

Lead Poisoning: Triggers and Thresholds

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Introduction

Lead poisoning remains a significant problem in the United States, especially in cities like Buffalo with old housing stock and concentrated poverty. Young children are particularly vulnerable to the dangers of lead toxicity because they are in a continuous state of growth and development.¹ Their smaller bodies absorb lead at a faster rate than adults, and they are more prone to exposure because of time spent on floors (e.g. while learning to crawl and walk), as well as age-appropriate hand-to-mouth exploratory activity. Pre-natal exposure to lead is also a grave concern. During pregnancy, the mother's lead exposure or past exposure (as a reservoir of lead in her bones) can be liberated, as though it were calcium, and transmitted to the fetus.

Lead's toxicity results, in part, from its ability to mimic other metals necessary for normal neurodevelopment. It is able to pass through the blood brain barrier because the body mistakes it for calcium. Ultimately, the brain's exposure to lead results in a reduced number of neurons, interference with neurotransmissions, and decreased neuronal growth.² At lower levels of exposure, this can result in reduced IQ, behavioral changes such as reduced attention span and increased antisocial behavior, and reduced educational attainment.³ Higher levels of exposure can result in renal impairment, coma, or even death.⁴ These neurological and behavioral effects are believed to be irreversible.⁵



Over the last forty years, various pieces of legislation at the federal, state, and local level have been enacted in order to combat the problem. Many of these regulations focus on eliminating the prime exposure sources, most notably lead-based paints. However, because a large portion of the nation's

housing stock pre-dates enactment of these regulations, old lead-based paint continues to be the most significant source of lead exposure in the United States. ⁶

A secondary approach to combatting lead poisoning focuses on testing the blood of young children, followed by an appropriate remedial course of action in cases where the blood-lead level exceeds certain thresholds. However, such reactive measures are not ideal, since there is no known “safe” level of lead exposure. Therefore, it is important to question whether the various thresholds and “trigger points” used in lead poisoning laws and policies are truly effective tools for achieving a lead-safe society, and whether these thresholds should be lowered.

Environmental (Proactive) Regulations

Paint, Dust, and Soil

In 1971, Congress passed the Lead-Based Paint Poisoning Prevention Act (LBPPA), which identified lead-based paint chips as the primary health hazard of lead-based paint.⁷ In 1978, the Consumer Product Safety Commission banned the residential use of paint containing greater than or equal to 0.06 percent (measured by weight of the dried product), or 600 parts per million (ppm) of lead.⁸

Perhaps the most important legislation pertaining to residential lead exposure is the Toxic Substances Control Act of 1976 (TSCA), which authorized the Environmental Protection Agency (EPA) to regulate lead-based paint hazards. Notably, TSCA Section 403 set standards for what should be considered “dangerous” levels of lead in paint, dust, and residential soil.⁹

According to these standards, lead in dust (most often resulting from disturbed paint) qualifies as “hazardous” when it meets or exceeds 40 micrograms of lead per square foot (ug/ft²) on floors, 250 ug/ft² of lead on interior window sills, and 400 ug/ft² of lead in window troughs.

Section 403 also establishes “hazardous” lead thresholds for residential soil. Any sample that meets or exceeds 400 parts per million (ppm) of lead in bare soil in areas where children commonly play, or 1,200 ppm average in bare soil in the rest of the yard, must either be capped or removed.



In 2008, the EPA enacted the Lead-Based Paint Renovation, Repair and Painting Rule, commonly known as the “RRP Rule.” The RRP Rule aims to reduce the risk of lead contamination arising from home renovation activities by requiring all renovators working in homes built before 1978 and disturbing more than six square feet of lead paint inside the home, or twenty square feet outside the home, to be certified by the EPA in lead-safe removal procedures. It also requires that firms performing renovation, repair, and painting projects that disturb lead-based paint in homes, child care facilities and pre-schools built before 1978 be certified by the EPA and use certified renovators who have been trained by EPA-approved training providers.¹⁰

Water

During the first half of the twentieth century, when the public health hazards of lead were less known, lead was considered the ideal material for water pipes due to its durability and malleability. Once the adverse effects of lead poisoning became clear, the federal government took steps to curtail lead exposure via drinking water.

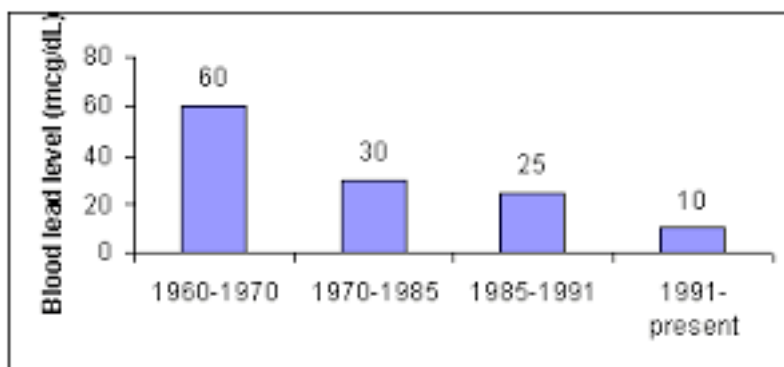
In 1986, Congress amended the Safe Drinking Water Act of 1974 (SDWA), requiring the EPA to set standards limiting the concentration of lead in public water systems. In 1991, pursuant to the SDWA, the EPA promulgated what is known as the Lead and Copper Rule (LCR). The LCR applies to water utility companies (all community water systems and non-transient non-community water systems), and it defines an “action level” of 0.015 mg/L. If more than ten percent of customer taps sampled exceed this action level, various requirements may be triggered, including water quality parameter monitoring, corrosion control treatment, source water monitoring and/or treatment, public education, and lead service line replacement.¹¹



Because these are federal regulations, state and local policies largely correspond with the thresholds listed above. For example, the New York State Department of Health’s “Drinking Water Protection Program” expressly refers to the federal LCR, including recommended tap sampling and corrosion control procedures.¹² However, state and local policymakers are permitted to set more stringent standards than those fixed at the federal level. Very recently, the city of Buffalo lowered the “action level” for the city’s drinking water from the federally mandated 0.015 ppm to 0.005 ppm, which mirrors the FDA’s requirements for bottled water.¹³

Blood-based Regulations (Reactive)

The second approach to lead poisoning is through screening programs that attempt to identify lead-poisoned children and then identify and eliminate the sources of their exposure. In 1991, the U.S. Centers for Disease Control and Prevention (CDC) published a comprehensive statement, part of which outlines a recommended screening program and how to proceed when confronted with test results that exceed certain specified “actionable” levels. However, the statement itself is merely advisory, and the individual states are permitted to set their own “actionable levels” that trigger environmental and educational intervention.

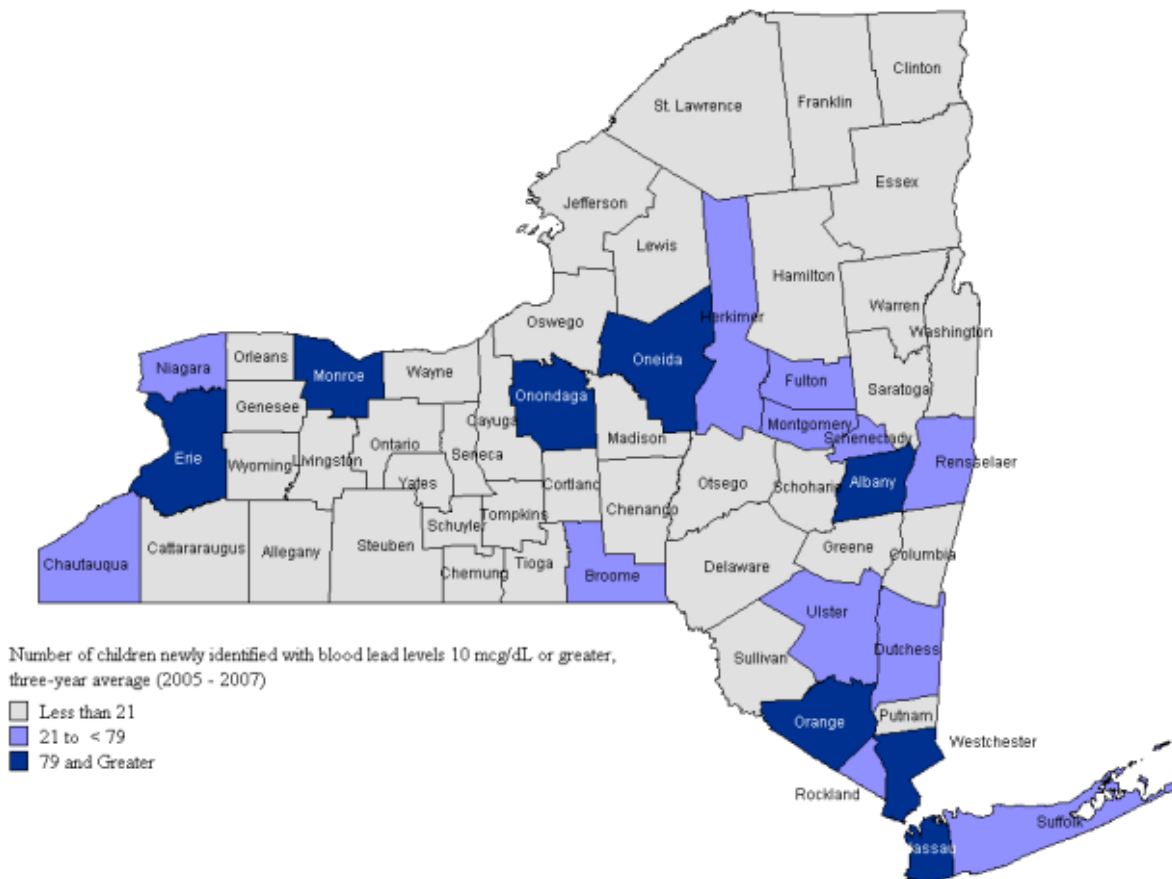


It is important to reinforce the fact that there is no known safe level of

lead in the human body. In 1992, scientists measured the amount of lead in the bones of pre-industrial humans for the purpose of estimating the “natural background” level of lead in blood. They concluded that this natural background level was approximately 0.016 micrograms per deciliter (ug/dL).¹⁴ In comparison, the CDC’s current recommended action level is 5 ug/dL, or 300 times the natural level. This 5 ug/dL mark is the most recent in a series of incremental adjustments the CDC has made to its recommended “reference range value” for when intervention and case management are appropriate. For children living in publicly funded housing, the U.S. Department of Housing and Urban Development still uses 20 ug/dL as its “environmental intervention blood lead level,” although as of September 2016, adoption of the CDC’s more stringent standard is being considered.¹⁵ According to CDC national lead surveillance data, just under 2.5 million children underwent blood-lead-level testing in 2015.¹⁶ Of those tested, approximately 250,000 (~0.5%) had BLLs greater than or equal to 10 ug/dL, while approximately 1.8 million (~2.8%) fell within the 5-9 ug/dL range.¹⁷

At this juncture, New York Public Health Law and Regulations require that “At each routine well-child visit, or at least annually if a child has not had routine well-child visits, primary health care providers shall assess each child who is at least six months of age but under six years of age, for high dose lead exposure using a risk assessment tool based on currently accepted public health guidelines. Each child found to be at risk for high dose lead exposure shall be screened or referred for lead screening.”¹⁸ Additionally, non-primary health care providers (such as hospital intake facilities) must inquire whether patients between 6 months and 6 years have received routine lead screenings as part of well-child checkups.¹⁹ In either case, the applicable health care provider is also directed to provide the parent or guardian of children between 6 months and 6 years with anticipatory guidance on lead poisoning prevention.²⁰

New York State defines “elevated lead level” as a blood lead concentration greater than or equal to 10 ug/dL. If a child measures at a level **between 10 and 15 ug/dL**, “primary health care providers shall provide or make reasonable efforts to ensure the provision of risk reduction education and nutritional counseling.” § 67-1.2(a)(8). “For each child who has a confirmed blood lead level **equal to or greater than 15 micrograms per deciliter** of whole blood, primary health care providers shall provide or make reasonable efforts to ensure the provision of a complete diagnostic evaluation; medical treatment, if necessary; and referral to the appropriate local or State health unit for environmental management. A complete diagnostic evaluation shall include at a minimum: a detailed lead exposure assessment, a nutritional assessment including iron status, and a developmental screening.” § 67-1.2(a)(10). In short, children in the 10-15 ug/dL range receive more passive, risk-avoidance counseling, while children with measurements above 15 ug/dL receive more hands-on, risk-intervention treatment designed to find and remediate the source of the poisoning – most often lead paint dust or chips in the home. Critically, the New York state regulations do not provide any directive for how to respond to a child with a BLL between 0 and 9.9 ug/dL.



With regards to local policy, the Erie County Department of Health (ECDOH) currently operates three lead poisoning prevention programs: the “Childhood Lead Poisoning Prevention Program,” which deals with case management of lead poisoned children in the County; the “Lead Poisoning Primary Prevention Program,” which works to prevent children from being exposed to lead hazards; and the “Lead Hazard Control Program,” which deals with the remediation and control of residential lead

hazards.²¹ 2016 has been a banner year for lead prevention and awareness in Erie County. In March, Erie County Executive Mark Poloncarz announced a \$3.75 million commitment over the next five years to increase lead inspection and remediation throughout Erie County. In June, Poloncarz announced that Erie County was among the counties chosen to receive \$3.4 million in federal funding from HUD, to be used in addressing lead issues in 180 low-income housing units located in Buffalo and Lackawanna.²² As of December 1, 2016, Erie County began treating 5 ug/dL as its threshold and offering case management to children with levels over 5.

New York should adopt the CDC's recommended "action" level of 5 ug/dL, and the CDC consider lowering its "actionable" level to 2 ug/dL

New York State should adopt the CDC's 5 ug/dL action level, while the CDC itself should consider lowering that number to 2 ug/dL. Current parental guidance materials about lead poisoning, published and disseminated by the state of New York, identify 2 ug/dL as the approximate "average" lead test for young children.²³ And contrary to the CDC's recommendation, the state informs parents that a test level between 5 and 9 ug/dL simply means that their child has "a little more lead than most children," and that they "might" want to have the child tested again in 3 to 6 months.²⁴ However, as the scientific community's understanding of lead's effects continues to grow, it is increasingly evident that even low single-digit BLLs can have deleterious consequences on a child's development.²⁵

Research on lead poisoning shows that it can lead to decreased cognitive performance and increased antisocial behavior. Subtle but measureable effects can be found even at relatively low lead levels. One study examining repeated BLLs in children under 5 years of age detected declines in cognitive abilities in children whose maximum blood lead level never reached NYS current 10 ug/dL intervention threshold. The data indicates that, overall, every 1 ug/dL increase in BLL results in a decrease of 0.87 intelligent quotient (IQ) points. But for BLLs below 10ug/dL, a 1 ug/dL increase results in a 1.37 IQ decrease.^{26 27} This suggests that the cognitive damage associated with childhood lead poisoning is not only irreversible, but also front-loaded. Therefore, it would behoove policymakers to predicate intervention on the lowest BLL possible. While the damage to individual children with these lower lead levels may be subtle, those small harms add up to larger societal impacts when one considers how many children are affected.

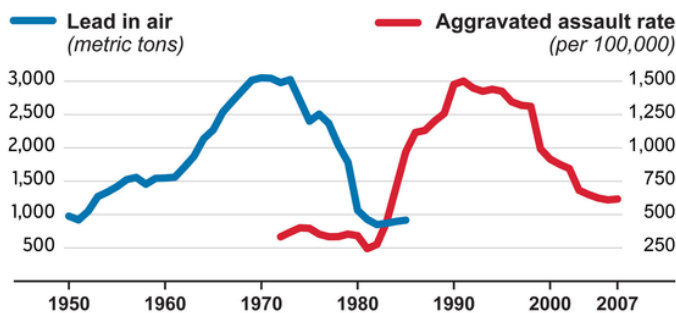
The long-term results of childhood lead poisoning lead to direct and indirect costs on both the individual and society as a whole. A 2002 study focused on Mahoning County, Ohio (population 252,205 at the time) found that the direct cost to taxpayers of providing medical care and public health services to children diagnosed with lead poisoning was approximately \$500,000 each year.²⁸ Adjusted for inflation, that's just over \$670,000 for a county with ¼ the population of Erie.

In 2006, the New York Comptroller found that the cost of medical treatment for just one child with lead poisoning in Monroe County, coupled with three years of special education, cost almost \$45,000 dollars.²⁹ And while the correlation between IQ and lifetime earnings is debatable, it seems logical that lower cognitive ability can lead to fewer professional opportunities, which in turn leads to lower wages and thus lower career earnings. In fact, research on communities across the United States suggests that decreasing lead poisoning results in raised IQs and increased economic output.³⁰ The lifetime loss of earnings for a lead-poisoned individual, based on loss of IQ points, could be anywhere from around \$42,000 to \$75,000.³¹

The indirect costs on society must also be taken into account. Lead poisoning can lead – depending on the level of exposure – to a variety of emotional and behavioral problems, including hyperactivity, aggression, and poor impulse control. Since these effects can persist into adulthood, some scientists believe that childhood lead exposure can make an individual more susceptible to

violent criminal behavior later in life. An investigation by the *Chicago Tribune* found a startling correlation between lead pollutants in the air from the 1950s to the 1970s and the city’s assault rate from the 1980s to the early 2000s.³² Although it would be nearly impossible to untangle lead’s impact on criminality from other factors such as concentrated poverty, it is possible that lead poisoning plays a role in criminality.

Trends in lead pollution, assault rates in Chicago



Sources: Howard Mielke, Tulane University School of Medicine, Sammy Zahran, Colorado State University

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Recommended Course of Action

New York State should follow Erie County’s lead and lower its actionable levels such that 5 ug/dL is the minimum BLL-intervention threshold and 10 ug/dL triggers the full environmental management and remediation response. This would provide children falling in the 5-9 ug/dL range with the type of risk-awareness assistance currently allocated to children in the 10-15 ug/dL range, while any child with a BLL greater than or equal to 10 ug/dL would receive the more involved, hands-on treatment currently only offered to children with a BLL greater than or equal to 15 ug/dL.

However, it is important to stress that any expansion of blood-lead treatment and prevention services would require a simultaneous increase in funding. Ideally, this increased funding would ensure that no child receives inferior care due to an expanded pool of eligible recipients. Lowering the intervention levels without a requisite financial commitment would create the risk that, in order to serve more

families, counties and other providers would decrease the level of assistance to more severely poisoned children.

Data on lead poisoning provides some indication of funding needs. According to CDC statistics collected in 2015, the frequency of BLLs in the 5-9 ug/dL range is about 5.6 times greater than those measured at or above 10 ug/dL at the local level, and about 5.8 times greater on a national level.^{33 34} Since neither the CDC nor the NYDPH/ECDOH consider BLLs between 2 -5 ug/dL “concerning,” those numbers are more difficult to forecast. Whatever the costs of lowering the threshold may be, it should be weighed carefully against all the costs, both direct and indirect, that lead poisoning imposes on individuals and society.

2015	Erie County	Nationwide
# of children tested	5,690	2,415,604
Total # Children Tested 5-9 ug/dL	336	68,274
Confirmed BLLs ≥ 10 ug/dL	59	11,681

NOTES

¹ Philip J Landrigan, Clyde B Schechter, Jeffrey M Lipton, Marianne C Fahs, and Joel Schwartz, “Environmental pollutants and disease in American children: estimates of morbidity, mortality, and costs for lead poisoning, asthma, cancer, and developmental disabilities,” *Environ Health Perspectives* 110(7) (2002): 721–728.

² H.A Pearson; D.J. Schonfeld, (2003). “Lead,” *C.D. Rudolph’s Pediatrics* (21st ed.). McGraw-Hill Professional. ISBN 0-8385-8285-0.

³ “Lead poisoning and health” World Health Organization, Reviewed September 2016, <http://www.who.int/mediacentre/factsheets/fs379/en/>.

⁴ Ibid.

⁵ Ibid.

⁶ “Lead-Based Paint: Remodeling Your Home? US Environmental Protection Agency,” Environmental Protection Agency, accessed November 16, 2016

⁷ “Legislative History of Lead-Based Paint,” US Department of Housing and Urban Development, http://portal.hud.gov/hudportal/documents/huddoc?id=20258_legislativhistory.pdf.

⁸ Ibid.

⁹ “Lead Regulations,” EPA, <https://www.epa.gov/lead/lead-regulations>.

¹⁰ “Electronic Code of Federal Regulations,” U. S Government Publishing Office, http://www.ecfr.gov/cgi-bin/text-idx?SID=cd05f748c481fd0ec85ffb94b9193066&node=sp40.31.745.e&rgn=div6#se40.34.745_185.

¹¹ “Lead and Copper Rule: A Quick Reference Guide,” EPA, <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=60001N8P.txt>

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- ¹² “Information on Lead in Drinking Water,” New York Department of Health, <https://www.health.ny.gov/environmental/water/drinking/lead/>.
- ¹³ Dan Telvoc, “Buffalo Beefs Up Effort to Test Water for Lead,” *Investigative Post*, October 20, 2016, <http://www.investigativepost.org/2016/10/20/buffalo-adopts-more-stringent-water-standards-for-lead/>.
- ¹⁴ “U.S Totals of Blood Lead Surveillance, 1997- 2015,” Center of Disease Control, https://www.cdc.gov/nceh/lead/data/Chart_Website_StateConfirmedByYear_1997_2015.pdf.
- ¹⁵ “HUD Proposes New Rule to Help Children Exposed to Lead Paint Hazard,” HUD, August 31, 2016, https://portal.hud.gov/hudportal/HUD?src=/press/press_releases_media_advisories/2016/HUDNo_16-129.
- ¹⁶ “U.S Totals of Blood Lead Surveillance, 1997- 2015,” Center of Disease Control, https://www.cdc.gov/nceh/lead/data/Chart_Website_StateConfirmedByYear_1997_2015.pdf.
- ¹⁷ Ibid.
- ¹⁸ *NYS Regulations for Lead Poisoning Prevention and Control* – NYCRR Title X, Part 67, § 67-1.2(a)(1).
- ¹⁹ Ibid, § 67-1.2(b).
- ²⁰ Ibid.
- ²¹ “Lead Poising Prevention,” Erie County, NY DOH, <http://www2.erie.gov/health/index.php?q=node/38>.
- ²² “Poloncraz Statement on Lead Hazard Reduction Funding Grant,” June 13, 2016, <http://www2.erie.gov/exec/index.php?q=press/poloncraz-statement-lead-hazard-reduction-funding-grant>.
- ²³ This is technically true; according to the National Center for Health Statistics, 2.1 ug/dL is the mean BLL as measured by the 2003-04 National Health and Nutrition Examination Survey (NHNES). However, this is misleading, because it seems to indicate that a 2 ug/dL BLL is a naturally-occurring average for *any* young child, even those who have somehow never been exposed to lead.
- ²⁴ “What Your Child’s Blood Lead Test Means,” NY DOH, July 2015, <http://www.health.ny.gov/publications/2526.pdf>.
- ²⁵ Although 0 or even 1 might be ideal, 2 ug/dL provides a tangible goal that is technically and psychologically attainable.
- ²⁶ Richard L. Canfield, Charles R. Henderson, Jr., Deborah A. Cory-Slechta, Christopher Cox, Todd A. Jusko, and Bruce P. Lanphear, “Intellectual impairment in children with blood lead concentrations below 10 microg per deciliter.” *New England Journal of Medicine* 348(16) (2003): 1517-26.
- ²⁷ Steven G. Gilberta and Bernard Weiss, “A rationale for lowering the blood lead action level from 10 to 2 ug/dL,”
- ²⁸ Matthew Stefanak, Joe Diorio, and Larry Frisch, “Cost of child lead poisoning to taxpayers in Mahoning County, Ohio.” *Public Health Rep* 120(3) (2005): 311-15.
- ²⁹ Thomas P. DiNapoli, Office of the New York State Comptroller, Division of Local Government and School Accountability, *Monroe County and City of Rochester Lead Control Programs: Report of Examination* (2010).
- ³⁰ Scott D Grosse, Thomas D Matte, Joel Schwartz, and Richard J Jackson, “Economic gains resulting from the reduction in children’s exposure to lead in the United States,” *Environ Health Perspective* 110(6) (2002):563–569.
- ³¹ Ibid.
- ³² Michael Hawthorne, “Studies Link Childhood Lead Exposure, Violent Crime,” *Chicago Tribune*, June 6, 2015 <http://www.chicagotribune.com/news/ct-lead-poisoning-science-met-20150605-story.html>.
- ³³ “Lead: New York Data, Statistics, and Surveillance” CDC, <https://www.cdc.gov/nceh/lead/data/state/nydata.htm>.
- ³⁴ “Lead: CDC’s National Surveillance Data (1997-2015),” <https://www.cdc.gov/nceh/lead/data/national.htm>.