The State of Childhood Lead Poisoning Prevention in Hawai‘i

Diana Felton MD; Kelly Hoffman BS; Derek Priddy MPA; and Patricia Heu MD, MPH

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Abbreviations
BLL = blood lead level
CDC = Centers for Disease Control and Prevention
DOH = Hawai‘i Department of Health
EPA = Environmental Protection Agency
HI-CLPPP = Hawai‘i Childhood Lead Poisoning Prevention Program
HIEDSS = Hawai‘i Electronic Disease Surveillance System
PCP = primary care provider

Introduction

Childhood lead poisoning has long been recognized as an important public health concern. Lead has no biological role in the human body; therefore, any detected lead in the blood is considered abnormal and indicates an exposure to environmental lead contamination. In children, low to moderate elevated blood lead levels (BLLs) are associated with difficulty paying attention, decreased IQ and poor academic performance,[1–3] and can have a profound effect on the life of a child, their family and their community. Most children with elevated blood lead levels are asymptomatic, with neuropsychiatric deficits appearing as children age. Children with very high BLLs (>45 µg/dL) may have acute symptoms such as abdominal pain, vomiting, constipation, anemia, lethargy, irritability, and loss of appetite.[4] In 2012, the US Centers for Disease Control and Prevention (CDC) lowered the blood lead reference value from 10 µg/dL to 5 µg/dL and reinforced the need for primary prevention of lead poisoning by eliminating environmental exposure to lead.[5,6] This reference value is based on lead levels in US population studies and is used to identify children exposed to lead in whom intervention is indicated.

In the United States, the majority of lead poisoning cases are from exposure to deteriorating, lead-based paint on interior surfaces despite the banning of lead-based paint for residential usage in 1978.[1] Young children are particularly at risk given their hand-to-mouth exploratory behaviors and the resulting unintentional ingestion of lead-contaminated dust and paint chips.[7] Soil may be contaminated with lead from deteriorating outdoor lead-based paint and the historic use of leaded gasoline, as well as from outdoor activities such welding and certain types of vehicle repair. The home smelting of lead fishing weights, a common practice in Hawai‘i, can also introduce lead into the soil.[8] Home water catchments systems can leach lead from roofing and plumbing materials into the water in acidic conditions, which occur with volcanic emissions.[9,10] The recent recognition of elevated levels of lead in certain religious and cultural products as well as in some imported spices, ayurvedic medicines, and dietary supplements are also cause for concern as Hawai‘i is the home of cultural groups from all over the world and imports a large quantity of foreign goods.[11,12]

Treatment for children with lead poisoning includes identification and removal of the source of lead, maximizing nutrition, and referral to early intervention services that can help mitigate the impact of lead on intellectual development.[1,13,14] In cases of high lead levels and/or symptoms, chelation therapy and occasionally hospitalization may be indicated.[4] Population studies show that lead levels have been steadily decreasing since the 1970s due to public health efforts in conjunction with the ban of lead-based paint in residential settings and the phase-out of leaded gasoline. However, recent biomonitoring data from National Health and Nutrition Examination Survey (NHANES) shows a slight rise in the 95th percentile BLLs for children ages 1-5 years in 2015-2016 as compared to 2013-2014 data.[15] An analysis of Quest Diagnostics Laboratory BLL data over a period of 6 years (2009-2015) in a significantly larger sample of 3.8 million children ages 1-5 years also demonstrated a small increase in the incidence of high blood lead levels in the final year of the study.[16] The implications of this unexpected rise after years of continuous decline are unclear and further evaluation of childhood BLLs is required to understand the progression of lead exposure in the United States. Continued public health efforts are needed to promptly identify children with elevated BLLs and exposure to lead hazards and to provide resources to eliminate the exposure to and decrease the harmful effects of lead.

Hawai‘i Childhood Lead Poisoning Prevention Program (HI-CLPPP)

The CDC was charged with funding state-based programs for childhood lead poisoning prevention (CLPP) by the Lead Contamination Control Act of 1988.[17] The goal of CLPP programs was to increase identification of children with lead poisoning and coordinate surveillance, clinical treatment, and environmental services. An earlier version of Hawaii's Childhood Lead Poisoning Prevention Program (HI-CLPPP) was lost in 2003 due to CDC funding cuts. However, in October 2017, CDC granted HI-CLPPP funds for 3 years and the program is now housed in the Department of Health (DOH) Children with Special Health Needs Branch (CSHNB). With the return of CDC funding and through collaborations with the DOH Hazard Evaluation and Emergency Response Office (HEER) and Public Health Nursing Branch, HI-CLPPP has once again become an active participant in the effort to protect children's health in Hawai‘i.

Currently, HI-CLPPP consists of a mix of full-time and part-time program staff with additional support from physicians and other DOH offices. HI-CLPPP's strategies and activities aim to strengthen BLL testing and surveillance, identify lead-exposed children and link them with needed services, and improve population-based interventions. In March 2018, HI-CLPPP implemented the Hawai‘i Electronic Disease Surveillance System (HIEDSS) for BLL surveillance, using the Maven Disease Surveillance and Outbreak Management System© (CONDUENT, Florham Park, NJ). Now, all blood lead test results from laboratories in Hawai‘i are electronically reported and received in HIEDSS in real-time for immediate review. HI-CLPPP recommends that children in Hawai‘i are tested for lead at ages 1 and 2 years. When a child with a BLL ≥5 µg/dL is identified, HI-CLPPP contacts the primary care provider to advise on follow-up testing and care coordination. A packet of resources is sent to the family, which includes information on minimizing lead hazards, recommended nutrition and hygiene, and improving development and cognition. Children with BLLs ≥10 µg/dL receive follow-up care from the program's nurse or a state public health nurse. If needed, the nurses make referrals to developmental programs or other state and community services. HI-CLPPP also offers environmental investigations through a collaboration with the Region 9 US Environmental Protection Agency (EPA) On-Scene Coordinators. All child and family case management information, including identified environmental hazards, is stored in HIEDSS.

In August 2018, HI-CLPPP published new childhood lead poisoning prevention guidelines for health care providers.[18] These screening and testing recommendations were distributed via a mass mailing campaign to more than 800 health care providers in an effort to increase blood lead testing statewide. HI-CLPPP is also working to increase awareness of lead poisoning prevention in Hawaii's communities through various outreach events, advertisements, and presentations. Collaborations with local organizations and other state programs have been instrumental in reaching targeted audiences.

Childhood Lead Data Trends

Elevated BLLs among Hawaii's children continue to be a concern. In 2018, of the 16,539 children under 6 years of age tested for lead, 160 children (1.0%) had a BLLs ≥ 5 µg/dL, a slight decline from the 2017 rate of 1.2%. The majority of elevated BLL cases occurred in urban Honolulu, O‘ahu's Leeward areas, and the east side of Hawai‘i Island. In Honolulu County, Maui County, and Kaua‘i County, the prevalence of elevated BLLs among tested children under 6 years of age was between 0.7% to 1.0%, while the prevalence among tested children under 6 years of age in Hawai‘i County was 1.8%, indicating possible disparities in lead exposure (Table 1).

Unfortunately, lead testing rates in all of Hawaii's counties remain very low. From 2017 to 2018, less than 16 percent of children under 6 years of age were tested for lead statewide. For children with Medicaid insurance, lead testing is required at ages 9-12 months and 2 years, and between 3-6 years if there is no record of a previous blood lead test or if risk changes.[16] However, in 2017, Medicaid reported that 16,620 children ages 1-2 years should have received at least 1 initial or periodic blood lead test in Hawai‘i, yet only 6,390 of these tests were done. Assuming that each child was tested once, this means that only an estimated 38.4% of these children age 1-2 years were appropriately tested for lead.[19] Children who miss lead screening may have an unrecognized elevated BLL, and families may miss the opportunity for early identification and interventions to reduce or eliminate lead exposure for that child as well as other children in the home.

Table 1. Children Under Age 6 Years with Elevated Blood Lead Levels ≥5 µg/dL by County, Hawai‘i 2018

County	Population of Children <6 Years (2017 estimate)[20]	Number of Children <6 Years Tested for Lead (2018)*	Number (%) of Children <6 Years with Elevated BLL (2018)
Honolulu	76,357	11,851	102 (0.9)
Hawai‘i	14,666	1,931	35 (1.8)
Maui	12,144	1,971	19 (1.0)
Kaua‘i	5,519	755	5 (0.7)

*31 children with blood lead test results were missing county address information and were excluded from the analysis.
Data Source: HIEDSS, Hawai‘i Department of Health, 2019.

Local Case Study

A 13-month-old boy was found to have a venous BLL of 18.2 µg/dL at a well-child exam. The child was asymptomatic and showed no developmental delays. The family resided in an apartment building built after 1978 and his parents did not work in any occupations involving lead. Originally from South Asia, the family commonly used a variety of cultural products and foods imported from Asia. The patient's primary care provider (PCP) suspected that the ceremonial makeup used on his face daily may be the lead source and this practice was discontinued. However, follow-up lead testing showed an increase to a venous BLL of 22.1 µg/dL. A thorough environmental history by his PCP with assistance from HI-CLPPP did not identify an obvious source of lead, however, concern developed about the family's heavy use of imported turmeric which previous studies have found to be frequently contaminated with lead.[11,12] The turmeric was tested by DOH and did not have significantly high levels of lead. Due to persistently elevated BLLs, the EPA was contacted to collaborate on an environmental investigation. An extensive evaluation of the home revealed a metal chest used for storing bed linens which the child would use to pull himself into a standing position and then proceed to suck on the metal. When tested with an X-ray fluorescence spectrometer (XRF), the decorative metal on the chest was noted to be >10% lead by weight, or over 100,000 ppm. A lead wipe sample was collected from the chest and the result was 520,000 µg/ft^2. Removal of the chest from the child's environment resulted in a rapid decrease of the child's BLL to 6 µg/dL. This case illustrates that there may be many unusual potential sources of lead in a child's environment and that it may be difficult to identify the source of exposure. Traditional questionnaires aimed at identifying high-risk children would not have identified this patient. Without the diligence of his primary care provider, this child's lead poisoning may have gone undetected for years. Identifying the lead source resulted in stopping the exposure and provided the family with resources to help mitigate the detrimental effects of lead poisoning.

Successes and Challenges

Although HI-CLPPP has only been reinstated for 2 years, there have been some exciting successes. With the start of real-time surveillance in HIEDSS, outreach to families and providers of children with elevated BLLs has improved substantially. Approximately 400 letters have been mailed to parents and health care professionals, providing resources on lead poisoning and reminders about confirmatory and overdue blood lead testing. More than 300 PCPs were individually contacted to collaborate on providing optimal care for patients with elevated BLLs. Thirty-one children received follow-up care from a registered nurse, and the EPA provided environmental investigations in 4 cases of lead poisoning. Since HI-CLPPP has been reinstated, 100% of the children identified in HIEDSS with an elevated BLL have received the recommended initial follow-up services within 2 weeks of a confirmed elevated blood lead test result. Awareness of lead exposure as a problem in Hawai'i is rising within the healthcare system and the community. Approximately 10,000 lead poisoning prevention brochures were distributed directly to health care providers and additional educational resources are available by request. A new interactive HI-CLPPP website (https://lead.hawaii.gov) was developed to communicate the individual and social costs of lead in Hawai'i as well as provide resources for families, health care professionals, and contractors. HI-CLPPP has provided outreach at numerous events, including the Early Childhood Leadership Symposium, Pediatric Island Style Conference, and Keiki Health Learning Fair. Presentations were provided for public health nurses, early childhood program staff, and child care providers. The first public advertisement for HI-CLPPP was created for the inside front cover of Kaua'i Family Magazine Summer Edition for distribution in May, June, and July 2019.

Although these successes are encouraging, there remain many challenges in the continued effort to reduce lead exposure in Hawai'i. Of primary importance is the need for testing of more children. Without increased testing, it is impossible to understand the burden of childhood lead poisoning in Hawai'i. Another challenge involves resources and authority for environmental investigations. Currently, HI-CLPPP has no in-house capabilities to provide assessments to identify sources of lead exposure. EPA has collaborated with HI-CLPPP to provide investigations for difficult cases where the source could not be identified, but in most situations, there are few resources or funds to support these investigations, and the burden of paying for them and any subsequent remediation falls on the homeowner or landlord. Because tenants may be unwilling to risk their housing status or may have tenuous relationships with their landlords, families will often refuse HI-CLPPP and EPA access to their homes. This may result in persistent lead exposure to the child or future residents. In 2018, HI-CLPPP offered an investigation and/or home visit to 25 families of children with an elevated BLL and 44 % turned down the free resources.

Going Forward

Much work remains for HI-CLPPP and its partners in the effort to eliminate childhood lead poisoning in Hawai'i. HIEDSS surveillance data will continue to be monitored for unusual clusters or geographic patterns of lead exposure. Efforts to follow-up with families and providers of children with EBLLs in HIEDSS will remain a key part of the program. HI-CLPPP will continue to strengthen partnerships with health care professionals and local communities to increase awareness of the dangers of lead exposure statewide.

HI-CLPPP is working to better understand and remove the barriers that keep children from being tested for lead in Hawai'i. In some states, universal testing was adopted for a short period (i.e. 3 years) to obtain a baseline prevalence of lead poisoning. The resulting data was used to determine if universal testing should be continued or if targeted screening was adequate to

protect public health.[21] This may be a viable future option for Hawai‘i. Hawaii's children would also benefit from:

- Stable HI-CLPPP funding to ensure continuing program progress.
- Meaningful laws protecting renters from lead hazards.
- Increased resources and clear legal authority to provide environmental investigations and require remediation.

In conclusion, childhood lead poisoning remains an ongoing problem in Hawai‘i, affecting children and families statewide. HI-CLPPP, the Department of Health, and community partners are working hard to eliminate childhood lead poisoning in Hawai‘i, but more support, resources, and awareness are needed to reach this goal.

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Authors' Affiliations:
- Hawai'i Department of Health, Hazard Evaluation and Emergency Response Office, Pearl City, HI (DF, KH)
- Hawai'i Childhood Lead Poisoning Prevention Program, Honolulu, HI (KH, DP, PH)
- Hawai'i Department of Health, Children with Special Health Needs Branch, Honolulu, HI (DP, PH)

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