Running the Numbers

A Periodic Feature to Inform North Carolina Health Care Professionals About Current Topics in Health Statistics

Trends in Lead Poisoning Prevention Data for Children Aged < 6 Years in North Carolina

European countries banned the use of lead in household paint before 1920 due to known adverse health effects. After opposition from the lead paint industry, the United States finally banned lead from paint intended for consumer use in 1978. Many older US homes still contain lead paint, and ingestion of lead from deteriorating paint remains a common source of childhood lead exposure. Other common sources include contaminated soil and water, occupational take-home lead dust, keys, vinyl mini-blinds, spices, ceremonial powders, traditional medicines, costume jewelry, bullets, and fishing weights. Leaded gasoline was an important source of lead exposure until the 1970s when the US Environmental Protection Agency (EPA) called for its phaseout. In 1996, the EPA Administrator noted that blood lead levels (BLLs) in children had decreased by 70% since the phaseout began [1].

Public health recommendations changed with improved diagnostic testing and stronger epidemiologic evidence of adverse health effects at lower BLLs. The level of concern in children was 60 micrograms per deciliter (μg/dL) in 1960 and was lowered to 10 μg/dL by 1991. After emerging research showed cognitive effects at even low blood lead levels in children, the Centers for Disease Control and Prevention (CDC) Advisory Committee on Childhood Lead Poisoning Prevention recommended a reference value of ≥ 5 μg/dL in 2012, based on data showing that 97.5% of US children aged 1 to 5 had a BLL below 5 μg/dL [2]. Healthy People 2020 objectives include further reduction of childhood BLLs [3].

The Lead Contamination Control Act of 1988 authorized the CDC to develop and fund programs to eliminate childhood lead poisoning. In 1990, North Carolina's Childhood Lead Poisoning Prevention Program (NC CLPPP) started coordinating clinical and environmental services for the detection and elimination of lead poisoning in children under 6 years old. The program provides technical assistance and training to local environmental health specialists (EHSs), public health nurses, laboratory staff, and medical providers.

Methods

All blood lead test results and demographic data for children under 6 are required to be electronically reported to NC CLPPP (NC § 130A-131.8) [4]. Since 2012, the North Carolina Lead Surveillance System (NCLEAD) has been used to collect and manage lead data. NCLEAD allows clinical and environmental public health professionals to document education, case management, and environmental actions. NCLEAD data analyses were conducted in SAS 9.4 [5].

Childhood Lead Data Trends

Since the 1970s, the number of children with elevated BLLs has been declining nationally and statewide, but lead poisoning has not been eliminated [6, 7]. Each year in North Carolina, approximately 600 children have confirmed BLLs ≥ 5 μg/dL [6].

Only around half of all eligible North Carolina children are screened for lead. Though the risk of lead poisoning peaks at age 2, testing rates for 2-year-olds are consistently lower than for 1-year-olds (see Figure 1). Although a well-child visit is recommended for 2-year-olds there is no required immunization at that visit and clinicians may neglect to screen for lead.

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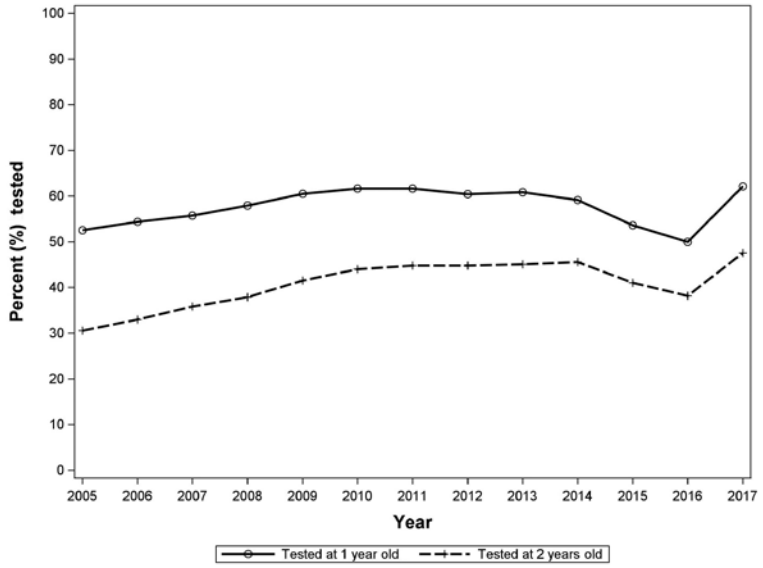
FIGURE 1.
Percent of North Carolina Children Tested at 1 and 2 years old, 2005-2017



From 2013 to 2017, 0.58% of tested North Carolina children (aged 6 months up to 6 years) had a confirmed elevated BLL. In the northeastern region of the state, several counties had rates of elevated BLLs greater than 1%, indicating disparities in lead poisoning rates (see Figure 2). Over 2 decades ago, researchers found that children living in rural areas of North Carolina had higher odds [OR = 1.9 (95% CI: 1.6-2.4)] of having a BLL U 10 ×g/dL compared to those in urban areas [8]. Poverty and deteriorated older housing in rural areas put children at particular risk.

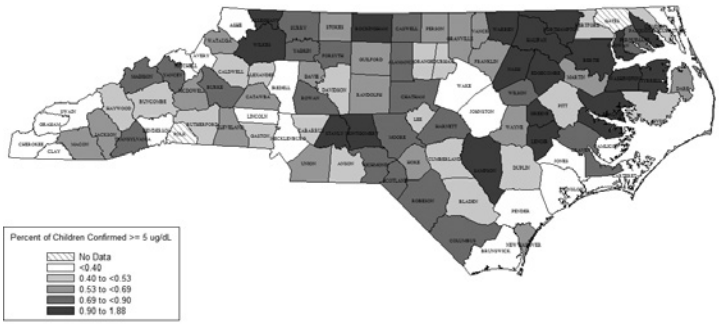
In 2011 and 2012, NC CLPPP conducted more than 200 lead home investigations per year. However, when CDC funding was discontinued for 2013 the number of lead home investigations fell. After regaining funding at the end of 2014, NC CLPPP was able to rebuild capacity and increase the number of investigations completed (see Figure 3).

Local Case Study

A 12-month-old girl had a capillary BLL drawn at a well-child exam, with a result of 66 μg/dL. A diagnostic venous sample was immediately drawn and confirmed the lead poisoning at 65.9 μg/dL. The child was asymptomatic and meeting developmental milestones. One month before, she and her sibling spent time at a family member's shooting range. Her 2.5-year-old sibling was subsequently tested and had a venous BLL of 40 μg/dL, markedly increased from the BLL of 1 μg/dL drawn 7 months earlier. The 12-month-old was admitted to a hospital and had an abdominal x-ray negative for any foreign body. Lab work revealed anemia with a hemoglobin level of 9.3 gm/dL (normal range: 10.5-13.5 g/dL) [9]. A toxicologist was consulted, and oral chelation initiated. The child was discharged after a brief stay. Two months later, her BLL had decreased to 50 μg/dL. Her sibling's BLL decreased from 40 μg/dL to 25 μg/dL over the same period. The environmental health investigation and interview with the children's parents confirmed that lead dust from the shooting range was the likely source of lead exposure.

As this case illustrates, asymptomatic children may still have very elevated BLLs. Universal screening of children is recommended to ensure that all lead-poisoned children are identified and can receive early intervention services to mitigate the potential long-term effects on cognition and behavior. This case also highlights that, even with chelation, excretion of the total body burden of lead is slow and may even take years because lead is stored in bone. For a child with a confirmed BLL ≥ 45 μg/dL, consult a Carolinas Poison Center toxicologist who can advise on whether chelation is

FIGURE 2.
Percent of North Carolina Children (6 months to 6 years old) Confirmed to Have Blood Lead Levels ≥ 5 μg/dL between 2013-2017, by County



necessary. The child must stay in a lead-free environment during chelation.

Successes and Challenges

On July 1, 2017, state law was amended to lower the BLL at which an environmental investigation must be offered from 10 μg/dL to 5 μg/dL for children under 6 years old, aligning our program with CDC recommendations. NC CLPPP is also able to offer environmental investigations to pregnant women with a confirmed BLL of ≥ 5 μg/dL. NC CLPPP has hired and trained several new regional EHSs for the July 1, 2018 implementation. More details are available in the "Childhood Lead Poisoning Prevention Program Expansion Implementation Plan [10]."

With the program expansion, NCLEAD data will be critical to managing cases and tracking source remediation. With only 2 and a half data positions managing more than 150,000 test results annually, data entry, cleaning, and management is a challenge. Blood lead test tesults from the State Laboratory of Public Health and most commercial laboratories are directly transmitted to NCLEAD. Results obtained from point-of-care lead analyzers must be manually entered by the clinic's staff and processed by NC CLPPP staff. Manual entry causes delays in reporting and reductions in data quality and demands a significant investment of time. Clinicians can assist in proper data collection by ensuring that the child's full name, demographics, physical address, and Medicaid number (where applicable) are on laboratory order forms and that all point-of-care test results are submitted weekly to NC CLPPP.

FIGURE 3.
Number of North Carolina Lead Investigations by Year with NC Childhood Lead Poisoning Prevention Program History, 2011-2017

This figure is available in its entirety in the online edition of the NCMJ.

Another significant challenge is the paucity of financial assistance available for families who cannot afford to properly abate lead hazards using a lead-certified contractor. Families should be refered to the NC Healthy Homes website (https://nchealthyhomes.com/countyresources/) to find lead-certified contractors, local housing agencies, and legal assistance.

Discussion

No lead level is considered "safe." Lead is more readily absorbed by children than adults and is especially toxic to the developing brain. As highlighted by the water contamination in Flint, MI, lead poisoning is still a public health concern. Nationally, 535,000 children aged 1 to 5 have BLLs high enough to cause health problems [11]. While primary prevention is the goal, secondary prevention through blood lead testing is important in identifying affected children and sources of exposure. For example, through routine testing, a North Carolina clinic identified a child poisoned after consuming an Ayurvedic medicine that later became the subject of a Food and Drug Administration (FDA) alert [12].

Medical providers play a critical role in public health efforts to identify and remove lead sources by educating families and testing children.

Clinicians are encouraged to:

- Provide educational materials to parents about sources and health effects of lead.
- Test for lead poisoning when children present with developmental delays, gastrointestinal complaints, and other related symptoms [9].
- Follow updated screening guidelines. Universal screening is recommended for children at ages 1 and 2 and all international adoptees, recent immigrants, and refugee children. Testing is required for children covered by Medicaid, Health Check, and WIC at ages 1 and 2. A lead risk-assessment form may be found at https://ehs.ncpublichealth.com/docs/forms/cehu/2012-0416-46Lead-RiskAssessmentQuestionnaire3958.pdf.
- Check blood lead test orders for required demographic information including the child's physical address [4].
- Report blood lead test results from point-of-care testing devices as required [4]. Point-of-care lead testing devices are approved for testing of capillary blood only.
- Follow recommendations for management and follow-up testing of children with a BLL $\geq$ 5 μg/dL. An initial BLL $\geq$ 5 ug/dL should be confirmed by a venous test sent to a reference laboratory for analysis. See the NC CLPPP follow-up schedule for more details [13].
- Refer children with elevated BLLs to your local health department and early intervention services when necessary. Every North Carolina county has state and local EHSs who can test homes and substances for the presence of lead.
- Contact NC CLPPP for technical assistance and medical consultation if needed. NCMJ

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