IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW JERSEY

NEWARK EDUCATION WORKERS CAUCUS et al., Plaintiffs, v. CITY OF NEWARK, et al., Defendants.	Case No. 2:18-cv-11025 Judge Katharine S. Hayden Magistrate Judge Cathy L. Waldor

Declaration of Mona Hanna-Attisha, M.D., M.P.H.

I, Mona Hanna-Attisha, do hereby affirm and state:

Introduction and Qualifications

1. I am a board-certified pediatrician. I earned my medical degree from Michigan State University College of Human Medicine in 1998, thereafter completing my residency and chief residency at the Children's Hospital of Michigan. I received my undergraduate degree from the University of Michigan's School of Natural Resources and Environment with a focus in environmental health in 1994 and Masters in Public Health from the University of Michigan School of Public Health in 2009.

2. I am currently an Associate Professor of Pediatrics and Human Development at Michigan State University College of Human Medicine. I am also Founder and Director of the Pediatric Public Health Initiative, a partnership between the Hurley Children's Hospital and Michigan State University addressing population-wide lead exposure in Flint.

3. In 2015, I studied the blood lead levels of hundreds of children in Flint, Michigan. I found that the percentage of children with elevated lead levels doubled after the city's drinking water lead levels increased in 2014. My research and public education efforts contributed to the exposure of the lead crisis in Flint and prompted the Michigan Department of Environmental

Quality and State of Michigan to acknowledge the severity of the city's lead-contamination problem.

4. I have testified twice before the United States Congress on the association between lead in Flint drinking water and elevated blood lead levels in Flint children.

5. For my research on children's blood lead levels in Flint and, more generally, the health risks of exposure to lead through drinking water, I was awarded the Freedom of Expression Courage Award by PEN America and named one of Time Magazine's 100 Most Influential People in 2016. I have also received the American Academy of Pediatrics Presidential Award, the American Pediatric Association Michael Shannon Research Award, the National Center for Health Research Health Policy Hero Award, the Michigan State Medical Society Public Health Leadership Award, the Michigan State University Inspirational Woman of the Year Award, the Chaldean Chamber of Commerce Humanitarian of the Year Award and the Ridenhour Prize for Truth-Telling Award. I have also been listed to Medscape's list of Best Physicians in the World for 2016, among other honors.

6. I have extensively researched and written about the effects of lead in drinking water on blood lead levels, lead toxicity, and the health harms associated with lead exposure. I have also treated many children suffering from

the effects of lead exposure through drinking water. I currently serve as Principal Investigator of the Flint Lead Exposure Registry, a $14.4 million grant supported by the Center for Disease Control and Prevention's National Center for Environmental Health. Nationally, I served on the steering committee of the 2016 National Lead Summit and the advisory committee of the Robert Wood Johnson Foundation and Pew Charitable Trust Lead Advisory Committee. In Michigan, I co-chair the State of Michigan Childhood Lead Exposure Elimination Committee. Through my research, clinical work, educational training, and my knowledge of scientific literature, I have become an expert on lead toxicity and the association between drinking water lead levels and blood lead concentrations in children.

7. A more complete description of my educational and work experience, as well as a list of my publications, is appended as Exhibit 1 to this declaration.

8. The information set forth in this declaration is based upon my education, personal knowledge, and experience as well as my review of the literature and the documents.

Association Between Lead in Drinking Water and Blood Lead Levels

9. A robust and well-established body of science demonstrates the causal relationship between elevated levels of lead in drinking water and

elevated blood lead levels in the exposed population. A substantial number of peer-reviewed studies identify drinking water lead levels as making a significant contribution to blood lead levels.[1]

10. When people drink lead-contaminated drinking water, the lead they consume is retained in body, first in their blood and later in their skeletal system. Lead service lines are an independent risk factor for blood lead levels

[1] *See*, *e.g.*, Mona Hanna-Attisha et al., *Elevated Blood Lead Levels in Children Associated with the Flint Drinking Water Crisis: A Spatial Analysis of Risk and Public Health Response*, 106 Am. J. Public Health 2, 283-90 (2016): 283-290 (attached to Griffiths Decl. as Ex. N); Gerard Ngueta et al., *Use of a Cumulative Exposure Index to Estimate the Impact of Tap Water Lead Concentration on Blood Lead Levels in 1-to 5-Year-Old Children (Montréal, Canada)* (attached to Griffiths Decl. as Ex. L), 124 Envtl. Health Persp. 3 (2016); Patrick Levallois et al., *The Impact of Drinking Water, Indoor Dust and Paint on Blood Lead Levels of Children Aged 1–5 Years in Montréal (Québec, Canada)*, 24 J. Exposure Science & Envtl. Epidemiology 2, 185-91 (2014); Marc Edwards, *Fetal Death and Reduced Birth Rates Associated with Exposure to Lead Contaminated Drinking Water*, 48 Envtl. Science & Tech. 1, 739-46 (2014) (attached to Griffiths Decl. as Ex. O); Simoni Triantafyllidou & Marc Edwards, *Lead (Pb) in Tap Water and in Blood: Implications for Lead Exposure in the United States*, 42 Critical Reviews in Envtl. Science & Tech. 13, 1297-1352 (2012) (attached to Griffiths Decl. as Ex. P); Marc Edwards et al., *Elevated Blood Lead in Young Children Due to Lead-Contaminated Drinking Water: Washington*, *DC, 2001−2004*, 43 Envtl. Science & Tech. 5, 1618-1623 (2009) (attached to Griffiths Decl. as Ex. C); Bruce P. Lanphear et al., Envtl. Lead Exposure During Early Childhood, 140 J. Pediatrics 1, 40-47 (2002) (attached to Griffiths Decl. as Ex. Q); G. C.Watt et al., *Public Health Implications of New Guidelines for Lead in Drinking Water: A Case Study in an Area with Historically High Water Lead Levels*, Food & Chem. Toxicology 38 (2000); A.D. Beattie et al., *Envtl. Lead Pollution in an Urban Soft-Water Area*, 2 British Medical J. 5812, 491-93 (1972).

above 5 and 10 micrograms per deciliter.[2] High blood lead concentrations have been reported in individuals in areas where drinking water is known to be contaminated by lead.[3]

11. Drinking water is not always the predominant source of exposure to lead. However, drinking water is a major source of exposure – and may be the predominant source of exposure – to lead for people living in communities with drinking water contaminated by elevated lead levels and especially for infants.[4] As the relative contribution of lead paint to overall lead exposures has diminished over time, the contribution of lead in drinking water to blood lead levels has correspondingly increased.[5]

12. When drinking water lead concentrations are elevated, the ingestion of contaminated water becomes a contributor to lead exposure.

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[2] M.J. Brown et al., *Association Between Children's Blood Lead Levels, Lead Service Lines, and Water Disinfection, Washington, DC, 1998–2006*, 111 Envtl. Res. 1, 67–74 (2011).

[3] Edwards et al., *supra* note 1.

[4] M.L. Miranda et al., *Changes in Blood Lead Levels Associated with Use of Chloramines in Water Treatment Systems*, 115 Envtl. Health Persp. 2, 221- 225 (2007) (attached to Griffiths Decl. as Ex. B); M. Edwards et al., *Elevated Blood Lead in Young Children Due to Lead-Contaminated Drinking Water: Washington, DC, 2001-2004*, 43 Envtl. Science & Tech. 5, 1618-1623 (2009) (attached to Griffiths Decl. as Ex. M); R. Renner, *Out of Plumb: When Water Treatment Causes Lead Contamination*, 117 Envtl. Health Persp. 12, A542-A547 (2009).

[5] Edwards et al., *supra* note 1; Miranda et al., *supra* note 4.

13. Studies have shown that lead in water results in lead in blood. For example, one study established that an increase in water lead concentrations from background levels of 5 ppb to 15 ppb is associated with a 13.7 percent increase in the percentage of children estimated to have blood lead concentrations exceeding 10 micrograms per deciliter.[6] Similarly, a study following children from 6 months to 24 months found that children living in housing with a water lead concentration over 5 ppb had blood lead levels that were 20.4 percent higher than children served by drinking water with lead levels below 5ppb.[7] Researchers estimated that water lead concentrations over 5 ppb contributed, on average, 1.02 micrograms per deciliter of lead to children's blood.[8]

14. Incidences of elevated blood lead levels above 10 micrograms per deciliter in children aged less than 1.3 years in Washington, D.C. increased by more than 400 percent between 2001 and 2003, when lead in drinking water rose to more than 45 ppb at the 90th percentile, exceeding the federal action

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[6] Bruce P. Lanphear et al., *Environmental Exposures to Lead and Urban Children's Blood Lead Levels*, 76 Envtl. Res. 2, 120-130 (1998) (attached to Griffiths Decl. as Ex. S)

[7] Lanphear et al., *supra* note 1.

[8] *Id.*

level of 15 ppb by several factors.[9] The incidence of elevated blood lead levels was highly correlated to the 90th percentile drinking water lead levels from 2000 to 2007 for children aged under 1.3 years.[10]

15. Even relatively low lead concentrations in drinking water are associated with increases in blood lead levels. A child's blood lead level will increase by an amount about 1.10 times greater than a corresponding increase in the cumulative lead concentration ingested via drinking water.[11] For children aged between 1 and 5 years, an increase of 1 ppb in the drinking water lead level will result in a blood lead level increase of 35 percent after 150 days of exposure.[12] The federal Toxic Substances Disease Registry has found that children can absorb about 50 percent of an oral dose of water-soluble lead.[13]

16. For infants, blood lead levels are often further elevated due to ingestion of infant formula prepared with contaminated drinking water.[14]

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[9] Edwards et al., *supra* note 1.

[10] Edwards et al., *supra* note 1.

[11] Ngueta, *supra* note 1.

[12] *Id.*

[13] U.S. Dep't of Health & Hum. Servs., Agency for Toxic Substances Diseases Registry (2007), Toxicological Profile for Lead, http://www.atsdr.cdc.gov/toxprofiles/tp13.pdf.

[14] Simoni Triantafyllidou et al., *Assessing Risk with Increasingly Stringent Public Health Goals: The Case of Water Lead and Blood Lead in Children*, 12 J. Water Health 1, 57-68 (2014).

Among infants drinking formula prepared with lead-contaminated tap water at 10 ppb, about 25 percent experience a blood lead level of 5 micrograms per deciliter.[15] Tap water may account for more than 85 percent of total lead exposure for infants drinking reconstituted formula.[16]

17. An ecological study of the association between fetal death rates in Washington, D.C. and the city's water lead levels, which spiked to over 45 ppb at the 90th percentile between 2001 and 2004, showed that the city's increase in lead in drinking water was correlated with a sudden and substantial increase in fetal deaths. As reported on the New Jersey Drinking Water Watch Website, the 90th percentile for lead in drinking water in Newark in the second 2018 monitoring period was 42.9 ppb as of the date of this writing.

18. In 2016, I published a study analyzing the difference in pediatric elevated blood lead levels before and after high lead levels were found in Flint's drinking water.[17] Together with my co-authors, Jenny La Chance, MS, Richard Casey Sadler, PhD, and Allison Champney Schnepp, MD, I reviewed blood lead levels for children younger than five years before and after Flint's

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[15] Triantafyllidou et al., *supra* note 14.

[16] Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 56 Fed. Reg. 26,460, 26,564 (June 7, 1991).

[17] Hanna-Attisha, *supra* note 1.

water source change. We found that the incidence of elevated blood lead levels in children more than doubled from 2.4 percent to 4.9 percent after drinking water lead levels increased, and the neighborhoods with the highest water lead levels experienced a 6.6 percent increase in elevated blood lead levels with no statistically significant change outside of Flint water limits.[18] Geospatial analysis identified disadvantaged neighborhoods as having the greatest elevated lead level increases among children.[19] Our research was validated by the U.S. Centers for Disease Control and Prevention (CDC) and published in the federal Morbidity and Mortality Weekly Report using the state's larger sample size of blood lead levels.[20] The CDC also noted an increase in the percentage of elevated blood lead levels correlating with exposure to the lead contaminated water.

19. Both our data and the CDC study greatly underestimate the number of children in Flint affected by lead in water. Both studies were conducted on retrospective blood lead levels garnered from routine blood lead testing performed at the recommended ages of 1 and 2 years. Lead in water

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[18] Hanna-Attisha, *supra* note 1.

[19] *Id.*

[20] U.S. Ctrs. Disease Control & Prevention, *Morbidity & Mortality Weekly Report, Blood Lead Levels Among Children Aged < 6 years – Flint, Michigan, 2013-2016*, 65 Weekly 25 (July 1, 2016).

disproportionally affects formula-fed infants and pregnant women who were not routinely tested and therefore not captured in this research, secondary to the short detection window of lead in blood. In addition, this research was conducted during a time-period when there was a lack of public awareness of lead in water, and thus the screening rate was less than 50 percent.

20. For these underestimating reasons and more, blood lead levels have never been considered as a marker for exposure in Flint. Exposure has only been determined as a measure of consumption of the contaminated water. This has applied to all exposure-related recovery services such as early intervention, childcare and preschool placement, Medicaid expansion, Flint Registry and more.

21. Without recognizing the nuances of blood lead screening in Flint and elsewhere, comparisons and interpretations of the extent of exposure from blood lead data is misinformed and unscientific.

22. I am familiar with a 2018 study authored by Hernan Gomez et al. that characterizes children's blood lead levels during Flint's lead crisis.[21] The study understates the severity of the harm caused to Flint residents from ingesting lead-contaminated drinking water, most notably by using a diluted

[21] Hernan Gomez et al., *Blood Lead Levels of Children in Flint, Michigan: 2006-2016*, 197 J. Pediatrics 158 (2018).

time frame (calendar years), by failing to incorporate the geographic considerations (worse in areas of greatest water lead levels and no change outside of the city limits), and by failing to consider the previously stated underestimating conditions (low population screening rate, short detection window of lead in blood, and screening ages). Despite these flaws, the study concludes that lead levels increased during Flint's lead crisis and decreased after measures were taken to address the crisis.[22]

23. When a poison has no safe level and the public health community recommends primary prevention, then the focus should be on the determination of lead in the environment and working towards its elimination, rather than using children as detectors of environmental contamination and extent of harm. Using blood lead levels to determine community exposure is "ethically problematic" since "in the case of lead, preventing exposure is the only method known to be effective in reducing the risk of adverse health outcomes."[23]

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[22] Mona Hanna-Attisha, *Dr. Mona: Don't Downplay Lead Problems or Solutions, for Kids in Flint Water Crisis*, Detroit Free Press (Mar. 28, 2018), https://www.freep.com/story/opinion/contributors/2018/03/28/flint-water-crisis-lead/466698002/.

[23] Sue M. Moodie & Emily Lorraine Evans, *Ethical Issues in Using Children's Blood Lead Levels as a Remedial Action Objective*, Am. J. Pub. Health (2011).

Lead Accumulation in the Body

24. Blood lead level data does not reflect lifetime exposures to lead, nor does it fully reflect exposures to lead that occur over the course of several months or years. Lead persists in the body and is retained long after exposure ceases. However, once lead enters the body, it is distributed to organs such as the brain, kidneys, and liver, and is stored in the teeth and bones. This process is called bioaccumulation. Lead bioaccumulates in the bodies of people of all ages.[24]

25. Blood lead levels are not a reliable indicator of lifetime lead exposure. Because lead is bound to red blood cells and gradually distributed to soft tissues and bones, blood lead levels are a reliable measure of lead exposures occurring in the prior 30 to 60 days.[25] For this reason, blood lead levels cannot be used as a long-term measure of exposure to lead. There is little correlation between a single, randomly obtained blood lead level test result and the cumulative amount of lead stored in the body, or the body's overall lead

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[24] World Health Org., Pan Am. Health Org., *Lead Contamination*, https://www.paho.org/hq/index.php?option=com_content&view=article&id=8206:2013-lead-contamination&Itemid=39800&lang=fr.

[25] U.S. Dep't of Health & Hum. Servs., Agency for Toxic Substances and Disease Registry, *Lead Toxicity: What is the Biological Fate of Lead in the Body* (June 12, 2017), https://www.atsdr.cdc.gov/csem/csem.asp?csem=34&po=9 (finding that the half-life of blood lead is approximately 28 to 36 days, and is thereafter cleared to soft tissues and the skeletal system) (attached to Griffiths Decl. as Ex. D).

burden.[26] Other scientific options to assess lead burden are invasive, expensive, and impractical and include bone biopsies and teeth analysis.

25. Lead can continue to be stored in the body of exposed populations for more than thirty years after a single exposure.[27]

Newark Drinking Water Lead levels and Blood Lead Levels

26. I have reviewed the sampling data available on New Jersey's Drinking Water Watch Website. Since January 2017, Newark has exceeded the 15 ppb action level in three consecutive monitoring periods. In 2018, more than 20 homes have tested above 30 ppb thus far, with one home testing at an astonishing 250 ppb.

27. It is important to note that the 15 ppb action level is not a health-based standard. Recognizing no safe level of lead, the EPA's Maximum Contaminant Level Goal for lead in water is set at 0 ppb. The Food and Drug Administration's bottled water standard for lead in water is set at 5 ppb. The

[26] Philip J. Landrigan & Andrew C. Todd, *Direct Measurement of Lead in Bone A Promising Biomarker*, 271 J. Am. Med. Ass'n 3 (1994).

[27] Envtl. Prot. Agency, Lead Abatement for Workers, Health Effects: How Lead Affects the Body (2017), https://www.epa.gov/sites/production/files/2017-02/documents/wkrch2_stu_eng.pdf.

American Academy of Pediatrics recommends an action level of 1 ppb for schools and childcare facilities.[28]

28. The 90th percentile drinking water lead level in Newark as of the date of this writing was 42.9 ppb — as described above, 90th percentile drinking water lead levels only slightly higher were associated with a quadrupling in blood lead levels among children aged under 1.3 years and a substantial increase in fetal deaths in Washington, D.C.

29. New Jersey data shows that in 2016, 24 percent – nearly one-quarter – of Newark children under six years of age tested with 3 to 4 micrograms of lead per deciliter of blood.[29] An extensive array of evidence indicates that lead-associated cognitive deficits and behavioral problems can occur at these blood lead concentrations. The U.S. National Toxicology Program of the National Institutes of Health reports that lead concentrations of 3 to 4 micrograms per deciliter are strongly associated with intellectual deficits, diminished academic abilities, attention deficits and problem behaviors.[30]

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[28] Council Envtl. Health, *Prevention of Childhood Lead Toxicity*, 38 Pediatrics 1 (2016).

[29] Advocates for Children N.J., *Childhood Lead Exposure in Newark* 7 (2018), https://acnj.org/downloads/2018_03_27_newark_kids_count_childhood_lead_exposure.pdf (attached to Griffiths Decl. as Ex. F).

[30] Nat'l Toxicology Program, *Monograph on Health Effects of Low-Level Lead*, U.S. Dep't of Health & Hum. Servs., xiii, xv–148 (2012).

According to the CDC, there is no safe level of lead in blood "without deleterious effects" which "appear to be irreversible," underscoring the "critical importance of primary prevention."[31]

30. Newark children had blood lead levels nearly twice as high as the State of New Jersey overall. 4.7 percent of Newark children under six years of age tested with blood lead levels exceeding 5 micrograms per deciliter, compared with 2.8 percent of children across the state.[32] 5.3 percent of Newark children aged between 6 to 26 months had blood lead levels that were higher than 5 micrograms per deciliter.[33] Children who have blood lead concentrations over 5 micrograms per deciliter experience, on average, a lead-associated IQ deficit of 6.1 points.[34] Studies have demonstrated that every 5

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[31] U.S. Ctrs. Disease Control & Prevention, *Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention, Report of the Advisory Committee on Childhood Lead Poisoning Prevention* (Jan. 4, 2012), https://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf.

[32] N.J. Dep't of Health, *Childhood Lead Exposure in New Jersey Drinking Water* (2016), https://www.state.nj.us/health/childhoodlead/documents/reports/childhoodlead2016.pdf.

[33] Advocates for Children N.J., *supra* note 29, at 6.

[34] Am. Acad. of Pediatrics, *Prevention of Childhood Lead Toxicity*, 138 Pediatrics 1 (2016) (attached to Griffiths Decl. as Ex. J).

micrograms per deciliter increase in maternal blood lead results in a 180 percent increased risk of miscarriage or fetal deaths.[35]

31. More than twenty Newark children tested with blood lead levels between 20 and 44 micrograms per deciliter.[36] Only one other city in New Jersey had more children that reached these high blood lead levels. The World Health Organization has stated that levels in this range are associated with acute pediatric effects including decreased hemoglobin synthesis, increased nerve conduction velocity and decreased calcium homeostasis, in addition to the decreased IQ level, decreased growth, impaired nerve function and decreased hearing associated with much lower levels of exposure.[37]

32. The elevated lead concentrations in Newark's drinking water are likely contributing to Newark children's blood lead levels. As explained above, these blood lead levels do not optimally capture, and likely significantly underestimate, the contribution of lead burden from lead in water exposure. And when it comes to lead – an irreversible neurotoxin with no treatment and

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[35] V. H. Borja-Aburto et al., *Blood Lead Levels Measured Prospectively and Risk of Spontaneous Abortion*, 38 Am. J. Epidemiology, 300-309 (2000).

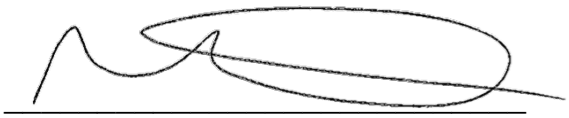
[36] N.J. Dep't of Health, *supra* note 32, at 20.

[37] World Health Org., *Childhood Lead Poisoning* 24 (2010), http://www.who.int/ceh/publications/leadguidance.pdf.

no safe level – the focus should be on prevention of harm by addressing elevated lead in water levels, rather than parsing the nuances of lead in blood.

33. Newark residents, and particularly children and those in utero, face serious and irreparable health risks because of their exposure to drinking water with extremely high lead levels. Providing vulnerable Newark residents with a safe, alternate source of drinking water and/or lead-clearing filters is necessary to prevent further harm.

34. I declare under penalty of perjury that the foregoing is true and correct.



10/11/18

Mona Hanna-Attisha, M.D., M.P.H. Date