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.	No. 2:18-cv-1102 Judge Katharine S. Hayden Magistrate Judge Cathy L. Waldor

Declaration of Philip J. Landrigan, M.D., M.Sc.

I, Philip J. Landrigan, do hereby affirm and state:

Introduction and Qualifications

1. I am a pediatrician and epidemiologist, board certified in Pediatrics, in General Preventive Medicine, and in Occupational and Environmental Medicine. I have extensive experience in researching environmental threats to human health and especially to the health of children. I am currently a Professor of Biology and the Director of the Program in Global Public Health at Boston College, located in Chestnut Hill, Massachusetts. At Boston College I am directing the launch of a new undergraduate program in Global Public Health and continuing my research on environmental threats to human health.

2. From July 1985 until June 2018, I was a member of the faculty of Icahn School of Medicine at Mount Sinai, where I served as Chair of the Department of Preventive Medicine from 1995 to 2015 and Dean for Global Health from 2010 until I accepted my current position at Boston College earlier this year. As Chair of Preventive Medicine at Mount Sinai, I oversaw the federally funded World Trade Center Medical Program that provides diagnostic and treatment services to over 20,000 9/11 first responders.

3. Before joining Mount Sinai School of Medicine in 1985, I served as an Epidemic Intelligence Service Officer and medical epidemiologist at the

Centers for Disease Control and Prevention and the National Institute for Occupational Safety and Health, components of the U.S. Public Health Service.

4. I graduated from Boston College in 1963 and from Harvard Medical School in 1967. I completed my residency in Pediatrics. In 1977, I received a Diploma of Industrial Health from the University of London and a Master of Science degree in Occupational Medicine from the London School of Hygiene and Tropical Medicine.

5. I was awarded the Meritorious Service Medal of the United States' Public Health Service. I was elected a member of the National Academy of Medicine (formerly the Institutes of Medicine). I have chaired committees at the National Academy of Sciences on environmental neurotoxicology. I have also served as Senior Advisor on Children's Health to the Administrator of the U.S. Environmental Protection Agency, during which time I was instrumental in helping to establish a new Office of Children's Health Protection.

6. From 1996 until 2005, I served as a physician in the U.S. Naval Reserve and retired from the Navy at the rank of Captain (O-6). I served in

Korea, Ghana, and Senegal. I was awarded the Naval Commendation Medal (three awards).

7. I have published more than 500 scientific papers and five books, many of which address the effects of neurotoxicants, including lead, on children's health and development.

8. I have extensively studied, written, and taught about the effects of lead on the human body. I have also treated countless patients suffering from the effects of lead exposure. Through my educational training, clinical work, research, and my knowledge of pertinent scientific literature, I have become one of the nation's leading experts on lead toxicity and the sources and effects of lead exposure, particularly in children.

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

10. The information set forth in this declaration is based upon my education, personal knowledge, and experience as well as my review of the documents attached as Exhibits B-N.

Background on Lead

11. Lead is a powerful neurotoxicant. Throughout much of the 20th century, lead was commonly used in industry, consumer products, and infrastructure.[1] It was marketed aggressively by the lead industry and used widely in paint, gasoline, and water pipes.[2]

12. Lead exposure can occur in many ways. People are typically exposed to lead when they ingest lead-contaminated dust, soil, or water. Lead is present in dust and soil typically as the result of erosion from lead-based paint and legacy emissions of lead from gasoline.

13. Exposure to lead through drinking water usually occurs through corrosion of pipes and plumbing that contain lead.[3] Lead-containing water infrastructure is particularly common in older homes and cities. Lead in drinking water has become one of the leading sources of ongoing lead exposure as lead in paint and gasoline have been banned, and exposures from those sources have diminished.

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[1] Philip Landrigan & David Bellinger, *How to Finally End Lead Poisoning in America*, Time (Apr. 11, 2016), http://time.com/4286726/lead-poisoning-in-america/.

[2] *Id.*

[3] Ronnie Levin et al., *Lead Exposures in U.S. Children, 2008: Implications for Prevention*, 116 Envtl. Health Persp. 1285, 1287 (2008).

14. Upon ingestion, lead may be found in a person's blood. However, the half-life of lead in blood is only about 60 days.[4] The body treats lead like calcium and eventually stores the lead in a person's bones. During times of stress, such as pregnancy, lactation, and menopause, lead can mobilize from the bones and move back into blood. The amount of lead in a woman's blood, for instance, increases by about thirty percent after menopause.[5]

15. Blood lead tests can be an effective way to test a child for ongoing exposure to lead. However, because lead quickly retreats from the blood to the bones, testing a person's blood lead level may not capture a person's lifetime lead exposure and associated health risks. In people with ongoing exposure, there is little correlation between a single, randomly obtained blood level, and either a cumulative index of absorption or the body lead burden.[6]

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[4] Philip J. Landrigan & Andrew C. Todd, *Direct Measurement of Lead in Bone: A Promising Biomarker*, 271 J. Am. Med. Ass'n 239 (1994).

[5] Nat'l Toxicology Program, U.S. Dep't of Health & Hum. Servs., *NTP Monograph on Health Effects of Low-Level Lead*, at xii, 11, 16 (2012) (attached as Ex. B).

[6] Landrigan & Todd, *supra* note 4.

Health effects of lead exposure

16. There is no safe level of lead exposure.[7] Lead has toxic effects down to the lowest measurable levels.[8] The effects of lead exposure arise in multiple organ systems at relatively low levels of exposure.[9]

17. Fetuses, infants, and children are uniquely vulnerable to the toxic effects of lead.[10] This is because their bodies and organ systems are still growing. Children's brains and other organ systems are exquisitely vulnerable to toxic chemicals, including lead, especially during the nine months of

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[7] Landrigan & Bellinger, *supra* note 1; Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 56 Fed. Reg. 26,460, 26,467 (Jun. 7, 1991) (attached as Ex. C); U.S. Ctrs. for Disease Control & Prevention, *Water*, https://www.cdc.gov/nceh/lead/tips/water.htm (last updated Feb. 18, 2016) (attached as Ex. D) ("CDC reiterates . . . because no safe blood level has been identified for young children, all sources of lead exposure for children should be controlled or eliminated. Lead concentrations in drinking water should be below the EPA action level of 15 parts per billion."); *With No Amount of Lead Exposure Safe for Children, American Academy of Pediatrics Calls for Stricter Regulations*, Am. Acad. of Pediatrics (Jun. 20, 2016), https://www.aap.org/en-us/about-the-aap/aap-press-room/pages/With-No-Amount-of-Lead-Exposure-Safe-for-Children,-American-Academy-of-Pediatrics-Calls-For-Stricter-Regulations.aspx (attached as Ex. E).

[8] Philip J. Landrigan, *Lead and the Heart: An Ancient Metal's Contribution to Modern Disease*, 3 Lancet Pub. Health e156 (2018) (attached as Ex. F).

[9] *Id.*

[10] Philip J. Landrigan et al., *Environmental Pollutants and Disease in American Children: Estimates of Morbidity, Mortality, and Costs for Lead Poisoning, Asthma, Cancer, and Developmental Disabilities*, 110 Envtl. Health Persp. 721 (2002) (attached as Ex. G).

pregnancy and in the first years after birth.[11] Infants and young children also have less capacity to break down and excrete toxic chemicals than adults.[12] Infants and young children also drink more water per pound of body weight than adults, placing them at greater risk of lead exposure from drinking water. A six-month-old infant drinks seven times more water per pound of body weight than an adult.[13] Infants also absorb lead at higher rates than adults, particularly lead from drinking water.[14]

18. During pregnancy, lead that has accumulated in a woman's bones is drawn from her bones into her blood, and then can pass freely from mother to child through the placenta.[15] Maternal and fetal blood lead levels are virtually identical.[16]

19. Once in the fetal circulation, lead readily enters the developing brain because the blood-brain barrier has not yet matured.[17] If a fetus is

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[11] *Id.*

[12] Philip J. Landrigan & Mary M. Landrigan, *Children and Environmental Toxins: What Everyone Needs to Know* (2018).

[13] *Id.*

[14] World Health Org., *Childhood Lead Poisoning* 22 (2010), http://www.who.int/ceh/publications/leadguidance.pdf (attached as Exhibit H)

[15] *Id.*; Philip J. Landrigan, *The Worldwide Problem of Lead in Petrol*, 80 Bull. World Health Org. 768 (2002).

[16] World Health Org., *supra* note 14, at 22.

[17] *Id.*

exposed to lead while in utero, the lead can interfere with neuronal migration, cell proliferation, and synapse formation during critical periods of early vulnerability.[18]

20. Infants can be exposed to lead through breastfeeding.[19] They can also be exposed to lead if lead-contaminated water is used to make the formula that they drink.

21. In fetuses, infants, and children, exposure to lead can cause lowered IQ scores, Attention Deficit and Hyperactivity Disorder (ADHD), dyslexia, developmental delays, as well as other learning and behavioral challenges.[20] Exposure to lead can impair language skills, shorten attention span, and predispose children to hyperactive and aggressive behavior.[21] Lead exposure has also been linked to decreased hearing, insomnia, anorexia, and muscle irritability, and it has been inversely linked to height.[22]

22. Infants in the womb and children under the age of 6 years are the groups within the population most vulnerable to lead exposure because their

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[18] Landrigan, *supra* note 15.

[19] World Health Org., *supra* note 14, at 22.

[20] *Id.*

[21] Landrigan & Bellinger, *supra* note 1.

[22] Jacqueline M. Moline & Philip J. Landrigan, *Lead,* Textbook of Clinical Occupation and Environmental Medicine 967 (2d ed. 2005).

brains are rapidly developing. Infants and young children do not yet have a fully developed blood-brain barrier. Without such a barrier, their brains are more vulnerable to lead. The neurologic damage caused by lead is typically noticed when children enter school at about age 5.[23]

23. Even extremely low exposures—those too low to produce obvious symptoms that would be observed in standard clinical examinations—can produce IQ deficits, attentional dysfunction, slowed growth, cognitive dysfunction and behavior problems.[24] This is known as subclinical lead poisoning or silent lead poisoning.[25] Studies have shown that lead can cause IQ deficits in children down to the lowest measurable levels of lead in blood.[26] Further, the association between low IQ and lead exposure is even stronger at blood lead levels below 5 micrograms per deciliter than at higher levels. Thus, a large part of the damage occurs at the lowest exposure levels.[27] Injury at a young age may cause irreversible lifelong disability.

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[23] Landrigan et al., *supra* note 10.

[24] World Health Org., *supra* note 14, at 22.

[25] Philip J. Landrigan, *Pediatric Lead Poisoning: Is There a Threshold?*, 115 Pub. Health Rep. 530, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1308623/pdf/pubhealthrep00019-0036.pdf (attached as Ex. I).

[26] Herbert L. Needleman & Philip J. Landrigan, *What Level of Lead in Blood is Toxic for a Child?,* 94 Am. J. Pub. Health 8 (2004) (attached as Ex. J).

[27] *Id.*

24. Lead exposure is also associated with an overall reduction in lifetime earnings.[28] The estimated present value of economic losses attributable to lead exposure in the birth cohort of current 5-year-olds in the United States amounts to $43.4 billion per year.[29]

25. Adults exposed to lead can also suffer from serious health effects. Lead has long been recognized to be a cause of hypertension, cardiovascular disease, stroke, and chronic kidney disease.[30] It can also cause gastroenterological problems and damage to the central nervous system, resulting in fatigue, memory loss, headache, coma, convulsions, and behavioral changes.[31] Chronic lead toxicity has been linked to depression, delayed pregnancy, anemia, decreased fertility, and decreased thyroid and adrenal function. Chronic occupational lead exposure in adults has been linked to increased risk of dementia.

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[28] Landrigan et al., *supra* note 10; *see also* Aaron Ruben et al., *Association of Childhood Blood Lead Levels with Cognitive Function and Socioeconomic Status at Age 38 Years and with IQ Change and Socioeconomic Mobility Between Childhood and Adulthood,* 317 J. Am. Med. Ass'n 1244 (2017), https://jamanetwork.com/journals/jama/article-abstract/2613157 (attached as Ex. K).

[29] *Id.*

[30] *NTP Monograph*, *supra* note 5, at xxii, xxiii, 61-63, 70, 88.

26. Lead is associated with fertility and reproductive challenges in adults. Men exposed to lead have shown decreased sperm count and motility.[32] Women exposed to lead can have difficulty conceiving or delayed incidence of pregnancy. Those who are able to become pregnant may have increased risk of miscarriage, premature labor, and low birthrate. One case control study showed that the odds of miscarriage nearly doubled for every 5 micrograms per deciliter increase in maternal blood lead concentration.[33]

27. The International Agency for Research on Cancer has classified lead as a (group 2A) probable human carcinogen. Lead has produced tumors and renal cancers in experimental animal studies. Lead has been linked to excess kidney cancer and tumors in the brain and central nervous system in humans.[34]

28. Lead exposure is associated with increased risk of mortality.[35] Recent studies have shown that lead accounts for more than 400,000 deaths

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[32] Ana Navas-Acien et al., *Lead Exposure and Cardiovascular Disease—A Systematic Review*, 115 Envtl. Health Persp. 472 (2007).

[33] Victor H. Borja-Aburto et al., *Blood Lead Levels Measured Prospectively and Risk of Spontaneous Abortion*, 150 Am. J. Epidemiology 590, 590-97 (1999) (attached as Ex. L).

[34] Moline & Landrigan, *supra* note 22.

[35] Landrigan, *supra* note 8.

annually in the United States.[36] Researchers have found that, when comparing mortality for those with blood levels in the 10th percentile with those in the 90th percentile, there is a 37% increase in all causes of mortality, and 70% increase in mortality from cardiovascular disease.[37]

29. Because the brain has little capacity for repair, many of the effects of exposure to lead are irreversible and untreatable.[38]

30. Even slightly elevated blood lead levels are linked to antisocial, disruptive, and violent behaviors, with increased risk of criminal arrests. Lead exposure is associated with cognitive and behavioral changes that may produce increased rates of criminality, drug abuse, and incarceration.[39] Notably, a sharp decline in the murder rate occurred 20 years after the removal of lead from gasoline.[40] This finding is consistent with the notion that exposure to lead in early life is a powerful determinant of behavior in adult life decades later.

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[36] *Id.*; *see also* Bruce P. Lanphear et al., *Low-Level Lead Exposure and Mortality in US Adults: A Population-Based Cohort Study*, 3 Lancet Pub. Health e177 (2018), http://dx.doi.org/10.1016/S2468-2667(18)30025-2.

[37] Landrigan, *supra* note 8; *see also* Lanphear, *supra* note 36.

[38] World Health Org., *supra* note 14, at 12, 22, 28.

[39] Landrigan et al., s*upra* note 10.

[40] Rick Nevin, *Understanding International Crime Trends: The Legacy of Preschool Lead Exposure*, 104 Envtl. Res. 315 (2007) (attached as Ex. M).

Lead exposure in Newark

31. The prevalence of elevated blood lead levels in children is much higher among inner-city populations, where residents are exposed to lead from multiple sources, than in most other American populations. Lead poisoning is more likely to affect non-Hispanic Black children and children from low-income families than Caucasian children and children from families of higher socioeconomic status.[41]

32. A 2016 study showed that elevated blood lead levels occur among children in Newark at a rate three times greater than among children in the State of New Jersey overall.[42] Newark has the greatest number of children with elevated blood lead levels of any municipality in the state.[43] In some parts of the City of Newark, as many as 8.7 percent of children under six years of age have blood levels that exceed 5 micrograms per deciliter.[44]

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[41] *NTP Monograph*, *supra* note 5, at xii, 11, 16.

[42] Keneil K. Shah et al., *Blood Lead Concentrations of Children in the United States: A Comparison of States Using Two Very Large Databases*, 185 J. Pediatrics 218 (2017), https://www.jpeds.com/article/S0022-3476(17)30169-5.

[43] Child & Adolescent Health Program, N.J. Dep't of Health, *Childhood Lead Exposure in New Jersey Annual Report* (2016), https://www.state.nj.us/health/childhoodlead/documents/reports/childhoodlead2016.pdf.

[44] Advocates for Children New Jersey, *Childhood Lead Exposure in Newark* 10 (2018), https://acnj.org/downloads/2018_03_27_newark_kids_count_childhood_lead_exposure.pdf (attached as Ex. N).

33. Poverty and older housing stock are strong indicators of lead risk. Older cities, like Newark, have a high proportion of housing built before 1978, when the federal government prohibited consumer uses of lead-containing paint. Legacy forms of lead persist, with the heaviest burden falling on the poorest and most vulnerable.

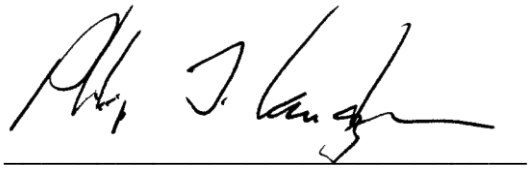
34. Low-income families in older cities like Newark are often exposed to lead through multiple sources, including through the water they drink, the air they breathe, and through contact with lead in lead paint. Exposure to lead from multiple sources presents a cumulative toxicological threat.

35. To prevent further harm and protect the future of the children of Newark, we must reduce or prevent ongoing exposures to lead in drinking water. This means providing children and adults with a reliable source of clean drinking water. Eliminating lead hazards *before* exposure—primary prevention—is far and away the most effective way to protect children from the toxic consequences of environmental hazards.

36. Pediatric lead poisoning is not a treatable disease. The consequences of lead exposure in early life can be lifelong, and may blunt a child's intelligence, diminish achievement, increase risk of school failure, increase risk of criminal behavior and incarceration, and place an enormous financial burden upon society.

37. Prevention of lead poisoning by prevention of exposure is the only way to protect children against this scourge. With each passing year, the burden of disease and disability will further increase.

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



August 22, 2018

Philip J. Landrigan, M.D., M.Sc. Date