Still Treating Lead Poisoning After All These Years

Bruce Lanphear, MD

Twenty-five years ago, in a commentary published in *Pediatrics*, Drs Needleman and Jackson[1] asked whether we would still be treating lead poisoning in the 21st century. Unfortunately, despite considerable progress, our public health system is still failing to prevent children from being lead poisoned and the specter of lead poisoning continues to cast a shadow over the country: over 500 000 American children have a blood lead level of >5 μg/dL (>50 ppb); 23 million homes have 1 or more lead hazards; an unknown number of Americans drink water from lead service lines; and federal standards for lead in house dust, soil, and water fail to protect children.[2,3] We have understandably focused on the plight of children in Flint, Michigan, but children in hundreds of other cities have blood lead levels higher than the children of Flint.[4]

Studying the impact of lead and other toxic chemicals, which are regularly found in the blood and body fluids of pregnant women and children,[5–8] is only possible because technology was developed to measure them at extraordinarily low concentrations. The Centers for Disease Control and Prevention's (CDC) environmental health laboratories has been at the forefront of developing laboratory techniques to measure a vast array of chemicals, such as lead, mercury, bisphenol A, and polybrominated diethyl esters. Beginning in 1976, the CDC has measured the concentrations of chemicals in participants of the NHANES, which is a nationally representative sample of the US population.[8]

Lead was one of the first blood tests to be used in NHANES. The figure showing blood lead levels plummeting from 1976 to 1980, during the phase out of leaded gasoline, is among the most iconic figures in public health.[9] Since then, children's blood lead levels have declined further because of the continued phase out of leaded gasoline and the ban on lead in paint, canned foods, and other consumer products.[10] Unfortunately, as described by Caldwell et al,[11] the Clinical Laboratory Improvement Amendment for blood lead has not been updated since 1988, when blood lead levels >25 μg/dL (>250 ppb) were considered elevated. Not surprisingly, they found that many commercial laboratories were not able to achieve the accuracy and precision of blood lead analyses necessary for pediatricians to effectively manage lower blood lead test results typical for contemporary children.[11]

As children's blood lead levels declined and the technology needed to measure minute quantities of lead in children's blood was developed, numerous teams of investigators from around the world found that exceedingly low concentrations of lead adversely impacted brain development.[12–14] In 2012, the National Toxicology Program of the National Institutes of Health concluded that blood lead concentrations <5 μg/dL (<50 ppb) are linked with IQ decrements, diminished academic abilities, and elevated rates of attention-related behavior problems and problem behaviors, such as attention-deficit/hyperactivity disorder and conduct disorder.[14] In that same year, the CDC reached the remarkable conclusion that there is

FREE

Department of Health Sciences, Simon Fraser University, Burnaby, British Columbia

DOI: https://doi.org/10.1542/peds.2017-1400

Accepted for publication Apr 25, 2017

Address correspondence to Bruce Lanphear, MD, 3415 Ash St, Vancouver, BC V6H 3V4, Canada. E-mail: blanphear@sfu.ca

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: Dr Lanphear has served as a paid consultant on a US Environmental Protection Agency research study, for the NIH research awards, and for the California Department of Toxic Substance Control.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: Dr Lanphear served as an expert witness in California for the plaintiffs in a public nuisance case of childhood lead poisoning, which was a Proposition 65 case on behalf of the California Attorney General's Office; a case involving lead-contaminated water in a new housing development in Maryland; a Canadian tribunal on trade dispute about using lead-free galvanized wire in stucco lathing; and as a plaintiff on a case involving lead-poisoned children in Milwaukee, Wisconsin, but he received no personal compensation for these services.

COMPANION PAPER: A companion to this article can be found online at www.pediatrics.org/cgi/doi/10.1542/peds.2017-0272.

To cite: Lanphear B. Still Treating Lead Poisoning After All These Years. *Pediatrics.* 2017;140(2): e20171400

"no safe level of lead in children's blood."[15]

Our failure to adopt or use existing technology is the primary reason for the ongoing epidemic: we have failed to promulgate scientifically based environmental standards for lead in housing, soil, and water; we have failed to deploy lead sampling tools to identify lead hazards before a child is exposed; and we have failed to eliminate recognized lead hazards and ban nonessential uses of lead. Predictably, pediatricians are still treating lead poisoning after all these years.

Moreover, we have failed to learn from the lead epidemic that low-level exposure to environmental chemicals can be toxic; we lean on old familiar ways. It shouldn't be surprising that low concentrations of environmental contaminants can be toxic. The range of lead and other toxic chemicals that are routinely found in pregnant women and children (~50–300 ppb) is equivalent to the therapeutic window for some drugs, like methylphenidate.[16] This is ironic because the chemical industry, which argues that the concentrations of lead and other toxic chemicals in the blood of pregnant women and children are too low to be of any consequence, gave rise to the pharmaceutical industry.[17]

Parents, pediatricians, and even scientists who study toxic chemicals cannot hope to keep up with the plethora of poisons that impact children. Children are regularly exposed to dozens, if not hundreds, of chemicals; most of them have not been tested for toxicity.[5,18] Requiring industries to prove that chemicals are not toxic before they are put on the market or emitted by polluting industries is the only way to protect children. Unfortunately, this will not happen anytime soon. In 2016, Congress passed the Lautenberg Chemical Safety Reform Act that failed to enact regulations necessary to protect children's health. So pediatricians can expect to treat another generation of children who have been harmed by an array of insidious and largely untested toxic chemicals, even before the epidemic of lead poisoning has faded.

What should pediatricians do? The American Academy of Pediatrics Council on Environmental Health recommends greater emphasis on screening children's environments to identify lead hazards before a child is poisoned, using tools to sample and test house dust, soil, or water for lead. Pediatricians can advocate for regulations to inspect and abate lead hazards in older housing before occupancy or during renovations, replace lead service lines, and ban the use of lead in aviation gas, wheel weight, and bullets.[19,20] Pediatricians can also advocate for regulations to protect children from toxic chemicals as well as chemicals of unknown toxicity.[5] Pediatricians are not trained in environmental health or compensated for advocacy, but it is unlikely that we will protect children from toxic chemicals until there is a concerted effort that involves pediatricians.

ACKNOWLEDGMENT

This commentary was largely written during an Academic Writing Retreat at the Rockefeller Center in Bellagio, Italy.

ABBREVIATION

CDC: Centers for Disease Control and Prevention

REFERENCES

1. Needleman HL, Jackson RJ. Lead toxicity in the 21st century: will we still be treating it? *Pediatrics*. 1992;89(4 pt 1):678–680
2. Council on Environmental Health. Prevention of childhood lead toxicity. *Pediatrics*. 2016;138(1):e20161493
3. US Department of Housing and Urban Development. *American Healthy Homes Survey: Lead and Arsenic Findings*. Washington, DC: US Department of Health and Human Services, Office of Healthy Homes and Lead Hazard Controls; 2011
4. McClure LF, Niles JK, Kaufman HW. Blood lead levels in young children: US, 2009-2015. *J Pediatr*. 2016;175:173–181
5. Council on Environmental Health. Chemical-management policy: prioritizing children's health. *Pediatrics*. 2011;127(5):983–990
6. Woodruff TJ, Zota AR, Schwartz JM. Environmental chemicals in pregnant women in the United States: NHANES 2003-2004. *Environ Health Perspect*. 2011;119(6):878–885
7. Braun JM, Kalkbrenner AE, Just AC, et al. Gestational exposure to endocrine-disrupting chemicals and reciprocal social, repetitive, and stereotypic behaviors in 4- and 5-year-old children: the HOME study. *Environ Health Perspect*. 2014;122(5):513–520
8. Centers for Disease Control and Prevention. National report on human exposures to environmental chemicals. Available at: www.cdc.gov/exposurereport/. Accessed March 17, 2017
9. Annest JL, Pirkle JL, Makuc D, Neese JW, Bayse DD, Kovar MG. Chronological trend in blood lead levels between 1976 and 1980. *N Engl J Med*. 1983;308(23):1373–1377
10. Brown MJ, Margolis S; Centers for Disease Control and Prevention. Lead in drinking water and human blood lead levels in the United States. *MMWR Suppl*. 2012;61(4):1–9
11. Caldwell KL, Cheng P-Y, Jarrett JM, et al. Measurement challenges at low blood lead levels. *Pediatrics*. 2017;140(2):e20170272
12. Rogan WJ, Ware JH. Exposure to lead in children–how low is low enough? *N Engl J Med*. 2003;348(16):1515–1516
13. Lanphear BP, Hornung R, Khoury J, et al. Low-level environmental lead exposure and children's intellectual function: an international pooled analysis. *Environ Health Perspect*. 2005;113(7):894–899

14. National Toxicology Program. Monograph on health effects of low-level lead. *NTP Monogr*. 2012;(1):xiii, xv-148

15. Centers for Disease Control and Prevention, Advisory Committee on Childhood Lead Poisoning Prevention. *Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention*.Atlanta, GA: Centers for Disease Control and Prevention; 2012. Available at: www.cdc.gov/nceh/lead/ACCLPP/Final_Document_030712.pdf. Accessed April 15, 2017

16. Lanphear BP. The impact of toxins on the developing brain. *Annu Rev Public Health*. 2015;36:211–230

17. Jones AW. Early drug discovery and the rise of pharmaceutical chemistry. *Drug Test Anal*. 2011;3(6):337–344

18. Grandjean P, Landrigan PJ. Neurobehavioural effects of developmental toxicity. *Lancet Neurol*. 2014;13(3):330–338

19. Korfmacher KS, Ayoob M, Morley R. Rochester's lead law: evaluation of a local environmental health policy innovation. *Environ Health Perspect*. 2012;120(2):309–315

20. Bellinger DC, Chen A, Lanphear BP. Establishing and achieving national goals for preventing lead toxicity and exposure in children [published online ahead of print May 15, 2017]. *JAMA Pediatr*. doi:10.1001/jamapediatrics.2017.0775

Still Treating Lead Poisoning After All These Years

Bruce Lanphear

Pediatrics 2017;140;
DOI: 10.1542/peds.2017-1400 originally published online July 17, 2017;

PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Still Treating Lead Poisoning After All These Years

Bruce Lanphear

Pediatrics 2017;140;
DOI: 10.1542/peds.2017-1400 originally published online July 17, 2017;