drinking water in homes and schools has become a national issue due to the Flint, Michigan crisis of 2014. Since then, there has been increased testing by independent researchers, growing complaints from residents and communities, and increased media attention on the topic. Both professionals and the public have grown concerned about lead in drinking water being a more widespread problem than previously acknowledged (Sullivan et al., 2019). A 2017 EPA report found that only 8,000 schools and childcare centers out of 598,000, or 1.3%, are routinely required to test their drinking water for lead. Children spend 7 hours a day in school for 9 months of the year. There are breaks, weekends, and summer vacations, when school is closed, leaving water to sit in the pipes and for lead to contaminate the water (Sullivan, 2019).

Prevention of lead exposure and early detection of elevated serum lead levels, when exposure occurs, can reduce the incidence of associated adverse physical and cognitive effects in children. Detection of sources of lead in homes and in schools and subsequently acting to remove lead when detected can prevent exposure (CDC, 2022). Many states require primary health care providers to recommend serum lead levels at 1 and 2 years of age, however, it is up
to the parents to comply. Primary care providers are required to share results with local and state public health departments who must report to the CDC (CDC, 2022).

In the United States, a federal universal requirement for testing blood lead levels in children aged 6 and under does not exist. The Centers for Disease Control (CDC) cannot require blood lead testing, they can only make recommendations. The Centers for Medicare and Medicaid Services (CMS) is the only federal agency that, in the past, required blood lead level screening and testing in children who were receiving Medicaid’s Early and Periodic Screening, Diagnostic, and Treatment (EPSDT) benefit. This requirement was dropped by CMS in 2012 when CMS began to align with the CDC’s recommendation of allowing states to target test children who were at high risk for lead exposure and in the most need of screening (Dickman, 2017). Despite this recommendation, it has been reported that an estimated 35%-60% of children who are enrolled in Medicaid do not get screened for lead (Schmidt et al., 2022). When lead testing decreases there is an associated increase in elevated lead levels. In Illinois, during the COVID pandemic, testing children for lead decreased by 24% and consequently, the incidence of high serum lead levels increased by 51% (Loza & Doolittle, 2022; Fokum et al., 2023).

The purpose of this review is to determine reliable and valid methods to prevent and screen for lead exposure in children less than five years of age to inform practice, research, and policy.

Methods

Strategies to prevent lead exposure and ensure early detection of elevated lead levels in children less than five years of age was the focus of this systematic literature review. The study was conducted from November 2023 to March 2024 by accessing articles in Google Scholar,
CINAHL, and Medline databases. Keywords used in the search were a combination of lead prevention, lead screening, blood lead levels in children, lead exposure, elevated lead levels, lead screening guidelines, early detection of elevated lead levels, risks of lead exposure, and lead education, separated by “AND.” Only quantitative studies were included in the review. Qualitative studies were not included because the focus of this review is not on people’s lived experience, but instead on evidence that supports methods of testing and screening. Twenty-three studies on lead exposure and test completed between 2014 and 2024 were included in the first phase of the review. Ten of the 23 studies were excluded as they did not meet the criteria of a focus on preventing exposure specifically in homes and schools and/or screening.

Results

A total of 13 research articles were included in the systematic review of the literature. Five quantitative studies on prevention of lead exposure were reviewed. Of those five, four focused on identifying sources of lead in homes or schools and one focused on preventive community education. Six quantitative studies on lead screening were reviewed. Of those six, five focused on targeted screening of children ≤5 years of age and one focused on screening education for pediatricians (See Appendix A).

Prevention of Lead Exposure in Homes and Schools

Lead prevention efforts focus on reducing exposure to lead, especially young children who are most vulnerable to its toxic effects. For children a primary prevention strategy is to identify sources of lead exposure in schools and homes (CDC, 2022). Public education on the dangers of lead exposure can also serve as a preventive measure (Mitra & Anderson-Lewis, 2020). Implementing lead prevention strategies can create safer environments for people,
especially young children, to live, work, and play by reducing the risks of lead exposure and its related health effects.

The Flint, Michigan water crisis of 2014 garnered national attention as contaminated water contributed to large increases in the incidence of elevated blood lead levels in children living in Flint. Awareness of lead in the water supply became more widespread amongst both the public and professionals, raising concern across the United States (Sullivan et al., 2019). Subsequently, states started looking closer at lead levels in school drinking water. New Jersey started looking closer at lead levels in school drinking water. Testing school drinking water for lead was mandated and guidelines were provided for districts to follow, such as posting results on district websites. A 2019 study conducted by Sullivan, et al (2019), analyzed compliance rates for lead testing in drinking water for school districts in New Jersey from October 2016-January 2018. Lead testing data for 581 school districts were reviewed. Compliance with testing was 90% and 87% of these same districts shared their results on their school websites. Lead levels in school drinking water of schools that complied with testing were >15 parts per billion (ppb) in 79% of the districts which is the Environmental Protection Agency’s (EPA) requirement for remediation. By mandating school testing of drinking water, lead contamination can be detected preventing children from exposure and poisoning (Sullivan, 2019).

A second study by Cradock and colleagues (2022) analyzed data collected between 2016 and 2018 from seven states in the US with lead testing programs or policies for drinking water in schools. The seven participating states were Arizona, California, Massachusetts, Nevada, Rhode Island, Utah, and Washington D.C. Of these seven states, 13%-80% of participating schools had lead levels >5 ppb, and four states had lead levels >20% ppb which exceeds the EPA remediation
requirement. Implementing a state-wide policies and programs to test for lead in school drinking water can identify problem areas quickly, reduce the risk of lead exposure, and provide quality drinking water for children (Cradock et al., 2022).

In Las Vegas Nevada, Barber et al., (2022), studied the impact of community education on preventing lead exposure as a part of the Las Vegas Lead Hazard Control and Healthy Homes Program (LHCHHP). Wide distribution of educational pamphlets (32,580) in Las Vegas communities were distributed to recruit residents with children under the age of 5 to enroll in a home lead inspection program; 586 responses of interest were received, and 63 applications were completed and accepted. Participants were enrolled in the program from 2018 to 2020 and preference was given to candidates who were homeowners and had children <5 years (n=36). Out of 63 participants, 43 homes had a lead inspection and risk assessment and 39 had a visual assessment. The LHCHHP found most homes had ≥1 lead dust hazard and ≥1 lead-based paint hazard. A Lead Hazard Control and Healthy Homes Program allows for early identification of lead exposure reducing the risk of toxic lead levels (Barber et al., 2022).

Angelon-Gates et al., (2018) analyzed lead levels in spices, herbal remedies, and ceremonial powders from homes in North Carolina who had children with already elevated lead levels. Samples of spices, herbal remedies, and ceremonial powders (n = 392) were collected from 59 properties, six samples were excluded as they required different sampling and analyzing methods. Twenty-nine percent of the samples were found to have ≥1 mg/kg lead. After this finding, a survey was developed to measure child-specific consumption of the lead contaminated products and details of each individual product were recorded. This study demonstrates sources of lead in the home may be in substances other than paint, dust, soil, and water highlighting the need for product safety and other lead prevention measures in spices.
Mitra and Anderson-Lewis (2020) used education, outreach, and community-based training in Mississippi to encourage health promotion and awareness of childhood lead poisoning prevention. Participants from kindergarten classrooms, health fair and community events, home buyers, builders, rental homeowners, and realtors were provided with hands-on training and educational materials. Their training consisted of an online Lead Based Paint Visual Assessment training created by the U.S. Department of Housing and Urban Development (HUD). The success of the training was measured by pre and post-tests. Realtors, contractors, inspectors, and DIY workers (n= 295) demonstrated the highest scores on the post-test. Fifty-nine percent of 220 realtors were able to identify soil as a potential source of lead. Sixty-eight percent of realtors identified car batteries as a potential source of lead, and 65% were able to identify paint as a potential source of lead in the environment. Of the same cohort of realtors 62.3%, 48.1%, and 58.5%, at posttest identified three complications—mental, physical, and psychological, respectively, and mean posttest score was significantly higher than the pretest scores (7.47 ± 2.07 vs. 6.60 ± 1.68, p = 0.04, respectively). At the two-month follow-up, all participants (n= 295) reported implementation of the information from the HUD training into their practices. This study shows the importance of educating and increasing people’s knowledge in identifying sources of lead, complications, and prevention of lead exposure.

**Methods of Lead Screening of Children Less than 5 Years of Age**

Over the last few decades, primary prevention of lead exposure through screening has been a focus of the CDC and American Academy of Pediatrics (AAP) (Hillyer, 2021). An Ambulatory Care Network (ACN) practice of New York Presbyterian Hospital (NYP) conducted a retrospective study of lead screening of high-risk children at one urban location. Between 2010-2015, all high-risk children 1-5 years of age had annual blood lead level testing. The
purpose of the study was to determine blood lead levels of participants and to assess the effectiveness of city and state guidelines for identifying children who might be at high risk of lead exposure (Hillyer, 2021). Of the 3274 study participants, 24 had elevated lead levels. Seventy-five percent of children with elevated lead levels were identified at age 1 or 2 and 67% of children with elevated lead levels first detected at age 3 or older, had developmental delays. These findings suggest that routine testing of high-risk children detects elevated serum lead levels early and may prevent developmental delays (Hillyer, 2021).

Beidinger-Burnett et. al. (2019) reported inconsistencies in lead screening can be harmful to children in vulnerable populations. Children living in South Bend, Indiana between 2005 and 2015 had high serum lead levels yet levels of screening were low. Indiana has no formal lead testing policy and the overall screening rate for all children age 6 years and younger was 10%. Their research revealed that out of 18,526 children under the age of 5, only 4.7% to 16.7% of children were screened for lead before the age of 3. Even with low screening rates more than 75% of the children that did get screened had an elevated lead level ranging from 1-10μg/dL. Beidinger-Burnett et. al. (2019), concluded that low and inconsistent screening rates in vulnerable populations increases the risk for harmful lead exposure, especially in states without a formal testing policy. The push for formal policies and universal screening is important for generating awareness, increasing screening rates, and protecting high risk children.

Serum lead levels of children participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) were compared to children enrolled in Medicaid and children who did not participate in either program. Aoki and Brady (2018) determined that “WIC only,” “Medicaid only,” and “Both WIC and Medicaid” children had an increased prevalence of elevated blood lead levels when compared to children who did not
participate in either program with adjusted prevalence ratios (aPRs) of 3.29 (95% CI: 1.19, 9.09), 4.56 (95% CI: 2.18, 9.55), and 2.58 (95% CI: 1.18, 5.63), respectively. The researchers concluded that those participating in one or both programs were likely to have higher lead levels and screening these groups would help identify additional children with high blood lead levels.

Despite the Flint, Michigan water crisis of 2014, little research has been conducted in Flint on post-crisis lead screening behaviors and possible health-related outcomes from contaminated water. In 2019 researchers conducted a cross-sectional study in Flint, Michigan, and gathered demographic data, whether children had blood lead level screening before and/or after elimination of the lead contaminated water, if an elevated blood level was diagnosed by a clinician, and any new onset cognitive-behavioral or physical symptoms in children (n = 244) (Ezell et al., 2019). Seventy-seven percent (n= 187) of children were screened for elevated blood lead levels after elimination of the lead contaminated water source of which 32.6% (n= 61) were diagnosed with elevated blood lead levels. Multivariable logistic regression was used to evaluate associations between elevated blood lead levels and cognitive-behavioral and physical outcomes. Elevated blood lead levels were associated with adverse cognitive/behavioral outcomes (comprehension issues/learning delays OR=4.0, hyperactivity OR=6.6, emotional agitation OR=3.5, p<0.01 for all outcomes), (Ezell et al., 2019).

Azofeifa and Sripipatana (2020) looked at lead testing rates of children 1-5 years of age at Health Resources and Services Administration (HRSA) funded Health Centers (HC). The purpose of the study was to inspect blood lead levels of children across the United States in underserved communities impacted by social determinants of health, such as low income, race, and limited access to health care. 1.1 million caregivers of children < 5 years of age reported that blood lead level testing was performed on their children. Urban HCs reported higher rates of
blood lead testing than rural HCs (74.1%; 95% CI, 59.4-88.8) and those who used HCs as their primary source of medical care had higher testing rates as well (99.9%; 95% CI, 99.7-100) (P ≤.05), (Azofeifa & Scripripatana, 2021). From 2012-2019, the total HRSA Health Center child patient population for those 6 years and under increased from 2,674,500 in 2012 to 2,989,184 in 2017. This increase in the number of patients served was associated with a 34.4% increase in blood lead testing. Access to HRSA funded Health Centers helps provide blood lead level screenings and education on lead exposure and lead prevention to families in low-income areas. Vulnerable populations are at an increased risk for elevated blood lead levels. Providing education and screening efforts can lead to increased screening rates among high-risk groups.

Educating healthcare practitioners and the public about the importance of lead screening and testing in children under the age of 6, can increase testing rates, identify lead exposure early on, and ensure the health and safety of children. Calabrese, et al. (2022), reported that two weeks to one month after training on the effects of lead exposure and the importance of screening, 80% of pediatricians reported an increase in lead testing and practice changes. The Increasing Capacity for Blood Lead Testing Extension for Community Healthcare Outcomes (ECHO) project was launched by the American Academy of Pediatrics (AAP) and the CDC conducted the training. Training pediatricians can increase early lead screening allowing for prompt treatment if needed (Calabrese, 2022).

Conclusion

This systematic review supports screening water sources in homes and schools for the presence of lead and preventing exposure. However, in the United States there is a lack of universal lead testing regulations which can result in a significant number of children residing in homes and attending schools with lead in the water supply. We know that even low levels of lead
exposure can be associated with cognitive-behavioral issues, intellectual deficits, academic disabilities, and attention deficits (Dickman, 2017).

Serum lead screening for children under the age of 5 has been demonstrated to identify those with elevated lead level and promotes early treatment when necessary. However, in the US, universal mandates regarding lead screening do not exist. This has serious consequences because targeted testing only focuses on high-risk groups or those we think may be affected, and limits identifying all the children at risk for lead exposure (Dickman, 2017).

Based on this review, implications for practice, research, and policy can be considered to improve prevention of lead exposure in homes and schools and early screening to identify children with elevated lead levels.

**Implications for Practice, Policy, and Research**

This systematic review of the literature substantiated effective strategies to prevent lead exposure in homes and schools primarily by testing drinking water for lead. Consistent screening for serum lead levels in children ≤5 years of age has been demonstrated to identify children with elevated lead levels allowing for prompt interventions. Continuous research on lead and its side effects, plus changes to lead prevention and screening policy and practice may eliminate a child’s exposure to lead (Dickman, 2017).

Public health officials and providers can target home buyers, builders, rental homeowners, and realtors to provide training and educational materials on methods to identify lead in drinking water in homes and schools. Lead education videos on prevention created by the CDC can easily be shared by public health officials and providers on social media or used in
other venues to educate the general public. Increasing awareness and education can initiate behavior changes and reduce lead exposure in homes and schools (LeBlanc, 2023).

There are several policy strategies that may impact prevention efforts in a positive way. A federal requirement to test for the presence of lead in drinking water of homes and schools during annual inspections is one practice change to consider. These efforts allow for early detection of lead in the water supply and accelerate intervention efforts to remediate the situation. The FDA can regulate lead levels in spices. Currently there is no limit to the amount of lead in spices and spices are considered part of a child’s diet, especially amongst certain cultures and ethnic groups (Angelon-Gates et. al, 2018). Implementing policies at the federal and state levels can increase lead prevention efforts and reduce exposure.

Universal screening as opposed to screening only those children identified as high risk would more reliably identify children with elevated lead levels. This is supported by data from North Carolina demonstrating that by focusing only on high-risk groups more than 30% of children with elevated serum lead levels were missed (Schmidt, 2022). Educating primary care providers, operators of day care centers, and administrators of preschool programs may be a practice that would increase universal lead screening for children < 5 years of age and eliminate the assumption that only high-risk groups need to be tested (Dickman, 2017).

In the United States, screening practices across states are inconsistent due to lack of a federal policy for lead screening (Dickman, 2017; Sobin, 2023). Universal testing strategies are more useful and cost-effective than targeted testing and allows us to look at the bigger picture to determine actual exposure (Dickman, 2017). When children are identified to have elevated blood lead levels through screening prompt and continuous follow up testing is essential. Follow-up can be particularly challenging for children who live in poverty, reside in geographic areas with
high concentrations of lead, and lack access to health care. Creating awareness, promoting health literacy, and increasing access to testing services may increase follow up compliance. Public health officials need to work together with health care providers and stakeholders to update policies that will improve follow up testing and lead prevention strategies, especially among vulnerable populations (Chen, 2023). Furthermore, states should consider adopting a universal screening approach due to its ability to reach all children instead of targeted groups (Dickman, 2017). It is evident that vulnerable populations are at a high risk for elevated blood lead levels, but we do not know the impact of missed opportunities in screening all children (Madrigal et al., 2018).

Future research should continue to focus on the impact of educating both providers, caregivers and the community about lead awareness, exposure, and risk of potential medical problems. This can help increase prevention efforts and screening rates. Partnering with public health departments, stakeholders, or non-profit agencies can help expand lead awareness (Dickman, 2017).

Protecting the health and well-being of children should be a priority. The extent of lead’s harmful effects will not fully be understood until we can identify all children with elevated blood lead levels and the environments they live in (Madrigal et al., 2018). To maximize testing rates and improve outcomes, states should use a combination of universal screening, education, and increased access to care to increase screening rates and reduce lead exposure.
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## Appendix A

Research on Methods of Preventing Lead Exposure in Home and in Schools

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Angelon-Gaetz et al., 2018</td>
<td>392 samples of spices, herbal remedies, and ceremonial powders in one county in North Carolina</td>
<td>No national limit for lead in spices exists and may be seen as a source of lead exposure. 29% of samples tested contained ≥1 mg/kg lead</td>
</tr>
<tr>
<td>2. Barber et al., 2022</td>
<td>63 homes in Las Vegas, Nevada</td>
<td>43 homes had lead dust hazards identified throughout their homes, mostly on windowsills and the floor</td>
</tr>
<tr>
<td>3. Cradock et al., 2022</td>
<td>7 states with lead testing policies for drinking water in schools</td>
<td>13%-80% of participating schools had lead levels &gt;5ppb, and four states had lead levels &gt;20% ppb in their drinking water</td>
</tr>
<tr>
<td>4. Mitra et al., 2020</td>
<td>295 Realtors, contractors, inspectors, and DIY workers in Mississippi</td>
<td>Two months after post lead education training, all 295 participants reported changing their practice to incorporate what they learned from their lead training</td>
</tr>
<tr>
<td>5. Sullivan et al., 2019</td>
<td>581 school districts in New Jersey</td>
<td>79% of participating school districts had lead levels in their drinking water &gt;15ppb</td>
</tr>
</tbody>
</table>
## Research on Methods of Lead Screening of Children < 5 Years of Age

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aoki et al., 2018</td>
<td>3,170 children ages 1-5 years old across the United States whose data was retrieved from the National Health and Nutrition Examination Surveys</td>
<td>“WIC only,” “Medicaid only,” and “Both WIC and Medicaid” children had an increased prevalence of elevated blood lead levels when compared to children who did not participate in either program with adjusted prevalence ratios (aPRs) of 3.29 (95% CI: 1.19, 9.09), 4.56 (95% CI: 2.18, 9.55), and 2.58 (95% CI: 1.18, 5.63), respectively</td>
</tr>
<tr>
<td>2. Azofeifa &amp; Sripipatana 2020</td>
<td>1.1 million children &lt; 5 using Health Resources and Services Administration funded Health Centers across the United States</td>
<td>Blood lead level testing was higher in urban areas vs rural (74.1%; 95% CI, 59.4-88.8) and in those children who used Health Centers as their primary source of medical care (99.9%; 95% CI, 99.7-100) (P ≤.05)</td>
</tr>
<tr>
<td>3. Beidinger-Burnett et al., 2019</td>
<td>18,526 children age 5 and under in South Bend, Indiana</td>
<td>4.7%-16.7% were screened for lead before age 3, 75% of those screened had elevated lead levels ranging from 1-10μg/dL</td>
</tr>
<tr>
<td>4. Calabrese et al., 2022</td>
<td>84 pediatric providers representing 21 states</td>
<td>Two weeks to one month after training on the effects of lead exposure and the importance of screening, 80% of pediatricians reported an increase in lead testing and practice changes</td>
</tr>
<tr>
<td>5. Ezell et al., 2019</td>
<td>244 children in Flint, Michigan 5 years after the water crisis</td>
<td>Elevated blood lead levels were associated with adverse cognitive/behavioral outcomes (comprehension issues/learning delays OR=4.0, hyperactivity OR=6.6, emotional agitation OR=3.5, p&lt;0.01 for all outcomes)</td>
</tr>
<tr>
<td>6. Hillyer et al., 2021</td>
<td>3274 ages 1-5 years old at one New York City Ambulatory Care Network</td>
<td>Seventy-five percent of children with elevated lead levels were identified at age 1 or 2 and 67% of children with elevated lead levels first detected at age 3 or older, had developmental delays</td>
</tr>
</tbody>
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