Case No. 18-36082

IN THE UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

KELSEY CASCADIA ROSE JULIANA, *et al*.,
Plaintiffs-Appellees,
v.
UNITED STATES OF AMERICA, *et al*.,
Defendants-Appellants.

On Interlocutory Appeal Pursuant to 28 U.S.C. § 1292(b)

DECLARATION OF JEROME A. PAULSON IN SUPPORT OF PLAINTIFFS' URGENT MOTION UNDER CIRCUIT RULE 27-3(b) FOR PRELIMINARY INJUNCTION

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I, Jerome A. Paulson, hereby declare as follows:

1. In this declaration I describe how the health of Plaintiffs and other children is being impacted ***right now*** as a result of climate change pollution from fossil fuels. While Plaintiffs and other children are already being harmed as a result of climate change and fossil fuels, those harms will get worse unless immediate steps are taken to reduce our nation's reliance on fossil fuels as our primary energy source and greenhouse gas emissions ("GHG") begin to decline. I also describe how children, including Plaintiffs are uniquely vulnerable to climate change and pollution from fossil fuels and how the adverse impacts to their health today could have life-long consequences. In my expert opinion, climate change is a public health emergency and rapidly decreasing GHG emissions is a prerequisite for addressing this emergency.
2. I graduated with honors and with general honors from the University of Maryland at College Park with a Bachelor of Science degree in biochemistry. I graduated from Duke University with an MD degree and did my house staff training in Pediatrics at the Johns Hopkins Hospitals and Sinai Hospital, both in Baltimore, MD.
3. I joined the faculty of the George Washington University ("GW") School of Medicine and Health Sciences in 1990. At GW, in addition to my appointment as Associate Professor in the Department of Health Care

Sciences, I was appointed an Associate Professor in the Department of Pediatrics. I also taught in the medical school's public health program and became a faculty member in the Milken Institute School of Public Health when it was chartered.

4. During the 1999-2000 academic year, I served as a special assistant to the director of the National Center for Environmental Health ("NCEH") of the Centers for Disease Control and Prevention ("CDC"). I worked on a number of issues related to children's environmental health for the director. I then received a fellowship that allowed me to work with the Children's Environmental Health Network ("CEHN") for two years on a broad range of children's environmental health issues.

5. In 2000, in conjunction with two colleagues, I created the Mid-Atlantic Center for Children's Health & the Environment ("MACCHE"). We were the third (of now 10) pediatric environmental health specialty units ("PEHSUs") funded in the U.S. The role of MACCHE is to educate health professional and others in the Mid-Atlantic region about issues related to children's health and the environment; and the organization serves as a consultant to parents, health care providers, government agencies and others on issues related to the environment and children's health.

6. In 2007, I was appointed by the board of directors of the American Academy of Pediatrics ("AAP") to serve on the Executive Committee of the Academy's Council on Environmental Health ("COEH"); and in 2011, I was elected by my peers to chair that committee. I completed my term on the COEH in 2015.
7. In 2007, I was also appointed by the U.S. EPA to serve on the Children's Health Protection Advisory Committee ("CHPAC"). I served the maximum 6 years on CHPAC.
8. I published, along with Dr. Kris Ebi, Global Climate Change and Its Impact on Children. *Pediatric Clinics of North America.* 2007; 54: 213-226. Several years later, Dr. Ebi and I published Climate Change and Child Health in the United States. Current Problems in Pediatric & Adolescent Health Care. 2010; 40: 2-18. During my tenure as chair of the COEH, I supervised the drafting of the new AAP Policy Statement and Technical Report on Climate Change. These were published in 2015. (AAP Council on Environmental Health. Global Climate Change and Children's Health. *Pediatrics* 136.5 (2015): 992 and Ahdoot, S, and Pacheco, SE. Global climate change and children's health. *Pediatrics* 136.5 (2015): e1468-e1484.)
9. In 2015, I created the Climate Change Initiative within the AAP, and was hired as a consultant to the AAP as Medical Director of that Initiative.

Through our work, internal AAP stakeholders recognize that climate change is an issue for all components of the AAP, not just the COEH and the Climate Change Initiative. We have developed educational materials for pediatricians and for parents related to climate change.

10. Beyond the AAP, I have been instrumental in creating the Medical Society Consortium on Climate and Health. The Consortium brings together 20 societies representing over 500,000 members to convey the messages that climate change causes health problems and that decreasing the use of fossil fuels and increasing energy efficiency and the use of clean energy sources will ameliorate these problems. The Consortium advocates at the Federal level on these issues.

11. I have received various honors and awards and I have written extensively and lectured widely in the U.S. and overseas on a variety of topics related to children's environmental health. Currently, I am Professor Emeritus of Pediatrics and of Environmental & Occupational Health George Washington University School of Medicine and Health Sciences and George Washington University Milken Institute School of Public Health.

12. I have been retained as an expert on behalf of Plaintiffs in this litigation before the United States District Court for the District of Oregon ("District Court").

13. I offer my expert opinion, on behalf of the 21 youth Plaintiffs in this case, as to the need for immediate relief to address the ongoing and potentially irreparable harm to Plaintiffs' physical health and well-being. My Expert Report, which is attached to this declaration as **Exhibit 1**, details additional public health impacts of climate change and fossil fuels on Plaintiffs and children in general. Additional information regarding my professional and educational background can be found in my curriculum vitae, attached to this declaration as **Exhibit A** to **Exhibit 1.**

Plaintiffs and Other Children are Already Being Harmed by Climate Change

14. In my expert opinion, climate change is a public health emergency. I agree with a November 2018 article published in the medical journal *Lancet*, which stated that climate change is the "biggest global health threat of the 21st century."[1] One of the conclusions of the *Lancet* article was that "the indicators and data presented . . . provide great cause for concern, with the pace of climate change outweighing the urgency of the response."[2] Here too, I agree. The federal governments' actions that are causing increasing quantities of fossil fuels to be extracted and causing the United States' GHG emissions to rise are exacerbating the harm to children's health from climate

[1] Watts, N. et al., (2018). *The 2018 report of the* Lancet *Countdown on health and climate change: shaping the health of nations for centuries to come*, Lancet, Vol. 392 at 2482.
[2] *Id.* at 2511.

change and fossil fuels. Our federal government needs to stop allowing third parties to extract coal from federal lands because coal, when burned, causes large amounts of GHG emissions. The federal government also needs to do what is necessary to rapidly reduce our nations GHG emissions. Each month that passes by without action by the federal government to reduce fossil fuel extraction and GHG emissions exacerbates this already grave public health emergency facing our nation's must vulnerable population – our children.

15. Climate change is not a distant or hypothetical threat to the health of Plaintiffs and other children. Rather, the health of children, including Plaintiffs, is already being harmed in a myriad of ways by climate change (see **Figure 1** below).

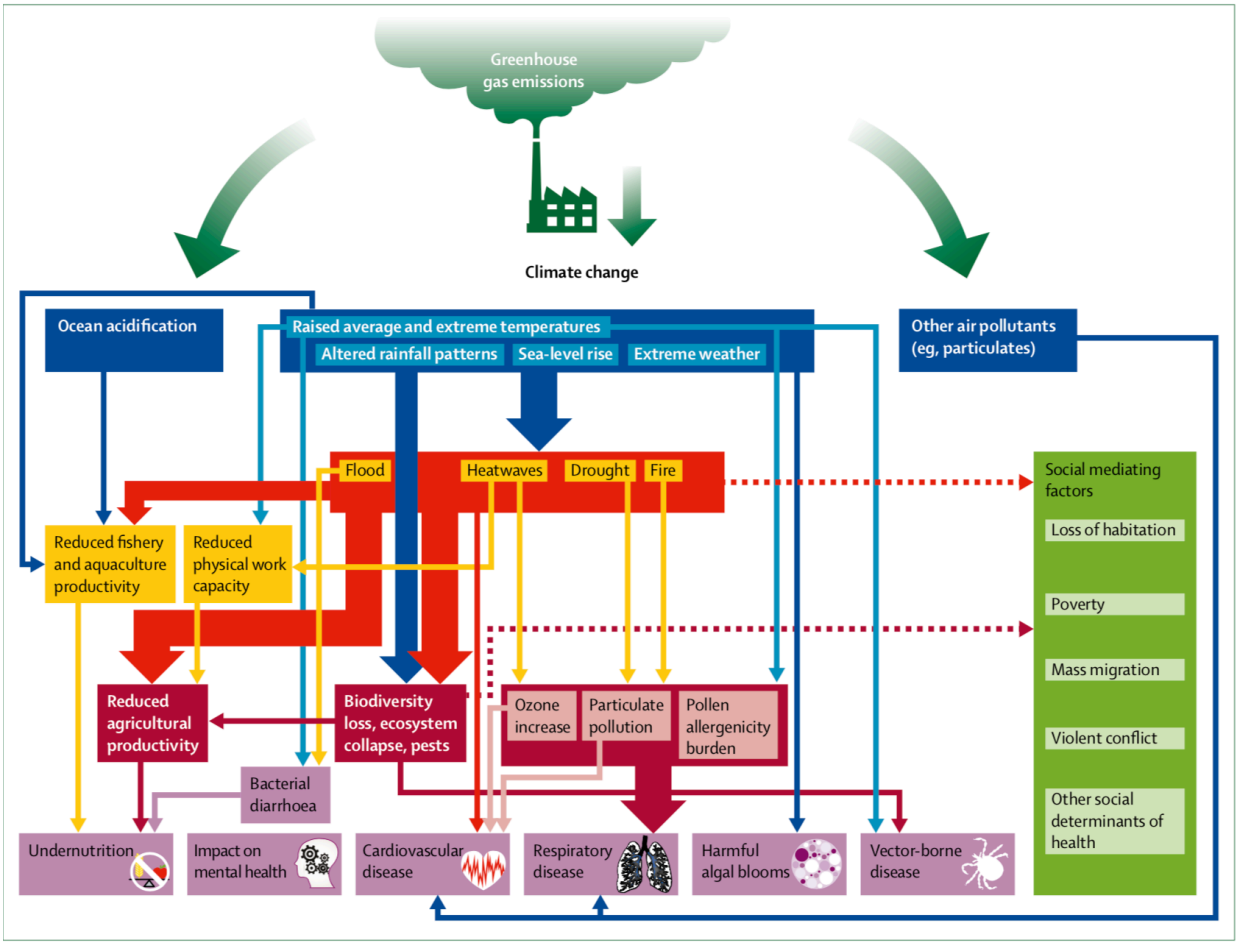

Figure 1: The pathways between climate change and health[3]

Increased heat stress and other temperature effects

16. As temperatures continue to rise due to unmitigated climate change, the morbidity and mortality associated with heat waves, which are already significant, are expected to increase. Children have a higher risk of dying, and are among those most vulnerable to health problems, from excess heat. Public health studies have concluded that children under 15 are more likely

[3] *Id.* at 2482.

to die from excess heat than adults.[4] The federal government has found, with a "very high confidence," that children face a higher risk of getting sick or dying from extreme heat.[5] A new study has also confirmed the link between climate-related maternal heat exposure during pregnancy and an increased incidence of congenital heart defects in babies.[6] Increasing temperatures and heat waves also affect the physical, emotional, and cognitive development of children, and adversely impact their learning. Beyond individual hot days impairing children's learning, *cumulative* heat exposure may inhibit children's cognitive skill development. Unfortunately, due to rising temperatures, healthy child activities such as playing outdoors will continue to be replaced by safer but not necessarily better options, like playing indoors.

17. Plaintiffs are already be harmed by rising temperatures and the harms to Plaintiffs will become increasingly severe and frequent without immediate actions to reduce greenhouse gas emissions. For example, Jaime B. states that she has "been negatively affected by the increasing temperatures, which

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[4] Zivin, J. E. & Shrader, J. (2016). Temperature Extremes, Health, and Human Capital. In Children and Climate Change. *The Future of Children, vol. 26(1).*
[5] Crimmins, A.J., et al. (2016). Executive Summary. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. U.S. Global Change Research Program, Washington, DC at 9.
[6] Zhang W., et al. (2019). Projected Changes in Maternal Heat Exposure During Early Pregnancy and the Associated Congenital Heart Defect Burden in the United States. *Journal of the American Heart Association* 8 e010995.

limits the time I'm able to safely spend time outdoors. . . . I feel happy when I'm outside and when I'm inside I feel monotonous." Jaime B. MSJ Decl., ¶ 26 (D. Ct. Doc. 282). Avery M. has become overheated during outdoor activities and been forced to limit her time spend outdoors during unusually hot summer days. Avery M. MSJ Decl., ¶¶ 10, 11 (D. Ct. Doc. 278). Hazel V. has suffered from heat exhaustion. Hazel V. MSJ Decl., ¶ 11 (D. Ct. Doc. 279). Nicholas V. states in his declaration: "It gets hot enough in the summer that there are significantly fewer days where it is possible for me to enjoy the outdoors than there used to be." Nicholas V. MSJ Decl., ¶ 8 (D. Ct. Doc. 290). These Plaintiffs are experiencing the ramifications of unseasonably hot days that scientists say are becoming the new normal.

18. I cannot advise Jaime, Avery, Hazel, Nicholas, or any of the other Plaintiffs to play indoors or get used to the heat. Playing indoors decreases their opportunity for aerobic exercise. Playing indoors deprives them of the benefit of being out in nature and exposure to fresh air, which should be healthier than indoor air quality. Worst of all, with the current projections for temperature increase in the U.S., I cannot tell them that things will get better in the foreseeable future and that their physical and mental health will not be affected. Instead, their stories illustrate how these Plaintiffs are already being harmed by extreme temperatures and other heat-related

impacts, in different ways from adults. In my expert opinion, urgent reductions in U.S. GHG emissions are needed to minimize the harm to the health of Plaintiffs' and other children from heat-related health impacts. The current health impacts we are seeing should be more than enough to trigger a response from the federal government.

Extreme Weather Events

19. Hurricanes, floods, droughts, and other extreme weather events, which climate change is making more frequent and severe, are already having dangerous impacts on the health of children, including Plaintiffs. In the aftermath of extreme weather events, there are often persistent health impacts associated with diarrheal illness from contaminated water, and limited or no access to medical care. Floodwaters are often contained with toxic chemicals, raw sewage, and other pollutants that make children ill. Adverse health impacts from exposure to contaminated floodwaters can include infectious, respiratory, and skin diseases, and increased risk of gastrointestinal illness due to exposure to pathogens like Cryptosporidium and Giardia. To make matters even worse, water-damaged homes are also often impacted by mold and mycotoxins which can cause respiratory problems for people when they move back into their water-damaged homes.

Exposure to mold and mold components has been known to trigger inflammation, and asthma, among other adverse health impacts.

20. Jayden F. has been personally impacted, more than once, by extreme flood events that have inundated her home, causing significant damage, and making her physical ill. In the 2016 Louisiana floods, Jayden was exposed to water polluted with raw sewage and other pollutants and forced to sleep in her contaminated home. As Jayden explains in her declaration, "I, along with everyone in my family, had flu-like symptoms with fevers and sore throats, as well as stomach pain and diarrhea. My whole body felt hot and my hands were very cold. I had bad headaches, a sore throat, and an upset stomach. . . . For over a month I was continually sick . . . . During that month we experienced hives and recurring migraines in addition to our flu-like symptoms. We tried to go to the doctors, but even they were sick. At one point they just gave us a bunch of medicine because they did not know what to do for this mystery illness." Jayden F. MSJ Decl., ¶¶ 19-20 (D. Ct. Doc. 283). Extreme rainfall events in Hawaii have harmed Journey, damaging his house and causing leaks that have led to mold. As Journey writes in his declaration to this Court: "Mold still grows in my house, even nine months after the April 2018 storm. It grows on my clothes and furniture. Only frequent, thorough cleanings prevent the mold from

completely taking over my house. But even with the constant cleaning, the mold is still causing me sinus infections and is worsening my allergies. I have to constantly use nasal sprays and take allergy medication to cope." Journey Z. Decl., ¶¶ 14-15, 18. Children should not be faced with these kinds of preventable situations. Immediate action by the federal government is needed to reduce GHG emissions so that extreme weather events, like the ones that have impacted Jayden and Journey, do not become even more frequent and severe.

Wildfires

21. As a result of climate change, the wildfire season is becoming longer and wildfires are more widespread, severe, and destructive. The effect of wildfires on children is expected to worsen as wildfires in some areas of the U.S. are expected to increase with unmitigated climate change. Of the many compounds present in the smoke of wildfires, particulate matter ("PM"), carbon monoxide ("CO"), and ozone ("O_3") are the most damaging to children's health. Children, and especially children with asthma, are among those most at risk from exposure to PM. The EPA has found that PM from wildfire "can contribute to acute and chronic illnesses of the respiratory system, particularly in children, including pneumonia, upper respiratory

diseases, asthma and chronic obstructive pulmonary disease."[7] Many of the compounds in wildfire smoke are strong irritants of the respiratory tract triggering asthma exacerbations and affecting other respiratory conditions.

22. The Plaintiffs in this case have already been exposed to poor air quality because of wildfires. McClure & Jaffe have identified a positive trend in PM2.5 in the Northwest United States, where many of the Plaintiffs live, due to the increase in wildfires.[8] As Sahara V. noted in her declaration, "I have been diagnosed with asthma. Breathing was much harder during the strong forest fire smoke that inundated the Willamette Valley, due to hotter and drier conditions. The smoke inhibits my ability to breathe and causes my throat to close up." Sahara V. MSJ Decl., ¶ 6 (D. Ct. Doc. 291). During the 2017 summer, Jacob Lebel was forced to work on his family farm in thick smoke that prompted air quality alerts by the Oregon DEQ. Jacob Lebel MSJ Decl., ¶ 11 (D. Ct. Doc. 281). Alex Loznak's asthma is aggravated by wildfire smoke, which makes it difficult for him work on his family farm or recreate outside when it is smoky. Alex Loznak MSJ Decl., ¶ 48 (D. Ct. Doc. 277). Isaac V., who has asthma, stated in his declaration: "It is really

[7] EPA. (2009). Endangerment Finding *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act Technical Support*.

[8] McClure, C. D., & Jaffe, D. A. (2018). US particulate matter air quality improves except in wildfire-prone areas. *PNAS*, 1.

hard for me to breathe and do anything outside when there is dust or smoke in the air." Isaac V. MSJ Decl., ¶ 4 (D. Ct. Doc. 280). Nicholas V. also has asthma and explains in his declaration to this Court how "wildfire smoke makes it impossible for me to exercise and sometimes I can't even go outside at all on particularly poor air quality days. Whenever I exercise when there is poor air quality I have coughing fits and I have difficulty breathing due to my asthma." Nicholas V. Decl., ¶ 4.

23. For Sahara, Jacob, Alex, Isaac, Aji, Nicholas, and other Plaintiffs exposed to smoke from wildfire, I expect, consistent with the literature, that their increased exposure to smoke will exacerbate existing health issues, such as asthma, and may cause new acute and chronic respiratory illnesses. By continuing to promote fossil fuels, the federal government is knowingly putting these children in an increasingly risky situation when it comes to their health.

Decreased Air Quality Leading to Asthma and Allergies

24. Climate change is affecting the distribution, allergenicity, seasonality and pollen production in different parts of the country as well as globally. The federal government has found with "high confidence" that "[c]hanges in climate, specifically rising temperatures, altered precipitation patterns, and increasing concentrations of atmospheric carbon dioxide, are expected to

contribute to increases in the levels of some airborne allergens and associate increases in asthma episodes and other allergic illnesses."[9] The longer flowering seasons can translate to increased allergen sensitization, increased morbidity for allergic individuals, and an increase in asthma or asthma exacerbation in susceptible individuals. Elevated pollen counts have been associated with increased emergency room visits in children and adolescents with asthma.

25. Several of the Plaintiffs in this case have asthma and allergies. Jaime B. states in her declaration that her "severe allergies have become increasingly worse over the last several years." Jaime B. MSJ Decl., ¶ 28 (D. Ct. Doc. 282). Levi D. states in his declaration that "[i]n the last three years, increased temperatures have caused my allergies to be much worse." Levi D. MSJ Decl., ¶ 13 (D. Ct. Doc. 287). Zealand B. explains how his "allergies and symptoms have only increased in severity and duration over the past few years. I now suffer from allergies throughout the spring and summer, experiencing sneezing fits, a stuffed nose, itchy eyes and headaches. . . . These symptoms have also made it hard for me to concentrate at school. Some days the headaches force me to leave class and/or take more

[9] Crimmins, A.J., et al. (2016). Executive Summary. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. U.S. Global Change Research Program, Washington, DC at 11.

medicine." Zealand B. MSJ Decl., ¶ 8 (D. Ct. Doc. 296). Nicholas V. explains in his declaration to this Court how fossil fuel pollution reduces the air quality where he lives in Colorado and causes him to suffer increased incidences of asthma attacks. Nicholas V. Decl., ¶ 5. Nicholas' asthma makes it harder for him to exercise outdoors, stay in shape physically, and has caused him to miss weeks of school at a time. *Id.,* ¶¶ 6-7. With each passing year, the number of children with asthma and allergies will increase, and those who already have asthma or allergies, will experience more severe health impacts as a result of climate change.

Air Pollution from Fossil Fuels is Harming Plaintiffs and Other Children

26. In addition to children being harmed by climate change in ways that are different from how adults are harmed, children are also harmed by the air pollution caused by the extraction, transportation, and burning of fossil fuels. Thus, the fossil fuel energy system of the nation has collateral adverse impacts on the health of children, in addition to climate change. Sometimes those harms are synergistic, like in the case of children's respiratory health and ozone. Given the role of fossil fuel infrastructure in facilitating the extraction, transportation, and combustion of fossil fuels, stopping the permitting of the development of new fossil fuel infrastructure would have the collateral benefit of reducing harmful air pollution.

27. The extraction and burning of fossil fuels, the primary driver of climate change, accounts for most of the airborne particulate pollution, which has a detrimental effect on air quality. Burning fossil fuels releases many chemicals and particulates to the air. These include fine particulate matter, black carbon, polycyclic aromatic hydrocarbons ("PAHs"), mercury, lead, oxides of nitrogen, sulfur dioxide, and carbon monoxide. In October of 2013, the International Agency for Research on Cancer ("IARC") classified air pollution as a human carcinogen. Out of the six criteria pollutants monitored in the U.S., four are the main culprits of respiratory disease exacerbation during days of poor air quality (ground level ozone ("O_3"), sulfur dioxide ("SO_2"), particulate matter ("PM"), and nitrogen dioxide ("NO_2")). Of these, ozone and PM have been associated with higher morbidity and mortality in vulnerable groups such as children.

28. Ground level ozone is an irritant to the lungs and is worsening with climate change and increased temperatures. Some of the health effects that are associated with ozone are: shortness of breath, coughing, and aggravation of chronic lung diseases such as asthma and chronic obstructive pulmonary disease ("COPD"). Damage to the lungs continues even when symptoms have dissipated. Exposure to ozone during childhood not only exacerbates asthma, but also can lead to a new on-set of asthma as well as permanently

impacting lung function. While everyone loses some of their lung function as they age, children with lesser lung function may be more likely to develop chronic lung diseases as adults.

29. According to a report by the federal government, there are roughly 6.8 million children in the U.S. impacted by asthma "making it a major chronic disease of childhood."[10] Several of the Plaintiffs in this case have asthma, including Jaime B., Sahara V., Tia Hatton, Alex Loznak, Levi D., Nicholas V., Isaac V., and Nathan B. I expect that the number of children with asthma will increase, and those who already have asthma or allergies, will experience more severe health impacts as a result of air pollution related to fossil fuels. Reducing our nation's reliance on fossil fuels as an energy source is one critical step that must be taken to prevent the worsening of the chronic childhood disease of asthma.

30. Asthma is the most common pediatric chronic disease, affecting 6.8 million, or 9.3% of American children in 2012.[11] However, the Plaintiff group has a disproportionate number of children with asthma at 38% of the 21 youth. In 2008, asthma accounted for an estimated 14.4 million lost days of school

[10] *Id*. at 11.

[11] Bloom B., Jones, L. I., & Freeman, G. (2013). Summary health statistics for US children: National Health Interview Survey, 2012. National Center for Health Statistics. *Vital Health Stat*. 10(258), 1–81.

among children in the U.S.[12] Early exposure to air pollution has been associated with the development of asthma in children.

31. We know, from research done in the Los Angeles area over many years, that children who grow up in an area with more air pollution have smaller lung capacity when they reach adulthood. Therefore, it is reasonable to expect that this will occur under climate change where there is a corresponding increase in air pollutants. Likewise, there is information that children growing up in areas with more air pollution will have a lower IQ. By continuing to pursue energy from fossil fuels, the government is contributing to these environmental conditions known to be perilous to children.

Children Uniquely Vulnerable to the Impacts of Climate Change and Air Pollution

32. Children are not little adults – parents know this, doctors know this, and both courts and legislatures treat them differently.

33. Children are uniquely vulnerable to the impacts of climate change and air pollution associated with fossil fuels. Children's bodies are not fully developed or mature, including vital organs like their lungs and the brain. Lung growth and development continues through childhood so the respiratory system of children is more susceptible to environmental-related

[12] Meng, Y. Y., Babey, S., & Wolstein, J. (2012). Asthma-Related School Absenteeism and School Concentration of Low-Income Students in California. *Preventing Chronic Disease, 9*:110312.

injuries and may be altered by environmental exposures. Additionally, children have a higher respiratory rate with higher minute ventilation and entry of polluted air to the lungs. Therefore, if the air that they are breathing is polluted, they will breathe more of that pollution than an adult per unit of body weight. Children also have an immature immune system, higher metabolic demands, and immature central nervous system.

34. Children are also more vulnerable because they spend more time outside than adults, which exposes them to excess heat, polluted air, and disease carrying insects. Ideally children should be outside in nature, playing, getting exercise, and learning. However, if the temperatures are high or the air they breathe outside is contaminated with particulate matter, ozone, carbon monoxide, or other harmful air contaminants, the child's health will be harmed by being outdoors. In my expert opinion, Plaintiffs in this case, are at risk of irreparable harm from having decreased lung function as a result of growing up in environments with more air pollution, as are all of their similarly situated peers, a risk that adults do not face in the same way because their lungs are already fully developed.

35. Moreover, and of particular importance in dangerous situations such as hurricanes, flooding, or wildfires, when important decisions, like whether or not to evacuate or where to seek safe shelter, need to be made, children are

dependent on adults for their safety. Children do not have the maturity, information, or resources on which to make decisions as to what to do in these situations. Children's inability to make decisions related to their own safety and other matters, is a reflection of brain maturation. Put simply, the brains of young children and adolescents are different from adults. In particular, the changes in brain development from in-utero through adolescence mark children as distinctly different from adults. "Indeed, much of the potential and many of the vulnerabilities of the brain might, in part, depend on the first two decades of life."[13] As a result of non-invasive techniques, such as functional magnetic resonance imaging ("fMRI"), we can actually see the very fibers of the brain and better understand the anatomical differences in adolescent brains. Brain imaging technology has shown that regions of the adolescent brain are not mature until after age 18.

36. The central nervous system of children is not mature – neurodevelopment continues through the second decade of life. Exposure to air pollution affects neuron development in children's brains, myelination[14] and synapse

[13] Toga, A. W., Thompson, P. M., & Sowell, E. R. (2006). Mapping brain maturation. *Focus*. TRENDS in Neurosciences 29:148-159.

[14] As children's brains mature, neurons become wrapped in a myelin sheath that increases the velocity of message transmission between neurons. This is known as myelination. Myelination of the regions of the brain responsible for higher cognitive functions is an ongoing process during child development and continues well into adolescence.

integrity,[15] halting the development of a healthy brain in children. It is thought that air pollutants in exposed children reach the brain via a disrupted nasal epithelium or the blood brain barrier. The ensuing immune activation generates a response that promotes brain tissue injury. Among affected brain areas are the prefrontal and frontal cortex, vital for normal cognition. In my expert opinion, children are already experiencing impaired neurodevelopment as a result of air pollution from fossil fuels that can have life-long implications. And the more fossil fuel emissions that enter the air will only make this situation worse for children.

37. Certain categories of children are especially vulnerable to the impacts of climate change and air pollution. The federal government has found that communities of color, immigrants, indigenous peoples, those living in coastal areas, those with preexisting or chronic medical conditions, and the economically disadvantaged are disproportionally vulnerable to public health threats due to climate change.[16] Among other hurdles, these

[15] Synapses are the place where neurons connect for the transmission of messages from one neuron to the other. In general, the number of synapses increases as the brain develops.

[16] Crimmins, A.J., et al. (2016). Executive Summary. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. U.S. Global Change Research Program, Washington, DC at 4; EPA. (2009). Endangerment Finding *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act Technical Support*.

populations tend to have reduced access to resources to help deal with the impacts of climate change, such as air conditioning, health care, adequate shelter, and the financial means to relocate either permanently or temporarily should that become necessary. The children in these population groups, which include some of these plaintiffs, face added vulnerabilities for the reasons explained above.

38. Children who live in coastal areas, like Levi D. who lives on the east coast of Florida, are on the frontlines of climate change due to sea level rise and flooding and are especially vulnerable. Children living in the low-lying coastal areas along the Gulf of Mexico, or just barely above sea level along Florida's coast, and other sea level rise prone areas in the U.S. already are, and will continue to experience a significant burden on their health from rising seas and higher storm surges. Levi D.'s home is about a mile from the Atlantic Ocean and is just about at sea level. Levi D. MSJ Decl., ¶¶ 1, 2 (D. Ct. Doc. 287). Levi has already had to evacuate his home several times due to hurricanes and flooding. Without immediate actions to reduce greenhouse gas emissions, Levi's displacement from his home will be permanent. *Id.*, ¶ 3. Miko V.'s fear that she will not be able to travel back to her home of origin in the Marshall Islands because they will be submerged by sea level rise is an appropriate response of an adolescent child who understands the

ramifications of climate change. Miko V. MSJ Decl., ¶¶ 3-8 (D. Ct. Doc. 288). There are a number of reports, both in the scientific literature and the popular literature about the inundation of the Marshall Islands.[17] Atoll islands, including parts of the Marshall Islands, are expected to be uninhabitable by mid-century.[18] These impacts of sea level rise on children's lives, while they are still developing, are psychologically significant and adverse. Journey Z., who lives on Hawaii, has also been directly impacted by rising seas and states in his declaration to this Court how "[w]atching the beaches erode away and disappear brings me deep emotional pain." Journey Z. Decl., ¶ 9.

The Adverse Impacts to the Health of Plaintiffs and other Children from Climate Change and Fossil Fuels Will Have Life-long Impacts

39. In my expert opinion, the adverse health impacts of climate change and fossil fuels will result in life-long impacts for children. Repeated exposure to the impacts of climate change (until the federal government adequately

[17] Webb, A. P., & Kench, P. S. (2010). The dynamic response of reef islands to sea-level rise: evidence from multi-decadal analysis of island change in the Central Pacific. *Global and Planetary Change*, *72*(3), 234-246; Storlazzi, C. D., Gingerich, S. B., van Dongeren, A., Cheriton, O. M., Swarzenski, P. W.,Quataert, E., Voss, C. I., Field, D. W., Anamalai, H., Piniak, G. A., & McCall, R. (2018). Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding. *Science Advances* 4: 1–9.

[18] *Id.*

responds to climate change and the threats are minimized) is likely to result in impaired physical or cognitive development with life-long consequences.

40. There is widespread scientific literature explaining how children who are exposed to stressful or traumatic events, often referred to as adverse childhood experiences ("ACEs"), experience a myriad of health problems throughout their life. Adverse childhood experiences broadly describe abuse, neglect, and other traumatic events that occur in an individual's life before the age of 18.[19] People with excessive exposure to ACEs in childhood are more likely to die at a younger age, as well as have a host of medical and mental health problems (see **Figure 2** below). Another term that has been used to describe the impact of adverse childhood events on children is toxic stress. Toxic stress is living situations and experiences that activate the human body's natural stress response system in an excessive, prolonged manner.

[19] Felitti, V. J., Anda, R. F., Nordenberg, D., et al. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. *American journal of preventive medicine*, *14*(4), 245-258.

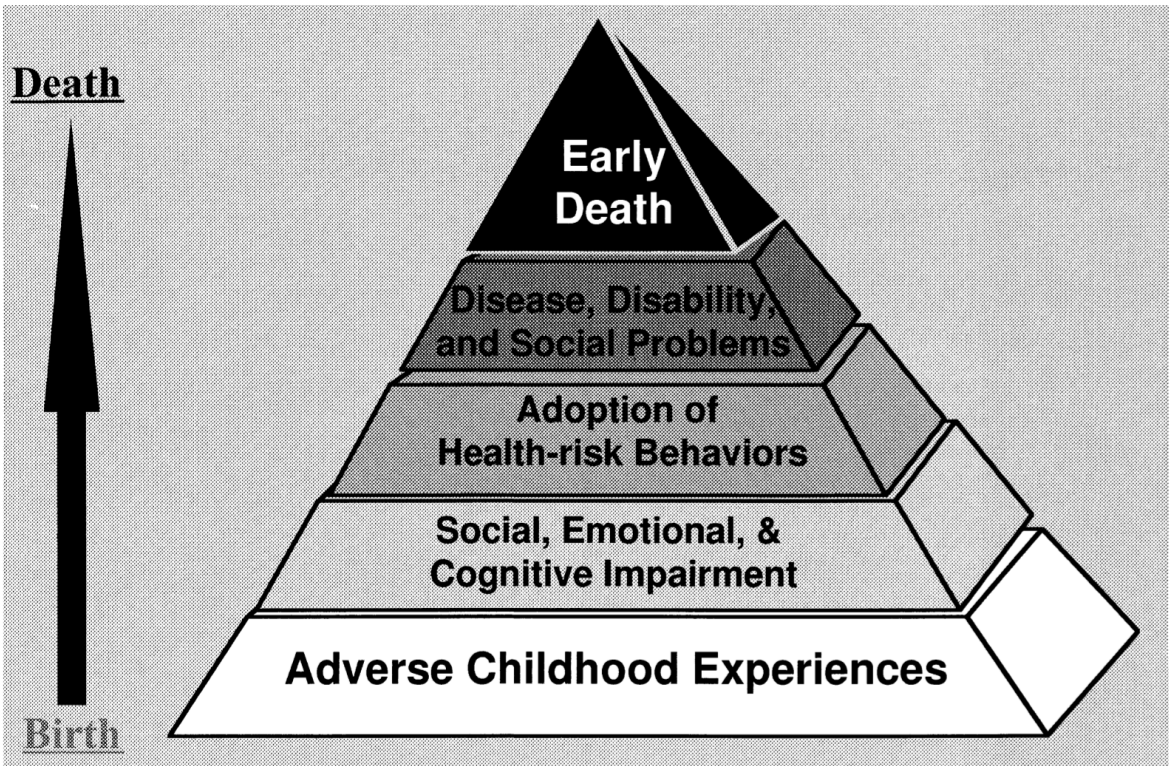

Figure 2: Illustrating the life-long impacts of adverse childhood experiences.[20]

41. These Plaintiffs, and similarly situated children throughout the U.S. have been, and continue to be, deprived of the opportunity to access their full health potential as a result of the government's actions that are causing climate change. The effects of climate change on children are well understood and routinely acknowledged in the medical literature. As a medical doctor, I believe that the federal government's actions in continuing to pursue fossil fuels in spite of the known and undisputed health risks to children is truly shocking.

[20] *Id.*

Conclusion

42. The health of these Plaintiffs, along with other children, *is already being harmed* by climate change and air pollution. We have never before had entire generations of children growing up in an environment so altered and degraded by climate change. In my expert opinion, which is consistent with the medical literature, the severity and scope of the harm to children's health will continue to increase in coming years unless the federal government responds immediately to the threats posed by climate change and air pollution.

43. Every decision that the federal government makes today that allows for the extraction of fossil fuels, and results in the construction of new fossil fuel infrastructure will lock in additional greenhouse gas emissions, exacerbate the climate impacts that are already harming Plaintiffs' health, and result in additional harms from air pollution associated with fossil fuels. In order to prevent additional physical harms to Plaintiffs from climate change and air pollution associated with fossil fuels, and to ensure that the Plaintiffs' current physical ailments do not worsen at the hands of their own government, the federal government must stop authorizing and sanctioning new investments in fossil fuel energy.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed on February 5, 2019.

Respectfully submitted,

Jerome A. Paulson

Exhibit 1

EXPERT REPORT
OF
SUSAN E. PACHECO, MD
and JEROME A. PAULSON, MD, FAAP

Kelsey Cascadia Rose Juliana; Xiuhtezcatl Tonatiuh M.,
through his Guardian Tamara Roske-Martinez; et al.,
Plaintiffs,

v.

The United States of America; Donald Trump,
in his official capacity as President of the United States; et al.,
Defendants.

IN THE UNITED STATES DISTRICT COURT
DISTRICT OF OREGON

(Case No.: 6:15-cv-01517-TC)

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TABLE OF ACRONYMS AND ABBREVIATIONS

AAP: American Academy of Pediatrics
ACEs: adverse childhood experiences
ACOS: asthma–chronic obstructive pulmonary disease overlap syndrome
CDC: Centers for Disease Control and Prevention
CEHM: Children's Environmental Health Network
CHPAC: Children's Health Protection Advisory Committee
CO: carbon monoxide
CO_2: carbon dioxide
COEH: Council on Environmental Health
COPD: chronic obstructive lung disease
DEQ: Department of Environmental Quality
EPA: U.S. Environmental Protection Agency
ER: emergency room
FEV1: forced expiratory volume
FVC: forced vital capacity
GAO: U.S. Government Accountability Office
GW: George Washington University
HAB: harmful algal bloom
HIA: health impact assessment
IARC: International Agency for Research on Cancer
ICU: intensive care unit
ICD-10-CM: International Classification of Diseases, 10th Revision, Clinical Modification
IPCC: Intergovernmental Panel on Climate Change
MACCHE: Mid-Atlantic Center for Children's Health & the Environment
MRI: magnetic resonance imaging
NCEH: National Center for Environmental Health
NO: nitric oxide
NO_2: nitrogen dioxide
O_3: ozone
PAHs: polycyclic aromatic hydrocarbons
PEF: peak expiratory flow
PEHSU: pediatric environmental health specialty unit
PM: particulate matter
PM2.5: particulate matter less than 2.5 micrometers
SO_2: sulfur dioxide
TENDR: Targeting Environmental Neurodevelopmental Risks
TRAP: traffic-related air pollution
UGE: unconventional natural gas extraction
UGRB: Upper Green River Basin
USGCRP: U.S. Global Change Research Program
VCCA: Virginia Clinicians for Climate Action
VOC: volatile organic compounds
WMH: white matter hyperintensities

INTRODUCTION

We, Dr. Susan Pacheco and Dr. Jerome Paulson, have been retained by Plaintiffs in the above captioned matter to provide expert opinion on the public health impacts on children from climate change and air pollution. We conclude that there is abundant evidence, both in the literature and from our clinical experience, that the health of children is already being adversely impacted as a result of climate change and air pollution.

We, Dr. Susan Pacheco and Dr. Jerome Paulson, are co-authoring this report and, unless otherwise specified within, we share the opinions expressed herein. The opinions expressed in this report are our own, and not the opinions of any of the institutions for which we work or donate our time. The opinions expressed herein are based on the data and facts available to us at the time of writing and are to a reasonable degree of scientific certainty, unless otherwise specifically stated. Should additional relevant or pertinent information become available, we reserve the right to supplement the discussion and findings in this expert report in this action.

Dr. Pacheco's CVs is contained in **Exhibit A** and Dr. Paulson's CV is contained in **Exhibit B** to our expert report in this action. The list of publications we have authored within the last ten years are included in our CVs. A statement of Dr. Paulson's previous testimony within the preceding four years as an expert at trial or by deposition is contained in **Exhibit C** to our expert report. Dr. Pacheco has not given previous testimony within the preceding four years as an expert at trial or by deposition. In preparing this report, we have reviewed a number of documents. Our report contains a list of citations to the documents that we have used or considered in forming our opinions, listed in **Exhibit D**.

In preparing our expert report and testifying at trial, we are not receiving any compensation and are providing our expertise pro bono to the Plaintiffs given the financial circumstances of these young Plaintiffs. Given the magnitude of the threat that children are facing, including these Plaintiffs, we also feel compelled to share our expertise in this important case.

EXECUTIVE SUMMARY

The federal government has known about the threats posed by climate change and air pollution for decades. In addition to the federal government's knowledge that fossil fuels are causing dangerous climate change impacts, like heat waves, sea level rise, and extreme weather events, the government also knows that climate change and air pollution from fossil fuels is harming the health of children. Children are uniquely vulnerable to the impacts of climate change due to their physiological features, including their higher respiratory rate, lung growth and development, immature immune system, higher metabolic demands, and immature central nervous system. Children also spend more time playing outside than adults, which exposes them to excess heat, polluted air, and disease carrying insects. Consistent with the literature, including reports by the federal government, it is our expert opinion that the health of children is already being severely impacted by climate change and air pollution. The adverse health impacts will continue to get more severe, and impact a growing number of children, unless the use of fossil fuels is promptly phased out. Because there is no comprehensive method or database that allows us to track health issues connected to climate change, we expect that climate change and air pollution are going under-diagnosed as a factor impacting the health of children.

While all children are uniquely vulnerable to the impacts of climate change and air pollution, certain populations of children are especially vulnerable, including those vulnerable to sea level rise, children with preexisting medical conditions, children from communities of color, and economically disadvantaged children. All of the Plaintiffs in this case are children, and some are from these especially vulnerable populations of children.

There are a variety of ways in which climate change is harming these Plaintiffs, and other children. Climate change is causing an increase in average temperature and heat waves, with a resulting increase in morbidity and mortality for children. The excess heat can impact children's neurological development and make it harder for them to attend school and play outside. Extreme weather events, like hurricanes, can result in the displacement of children and disrupt their school and social support networks. They also frequently cause children to be exposed to toxic substances in flood waters, and mold in water-damaged buildings, both of which have acute and chronic health impacts. Meanwhile, the increasing frequency and severity of wildfires is decreasing air quality, which is harmful to all children, and especially those with asthma and allergies. Children are increasingly exposed to infectious disease as the range of disease-carrying organisms expands due to climate change. Climate change is also contributing to food, water, and nutrient insecurity and scarcity, which can, among other things, increase the risk of malnutrition for children. Finally, the health of children is being harmed by a decrease in water quality and an increase in algal blooms, which make children sick when exposed to contaminated water.

In addition to being harmed by climate change impacts, children's health is adversely impacted by the extraction and combustion of fossil fuels, the primary driver of climate change. Air pollutants associated with fossil fuels, including particulate matter and ozone, as associated with higher morbidity and mortality in children. Air pollution impacts children's neurological development, exacerbates existing respiratory illnesses, such as asthma, and cause new respiratory illnesses.

The health impacts on children from climate change and air pollution will be life-long, and will also impact future generations. There is abundant evidence that children exposed to traumatic events, often referred to as adverse childhood experiences (ACEs), experience long-term health impacts and that ACEs can contribute to an early death. We agree. Climate change and air pollution can also cause long-term cognitive and behavioral impacts, which diminishes children's ability to learn, and ultimately prosper in life. We have never before had entire generations of children growing up in an environment so altered and degraded by climate change and air pollution. In our expert opinion, the severity and scope of the harm to children's health will continue to increase in coming years unless the federal government responds to the threats posed by climate change and air pollution. Indeed, addressing the underlying cause of the health impacts on children, climate change and air pollution, is the only way to properly respond to this health crisis.

QUALIFICATIONS

Qualifications of Susan E. Pacheco, MD

I obtained a bachelor's degree in Biology at the University of Puerto Rico in Mayagüez and a medical degree at the University of Puerto Rico Medical School in San Juan, Puerto Rico. I did my internship in pediatrics at Louisiana State University in New Orleans. In 1989 I moved to

Houston, Texas and completed my residency training in pediatrics at Baylor College of Medicine and subspecialty in Pediatric Allergy and Immunology (1992) at the same institution. I am board certified in Pediatrics and have certified in Allergy and Immunology three times, the last one in 2015. I have worked in academia all my life including Baylor College of Medicine and the University of Texas McGovern Medical School at the Houston Medical Center.

In the context of my over 20 years of practice in allergy and immunology I have taken care of a pediatric population with asthma, allergies, and immunodeficiency and have seen up close how air pollution, climate change, environmental exposures, and concerns about infections continue to shape their life. My interest in air pollution and climate change led me to join the medical advisory board of the American Lung Association Texas chapter. I implemented one of their initiatives at the University of Texas and other pediatric practices in Houston to improve asthma care in a group of underserved pediatric patients in these practices. I am in the process of developing a pediatric asthma clinic at the University that will be centered around education, including air pollution and prevention of environmental exposures to enhance asthma control.

In 2013, I received the White House Champion of Change Award for my work to raise awareness of climate-related health impacts. I was elected to join the American Academy of Pediatrics (AAP) Council of Environmental Health executive committee in 2014 and co-authored the 2015 AAP's technical report "Global Climate Change and Children's Health." My climate change-related activities have been centered around education in the medical community as this was a neglected subject in the climate conversation some years ago. I have focused my expertise around the effects of climate change on human health including respiratory diseases. I continue to teach on this subject at the regional, national and international level and as part of my academic responsibilities at the university to first and second year medical students, students in the global health concentration, pediatric residents and pediatric faculty. I have given over 75 presentations on the health effects of climate change.

Qualifications of Jerome A. Paulson, MD, FAAP

I graduated with honors and with general honors from the University of Maryland at College Park with a Bachelor of Science degree in biochemistry. I graduated from Duke University with an MD degree and did my house staff training in Pediatrics at the Johns Hopkins Hospitals and Sinai Hospital, both in Baltimore, MD. I also completed a one-year fellowship in ambulatory pediatrics at Sinai Hospital.

I was first introduced to environmental health during my residency training. Like most pediatric residents who trained in a large city in the mid-1970s, I learned about lead poisoning because it was a common clinical problem at the time. My first position after residency was as Assistant Professor of Pediatrics at Case Western Reserve University – Rainbow Babies & Children's Hospital. In addition to many other responsibilities, I became the hospital's expert on childhood lead poisoning and a consultant to the Cuyahoga County Health Department on lead poisoning.

After relocating to Washington, DC and then, in 1990, joining the faculty of the George Washington University (GW) School of Medicine and Health Sciences, I again took on the role of lead poisoning expert for the pediatricians who were part of the Department of Health Care Sciences. Through self-education, attending a number of continuing education meetings and several professional responsibilities that I will enumerate, I expanded my expertise to encompass the new field of research, education, advocacy and clinical care that is known as "children's environmental health."

At GW, in addition to my appointment as Associate Professor in the Department of Health Care Sciences, I also was appointed an Associate Professor in the Department of Pediatrics. I also taught in the medical school's public health program and became a faculty member in the Milken Institute School of Public Health when it was chartered.

When the Department of Health Care Sciences at the GW School of Medicine and Health Sciences was dissolved, my primary academic appointment ultimately moved to the Department of Pediatrics in the School of Medicine. In 2015, I resigned from my positions and was appointed Professor Emeritus in the Department of Pediatrics at the GW University School of Medicine and Health Sciences and Professor Emeritus in the Department of Environmental & Occupational Health in the GW University Milken Institute School of Public Health.

During the 1999-2000 academic year, I served as a special assistant to the director of the National Center for Environmental Health ("NCEH") of the Centers for Disease Control and Prevention ("CDC"). I worked on a number of issues related to children's environmental health for the director. I then received a fellowship that allowed me to work with the Children's Environmental Health Network ("CEHN") for two years on a broad range of children's environmental health issues.

In 2000, in conjunction with two colleagues, I created the Mid-Atlantic Center for Children's Health & the Environment ("MACCHE"). We were the third (of now 10) pediatric environmental health specialty units ("PEHSUs") funded in the U.S. The role of MACCHE is to educate health professional and others in the Mid-Atlantic region about issues related to children's health and the environment; and the organization serves as a consultant to parents, health care providers, government agencies and others on issues related to the environment and children's health. In 2015, I transitioned out of a leadership role at the MACCHE, and now serve as their pediatric consultant.

In 2007, I was appointed by the board of directors of the American Academy of Pediatrics (AAP) to serve on the Executive Committee of the Academy's Council on Environmental Health ("COEH"); and in 2011, I was elected by my peers to chair that committee. I completed my term on the COEH in 2015. In 2007, I was also appointed by the U.S. EPA to serve on the Children's Health Protection Advisory Committee ("CHPAC"). I served the maximum 6 years on CHPAC.

In 2007, the AAP became the first medical professional society to develop a policy statement on climate change. While I was not involved in the publication of that document, I did publish, along with Dr. Kris Ebi, Global Climate Change and Its Impact on Children. *Pediatric Clinics of North America.* 2007; 54: 213-226. Several years later, Dr. Ebi and I published Climate Change and Child Health in the United States. Current Problems in Pediatric & Adolescent Health Care. 2010; 40: 2-18. During my tenure as chair of the COEH, I supervised the drafting of the new AAP Policy Statement and Technical Report on Climate Change. These were published in 2015. (AAP Council on Environmental Health. Global Climate Change and Children's Health. *Pediatrics* 136.5 (2015): 992 and Ahdoot, S, and Pacheco, SE. Global climate change and children's health. *Pediatrics* 136.5 (2015): e1468-e1484.)

In 2014, I was hired as a consultant to the AAP to serve as the Medical Director of the Pediatric Environmental Health Unit program for the Eastern part of the U.S. I am responsible for providing oversight of the day-to-day operations of the units in Federal Regions 1-5; and, working with others, coordinate the management of all 10 units in the U.S.

In 2015, I created the Climate Change Initiative within the AAP, and was hired as a consultant to the AAP as Medical Director of that Initiative. Through our work, internal AAP stakeholders recognize that climate change is an issue for all components of the AAP, not just the COEH and the Climate Change Initiative. We have developed educational materials for pediatricians and for parents related to climate change.

Beyond the AAP, I have been instrumental in creating the Medical Society Consortium on Climate and Health (https://medsocietiesforclimatehealth.org/). The Consortium brings together 20 societies representing over 500,000 members to convey the messages that climate change causes health problems and that decreasing the use of fossil fuels and increasing energy efficiency and the use of clean energy sources will ameliorate these problems. The Consortium advocates at the Federal level on these issues.

In Virginia, I have worked with others to create Virginia Clinicians for Climate Action (VCCA) (https://states.ms2ch.org/va/) which is focused on the important relationship our changing climate has on health. VCCA advocates at the state level on these issues.

I have received various honors and awards, including, but not limited to: 2017 – Carol Strobel Memorial Award for Children's Environmental Health Advocacy, Children's Environmental Health Network; 2017 – John Rosen Memorial Lecture, Montefiore Medical Center, Albert Einstein College of Medicine; 2014 – Elected a Fellow of the Collegium Ramazzini, an international environmental and occupational health honorary society; 2014 – received the National Healthy Schools Hero Award from the Healthy Schools Network, 2013 – selected for the 11th Annual George J. Ginandes, M.D. Visiting Lectureship in Pediatrics at Mount Sinai School of Medicine, New York, NY; 2011 – Elected to the American Pediatric Society, a national honorary society.

Additionally, I have written extensively and lectured widely in the U.S. and overseas on a variety of topics related to children's environmental health. Please see my curriculum vitae for details.

EXPERT OPINION

I. YOUTH ARE DISPROPORTIONALLY IMPACTED BY CLIMATE CHANGE AND RELATED ENVIRONMENTAL POLLUTION

A. Physiological Features and Development of Children Make Them More Vulnerable and Susceptible to Certain Impacts

Children are not little adults – parents know this, doctors know this, and both courts and legislatures treat them differently. Therefore, when it comes to assessing children's vulnerability to adverse health impacts one cannot just extrapolate from a known health response to climate related problems, such as heat or smoke, etc., in an adult and predict the correct response in children (Selevan et al., 2000). There are numerous reasons why children are uniquely vulnerable to the impacts of climate change and air pollution associated with fossil fuels – most noteworthy, their bodies are not fully developed or mature, including vital organs like their lungs and the brain. Globally, children are estimated to bear 88% of the burden of disease due to climate change (Pass Philipsborn & Chan, 2018). For the purpose of this report, when we say childhood, or children, we include individuals up to age 21 years of age. There is no firm definition of childhood or children. Administratively, childhood is sometimes defined to end at 18 or 21 years of age. In terms of brain maturation, however, some people would say the brain doesn't finally mature until the frontal lobes are fully myelinated which doesn't occur until about 25.

Particularly when children are young, they breathe more air per unit time than adults. Therefore, if the air that they are breathing is polluted, they will breathe more of that pollution than an adult. Children also consume more food per unit of body weight and likewise drink more water per unit of body weight. Therefore, if that food or water contains an environmental contaminant, then the child will get higher doses of that contaminant (EPA, 2008). Some of the body's organs that metabolize environmental toxicants, such as the kidneys and the liver, are not fully developed and do not yet have the enzyme systems necessary for these processes (EPA, 2013).

The body will respond to stressors differently at different ages. For example, while the exposure to excess heat may injure a child in utero or cause a miscarriage; the response would be very different in an 8-year-old child. We are very concerned, and the literature indicates, that infants and adolescents are at the greasiest risk from heat injury. The reason why children are at greater risk is because their bodies don't adjust to changes in heat as fast as adults. They don't sweat as much and produce more body heat than adults when they are active. Because children do not have the decision making capacity to protect themselves, they are also more likely to not drink enough fluids or rest enough when they are playing sports or engaged in other outdoors activities, and therefore are more likely to become dehydrated. Infants can't even communicate their discomfort or distress when they are overheating. Again, this is a situation where very young children literally cannot remove themselves from harm's way. Adolescents, particularly young athletes, not only cannot recognize the signs of heat injury, they are incentivized and pressured to continue to play, even at their own peril.

Another reason children are more vulnerable is because they spend more time outside than adults. Ideally children should be outside in nature, playing, getting exercise, and learning. However, if the temperatures are high or the air they breathe outside is contaminated with particulate matter, ozone, carbon monoxide, or other harmful air contaminants, the child's health will be harmed by being outdoors (Sheffield & Landrigan, 2011; Seal &

Vasudevan, 2011; National Research Council, 1993). In our expert opinion, the Plaintiffs in this case are at risk of having decreased lung function as a result of growing up in environments with more air pollution, as are all of their similarly situated peers, a risk that adults do not face in the same way because their lungs are already fully developed.

The fact that children's immune systems are still developing also increases their vulnerability, especially when it comes to infectious diseases, a fact that the Environmental Protection Agency has acknowledged (EPA, 2013). Children less than five years old, both in industrialized and developing countries, absorb the majority, an estimated 88%, of the existing global burden of disease attributable to climate change (Zhang et al., 2007). Children in the world's poorest regions, where the disease burden is already disproportionately high, are most affected by climate change (Haines et al., 2006).

Moreover, and of particular importance in dangerous situations such as hurricanes, flooding, or wildfires, when important decisions, like whether or not to evacuate or where to seek safe shelter, need to be made, children are dependent on adults for their safety. Children do not have the maturity or the information on which to make decisions as to what to do in these situations. For the Plaintiffs involved in this suit, and for all children, they need the government to protect the environment so that dangerous situations do not occur, are less severe or less frequent. The government has failed the children in this fashion, and indeed, by ignoring or acting contrary to the knowledge it has had, the government has acted to make the dangers posed by climate change even more extreme.

Children's inability to make decisions related to their own safety and other matters, is a reflection of brain maturation. Put simply, the brains of young children and adolescents are different from adults. In particular, the changes in brain development from in-utero through adolescence mark children as distinctly different from adults. "Indeed, much of the potential and many of the vulnerabilities of the brain might, in part, depend on the first two decades of life" (Toga et al., 2006). As a result of non-invasive techniques, such as functional magnetic resonance imaging (MRI), we can actually see the very fibers of the brain and better understand the anatomical differences in adolescent brains. Brain imaging technology has shown that regions of the adolescent brain are not mature until after age 18.

The brain of the newborn is one-quarter to one-third of its adult volume and consists of an estimated 100 billion neurons and supporting glial cells at birth. As the brain matures, the neurons become wrapped in a myelin sheath that increases the velocity of message transmission between neurons. Myelination of the regions of the brain responsible for higher cognitive functions is an ongoing process during child development and continues well into adolescence (Sowell et al., 2004). Synapses are the place where neurons connect for the transmission of messages from one neuron to the other. In general, the number of synapses increases as the brain develops. "The first areas [of the brain] to mature were those with the most basic functions, such as those processing the senses and movement. Areas involved in spatial orientation and language (parietal lobes) followed, around the age of puberty (11–13 years). Areas with more advanced functions – integrating information from the senses, reasoning and other 'executive' functions (e.g. prefrontal cortex) – matured last, in late adolescence." (Toga et al., 2006). Over time, in repeated MRI scans on children developing in a typical fashion, changes in the thickness of the cerebral cortex correlated with changes in cognition as the child ages (Toga et al., 2006). Adolescents' cognitive differences become especially pronounced when emotions such as stress are present.

Exposure to air pollution affects neuron development, myelination and synapse integrity, halting the development of a healthy brain in children. It is thought that air pollutants in exposed children reach the brain via a disrupted nasal epithelium or the blood brain barrier. The ensuing immune activation generates a systemic and neuroinflammatory response that promotes brain tissue injury, demyelination and decreased synaptic activity. These injured areas, composed of demyelinated neurons with reduced blood flow, appear as white matter hyperintensities (WMH) on MRI studies. Among affected brain areas are the prefrontal and frontal cortex, vital for normal cognition. White matter hyperintensities are found in the brains of children living in areas of high air pollution and are associated to cognitive deficits (Brockmeyer, 2016).

To summarize, some of the key differences between children and adults are:

1. Children have larger body surface area compared to adults. This increases the risk of fluid and heat loss.
2. Children have a higher respiratory rate with higher minute ventilation and entry of polluted air to the lungs.
3. Lung growth and development continues through childhood so the respiratory system of children may be more susceptible to environmental-related injuries and may be altered by environmental exposures.
4. Children's immune system is immature before age 2 years.
5. Children have higher metabolic demands. They require more calories and water per unit of body weight.
6. The central nervous system of children is not mature. Neurodevelopment continues through the second decade with continued changed in myelinization, synaptogenesis, etc. This means children are more susceptible to damage by neurotoxicants.

B. Many Health Issues Children Experience Are Directly or Indirectly Related to Climate Change But Climate Change Goes Under-diagnosed as a Factor.

None of the medical issues currently related to climate change are being tracked by standard medical or pharmaceutical administrative databases. Unless something is changed in the way the data is coded and aggregated by the data systems, this will remain true for the foreseeable future. Therefore, we currently have no mechanism to accurately track the scope of medical problems that are linked to climate change. However, as discussed more below, there is abundant evidence that climate change is exacerbating health challenges for children, even if doctors aren't always making the direct connection to climate change. The lack of tracking means that the health impacts of climate change are likely being underestimated. The following are hypothetical, but realistic, scenarios, showing how the limitations of the coding systems means that information about the influence of climate on health is being, and will be, missed.

The International Classification of Diseases, 10th Revision, Clinical Modification, often abbreviated as ICD-10-CM is the system most commonly used in the U.S. to classify and code all diagnoses recorded in conjunction with all medical care in the United States. ICD-10-PCS is the system used to code procedures performed in in-patient settings. CPT codes are used by providers to report procedures and professional services in ambulatory settings.

For example, Jamisha is an 8-year-old from Cleveland who went on a camping trip in the woods with her Girl Scout troop. About 10 days later, she develops a halo-rash on her back. She sees her doctor who makes a diagnosis of Lyme Disease. The IDC-10-CM code for Lyme Disease is A69.20. There is no way to provide any additional coding to indicate that this is a diagnosis made in Ohio; and Ohio, absent climate change, is outside of the original range of the deer tick that bit Jamisha and transmitted the parasite that caused the Lyme disease.

Alex is a 10-year-old with known asthma. His father calls in a refill for his albuterol inhaler, a rescue as opposed to a maintenance medication. There is no way for the pharmaceutical database to code for that fact that Alex lives 50 miles downwind from a wildfire; and the air pollution from the wildfire is causing an exacerbation of his asthma.

Ms. C is a 36-year old-woman who is pregnant with her third child. Each of the prior pregnancies has been uncomplicated and the babies born at term. She is in her 36th week of pregnancy; and the ambient temperature has been 102 degrees F for the entire week. Nighttime lows are about 96 degrees. The family is low income and has a fan, but no air conditioner. The mother goes into labor and delivers a child. This child is considered premature. The baby's ICD-10-CM code would be p07.39. There are additional digits that can be added to indicate prematurity with or without major problems. The mother's diagnostic code would be ICD-10-CM diagnosis code o60.10x0. There are various other codes that could be used; but the point is that there are no codes or modifiers to indicate that this mother may have delivered a premature infant because of high ambient temperatures due to climate change in a setting where she has no access to air conditioning.

There are a number of other hypothetical cases that could be constructed around other diagnoses:

1. Gastroenteritis in children is more common when it rains a lot.
2. Gastroenteritis in children is more common when the ambient temperature goes up.
3. Asthma attacks are more common in warm weather.
4. Asthma attacks are more common when ambient ozone levels are higher (which may explain some, but not all, of 3).
5. The allergy season lasts longer in certain parts of the U.S.
6. Severe weather events result in more physical injury in children.
7. Infants, as well as teen-aged athletes (particularly football players), are more likely to have heat-related illness or injury the higher the temperature.
8. There are more children with mental health problems after severe weather events.

All of this information taken together indicates that the impact of climate change is occurring now and there is no way to systematically track the full magnitude of the impact. Unless the systems change, this problem will continue on into the future.

The Plaintiffs in this case have experienced some of the health issues enumerated above. The children of America have experienced all of the problems enumerated above. The federal government has been remiss in allowing the continued use of fossil fuels that have contributed to the greenhouse effect that is harming the planet and leading to excess health problems for children in the formative stages of their physical and emotional development.

C. Certain Categories of Children Are Especially Vulnerable to Climate Change Impacts and Air Pollution

The federal government has found that communities of color, immigrants, indigenous peoples, those living in coastal areas, those with preexisting or chronic medical conditions, and the economically disadvantaged are disproportionally vulnerable to public health threats due to climate change (Crimins A.J., et al., 2016; EPA Endangerment, 2009). Among other hurdles, these populations tend to have reduced access to resources to help deal with the impacts of climate change, such as air conditioning, health care, adequate shelter, and the financial means to relocate either permanently or temporarily should that become necessary. The children in these population groups face added vulnerabilities for the reasons explained above.

Children who live in coastal areas are on the frontlines of climate change due to sea level rise and flooding and are especially vulnerable. Sea level rise is a real problem today for many places in the U.S. and will become a more severe problem going forward. Already, in Virginia, we have experienced an increase in nuisance flooding. Norfolk, VA has seen a 325% increase in nuisance flooding for the time frame of 2007-2013 compared to 1957-1963 (US Climate Resilience Toolkit). Today, Virginia has 164,000 people at risk of coastal flooding. By 2050, an additional 137,000 people are projected to be at risk due to sea level rise in Virginia (Climate Central). Norfolk Public Schools have collaborated with many other constituencies to create the "[Norfolk] Coastal Resilience Strategy" (Norfolk Coastal Resilience Strategy). Children living in the low-lying coastal areas along the Gulf of Mexico, or just barely above sea level along Florida's coast, and other sea level rise prone areas in the U.S. already are, and will continue to experience a significant burden on their health from rising seas and higher storm surges. This flooding, whether associated with severe weather events or nuisance flooding associated with low-lying land and the vagaries of the tides, can be an Adverse Childhood event for the Plaintiffs and similarly situated children in the U.S. The need to leave a home, to have a school shutdown, to lose accessibility to a playing field or other recreational activities has a profound adverse impact on children. It affects their mental health leading to depression, anxiety and post-traumatic stress disorder. Moreover, it puts these children at risk for long-term health problems, myocardial infarction diabetes, etc. in adulthood (Balaban, 2006).

Several of the Plaintiffs in this case live in areas making them especially vulnerable to sea level rise. For example, Levi D.'s home is about a mile from the Atlantic Ocean and is just about at sea level (Declaration of Levi D. at ¶¶ 1, 2). Without immediate actions to reduce greenhouse gas emissions, scientists expect the ocean to be at his doorstep in the coming decades (Declaration of Levi D. at ¶ 3). Miko V.'s fear that she will not be able to travel back to her home of origin in the Marshall Islands because they will be submerged by sea level rise is an appropriate response of an adolescent child who understands the ramifications of climate change (First Amended Complaint at ¶ 57). There are a number of reports, both in the scientific literature and the popular literature about the inundation of the Marshall Islands, the Seychelles Islands, low lying parts of Bangladesh and elsewhere (Webb & Kench, 2010; Davenport, 2015; Storlazzi, 2018). Atoll islands, including parts of the Marshall Islands, are expected to be uninhabitable by mid-century (Storlazzi, 2018). These impacts of sea level rise on children's lives, while they are still developing, are psychologically significant and adverse.

It is also widely recognized that some populations, including poor populations and minority populations are also more likely to be located close to sources of environmental pollution, and accordingly, children from those communities are more vulnerable. It is not uncommon for these communities to be located next to petroleum plants, waste dumps or incinerators, high-traffic areas, hazardous waste sites and other sources of pollution (Rubin et al., 2013). Children, and their families, living in these types of situations experience psycho-social stress that may account for the decreased health status of the individuals in these communities (Gee & Payne-Sturges, 2004).

It is our expert opinion that the exigencies of climate change only add to the stress on the children in these low-income communities or communities of color or communities already exposed to multiple environmental health hazards and air pollutants. This is true for some of the Plaintiffs in this case and any similarly situated children in the U.S.

II. SPECIFIC WAYS YOUTH ARE IMPACTED BY CLIMATE CHANGE

As described in more detail below, climate change is currently affecting child health through increased heat stress, decreased air quality, altered disease patterns of some climate-sensitive infections, physical and mental health effects of extreme weather events, and food insecurity in vulnerable regions (see **Figure 1**). At present, the global health burden attributable to climate change is poorly quantified compared with other health stressors (IPCC, 2014). As we describe above, in our expert opinion, the lack of reporting for climate related health issues and diagnoses likely leads to an underestimate of the true impact of climate change on children's health.

A. Increased Heat Stress and Other Temperature Effects

In a business as usual scenario the frequency of hot days and heat waves will continue to increase. The federal government has stated that "increasing concentrations of greenhouse gases lead to an increase on both average and extreme temperatures" (Crimins et al., 2016). The devastating effect of heat waves is exemplified by the July 1995 Chicago heat wave that resulted in over 650 deaths in a period of 5 days (CDC, Extreme Heat). An even more sobering example is the 2003 Europe heat wave, which caused over 70,000 additional deaths (Robine et al., 2008). It is expected that climate change-related heat waves will overtake natural variability as the primary cause of heat waves in the western United States by the late 2020s and by the mid-2030s in the Great Lakes region. The same changes are expected in the northern and southern Plains in the 2050s and 2070s, respectively (Lopez et al., 2018).

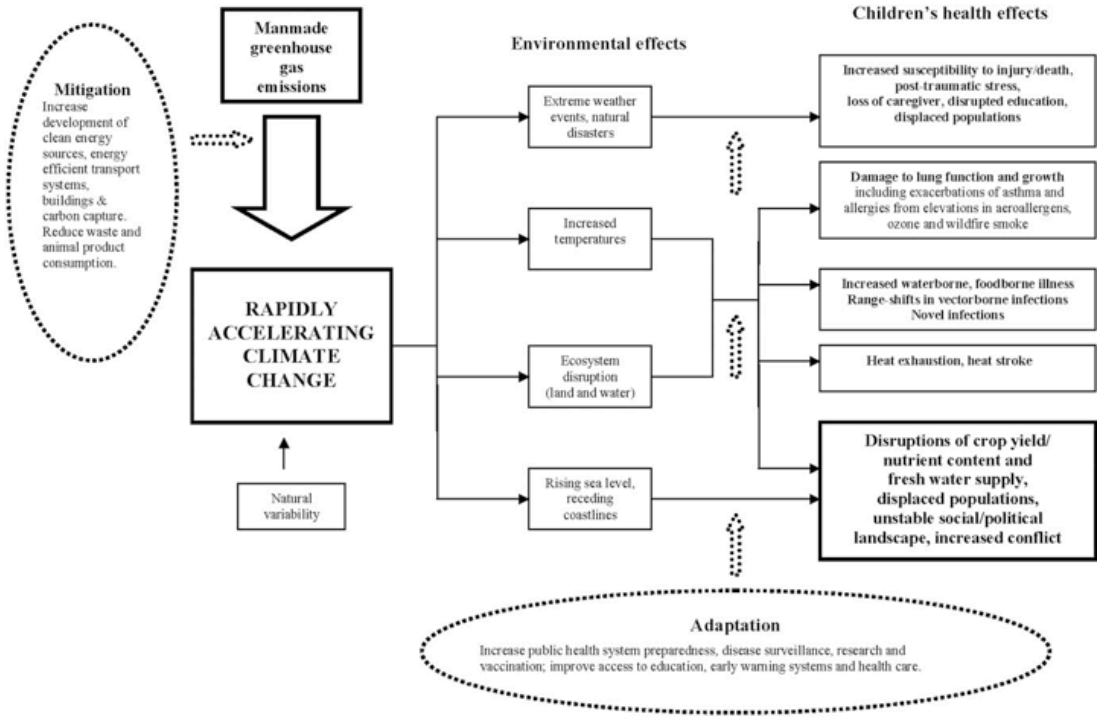


Figure 1: Potential effects of global climate change on child health. Adapted from American Academy of Pediatrics policy statement "Global Climate Change and Children's Health" (Shea, 2007).

Extreme heat is one of the leading causes of environmental deaths in the U.S. According to the EPA, over the past three decades, nearly 8,000 Americans were reported to have died as a direct

result of heat-related illnesses (EPA, 2014). As the temperature continues to rise due to unmitigated climate change, the morbidity and mortality associated with heat waves are expected to increase. This problem is compounded by the heat island effect resulting in daytime temperatures 0.9°–7.2°F (0.5°–4.0°C) higher and nighttime temperatures 1.8°– 4.5°F (1.0°–2.5°C) higher in urban areas compared to rural areas (Wuebbles et al., 2017). These temperature variations are alarming considering that in 2010 over 80.7% of the U.S. population lived in urban areas (U.S. Census Bureau)

Children have a higher risk of dying, and are among those most vulnerable to health problems, from excess heat. Public health studies have concluded that children under 15 are more likely to die from excess heat than adults, and children under five are particularly at risk (Zivin & Shrader, 2016). Research has found that for every increase in temperature of 1°C (1.8°F) above a temperature threshold of between 27°C (80.6°F) to 29°C (84.2°F) adults experience a 2-3 percent increase in mortality. The mortality rate for children is between 50-100 percent higher (Zivin & Shrader, 2016). The federal government has found, with a "very high confidence," that children face a higher risk of getting sick or dying from extreme heat (Crimins et al., 2016).

The vulnerability of children to extreme heat is multifactorial and results from their different physiologic, metabolic, behavioral characteristics and dependence in others to take care of them, as well as the fact that they tend to spend more time outside than adults (Xu et al., 2014b). Obese children, children with chronic diseases such as kidney disease, metabolic and respiratory diseases and neurologic conditions are more susceptible to heat-related illness. Although older adults comprise the most numerically affected group during heat waves, neonates, children less than one year of age or in the 0-4 age group are more vulnerable to heat-related morbidity and mortality (Basagaña et al., 2011; Basu et al., 2008; Xu et al., 2012; Xu et al. 2014a; Xu et al. 2014b). High heat has been linked to sudden infant death syndrome and evidence from heat waves shows that the leading causes of deaths for infants are cardiovascular illness, blood disorders, and failures of the digestive system (Zivin & Shrader, 2016). When one compares the heat-related vs. cold-related death rate for infants, higher rates of heat vs. cold-related mortality are observed, with a death rate of 4.2 vs. 1.0 deaths per million respectively (Berko, 2014). In the 2006 California heat wave ER visits in 58 counties in California in July and August were increased for all ages, but the effects were more significant in the 0-4 years age group (Knowlton et al., 2009).

Heat illness during outdoor sports is a leading cause of death and disability, with an average national estimate of 9,237 illnesses annually. A high risk group for heat-related exhaustion and stroke is high school athletes (CDC, 2010). According to the 2010 report by the American Football Coaches Association, from 1960 through 2009 there were 123 fatal heat stroke cases (Mueller & Colgate, 2010). In addition to the inevitable exposure to high heat, their competitiveness and group pressure makes them ignore early signs of heat-related illness making them more vulnerable to heat-related morbidity and mortality. Another high risk group for heat related illness is the hundreds of thousands of child farm laborers in the U.S., who are often exposed to scorching heat without adequate acclimatization or preventive measures to avoid heat-related illness.

The damage inflicted by the increase in environmental temperature resulting from climate change goes beyond the associated morbidity and mortality described in the previous section. Increasing temperatures will affect the physical, emotional, and cognitive development of children. Unfortunately, healthy child activities such as playing outdoors will continue to be replaced by safer but not necessarily better options. The substitution of outdoor play activities by indoor play spaces or use of entertaining electronic devices

is not an unusual scenario in the U.S. The ensuing sedentary life affects children in different ways. For obese children, the lack of participation in outdoor activities contributes to the complex dynamics leading to obesity. I (Dr. Pacheco) have patients with chronic conditions that wear cooling vests, similar to those used by outdoor workers, to be able to participate in outdoor activities such as going to the zoo on a hot day. In our expert opinion, this is not a healthy lifestyle for a child and certainly not a common practice for children fifty years ago; instead it is in direct response to increasing extreme temperature conditions. As pediatricians we don't have a good reply for Jaime, one of the Plaintiffs, when she says "I have been negatively affected by the increasing temperatures, which limits the time I'm able to safely spend time outdoors" (Declaration of Jaime B. at ¶ 7). We cannot advise her to play indoors, get used to it, or wear a cooling vest. Worst of all, with the current projections for temperature increase in the U.S., we cannot tell her that it will get better in the foreseeable future and that her physical and mental health will not be affected.

Children's learning is also affected by hot temperatures and heat waves. It is not hard to imagine how difficult it is to work in a classroom without air conditioning during a very hot day. Classroom temperature and ventilation is known to affect school performance (Wargoki & Wyon, 2007). Beyond individual hot days impairing children's learning, *cumulative* heat exposure may inhibit children's cognitive skill development (Goodman et al., 2018). During the September 2017 heat wave, the Elementary Teachers Federation of Ontario expressed their concern about how working in classrooms without air conditioning systems was insupportable and affected children's learning (Loriggio, 2017). This fall, 2018, schools were closed, or were letting students out early, in numerous Northeast cities due to extreme heat (Kelleher, 2018). There is also evidence linking heat waves and above average temperatures to an increase in violence and abuse as well as depression (Rinderu et al., 2018; Majeed & Lee, 2017).

In our expert opinion, extreme temperatures and other heat-related impacts especially harm children in different ways from adults due to the unique physiology and lifestyle of children.

B. Extreme Weather Events

i. Hurricanes, Heavy Precipitation Events, and Flooding

As a result of climate change, the frequency and severity of extreme weather events, such as hurricanes and floods, are predicted to continue to increase (Crimins et al., 2016). The federal government has stated with a "high confidence" that children living in coastal areas will be especially vulnerable due to flooding from an increase in extreme precipitation, hurricane intensity, as well as sea level rise and the related increase in storm surge (Crimins et al., 2016). Children are especially vulnerable because they rely on others for their safety and well-being, and their caregivers can often be unprepared or overwhelmed. Floodwaters are often contained with toxic chemicals, raw sewage, and other pollutants that make children ill. Adverse health impacts can include infectious, respiratory, and skin diseases, and increased risk of gastrointestinal illness due to exposure to pathogens like Cryptosporidium and Giardia (EPA, 2009). While for adults, the impacts of gastrointestinal diseases are often mild, for children, the impacts can be much more severe, and even fatal (EPA, 2008). Hurricanes and other extreme weather events are also linked to an increased risk of death and other injuries.

In the aftermath of extreme weather events, there are often persistent health impacts associated with malnutrition from disruptions in food supply, diarrheal illness from contaminated water, and limited or no access to medical care. Such disasters can also result in significant psychological harms for children who experience the loss of their home, possession, or pets; witness other people experience such losses; suffer grief and stress from the loss of loved ones or from seeing their parents undergo stress; and have their social support networks – such as school, friends, family, or church – destroyed, either temporarily or permanently (Kousky, 2016). Children who are exposed to such traumatic events often experience long-lasting impacts, especially if in the aftermath there is reduced attention and investment in the child's health and education or if the disaster occurs at a critical point in the child's development. The impacts can be life-long, and even impact the next generation.

To make matters even worse, water-damaged homes are also often impacted by mold and mycotoxins which can cause respiratory problems for people when they move back into their water-damaged homes (Hope, 2013). Exposure to mold and mold components has been known to trigger inflammation, asthma, autoimmune disorders, and immune suppression, among other adverse health impacts.

Puerto Rico's experience with Hurricane Maria is just a window to the world that our generation is leaving for Plaintiffs like Levi, Jayden, and Victoria, as well as other children living in the paths of extreme weather events like hurricanes. In a business as usual scenario and with unmitigated climate change, extreme weather events such as Hurricane Maria will occur with increased frequency.

When Hurricane Maria made landfall in Puerto Rico in September, 2017, no one could imagine the devastation the hurricane would cause. Maria struck Puerto Rico as a category 4 hurricane, with wind gusts above 175 mph. The day after the hurricane 3.4 million Puerto Ricans, including ~ 700,000 children, woke up to a destroyed island without access to power, clean water, gasoline or fresh food. A month after the disaster there were still 3 million Puerto Ricans without electricity and one million without access to clean water. As of March of 2018, 10% of electricity customers were still without power. The number of total deaths above average in September, October, and November was 1,230. Additionally, disasters such as Hurricane Maria may disrupt the global medical supply chain, leaving vulnerable populations even more vulnerable without needed medications and other essential medical supplies such as "intravenous" (IV) bags. (Pass Philipsborn & Chan, 2018).

From September to late December 2017, nearly 300,000 Puerto Ricans emigrated to the mainland; most of them (270,000) to Central Florida. Most of the people leaving the island are families with children, which has caused schools closures in many towns. Approximately 467 schools are expected to close by 2022 as a result of Maria. Florida school districts have enrolled more than 11,200 displaced students from Puerto Rico and the Virgin Islands. According to Save the Children: "Half a year since Hurricane Maria struck Puerto Rico, school-age children have collectively missed out on more than 13 million full days of learning. Many schools are only operating on a limited daily schedule, from 7:30 a.m. to 12:30 p.m., due to electricity, water and sewage problems." (Save the Children, 2018).

The potential negative effect that the departure to the mainland imposes to their cultural heritage is a source of anguish for many Puerto Ricans who want their children to value their roots. There is a sense of pride about living on an island with a strong sense of identity and resilience, historical monuments, unique fauna and lush vegetation. Without immediate actions by the federal government to address climate change, in our expert opinion, the number of

children experiencing significant health impacts from extreme weather events will continue to grow.

ii. Wildfires

As a result of climate change, the wildfire season is becoming longer and wildfires are more widespread, severe, and destructive. The effect of wildfires on children is expected to worsen as wildfires in some areas of the U.S. are expected to increase with unmitigated climate change (Abatzoglou & Williams, 2016). Of the many compounds present in the smoke of wildfires, PM, CO, and O_3 seem to be most damaging to children's health. Children, and especially children with asthma, are among those most at risk from exposure to PM. The EPA has found that PM from wildfire "can contribute to acute and chronic illnesses of the respiratory system, particularly in children, including pneumonia, upper respiratory diseases, asthma and chronic obstructive pulmonary disease" (EPA, 2009). Many of the compounds in wildfire smoke are strong irritants of the respiratory tract triggering asthma exacerbations and affecting other respiratory conditions. In the 2003 southern California wildfire, exposed children had mainly complaints relating to the eyes, and upper and lower respiratory tracts (Künzli et al., 2006). During the same wildfire season Delfino et al. found an association between PM2.5 exposure and increased asthma hospital admissions for the elderly and children age 0-4. Post-fire hospital admissions for pneumonia, bronchitis and bronchiolitis also increased. Although hospital admissions for 5-18-year-old children also increased, these were not specifically associated to PM2.5 (Delfino et al., 2009). The Plaintiffs in this case are already having their health impacted by wildfires. McClure & Jaffe have identified a positive trend in PM2.5 in the Northwest United States, where many of the Plaintiffs live, due to the increase in wildfires (McClure & Jaffe, 2018). As Sahara V. noted in her declaration, "I have asthma, and the increased frequency of forest fires in Oregon, due to hotter and drier conditions, has triggered asthma attacks for me. The smoke inhibits my ability to breathe, causes my throat to close up and causes me to use my inhaler often" (Declaration of Sahara at ¶ 4). During the 2017 summer, Jacob Lebel was forced to work on his family farm in thick smoke that prompted air quality alerts by the Oregon DEQ (Declaration of Jacob Lebel at ¶ 9). For both Jacob, Sahara, and other Plaintiffs exposed to smoke from wildfire, we would expect, consistent with the literature, that their increased exposure to smoke with more common and more severe wildfires to exacerbate existing health issues, such as asthma, and may cause new acute and chronic respiratory illnesses.

C. Decreased Air Quality Leading to Asthma and Allergies

There is evidence that climate change is affecting the distribution, allergenicity, seasonality and pollen production in different parts of the country as well as globally. The federal government has found with "high confidence" that "[c]hanges in climate, specifically rising temperatures, altered precipitation patterns, and increasing concentrations of atmospheric carbon dioxide, are expected to contribute to increases in the levels of some airborne allergens and associate increases in asthma episodes and other allergic illnesses" (Crimins et al., 2016). Climate change is leading to warmer spring temperatures, which means plants start producing pollen earlier, warmer fall temperatures, which extend the growing season for plants like ragweed, and increased pollen production per plant due to increased CO_2 (EPA, 2014; Crimins et al., 2016). This in turn can lead to increased allergen sensitization in susceptible individuals. Longer pollen seasons have been described for weeds such as ragweed (Ziska et al., 2011), and earlier flowering seasons have been reported for other pollens such as grass, birch, weeds (i.e., mugwort) and the olive tree (Bielory et al., 2012). Although the total pollen protein concentration remains stable, the ragweed allergen Amb a 1 concentrations increase with increasing CO_2 levels (Singer et al., 2005). The longer flowering seasons can translate to

increased allergen sensitization, increased morbidity for allergic individuals, and an increase in asthma or asthma exacerbation in susceptible individuals. Elevated pollen counts have been associated with increased emergency room visits in children and adolescents with asthma (Darrow et al., 2012, Erbas et al., 2018).

The combination of exposure to allergens and different air pollutants can increase allergic sensitization, allergic symptoms, and asthma in children and adolescents (Riedl, 2008). For example, the incidence of asthma increases by exposure to allergens and other pollutants, such as diesel exhaust products (Gilmour et al., 2006). Taken together there is a complex interplay between the individuals' characteristics, atopic disease, aeroallergen and air pollutants exposure and time of exposure that may facilitate and potentiate the development of asthma in susceptible individuals. According to a report by the federal government, there are roughly 6.8 million children in the U.S. impacted by asthma "making it a major chronic disease of childhood" (Crimins et al., 2016). Minorities and economically disadvantaged children are disproportionally impacted. Again, according to a federal government report, "[i]n 2007-2010, the percentages of Black non-Hispanic children and children of 'All Other Races' reported to currently have asthma, 16.0% and 12.4% respectively, were greater than for White non-Hispanic children (8.2%), Hispanic children (7.9%), and Asian non-Hispanic children (6.8%)" (Crimins et al., 2016). Several of the Plaintiffs in this case have asthma and allergies, including Jaime B., Sahara V., Levi D., and Nathan B. (First Amended Complaint at ¶¶ 46, 67, 75, 85). We would expect that the number of children with asthma and allergies will increase, and those who already have asthma or allergies, will experience more severe health impacts as a result of climate change.

D. Infectious Disease Patterns Changing

Climate change is expanding and shifting the range and habitat of disease-carrying organisms, such as mosquitos, ticks, and rodents, and as a result, exposing more people to diseases such as Lyme disease, West Nile virus, and dengue fever (EPA, 2013). Because children tend to spend more time outside and don't have fully developed immune systems, they are more vulnerable and more likely to contact disease-carrying organisms (EPA, 2013). The EPA has reported that "[t]he incidence of Lyme disease in the United States has approximately doubled since 1991, from 3.74 reported cases per 100,000 people to 7.01 reported cases per 100,000 people in 2012" (EPA, 2014). Outbreaks of dengue fever and West Nile virus have been reported in the United States in the last couple of decades. (Caminade et al., 2018). In our expert opinion, an increasing number of children will experience adverse health impacts as infectious disease patterns continue to change.

E. Food, Water, and Nutrient Insecurity, Scarcity, and Toxicity

Climate change, resulting from increasing CO_2 levels, is changing the way plants grow and will lead to food insecurity on a global scale and, in the long-run this will put American children at risk. By taking active steps to decrease CO_2 levels now, we can decrease the severity of this problem in the future.

On the one hand CO_2 can increase the growth of plants. However, increasing atmospheric CO_2 leads to lower protein content of the edible portions of wheat, rice and barley (Taub et al., 2008). Similarly, wheat, rice, soybeans, and field peas grown at higher CO_2 levels have been shown to have lower concentrations of zinc and iron (Myers et al., 2014). These changes in the nutrition value of basic food stuffs for billions of people across the globe pose grave risk for infant

malnutrition with death in some and stunting in many others (Högy & Fangmeier, 2008; Högy et al., 2009).

There are a number of other factors related to climate change that will impact agriculture and the availability and quality of food to feed the world's children. Extreme heat decreases the growth of plants. Water is likely to be less available for irrigation and animals as it will be needed for human use. This will decrease plant and livestock production. Severe weather events, including drought and flooding, not only impact human health directly as noted elsewhere in this report, they also limit the growth of crops or can destroy them in the field and orchard. Sea level rise can inundate and destroy farmland directly or, through salinification of groundwater, making it impossible to grow crops. These and other environmental changes associated with climate change will reduce yields and thus availability of starchy staple crops, nonstaple vegetables, and legumes (Scheelbeek et al., 2018). Unless, and until, the nation reduces CO_2 pollution and other anthropogenic greenhouse gases, there is a real increasing risk of malnutrition and death in children (Cohen et al., 2008; Lake et al., 2012; Miraglia et al., 2009; Hatfield et al., 2011; Battisti & Naylor, 2009; Asseng et al., 2011).

Changes in marine ecosystems, such as warming of the ocean's upper layers, ocean acidification, and declining oxygen concentrations in the oceans, are leading to the risk of decreased seafood availability and safety. Because so many population groups around the world depend on seafood for their source of protein, changes here only increase the risk of malnutrition leading to death or stunting.

Several of the Plaintiffs have expressed concerns about the changes in the oceans affecting their ability to adequately maintain seafood in their diet: Miko V., Kiran Oommenn, Zealand B., Aji P., Hazel V., and Avery M. In our expert opinion their concerns are well-founded. There is strong scientific evidence that the oceans are changing as a result of climate change, and those changes are putting the availability and safety of seafood at risk.

According to the EPA, "considering the trend over near- and long-term future conditions, the Administrator finds that the body of evidence points towards increasing risk of net adverse impacts on U.S. food production and agriculture, with the potential for significant disruptions and crop failure in the future." (EPA Endangerment, 2009). We agree and, in our expert opinion, children will be adversely impacted by food, water, and nutrient insecurity, scarcity, and toxicity.

F. Decreased Water Quality and Algal Blooms

Algae are a normal component of aquatic ecosystems. These are plant-like organisms that are multi-celled or single-celled and photosynthetic. Harmful algal blooms (HABs) occur when colonies of algae along seacoasts or in fresh water bodies proliferate, and produce toxic effects on people, pets, aquatic species, and birds. While the causes of HABs are complex, growing evidence suggests that climate change contributes to these events – algae blooms are more likely to occur in warmer waters, and waters are warming due to climate change (Gobler et al., 2017; O'Neil et al., 2012; Havens & Paerl 2015). The toxic effects of HABs can occur when the algae are consumed or, sometimes, just from skin contact. The symptoms of contact with HABs range from diarrhea to respiratory illness to neurotoxicity, and may even be fatal (Otten & Paerl 2015; Berdalet et al., 2015). Children are at specific risk from HABs because they are different from adults (Weirich & Miller, 2014). They have a smaller body size. Therefore, ingestion of fish or shellfish or drinking water contaminated by HABs delivers a greater dose of the toxin to the child than an adult. Children less able to make decisions to protect themselves from harm and

may play in or drink contaminated water when an adult would not do so. Specific Plaintiffs have already been affected by algae blooms and other water quality issues linked to climate change. For example, unprecedented algae blooms have closed and delayed the opening of the Dungeness crabbing season in Oregon and led to restrictions on mussel harvesting, which has limited the ability for Jacob to consume shellfish, an important part of his food supply, as well as recreational activities (Declaration of Jacob Lebel at ¶¶ 18, 20). Journey Z. can no longer swim in the Hanalei River in Hawaii because of dangerous bacteria levels that made him sick last time he swam there (Declaration of Journey Z. at ¶ 16). Levi D. can no longer swim in the Indian River Lagoon due to "flesh-eating bacteri"a and his ability to swim in the Atlantic Ocean has been limited for the same reason (First Amended Complaint at ¶ 83). Inaccurately called "flesh eating bacteria," bacteria such as "non-cholera *Vibrio*" thrive in warming waters and can cause infection through skin cuts or ingestion of raw or undercooked seafood (Baker-Austin et al., 2017). The Center for Disease Control and Prevention estimates that *Vibrio* infections have increased approximately 41% between 1996 and 2005 in the United States (Baker-Austin et al., 2017).

In our expert opinion, children are disproportionately impacted by decreased water quality and algae blooms as a result of climate change.

III. CHILDREN ARE ADVERSELY IMPACTED BY AIR POLLUTION FROM FOSSIL FUELS

In addition to children being harmed by climate change in ways that are different from how adults are harmed, children are also harmed by the air pollution issues from the extraction and burning of fossil fuels, which lead to climate change. Thus, the fossil fuel energy system of the nation has collateral adverse impacts on the health of children, in addition to climate change and sometimes those harms are synergistic, like in the case of children's respiratory health and ozone.

The extraction and burning of fossil fuels, the primary driver of climate change, accounts for most of the airborne particulate pollution, which has a detrimental effect on air quality. Burning fossil fuels releases many chemicals and particulates to the air. These include fine particulate matter, black carbon, polycyclic aromatic hydrocarbons (PAHs), mercury, lead, oxides of nitrogen, sulfur dioxide, and carbon monoxide. In October of 2013, the International Agency for Research on Cancer (IARC) classified air pollution as a human carcinogen. Out of the six criteria pollutants monitored in the U.S., four are the main culprits of respiratory disease exacerbation during days of poor air quality (ground level ozone (O_3), sulfur dioxide (SO_2), particulate matter (PM), and nitrogen dioxide (NO_2)). Of these, ozone and PM have been associated with higher morbidity and mortality in vulnerable groups such as children.

Ozone is formed when oxides of nitrogen, which can come from diesel exhaust, and VOCs interact with sunlight. Ground level ozone is an irritant to the lungs and is known to worsen with climate change and increased temperatures. Some of the health effects that are associated with ozone are: shortness of breath, coughing, and aggravation of chronic lung diseases such as asthma and chronic obstructive pulmonary disease (COPD). Damage to the lungs continues even when symptoms have dissipated. Exposure to ozone during childhood not only exacerbates asthma, but also can lead to new on-set of asthma as well as permanently impacting lung function (Searing & Rabinovitch, 2001). While everyone loses some of their lung function as they age, children with lesser lung function may be more likely to develop chronic lung diseases as adults.

PM is a complex mixture of solid and liquid particles released into the atmosphere when fossil fuels and other materials are burned or during wildfires. Particles of 2.5 micrometers or less (PM2.5) can enter the lung and reach the alveoli and from there the circulation.

In general, exposure to air pollutants can trigger airway inflammation and hyper-responsiveness and decrements in lung function (Koren, 1995; Seltzer et al., 1986; Silverman et al., 2010). Air pollution can lead to new cases of asthma, aggregate existing asthma, decrease lung functioning, increase respiratory symptoms like coughing, and lead to other adverse health impacts for children. Children with chronic health conditions such as asthma, aeroallergies, cardiovascular disease, cerebrovascular disease, or chronic lung diseases are more susceptible to poor air quality – visits to the emergency room (ER) and hospital admissions are more common during poor air quality days. Although some air quality conditions have improved since the implementation of the Clean Air Act, more than four in ten people in the U.S. (38.9%) live in communities with poor air quality (American Lung Association, 2017). Children from low income populations, both in the United States and globally are disproportionally exposed and affected by polluted air.

Children are particularly vulnerable to outdoor air pollution as they spend more time outdoors, have higher minute ventilation, and inhale more pollutants per pound of body weight (Gilliland et al., 1999; Dixon, 2002). Increased respiratory symptoms, such as asthma exacerbations, wheezing and cough, transient or permanent decrements in lung function, and upper airway infections, have been associated with exposure to air pollution in the pediatric population (Nicola, 1999; MacIntyre et al., 2014; Esposito et al., 2014). Asthma is the most common pediatric chronic disease, affecting 6.8 million, or 9.3% of American children in 2012 (Bloom et al., 2013). In 2008, asthma accounted for an estimated 14.4 million lost days of school among children in the U.S. (Meng et al., 2012). Early exposure to air pollution has been associated with the development of asthma in children. McConnell et al. followed a cohort of children less than 6 years and monitored the development of new-onset asthma in association to exposure to traffic-related air pollution (TRAP). They found that new onset asthma was associated with exposure to non-freeway traffic-related pollution at homes and schools, with rates higher in children with a history of allergy, parental history of asthma and maternal smoking during pregnancy (McConnell et al., 2010). A longitudinal birth cohort study assessed the incidence of asthma from follow-up visits up to 14-16 years in the context of exposure to NO_2 and PM2.5 at the birth address. It was found that exposure to NO_2 and PM2.5 at the birth address was associated to the incidence and prevalence of asthma throughout childhood and adolescence (Gehring et al., 2015).

Asthmatic patients have more emergency room visits and hospitalizations in days with poor air quality. Hospital admissions in three cities in Texas increased in children ages 5-14 after short-term exposure to elevated ozone (Goodman et al., 2017). Besides, increased pediatric ER department visits for asthma exacerbations have been associated with elevated ozone and PM10 levels (Tolbert et al., 2000). A retrospective study by Silverman et al. examined the risk of intensive care and general hospital admissions for patients of all ages in 78 hospitals in New York admitted to the hospital from 1999 – 2006, at times of elevated ozone and PM2.5. For both ozone and PM2.5 exposures, children ages 6 – 18 years had an increased rate of ICU admissions and general hospitalizations associated to high levels of PM2.5 and ozone (Silverman & Ito, 2010).

In my practice, I, Dr. Susan Pacheco, have seen children whose asthma has been under excellent control for a long time, present with an unexplained asthma exacerbation in spite of strict compliance with medical recommendations and no identifiable triggers. In these patients, I, Dr. Susan Pacheco, have invariably found that the days preceding their exacerbations were days with

poor air quality. To this effect many of the parents of children with asthma, and at times their own children (one as young as five years), monitor the air quality index to decide if they will participate in outdoor activities.

In addition to patients with asthma, other patient populations can be adversely affected by exposure to air pollution. In patients with cystic fibrosis, air pollution exposure can cause a functional decline in lung function and increased pulmonary exacerbations (Goss et al., 2004). This has been observed upon exposure to PM10, NO_2, and ozone (Goeminne et al., 2013). In addition, the mean annual concentration of PM2.5 in the calendar year prior to birth is an independent risk factor for MRSA and Pseudomonas acquisition (Psoter et al., 2017; Psoter et al., 2015). Children with sickle cell disease are vulnerable to complications in days of poor air quality. Exposure to ozone, NO_2, SO_2, and PM has been associated with pain exacerbations, ER visits, and increased hospital admissions (Piel et al., 2017; Barbosa et al., 2015).

Furthermore, part of the increase prevalence of chronic obstructive lung disease (COPD) in adults can be traced to exposures that occurred during childhood. Exposure to high levels of PM2.5 and ozone in patients with asthma has been associated to higher risk of developing asthma–chronic obstructive pulmonary disease overlap syndrome (ACOS) (Stocks et al., 2013; Grigg, 2009). The combination of many variables such as basic lung function parameters for FEV1 and FVC, partially established at birth, genetics, prematurity, and history of bronchopulmonary dysplasia contribute to the development of COPD in the adult (Martinez, 2016).

Unfortunately, even in the intrauterine environment the developing fetus is not sheltered from air pollutants. For example, fine (PM2.5) and ultrafine (PM.1) particulate matter breathed by the pregnant mother can reach the alveolar space and from there the circulation. The resulting inflammatory response and immune system activation is not confined to the airways but disseminates and may affect the developing child. Fetal development can be adversely affected by exposure to air pollutants such as NO_2, O_3, and PM during different stages of gestation, resulting in low birth weight, small for gestational age (SGA), and preterm births, all of which are associated to increased morbidity and mortality (Mendola et al., 2016; Stieb et al., 2016; van den Hooven et al., 2012; Hyder et al., 2014; DeFranco et al., 2016; Vinikoor-Imler et al., 2014). There is data on how chronic and acute exposures to ozone, NO_2, SO_2, CO, or PM increased the risk of stillbirth (Mendola et al., 2017; DeFranco et al., 2015; Faiz et al., 2012). Casey et al. concluded that oil and gas power plant decommissioning reduced preterm births within 0-5 km of the plant by almost 2% (Casey et al., 2018).

Children whose mothers have been exposed to air pollution during pregnancy are at risk of neurodevelopmental disorders. Exposure to high levels of PM2.5 during the third trimester of pregnancy increased the risk of autistic spectrum disorder in children (Raz et al., 2015). Similar findings were reported by Flores-Pajot et al. who described the association between exposure to NO_2 and PM2.5 during pregnancy and increased risk of autism spectrum disorder. Although limited data, a similar trend was observed with exposure to ozone in the same study (Flores-Pajot et al., 2016). Fetal lung development can be affected by exposure to pollutants during pregnancy and persist during childhood. Six hundred and twenty children from a group of U.S. mothers exposed to high NO_2 and benzene during pregnancy had decreased lung function parameters (i.e., forced expiratory volume (FEV1), forced vital capacity (FVC), peak expiratory flow (PEF)) at the age of 4.5 years (Morales et al., 2015). Additionally, maternal exposure to PM2.5 during the third trimester can result in elevated blood pressure in children at 3 to 9 years old (Zhang et al., 2018). To this effect, the potential adverse effects to the fetus upon exposure to air pollutants are not part of the routine counseling pregnant women receive.

The effects of air pollution on neurodevelopmental conditions in children with long-term exposures deserve special attention due to the long term implications for children in general and *all* future generations. In the early 2000s Dr. Calderón-Garcidueñas noticed that older dogs living in a highly polluted area in Mexico City exhibited signs of dementia and disorientation. Their brains had extensive deposits of the protein amyloid b, similar to those associated to Alzheimer's disease. Similar findings were found in the brains of children with long-term exposure to air pollution in Mexico City where their cognitive deficits were associated to neuroinflammation and neurodegeneration, structural and volumetric changes and tissue changes seen in patients with Parkinson and Alzheimer's disease (Calderón-Garcidueñas et al., 2015, Calderón-Garcidueñas et al., 2016).

While the combustion of fossil fuels is a major source of air pollution, the extraction of fossil fuels is too. In many areas, fossil fuels are now primarily extracted through hydraulic fracturing (fracking), a methodology that has been linked with numerous air pollution and public health concerns. Xiuhtezcatl M.'s concern that fossil fuel exploitation in Colorado adversely impacts air and water quality, and his health, is very well founded (First Amended Complaint at ¶ 22). Data collected in Colorado, Pennsylvania, and Texas indicates that a myriad of hazardous emissions occur in conjunction with natural gas facilities. These findings are summarized in Brown et al. (2015).

Emissions Occurring in Conjunction with Natural Gas Facilities (adapted from Brown et al. (2015))
Acetaldehyde
Benzene
Butadiene
CO (carbon monoxide)
1,3, carbon disulfide
Carbon tetrachloride
Ethyl Benzene
Formaldehyde
n-Hexane
NOx (oxides of nitrogen)
PM2.5 (particulate matter less than 2.5 microns)
PM10 (particulate matter less than 10 microns)
SOx (oxides of sulfur)
Toluene
Tetrachloroethylene

2,2,4-Trimethylpentane
Trimethyl pentene
VOCs (Volatile Organic Compounds)
Xylenes (isomers and mixture)

Gas and oil extraction requires extensive diesel truck traffic with its attendant air pollution. The large volume of truck traffic also creates dust and particulate matter. For those living along haul routes, increased truck traffic increases diesel exhaust, creates noise and vibration, and creates safety risks. In addition to truck traffic, traffic also increases from an increased population of workers commuting to and from the pads. A health impact assessment (HIA) in Battlement Mesa, Colorado estimated that traffic would increase 40 to 280 truck trips per day per pad as well as 120 to a 150 additional workers commuting to the well pads.

Diesel exhaust includes various gases: carbon dioxide, oxygen, carbon monoxide, nitrogen compounds, sulfur compounds, and numerous low molecular weight hydrocarbons. Other gases include formaldehyde, acetaldehyde, acrolein, benzene, 1-3 butadiene and polycyclic aromatic hydrocarbons (PAHs). Diesel exhaust particulates include PAHs, sulfates, nitrates, metals, organics and trace elements. PAHs are carcinogenic and cause respiratory problems. Much of the particulate matter in diesel exhaust is at the PM2.5 level. PM2.5 are small enough that they bypass many of the body's protective mechanisms to enter further into the lungs than PM10. They are small enough that some may enter directly into the blood stream. Overall, PM2.5 are more hazardous than PM10. Adverse health effects associated with exposure to PM2.5 include premature mortality for infants, asthma attacks, and other respiratory symptoms (EPA, 2015). Diesel exhaust is recognized as a human carcinogen.

Hazardous air pollutants, methane, and VOC releases can occur at any stage of unconventional natural gas extraction (UGE) as is occurring in Colorado: during exploration, during production through venting, flashing, flaring, or during storage and transportation through fugitive emissions. The majority of VOC emissions during extraction come during the well completion phase, with trucks, pneumatic controllers, and drill rigs as other significant sources as well. Numerous pieces of industrial equipment are needed during UGE, including diesel trucks, diesel engines, drilling rigs, power generators, phase separators, dehydrators, storage tanks, compressors, and pipelines. Each one can be a source of methane, VOCs, nitrogen oxides, particulate matter and other gases. Methane that comes up from the well is not pure methane, but is a mixture of methane and other VOCs, and HAPs. Once methane is recovered and moved through tanks, pumps, pneumatics, and pipelines, all of those components leak to some degree, or vent by design as in the cases of pneumatic controllers, and thereby contribute to air pollution.

Flaring is the burning of methane and other gases that are not captured for commercial sale. This burning is done at the top of the stack in the open air. While new federal regulations limit flaring, there are instances in which it is still allowed. Emissions from this incomplete combustion include: VOCs, carbon monoxide, particulate matter, sulfur dioxide, nitrogen dioxide, hydrogen sulfide, acetaldehyde, acrolein, benzene, ethylbenzene, formaldehyde, hexane, naphthalene, propylene, toluene, and xylenes.

Hazardous air pollutants, methane, and other volatile organic compounds (VOCs) are leaked into the air intentionally and unintentionally. Leakage begins once flow back starts and continues

from wellheads, compressor stations, storage facilities, and pipelines. There is a great deal of debate over the amount of gas leaked throughout the supply chain. One study estimated that between 3.6 and 7.9% of the lifetime production of a shale gas well is vented or leaked to the atmosphere. EPA estimates that just 1.5% of the gas produced is lost.

Although methane is the main component of the gas that is released from the ground following the hydraulic fracturing process, the gas also contains a variety of chemicals that must be separated from the methane prior to transportation in pipelines for use in businesses and homes for cooking, heating and other purposes. Benzene is one such chemical that is released from the ground along with natural gas. Although at the time of writing, there are no studies examining the relationship between benzene exposure from UGE and adverse health outcomes, there are now some studies that have looked at perinatal exposure to benzene from exposure to petroleum refineries in Texas and child health outcomes. Two studies examined populations in residential proximity to petroleum refineries and birth outcomes in the Texas birth defect registry. The studies found that women exposed to benzene during pregnancy are more likely to have children with neural tube defects and the two most common types of leukemia. McKenzie et al. (2017) found an association between maternal residence in proximity to UGE and offspring with congenital heart defects and possibly with neural tube defects. Another study in France assessed perinatal exposure to benzene by having women wear monitors to collect data on personal exposure to benzene. Women who had the most exposure to automobile and truck traffic near their homes were more likely to have children with smaller growth parameters than the women who were less exposed to traffic in their homes.

McKenzie and colleagues preformed a human health risk assessment of air emissions that quantified the risk of non-cancer and cancer endpoints. Exposure was separated into residents less than half a mile from well pads and greater than a half mile. Exposure was then determined with ambient air samples around well pads and categorized as during the well completion phase, when at least one well was undergoing uncontrolled flow-back emissions, and not during the completion phase. The results of the risk assessment found that the high exposure during the completion phase created the greatest risk due to higher exposure levels to several hydrocarbons. Residents living less than a half mile from a well had an elevated risk of both non-cancer and cancer endpoints. The elevated risk for cancer was found to be six in one million for residents greater than half a mile, and ten in one million for greater than half a mile, both of which are above EPA target of acceptable risk of one in a million. The authors found that benzene was a major component of the elevated cancer risk.

Macey et al. (2014) found markedly elevated levels of multiple air pollutants in samples taken in Arkansas, Colorado, Ohio, Pennsylvania, and Wyoming. Many of these samples were collected on residential property close to well pads (30-350 yards) at which elevated levels of benzene were measured. Macey et al. said that "[t]he results suggest that existing regulatory setback distances from wells to residences may not be adequate to reduce human health risks."

In addition to the air pollutants from the extraction of oil and gas, there are numerous other sources of air pollution associated with fossil fuels. For example, the EPA has observed that children of mothers who were exposed to increased levels of polycyclic aromatic hydrocarbons (PAHs), which are produced when gasoline is combusted, during pregnancy have a greater chance of experiencing negative effects on their neurological development, including reduced intelligence quotient (IQ) and behavioral problems, as well as respiratory effects (EPA, 2013). In the pediatric population exposure to traffic pollution, particularly benzene, has been associated to leukemia (Filippini et al., 2015).

Meanwhile, fossil fuel-powered electrical utilities and industry are the primary source of sulfur dioxide in the U.S., which is associated with respiratory symptoms for children, emergency department visits, and hospitalizations for respiratory conditions (EPA, 2013; EPA, 2015). Nitric oxide and nitrogen dioxide, which are emitted by motor vehicles as well as power plants, and engines and other equipment, are also associated with adverse health effects for children, including respiratory symptoms and respiratory-related emergency department visits and hospital admissions (EPA, 2013).

While these air pollutants are already harming children's health, because higher average temperatures and heat waves exacerbate this air pollution problem, actually increasing ground level ozone, fine particulate matter, nitrogen oxides, and sulfur oxides, the problem is only expected to get worse (EPA, 2013). These air pollutants can be harmful for children: they may contribute to the development of new cases of asthma, aggravate preexisting cases of asthma, cause decrements to lung function, increase respiratory symptoms such as coughing and wheezing, and increase hospital admissions and emergency room visits for respiratory diseases. Because children may spend a lot of time outdoors, even while exerting themselves for sports or play, they can be especially vulnerable to the impacts of poor air quality (EPA, 2013).

In the context of the adverse effects of air pollution described above, it is our expert opinion that the Plaintiffs and other children around the U.S. are destined to a future of illness, restrictions of outdoor activities, and psychological stress. It may not be evident but air pollution is already affecting the Plaintiffs, and all children in the U.S. without discrimination by race, ethnicity, gender socioeconomic status, or education, while certain groups of children are harmed even more. In our expert opinion, the fact that today's children and all future generations have been completely immersed and will have a lifelong exposure to the detrimental effects of air pollution starting in the intrauterine environment is an alarming fact. While at this point we do not know the full magnitude or severity of the long-term outcomes of these exposures and how it will affect these children as they become adults, we do know that we have more children with asthma and aeroallergies, chronic lung disease, neurodevelopmental conditions, and repeated infections. In our expert opinion, as long as fossil fuels are being extracted and combusted, children will continue to suffer from a myriad of adverse health impacts. The only way to address those health impacts is to reduce, and eventually eliminate, our reliance on fossil fuels as our primary energy source.

IV. CLIMATE CHANGE AND EXPOSURE TO AIR POLLUTION WILL HAVE SIGNIFICANT LONG-TERM IMPACTS FOR CHILDREN REGARDING THEIR DEVELOPMENT AND SUCCESS IN LIFE

In our professional opinion, the adverse health impacts of climate change for children will result in life-long impacts. The life-long impacts will result both from repeated exposure to the impacts of climate change (until the federal government adequately responds to climate change and the threats are minimized), and also because when children experience climate-related health issues, the impacts, even from acute exposure, can result in impaired physical or cognitive development with life-long consequences.

A. Children's Exposure to Adverse Childhood Experiences Can Cause Long-term Health Impacts

There is widespread scientific literature explaining how children who are exposed to stressful or traumatic events, often referred to as adverse childhood experiences (ACEs), can experience a myriad of health problems throughout their life. Adverse childhood experiences broadly describe

abuse, neglect, and other traumatic events that occur in an individual's life before the age of 18 (Felitti et al., 1998). People with excessive exposure to ACEs in childhood are more likely to die at a younger age, as well as have a host of medical and mental health problems (see **Figure 2**) (Brown et al., 2009; Foege, 1998; Chapman et al., 2004). The ACEs measured in the original Felitti study included such things as physical, sexual, and verbal abuse; physical and emotional neglect; and losing a parent to separation, divorce or other reason. Other research has shown that living in an unsafe neighborhood, being bullied, and other aspects of urban living can function as adverse childhood events (Cronholm et al., 2015). Likewise, living is a war zone has been shown, not surprisingly, to be an adverse childhood experience (Sagi-Schwartz, 2008). Another term that has been used to describe the impact of adverse childhood events on children is toxic stress. Toxic stress is living situations and experiences that activate the human body's natural stress response system in an excessive, prolonged manner (Shonkoff et al., 2009; Shonkoff et al., 2012; McEwen, 2007). Conditions that trigger chronic fear and anxiety similarly produce excessive, prolonged activation of the stress response system (National Scientific Council on the Developing Child, 2010).

In our expert opinion, many of the childhood experiences associated with climate change are ACEs, or comparable to ACEs, and cause toxic stress. Childhood displacement after major weather events is a well-documented traumatic phenomenon. The anxiety associated with living in an area experiencing repeated severe weather events, such as the Texas-Louisiana coast along the Gulf of Mexico (Weisler et al., 2006) or in areas experiencing repeated wildfires such as areas of California, Oregon, and Colorado create toxic stress (Marshall et al., 2007).

The Plaintiffs in this case who have experienced severe storms or wildfires have experienced adverse childhood events. This puts their long-term health at risk. They deserve protection from the government through actions that dramatically reduce greenhouse gas emissions and thereby limit their risk of experiencing additional ACEs. Research has shown that the more ACEs children are exposed to, the greater their health risks (Felitti, 1998). These Plaintiffs, and similarly situated children throughout the U.S. have been, and continue to be, deprived of full health as a result of the government's actions that are causing climate change.

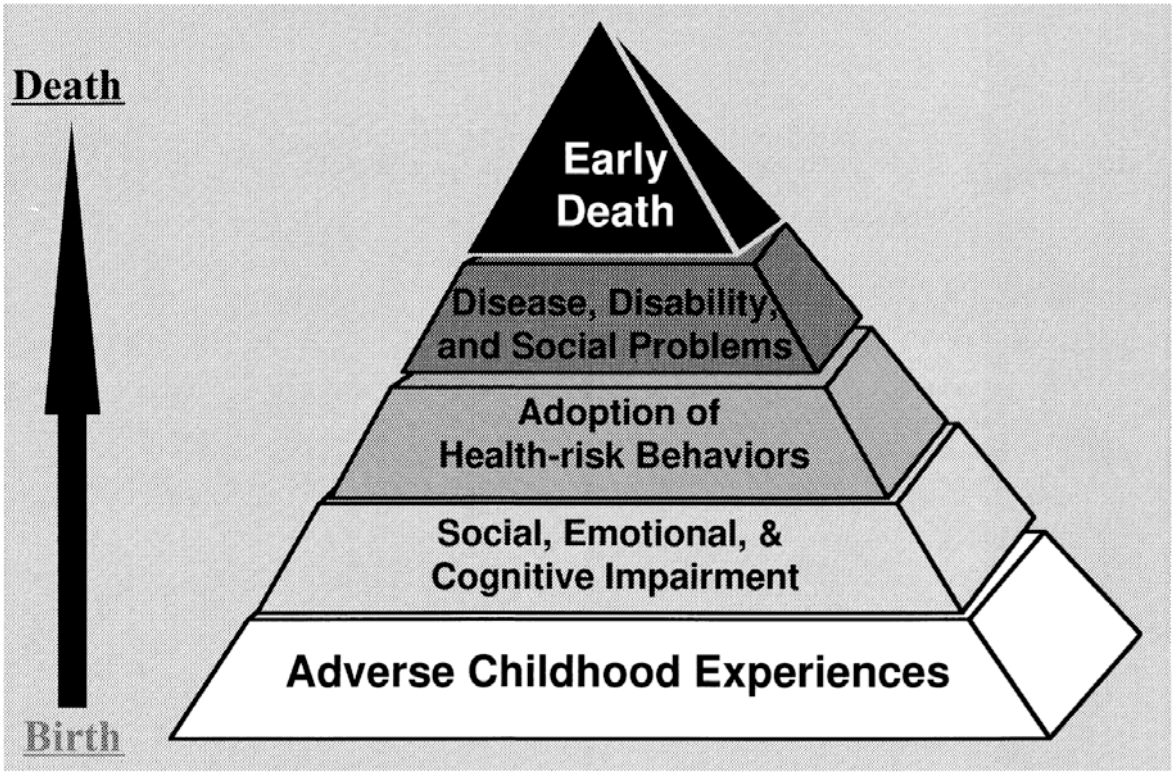


Figure 2: Illustrating the life-long impacts of adverse childhood experiences (Felitti et al., 1998).

B. Children's Exposure to Climate Change Can Cause Long-term Cognitive, Behavioral, and Mental Health Impacts, Inhibiting Children's Learning and Long-term Success

Children growing up and born today are "immersed" in climate change. Climate change is, by definition, creating an entirely new environment in which children are growing up. We will have entire generations of children who were conceived, born, and growing up in this new environment. Because this environment is unpredictable, and the threats posed by climate change are unprecedented, it makes predicting the full magnitude and severity of the impacts on children difficult. However, as described above, there is abundant evidence that the health of children is already being harmed by climate change, and in our expert opinion, the adverse health impacts will get significantly worse without immediate steps to address climate change. For example, we know, from research done in the Los Angeles area over many years, that children who grow up in an area with more air pollution have smaller lung capacity when they reach adulthood. Therefore, it is reasonable to expect that this will occur under climate change where there is a corresponding increase in air pollutants. Likewise, there is information that children growing up in areas with more air pollution will have a lower IQ.

Part of children's special vulnerability comes from the fact that they have a longer "shelf-life" than do adults. Because children live longer lives, they are more likely to develop health problems that occur years after an exposure to a health threat, or after years of exposure to a threat. If, for example, it takes about 40 years for a medical problem to develop after exposure to a particular hazardous contaminant, then the 16-year-old who is exposed is more likely to live long enough to develop the cancer. Likewise, if it takes 40 years of continuous exposure to elevated levels of air pollution for a medical problem to develop, then a child with onset of exposure at 16 is more likely to manifest that problem than an adult with onset of exposure at 60. This is the situation children are facing today – they are being exposed to hazardous, carcinogenic contaminants (for example petroleum products or other fossil fuel-based toxic substances in floodwaters after an extreme weather event, which can cause health problems years later (as well as immediately)); and children are exposed to continuously elevated level of air pollutants from the combustion and extraction of fossil fuels.

Children exposed to certain climate change and air pollutants can experience changes to neurological development, with life-long consequences. For example, pregnant women are especially vulnerable to high heat, which increases the number of preterm births and incidences of low-weight babies. Birth weight is a proxy measure of fetal health and is linked to illnesses in childhood and later in life. Elevating fetal temperature by 2°C-2.5°C for just an hour can lead to moderate to severe damage to the nervous system and impede neural development (Zivin & Shrader, 2016). Excess heat in the womb can also result in both physical defects, delay brain development, and cause other central nervous system problems – all of which can lead to life-long consequences by limiting a child's educational attainment and economic prospects (Zivin & Shrader, 2016). Thus exposure to high-heat, even when just a fetus, can result in life-long consequences.

Furthermore, there are now numerous studies that link exposure to outdoor air pollution and harmful impacts on the brain. The project Targeting Environmental Neurodevelopmental Risks (TENDR) Consensus Statement stated that air pollutants-related chemicals, including particulate matter PAHs and nitrogen dioxide, are "prime examples of toxic chemicals that can contribute to

learning, behavioral or intellectual impairment, as well as specific neurodevelopmental disorders such as attention deficit hyperactivity disorder or autism" (Bennett et al., 2016). The majority of brain development occurs before a child is born. Critical development continues until six; and further development continues into early adulthood. Neurological damage that occurs during childhood may continue to cause harm throughout the individuals' life (Perera, 2017). For example, three-year-old children exposed prenatally to high levels of PAHs had lower mental development scores on developmental tests (Perera et al., 2006). At age 5, these children performed lower on IQ tests than children with lower PAH exposure (Perera et al., 2009). As these children got older, they continued to manifest adverse neurocognitive impacts – including anxiety, depression and hyperactivity – as compared to children with lower PAH exposure (Perera et al., 2014).

Other studies have shown an association between prenatal exposure to combustion pollutants and children with autism spectrum disorders (von Ehrenstein et al., 2014; Becerra et al., 2013; Volk et al., 2014; Roberts et al., 2013; Kalkbrenner et al., 2015; Raz et al., 2015; Volk et al., 2013; Talbott et al., 2015).

There is also abundant evidence and literature on the association between climate change and mental health impacts. According to the federal government, "[t]he effects of global climate change on mental health well-being are integral parts of the overall climate-related human health impacts" (Crimins et al., 2016). For example, living in an environment with air pollution can lead to increased anxiety and depression (Lu et al., 2018). Those most vulnerable to distress and other adverse mental health impacts include children. Climate change can cause purely mental health impacts but mental health impacts also tend to be associated with physical ailments. Thus, as climate change causes more physical health problems for children, the increased prevalence of the physical ailments will lead to an increase in mental health impacts.

Accordingly, Kelsey Juliana's concerns about her psychological and emotional harm, in part from projections about Oregon's water supply and other impacts of climate change, is very well founded. It is well documented that individuals suffer from anxiety and other manifestations of mental distress when confronted with the reality of climate change (Clayton et al., 2014; Clayton et al., 2017). Given the results of the studies just mentioned, Journey Z. is not alone being scared and worried about the state of the planet. Given that he lives on an island and has seen first-hand some of the changes wrought by climate change, his anxiety is based in reality and is appropriate. We would expect the mental health impacts associated with climate change to become more widespread and severe in the coming years without immediate actions by the federal government to address climate change. Whether from acute or chronic climate change impacts, mental health impacts can result in life-long challenges for children, and can even alter one's DNA and be passed on to future generations.

V. PROMPT MITIGATION STRATEGIES ARE THE ONLY SOLUTION TO PROTECT CHILDREN AGAINST CLIMATE CHANGE HARMS AND DANGERS TO THEIR PERSONAL HEALTH SECURITY

It is our expert opinion that in order to mitigate and prevent health problems associated with climate change and air pollution, decreasing atmospheric CO_2 is essential. Decreasing atmospheric CO_2 can only reasonably and rationally be achieved by ending the burning of fossil fuels and ceasing other anthropogenic sources of greenhouse gases. One can build all the sea walls that one wants to try and adapt to sea level rise. One may treat children for Lyme disease, malaria, heat exhaustion, asthma, dehydration, and other health impacts, but those measures do not deal with the overall problem and will not solve the health problems facing children and

future generations. Decreasing atmospheric CO_2 concentrations and ceasing other anthropogenic sources of greenhouse gases (i.e., primary prevention), is the only way to ensure a safe and healthy future for children.

Similarly, the appropriate response to the health threats posed by lead is not just to treat children's medical conditions that result from exposure to lead, but to reduce and eliminate the use of lead and children's exposure to lead. Treating children's health problems associated with climate change, without addressing the underlying threat of climate change, would be akin to providing medical care to children exposed to lead-contaminated water in Flint, Michigan (or elsewhere), while children continue to drink water contaminated with lead – a preposterous notion. Just like it is impossible to adequately address the health threats posed by lead without eliminating children's exposure to lead, it is impossible to adequately address the health threats children face from the fossil fuel energy system and climate change without addressing the fossil fuel energy system and climate change.

CONCLUSION

The health of these Plaintiffs, along with other children, *is already harmed* by climate change and air pollution. As a result of their unique physiological features, children are especially vulnerable to the impacts of climate change, such as excess heat and extreme weather events. Children are also disproportionately vulnerable to air pollution related to the extraction and combustion of fossil fuels. At this point we know that the damage inflicted by the environmental changes imposed by the changing climate start in the intrauterine environment and continue to affect children as they grow. While children are also being impacted by climate change and air pollution, many more children will be impacted unless the federal government addresses the climate crisis.

Sea level rise is impacting not only the health of these Plaintiffs and other children, it is destroying the land (and islands) on which they live. It is our expert option that this loss of place will have incalculable consequences on the mental and physical health of the children so impacted. Furthermore, we are seeing changes in the patterns and severity of allergic diseases including asthma. For those Plaintiffs, and other children so impacted, this means the use of medication on a daily basis, the anxiety of not being able to breathe properly and the loss of simple childhood activities such as going outdoors to play. It is our expert opinion that the federal government's actions to promote fossil fuels have contributed to the problems sustained by these children. Severe weather events and wildfires are increasing in both severity and frequency. These events are quintessential Adverse Childhood Events. By definition, ACEs have long-term, negative impacts on the children's mental and physical health. It is our expert opinion that these problems would be less severe and less prevalent had the government implemented policies to curtail the use of fossil fuel at the time that they became aware of the threat.

Children like Plaintiff Jayden F. should not have to struggle to survive during a hurricane. Plaintiff Jaime B. should not have to worry about her family's displacement due to drought and lack of water or not being able to play outdoors. Plaintiff Levi D. should not have nightmares, experience anxiety, sadness or anger about the current and future effects of climate change. They should not have to worry about moving from their home because of sea level rise. Children should be allowed to be children and should have age-appropriate concerns.

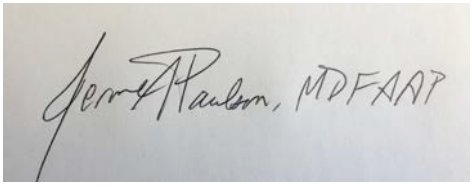
In our expert opinion, the magnitude of the threat facing these Plaintiffs, and other children, is unprecedented and will have life-long impacts for them, as well as future generations. It is also our expert opinion that this is an urgent situation. We need to start treating climate change like

the public health crisis that it is. In order to address the public health threats children are facing from climate change and air pollution, the federal government must ensure that carbon dioxide emissions and other greenhouse gas emissions are severely reduced immediately. Without prompt action by the federal government to phase out fossil fuels, the government will be consigning children and future generations to lives that will undoubtedly be less enjoyable, prosperous, successful, and, indeed, will be increasingly cut short. The physical and psychological damage imposed by the changing climate is insidious and if we don't immediately engage in adequate mitigation strategies it will become relentless. We must protect the future of our children from climate change. The health of our children and the future of our country are not negotiable.

Signed this 12th day of September, 2018 in Houston, Texas.

Dr. Susan Pacheco, MD

Signed this 12th day of September, 2018 in Sarasota, Florida.



Dr. Jerome Paulson, MD, FAAP

EXHIBIT A: CURRICULUM VITAE

SUSAN E. PACHECO, MD
CURRICULUM VITAE AND BIBLIOGRAPHY

April 11, 2018

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1976 – 1981 University of Puerto Rico in Mayaguez, Puerto Rico B.S.

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1981 – 1985 University of Puerto Rico, San Juan, Puerto Rico M.D.
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Microbiology/Immunology

POSTGRADUATE TRAINING:

1985 – 1986 Intern, Department of Pediatrics
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ACADEMIC AND ADMINISTRATIVE APPOINTMENTS:

1996 – 2005 Assistant Professor, Department of Pediatrics
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2007 – 2011 Assistant Professor, Department of Pediatrics
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2007 – 2012 Adjunct Professor, Department of Pediatrics
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1996 – 2005 Texas Children's Hospital, Houston, TX

2007 – present Children's Memorial Hermann Hospital, Houston, TX

2011 – present Lyndon B. Johnson Hospital, Houston, TX

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Louisiana Medical License, 1985-1987

CERTIFICATION:

1990 American Board of Pediatrics

1993, 2005, 2015 American Board of Allergy and Immunology

1994 Clinical and Laboratory Immunology

PROFESSIONAL ORGANIZATIONS AND COMMITTEES OF THESE

2002 – present	American Academy of Allergy, Asthma & Immunology
2003 – 2005	Mucosal Immunology Society
2009 – 2013	American Thoracic Society
2011 – present	Jeffrey Modell Foundation for Primary Immunodeficiency
2012 – present	American Academy of Pediatrics. Council on Environmental Health

HONORS AND AWARDS:

1991, 1992	Schering Travel Grant, 47th and 48th Annual Meeting, AAAAI. San Francisco, CA.
1992 – 1996	National Institute of Allergy and Infectious Diseases Institutional Training Award Clinical Research on AIDS. Bethesda, MD.
1993, 1994	Minority Scientist Travel Award, AIDS Postdoctoral Fellows Meeting, NIAID, NIH. Bethesda, MD.
2009 - 2015	Dean's Teaching Excellence Award. University of Texas Health Science Center. Houston, TX.
2013	"The United States White House Leadership Champions of Change Award". Awarded in recognition of leadership activities in public health and climate change in the United States and abroad. (http://www.whitehouse.gov/champions).
2013	"Climate Reality Leadership Corps" Recognition video (The Climate Reality Project) (https://www.youtube.com/watch?v=BNfFG9qfzuE).
2016	"Green Ring Award" Given in recognition of outstanding work towards solving the climate crisis" (The Climate Reality Project).

EDITORIAL POSITIONS:

2012 – present	Annals of Clinical and Laboratory Science (Dr. N. Tatevian, editor).

SERVICE ON NATIONAL GRANT REVIEW PANELS, STUDY SECTIONS, COMMITTEES:

1997, 1998, 2001	Center for AIDS Research (CFAR). Grant reviewer. Baylor College of Medicine, Houston, TX.
2001 – 2005	Women and Infants Transmission Study (WITS). Co-Investigator and executive committee member. NIAID, NIH. Bethesda, MD.

2001 – 2005	Pediatric AIDS Clinical Trials Group Vaccine Subcommittee. Member. NIAID, NIH. Bethesda, MD.
2002 – 2006	Mitochondrial Toxicity Review working group for the Women Infants Transmission Study (WITS). Chair. NIAID, NIH. Bethesda, MD.
2003	Biodefense Partnerships, Adjuvants, Therapeutics, Diagnostics and Resources. Scientific review committee. NIAID, NIH. Bethesda, MD.
2003 – 2005	Center for Research and Education and Unification against Disparities In AIDS of the Caribbean (CREHDAC), Steering committee. San Juan, PR.
2009 – 2013	Environmental and Occupational Respiratory Diseases Committee, American Academy of Allergy and Immunology (AAAAI). Vice-Representative.
2011 - 2013	Severe Combined Immunodeficiency (SCID) Newborn Screening pilot project. Consultant immunologist. University of Puerto Rico School of Medicine, San Juan, PR.
2012 – present	American Lung Association Medical Advisory Board, Houston, TX.
2014 – present	Council on Environmental Health (COEH), American Academy of Pediatrics. Executive Committee member.
2014 – present	Council on Environmental Health (COEH), Didactic activities committee for the 2016, 2017 National Convention, American Academy of Pediatrics. Chair.
2014 - present	U.S. Climate and Health Alliance. Member.

SERVICE ON THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON COMMITTEES:

2008 – 2011	Faculty Senate
2008 – 2014	Education Division Committee - Department of Pediatrics.
2008 – 2012	University of Texas Mitochondrial Center of Excellence, Co-Director.
2009	Center for Clinical and Translational Sciences – K12 Program grant reviewer
2012 – present	University of Texas Medical School Admission's Committee. Interviewer
2012 - present	University of Texas Pediatric Medical School Residency Admission's Committee. Interviewer.
2013 – present	Curriculum Committee
2015 - present	Women Faculty Forum

SERVICE TO THE COMMUNITY:

2005 – 2007 St. Stephen's Episcopal School, Houston, TX. Parent's Association. Chair.

2005 – 2007 University of Houston Charter School, Houston, TX. Advisory Board Member.

2006 – present "The Climate Reality Project" volunteer and mentor. Participated in national and international climate change trainings:

1. Nashville, 2007, 2008
2. Seville, Spain, 2007
3. Mexico City, 2011
4. San Francisco, 2012
5. Chicago, 2013
6. Brazil, 2014

2007 "Calentamiento Global". Wesleyan High School, San Juan, PR. Presenter.

2007 "Climate Change in Puerto Rico". American Meteorological Society, student chapter, University of Mayaguez, Mayaguez, PR. Presenter.

2007 "Experiencing Climate Change". American Chemical society, student chapter, University of Humacao, Humacao, PR. Presenter.

2006 – 2007 National Wildlife Federation. Volunteer.

2007 "Facing the Consequences of Climate Change in Puerto Rico". San Juan, PR. Health consultant.

2008 – 2010 University of Texas Recycling Group. Consultant.

2009 "Climate Change and Health: What are we doing?
Christian Life Commission Assembly, Austin, TX. Presenter.

2010 – 2012 Climate Reality Project - Puerto Rico. District Manager.

2011 – 2013 Habitat for Humanity, Houston, TX. Volunteer.

2011 – 2014 Puerto Rico Climate Change Council – Working Group III for the Assessment of the Health Impacts of Climate Change in Puerto Rico and the Caribbean. San Juan, PR. Consultant.

2012 – present Climate Science Rapid Response Team. Health consultant. (www.climaterapidresponse.org)

2012 – present American Lung Association Leadership Council Committee, Gulf Coast Region. Houston, TX. Member.

2013 – present Climate Change Working Group with the University of Rice, Houston, TX. Member.

2014 "Millennium Development Goals 6": The Threat of Climate Change". Global Issues Summit, Global Studies Academy. Invited speaker

2015 "The Non-pulmonary Effects of Air Pollution: Why we should reduce the current ozone standards to 60 ppm"'. Comments submitted to the EPA during the review of new ozone standards levels in the United States.

2015 - present Physicians for Social Responsibility, Texas chapter. Member.

2016 Air Alliance Houston Advisory Council. Member.

SPONSERSHIP OF CANDIDATES FOR POSTGRADUATE DEGREE:

1999 – 2004 Kelley Warfield. Department of Virology and Microbiology. Baylor College of Medicine, Houston, TX. Thesis committee member.

2009 – 2013 John M. Knight. Department of Immunology. Baylor College of Medicine, Houston, TX. Thesis committee member.

SPONSORSHIP OF POST-DOCTORAL FELLOWS:

2007 – present Department of Pediatrics, University of Texas Medical School, Houston, TX.

Fellows	Division	Training Years
Ricardo Mosquera	Pulmonary	2007 – 2010
Derek Pepiak	Pulmonary	2007 – 2010
Georgios Hartas	Cardiology	2008 – 2011
Pragya Rai	Pulmonary	2008 – 2011
Shela Razvi	Intensive care	2011 – 2014

CURRENT TEACHING RESPONSIBILITIES:

2007 – present Core lectures in Allergy and Immunology:

Pediatric residents
Pediatric Pulmonary fellows
Internal Medicine residents
Adolescent Medicine fellows
Cardiology fellows
Neonatology fellows
Fourth year medical students on subspecialty rotation in Allergy/Immunology and Rheumatology
Second year medical students
First year medical students

2007 – present Scholarly activities (e.g. abstracts, posters, lectures, journal club), with the pediatric fellows training in Pulmonary Medicine.

2007 – present Clinical rotation in Allergy/Immunology for Pediatric and Medicine/Pediatrics residents.

2010 – present Rheumatology and Immunology clinical rotation for fourth year medical students from the University of Texas School of Medicine students and out of state medical schools. (Ankur Kamdar, MD and Susan Pacheco)

2011 – present Global Health Scholarly Concentration. Mentor

2011- 2016 "Climate change and health". Yearly conference for the Global Health concentration students

2012, 2015 Department of Pediatrics Fellows Research Symposium. Abstract reviewer.

2012 – present Adolescent Medicine Program – Clinical rotation in Allergy and Immunology Clinic (3 months rotation).

1. Dr. Rebecca Beyda
2. Dr. Laura Groff

2013 - 2016 Introduction of Ethics and Professionalism Problem Based Learning (PBL) course for second year medical students.

2014 Journal Club, Global Health Concentration. Facilitator.

2015, 2016, Climate change and human health: Scientific and Humanistic perspectives. Blue Book Elective for first and second year medical students at the University of Texas McGovern Medical School (Thomas Cole, Ph.D., Director).

2016 University of Texas Medical Branch (UTMB) Allergy and Immunology fellowship rotation. Clinical rotation for Pediatric and Adult Medicine fellows training in Allergy and Immunology at UTMB, Galveston, TX. Director.

2016 Introduction to climate change. Lecture for first year medical students. Thomas Cole PhD, (Director) and Susan E. Pacheco, MD.

2017, 2018 "Climate change and health: Air pollution". Yearly lecture for first year medical students.

MENTORING ACTIVITIES:

2011 – present Global Health Scholarly Concentration. University of Texas School of Medicine. Mentor. Role: Mentorship of students interested in global medicine and climate change.

2008 – present Pediatric and Internal Medicine residents from the University of Texas School Texas interested in an Allergy and Immunology fellowship. Mentor.

CURRENT CLINICAL AND SERVICE RESPONSIBILITIES:

INPATIENT HOSPITAL CARE:

1. Allergist/ Immunology inpatient consultant for all pediatric and adult patients in the Memorial Herman Hospital System and Children's MHH (12 months/year service provider, available 24 hrs. /day).
2. Allergist/ Immunology consultant for pediatric and adult patients at the MDA Cancer Center (as needed on a 12 months/year service provider).
3. Pediatric emergency room consultant for all patients with mitochondrial disease with fever or suspected infections presenting to the CMHH or other MHH facilities emergency room or admitted to the hospital (12 months/year service provider, available 24 hrs. /day).
4. Consultant for all Children's Memorial Hermann Hospital and affiliated community pediatricians and LBJ inpatients who have an abnormal newborn screen (NBS) for Severe Combined Immunodeficiency (SCID). This service includes recommendations for evaluation, assessment and follow up, and notification to the DHHS about the evaluation outcome. (12 months/year service provider).

OUTPATIENT CARE:

1. Asthma Clinic Program Director at the University of Texas McGovern Medical School (project in process).
2. University of Texas Pediatric Pulmonary clinic "Enhancing Asthma Care Project Cohort IV" project director with the American Lung Association.
3. Allergist/Immunologist at the MHH/UT system for formal and informal consultations for adult and pediatric patients.
4. Phone consultations with UT pediatric physicians, community physicians and out of state physicians for patients with immunodeficiency and mitochondrial disease.
5. Phone consultations with MHH adult emergency room with patients with life threatening allergic or immune mediated diseases.
6. Work with the Department of State Health Services (DHSS) in the evaluation and follow up of all patients with abnormal newborn screen for severe combined immunodeficiency (SCIDS) born in the MHH/LBJ system.
7. University of Texas Pediatric Comprehensive Care Clinic consultant for the care of patients with asthma, allergy, eczema or immunodeficiency.
8. Monthly meetings with the Mitochondrial Center group for patient care related discussions.

9. Created and revised all patient care and safety guidelines, protocols and forms used in the Allergy and Immunology clinic at UT Physicians (e.g. management of anaphylaxis, consent forms, development of the v11 template for clinical evaluations).

CURRENT GRANT SUPPORT:

Project title: An enhanced medical home for High Risk Children's Clinic
Funding Agency: CMS
Percent Effort: 1%
Award Period: 2012

PAST GRANT SUPPORT:

Project Title: HIV-Specific Immunity in Mice after Mucosal Immunization
Funding Agency: NIAID, NIH
Award Period: 1996-1999

Project Title: Mucosal Immunization with Recombinant Vaccine Virus
Funding Agency: Center for AIDS Research
Award Period: 1997-1998

Project Title: Mucosal Immunization with Norwalk Virus Virus-Like Particles
Funding Agency: NIAD, NIH
Award Period: 1997-1999

Project Title: Child Health Research Center New Program Development (Mucosal Immunization Strategies)
Funding Agency: Child Health Research Center New Program Development
Award Period: 1998-1999

Project Title: Mucosal Vaccines: Memory Type -1 Immune Response to HIV
Funding Agency: Department of Health and Human Services, NIH, and NIAID
Award Period: 2001-2002

Project Title: Mucosal Vaccine Memory Type I
Funding Agency: CFAR
Award Period: 2002-2003

Project Title: Pediatrics Clinical Trials Program for AID
Funding Agency: NIAID
Award Period: 2002-2005

Project Title: Woman and Infants Transmission Study IV
Funding Agency: NICHD
Award Period: 2001-2005

Project Title: Supplemental Research Funds
Funding Agency: University of Texas Health Science Center, Department of Pediatrics
Award Period: 2008-2009

PUBLICATIONS:

A. Abstracts

Mbawuike, L.N., **Pacheco, S.E.**, Acuna, C.L., Walz, K.C., Harriman, G.R.: IgA-/- knockout Mice is not More Susceptible to Influenza Virus Infection. Poster presentation, American Association of Immunologists Conference, San Francisco, CA, 1997.

Pacheco, S.E., Ansari-Lari, M.A., Rogers, P.M.: Mucosal Immunization with HIV-1 RT: Comparison of Immune Responses after Intranasal and Intraperitoneal Immunization. Poster presentation, 9th Annual Meeting of the National Cooperative Vaccine Development Groups for AIDS, Bethesda, MD, 1997.

Pacheco, S.E., Ansari-Lari, M.A., Rogers, P.: Induction of Cellular Immune Responses after Intranasal Immunization with Low Doses of HIV-1 Reverse Transcriptase. Poster presentation, Keystone Symposia on Mucosal Immunity, Santa Fe, NM, 1997.

Pacheco, S.E., and Rogers, P.M.: Effect of Cholera Toxin Dose in the Th1 and Th2 Response Induced to Intranasal Immunization with HIV-1 Reverse Transcriptase. Poster presentation, 3rd National Basic Aspects of Vaccines Symposium, Washington, DC, 1998.

Masterson, J., **Pacheco, S.E.**, Rodgers, J.R.: Immune Responses to Human Alpha-1-antitrypsin are Controlled by a Non-MHC Gene on Mouse Chromosome 17. Poster presentation, North American Cystic Fibrosis Foundation Conference, 1999.

Pacheco, S.E., Foster, P.A., Rogers, P.M.: Intranasal Immunizations with Vaccinia Virus Expressing HIV Reverse Transcriptase (RT): Induction of Antigen-specific T-lymphocytes in Multiple Systemic and Mucosal Compartments. Poster presentation, Keystone Symposium on HIV vaccine development, Keystone, CO, 1999.

Pacheco, S.E., Foster, P., Rogers, P.: Oral Immunization with Low Doses of HIV-reverse Transcriptase and Cholera Toxin: Induction of a Disseminated Cellular Response in Mucosal and Systemic Compartments. Oral presentation, Child Health Research Centers National meeting, New Hampshire, 1999.

Pacheco, S.E., and Rogers, P.M.: Disseminated HIV-specific Immune Responses After Nasal Immunization with HIV Proteins. Poster presentation, 8th Conference on Retroviruses and Opportunistic Infections, Chicago, IL, 2001.

Husain, N., Rosenblatt, H.M., Shearer, W.T., **Pacheco, S.E.**, Abramson, S.L.: Granulocyte Transfusions in Patients with Chronic Granulomatous Disease: an Established or Experimental Therapeutic Procedure? Poster presentation, Poster presentation, American Academy of Allergy, Asthma & Immunology Annual Meeting, San Francisco, CA, 2004.

Tran, D.Q., Baliga, C.S., Hart, M.C., **Pacheco, S.E.**, et.al: Dose Effect of Mucosal Adjuvant LT9R192G) on the Induction of Th1 and Th2 Immunity. Poster presentation, American Academy of Allergy, Asthma & Immunology Annual Meeting, San Francisco, CA, 2004.

Baliga, C.S., Hart, M.C., Lamblin, C., Krater, S.S., Estes, M.K., **Pacheco, S.E.**, et.al.: Oral Antigen Delivery of Varying Doses of Soluble or Particulate Antigens in the Presence of

Adjuvant Selectively Induces Th1 or Th2 Responses in Systemic and Mucosal Compartments. Poster presentation, American Academy of Allergy, Asthma & Immunology Annual Meeting, San Francisco, CA, 2004.

Mofenson, L.M., Lu, M., **Pacheco, S.E.**, McIntosh, K., et.al: Perinatal Antiretroviral (ARV) Exposure and Effect on Hematopoiesis in HIV-exposed, Uninfected Children: The Women and Infants Transmission Study (WITS). Poster presentation. Med Gen Med; 6(3):ThPeB7024, 2004.

McCormick, T.G., Gottschalk, S., Okamura, T., Gresik, M., Dishop, M., **Pacheco, S.E.**: Epstein-Barr Virus (EBV) Infection of Natural Killer (NK) Cells and Hypersensitivity to Mosquito Bites: A different Presentation of X-linked Lymphoproliferative syndrome? American Academy of Allergy, Asthma & Immunology Annual Meeting, San Antonio, TX, 2005.

Mosquera, R.A., Khan, A.M., Atkins, C.L., Pepiak, D.L., Smith, K.G., Jon, C., Colasurdo, G.N., **Pacheco, S.E.**: Functional and Immune Response to RSV Infection in Aged BALB/c Mice: a Search for Genes Determining Disease Severity. Poster presentation, American Thoracic Society, San Diego, CA, 2009.

Pepiak, D.L., Atkins, C.L., Mosquera, R.A., Jon, C., **Pacheco, S.E.,** Bruce, S.R., Khan, A.M., Colasurdo, G.N., Alcorn, J.L.: Age-Dependent Respiratory Illness and Surfactant Protein-A (SP-A) Homeostasis in the Mouse Model of RSV Infection. Poster presentation, American Thoracic Society, San Diego, CA, 2009.

Pacheco, S.E., Smith, K.G., Muncy, J.L., Koenig, M.K.: Recurrent Sino pulmonary Infections, Bacteremia and Sepsis in Children with Mitochondrial Complex I-III Deficiency: Immunological Abnormalities. Mitochondrial Medicine. Poster presentation, Capitol Hill, Vienna, VA, 2009.

Pacheco, S.E., Muncy, J.L., Koenig, M.K., et al.: Children with Mitochondrial Disease and Recurrent Infections: A Paradigm Shift in our Interpretation of Immunodeficiency? Poster presentation, American Academy of Allergy, Asthma & Immunology Annual meeting, New Orleans, LA, 2010.

Mosquera, R.A**.,** Reverdin, A., Rai, P., Pepiak, D.L., Fan, L.L., Smith, K.G., Khan, A.M., **Pacheco S.E.,** Colasurdo, G.N., Jon, C.: Pulmonary Function Test Decline in Patients with Post-infectious Bronchiolitis Obliterans Despite Treatment. Poster presentation, American Thoracic Society, New Orleans, LA, 2010.

Mosquera, R.A., Koenig, M.K., Chevallier, J., Jon, C., Smith, K.G., Colasurdo, G. N., **Pacheco, S.E.**: Sleep Disordered-Breathing is a Frequent Finding in Children with Mitochondrial Disease. Poster presentation, American Thoracic Society, Denver, CO, 2011**.**

Mosquera, R.A., **Pacheco, S.E.**, Harris, S., Samuels, C.L., Wootton, S.H., Pedroza, C., Garcia, C., Avritscher, E., Tyson, J. E.: An Enhanced Medical Home Providing Comprehensive Care (CC) to High Risk Chronically Ill (CI) Children: A Randomized Trial (RCT). Oral presentation, Pediatric Academic Society Annual Meeting, Boston, MA, 2012.

Numan, M., **Pacheco, S.E.**, Martinez, R., Butler, I.: Does Histamine have a Role as Immune-modulator in Neurocardiogenic Syncope and Dysautonomia in Young Populations? Poster presentation, Dysautonomia International Conference, Washington, DC, 2013.

Mosquera, R.A., Tyson, J., Harris, T., Navarro, F., **Pacheco, S.E.**, Avritscher, S., Wootton, C., Pedroza, C., Yadav, A., Samuels, S.: An Enhanced Medical Home For Children With Severe Asthma Assessed In A Randomized Controlled Trial. Poster presentation, American Thoracic Society, San Diego, CA, 2014.

Pacheco, S.E., Knight, M., Jon, C., Smith, K., Koenig, M. K.: Etiology, Management and Clinical Outcomes of Patients with Leigh syndrome and Febrile Episodes Treated at the University of Texas Mitochondrial Center. Poster presentation, United Mitochondrial Disease Foundation, Pittsburgh, PA, 2014.

Tatyana, N., **Pacheco, S.E.**, Koenig, M.K., Barca, E., DiMauro, S., McGuire, P.: Mice l Lacking Cox10 in T-lymphocytes Recapitulate the Immune Phenotype of a Cohort of Patients with Primary Mitochondrial Disease. Poster presentation, United Mitochondrial Disease Foundation, Herndon, VA, 2015.

Pacheco, S.E., Lankford, J., Gourishankar, A., Numan, M.: Immunological Abnormalities in Young Patients with Dysautonomia. Oral presentation, International Society for Autonomic Neuroscience (ISAN) Meeting, Stresa, Italy, 2015.

Pacheco, S.E., McGuire, P.: Decreased Switched Memory B-cells in Pediatric Patients with Primary Mitochondrial Disease and Humoral Immunodeficiency. Poster presentation, Pediatric Academic Society Annual Meeting, Baltimore, MD, 2016.

DeJesus-Rojas, W., McBeth, K.E., Smith, K.G., **Pacheco, S.E.**: Specific Antibody Deficiency in Children with Down syndrome and Life-threatening Infections. Poster presentation. American College of Allergy, Asthma and Immunology Annual Meeting, San Francisco, CA, 2016.

B. Refereed Original Articles in Journals

Robinson, J.E., Holton, D., **Pacheco-Morell, S.E.**, Liu, J., McMurdo, H.: Identification of conserved and variant epitopes of human immunodeficiency virus type 1 (HIV-1) gp120 by human monoclonal antibodies produced by EBV-transformed cell lines. AIDS Res. Hum. Retroviruses. 6:56-579, 1990.

Mbawuike, I.N., **Pacheco, S.E.**, Acuna, C.L., Switzen, K.C., Zhang, Y.X., Harriman, G.R.: Mucosal immunity to influenza without IgA: an IgA knockout mouse model. J. Immunol. 162:2530-2537, 1999.

Harriman, G.R., Bogue, M., Rogers-Fani, P., Finegold, Ms., **Pacheco, S.E.,** Bradley, Zhang, Y.X., Mbawuike, I.N.: Targeted deletion of the IgA constant region in mice leads to IgA deficiency with alterations in expression of other immunoglobulin isotypes. J. Immunol. 162:2521-2529, 1999.

Pacheco, S.E., Gibbs, R.A., Ansari-Lari, M.A., Rogers, P.: Intranasal immunization with HIV-1 reverse transcriptase: effect of antigen dose in the induction of Th1-type and Th-2 type immunity. AIDS Res. Hum. Retro. 16:2009-2017, 2000.

Estes, M.K., Ball, J.M., Guerrero, R.A., Opekun, A.R., Gilger, M.A., **Pacheco, S.E.**, Graham, D.Y.: Norwalk virus vaccines: challenges and progress. J. Infect. Dis. Supp. 2(181); S367-373, 2000.

Guerrero, R., Ball, J.M., Krater, S.S., **Pacheco, S.E.,** Clements, J.D., Estes, M.K.: Recombinant Norwalk virus-like particles administered intranasally to mice induce systemic and mucosal (fecal and vaginal) immune responses. J. Virol. 75(20):9713-9722, 2001.

Zhang, Y., **Pacheco, S.E.**, Acuna, C.L., Switzer, K.C., Wang, Y., Gilmore, X., Harriman, G.R., Mbawuike, I.N.: Immunoglobulin A-deficient mice exhibit altered T helper 1-type immune responses but retain mucosal immunity to influenza virus. Immunology.105 (3):286-94, 2002.

Moylett, E.H., **Pacheco, S.E.**, Brown-Elliott, B.A., Perry, T.R., Buescher, S., Birmingham, M.C., et.al: Clinical Experience with Linezolid for the Treatment of Nocardia Infection. Clin. Infect. Dis. 36:313-318, 2003.

Mellins, C.A., Smith, R., O'Driscoll, P., Magder, L.S., Brouwers, P., et.al: For the NIH NIAID/ NICHD/ NIDA-Sponsored Women and Infant Transmission Study group (Shearer, W.T., **Pacheco, S.E.,** Cooper, N.J. Members): High rates of behavioral problems in perinatally HIV-infected children are not linked to HIV disease. 111:384-393, 2003.

La Monte, A.C., Paul, M.E., Read, J.S., Frederick, M.M., Erdman, D.D., Han, L.L., Anderson, L.J.: Women and Infants Transmission Study (Shearer, W.T., **Pacheco, S.E.**, Cooper, N. Members). Persistent parvovirus B19 infection without the development of chronic anemia in HIV-infected and -uninfected children: Women and Infants Transmission Study. J. Infect. Dis.189:847-851, 2004.

Pacheco, S.E., Gottschalk, S.M., Gresik, M.V., Dishop, M.K., Okmaura, T., McCormick, T.G.: Chronic active Epstein-Barr virus infection of natural killer cells presenting as severe skin reaction to mosquito bites. J. Allergy Clin. Immunol. 116(2):470-472, 2005.

Hershow, R.C., O'Driscoll, P.T., Handelsman, E., Pitt, J., Hillyer, G., Serchuck, L., Lu, M., Chen, K.T., Yaweta, S., **Pacheco, S.E.**, Davenny, K., Adenyl-Jones, S., Thomas, D.L.: Hepatitis C virus co-infection and HIV load, CD4+ cell percentage, and clinical progression to AIDS or death among HIV infected women: Women and Infants Transmission Study. Clin. Infect. Dis. 40(6):859-867, 2005.

Pacheco, S.E., McIntosh, K., Lu, M., Mofenson, L.M., Diaz, C., Foca, M., Frederick, M., Handelsman, E., Hayani, K., Shearer, W.T.: Effect of Perinatal Antiretroviral Drug Exposure on Hematologic values in HIV-Uninfected Children: An Analysis of the Women and Infants Transmission Study. J. Infect. Dis. 194(8):1089-1097, 2006.

Liu, Y., Zhu, L., Fatheree, N.Y., Liu, X., **Pacheco, S.E.**, Tatevian, N., Rhoads, J.M.: Changes in Intestinal Toll-like Receptors and Cytokines Precede Histological Injury in a Rat Model of Necrotizing Enterocolitis. Am. J. Physiol. Gastrointest. Liver Physiol. 297(3):G442-450, 2009.

Moody, S., **Pacheco, S.E.**, Butler, I.J., Koenig, M.K.: Secondary Erythromelalgia Successfully Treated with Intravenous Immunoglobulin. J. Child Neurol., 27(7):922-3, 2011.

Mosquera, R.A., Hashmi, S.S., **Pacheco, S.E.**, Reverdin, A., Chevallier, J., Colasurdo, G.N.: Dysanaptic growth of lung airway in children with Post-infectious Bronchiolitis Obliterans. Clin. Respir. J. 8:63-71, 2014.

Mosquera, R.A., Stark, J.M., Atkins, C., Colasurdo, G.N., Chevallier, J., Samuels, C.L., **Pacheco, S.E.**: Experimental Lung Research Manuscript ID: 859334 Manuscript Title:

Functional and immune response to Respiratory Syncytial Virus infection in aged BALB/c mice: a search for genes determining disease severity. Exp. Lung Res. 40(1):40-49, 2014.

Mosquera, R.A., Koenig, M.K., Adejumo, R.B., Chevallier, J., Hashmi, S., Mitchell, S., **Pacheco, S.E.**, Jon, C.: Sleep Disordered Breathing in Children with Mitochondrial Disease. Pulm. Med. 467576:1-8, 2014.

Mosquera, R.A., Elenir, B.C., Avritscher, E., Elenir, B.C., Samuels, C.L., Harris, T.S., Pedroza C., Evans, P., Navarro, F., Wootton, S.H., **Pacheco, S.E**., Clifton, G., Moody, S., Franzini, L., Zupancic, J., Tyson, J.E.: Effect of an Enhanced Medical Home on Serious Illness and Cost of Care Among High-Risk Children With Chronic Illness: A Randomized Clinical Trial. JAMA. 312(24):2640-2648, 2014.

Council on Environmental Health: Global Climate Change and Children's Health. Council on Environmental Health. Am. Academy Pediatrics. 136(5)992-997, 2015.

Ahdoot, S., **Pacheco, S.E.**: Global Climate Change and Children's Health. Council on Environmental Health. Am. Academy Pediatrics. 136(5):e1468-84, 2015.

Pacheco S.E., Tarasenko, T.N., Koenig M.K., Gomez-Rodriguez, J., Kapnick, S.M., Diaz, F., Zerfas, P.M., Barca, E., Sudderth, J., DeBerardinis, R.J., Covian-Garcia, R., Balaban R.S., DiMauro, S., McGuire, P. Cytochrome c oxidase (COX) activity is a metabolic checkpoint that regulates cell fate decisions during T-cell activation and differentiation. Cell Metab. 25 (6):1254-1268, 2017.

Pacheco S.E Periodic survey on Environmental health and climate change. Council on Environmental Health, American Academy of Pediatrics. *Forthcoming, 2018.*

C. Invited Articles and Commentaries

Pacheco, S.E., Shearer, W.T.: Diagnosis and management of HIV infection in infants born to mothers with HIV. Neonatal Monitor. 12:5-7, 1996.

Pacheco, S.E. Hurricane Harvey and climate change: the need for policy to protect children. Pediatr Res. 83(1-1):9-10. 2018. Invited commentary.

D. Chapters

Pacheco, S.E., Shearer, W.T.: "Laboratory aspects of immunology". Pediatric Clin. North Am. 41:623-655. 1994.

Pacheco, S.E. "Translation to Clinical Diagnostics". Next Generation Sequencing. Lee-Jun C. Wong Editor. ISBN978 1-44614-7000-7. 2013.

Pacheco S.E. "Outdoor Air Pollution". Pediatric Environmental Health. American Academy of Pediatrics. Ruth A. Etzel Editor. *Forthcoming, 2017.*

Pacheco, S.E., Kline D., Cole, T. "Introducing Climate Change to Medical Students: A Humanities Approach" in *Teaching Health Humanities*. Edited by Olivia Banner, Nathan Carlin, and Thomas Cole, Oxford University Press*, Forthcoming 2017.*

E. Other Professional Communications

1. Presentations

Local

"Th1 and Th2 Responses". Pediatric pulmonary fellow's conference series. University of Texas, 2007.

"Di George's Syndrome", Pediatric neonatology nurses conference. Children's Memorial Hermann Hospital. 2007.

"Anaphylaxis". Pediatric nurses conference. Children's Memorial Hermann Hospital. 2008

"Reviewing a Scientific Paper". University of Texas, Pediatric pulmonary fellow's conference series. 2007.

"Pediatric Cases in Pulmonary and Immunology". University of Texas, Pediatric Grand Rounds, 2007.

"An Allergist/Immunologist at UT?" University of Texas, Pediatric Grand Rounds, 2007.

"The Patient with Primary Immunodeficiency: The Pediatric Oncologist Perspective". MD Anderson Hospital Grand Rounds, 2008.

"Ike, Global Warming and Children: A population at risk". University of Texas, Pediatrics Grand Rounds, 2008.

"Climate Change, Health and Vulnerable Populations". UT Medical School Global Health Concentration conference series. University of Texas, 2011.

"Climate Change and Air Pollution: Who Protects Our Children's Lungs?" University of Texas, Pediatrics Grand Rounds, 2011.

"Climate Change, Health and Vulnerable Populations". UT Medical School Global Health Concentration conference series. University of Texas. 2012.

"Climate Change and Respiratory Diseases". University of Texas, Pediatrics Grand Rounds, 2012.

"DiGeorge's syndrome". University of Texas, Division of Cardiology. 2012.

"DiGeorge's Syndrome: Update & Clinical Management". University of Texas, Pediatrics Grand Rounds, 2013.

"Immune Evaluation of the Pediatric Patient". University of Texas, Comprehensive Care Clinic, 2013.

Severe Combined Immunodeficiency Newborn Screening. University of Texas, Division of Neonatology, 2013.

"Climate Change in Medical Education" University of Texas Medical Education Journal Club. 2014. Presenter.

"Climate change and health: The authority of the scientific community". University of Texas, UT Medical Global Health Concentration conference series. Houston, TX, 2015.

"Climate Change and Health" Expert panelist. Sponsored by the Student Environmental Group Rice University. Houston TX, 2016. Panelist.

"Asthma care at UT: Where we are and where are we going. University of Texas, Pediatric Grand Rounds, 2016.

"Women in Medicine". UT Medical School Student chapter of the American Medical Women's Association (AMWA). 2016. Presenter.

"Climate and Environmental Justice". "Climate Reality Leadership Corps Training, Houston Texas. (https://www.climaterealityproject.org/training) 2016. Panel moderator.

The Impact and Consequences of Climate Change to Human Being and Mother Earth. Forum "Struggle against climate change: Realities and social actions (Rice University) Houston, 2017. Speaker

Regional

"Severe Combined Immunodeficiency: What's new?" San Antonio Military Medical Center, Pediatric Residency Program Grand Rounds. San Antonio, TX, 2012. Presenter.

"Climate Change and Lung Disease". American Lung Association Asthma Educators Course, League City, TX, 2015. Keynote speaker.

"Factors Contributing to Asthma Exacerbations". American Lung Association Asthma Educators Course. League City, TX, 2015. Presenter.

Public Health and Climate Change in Texas". Roundtable with Christy Goldfuss, (Director of the White House Council on Environmental Quality). Steve Adler (Austin major) and other public health leaders to discuss adaptation and mitigation strategies to cope with climate change in Texas. Invited expert on climate change in human health. Austin, TX, 2015.

Public Hearings for the 2014 EPA's Proposal to Update the 2008 Air Quality Standards for Ground-level Ozone". Invited by the American Lung Association Gulf Coast **c**hapter and US Mothers for Clean Air to provide evidence on the need to implement stricter guidelines for ozone control in the US. Arlington, TX, 2015.

"Global Warming Solutions: How the Clean Power Plan will Help Texas". Green Building Resource Center, 2016. Speaker.

"How – and why – Moms can make a difference in protecting the health of our children". Panel discussion. Moms Clean Air Force and "Conserve America, Earth Day Texas. Dallas, Texas. 2016. Panelist.

National presentations

"Update on HIV Vaccines". University of Puerto Rico School of Medicine, San Juan, Puerto Rico 1999. Presenter.

"Antigen Specific Antibody Deficiency". Breakfast Seminar. American Academy of Allergy, Asthma, and Immunology. Annual meeting. San Diego, CA. 2000. Presenter.

"Antigen Specific Antibody Deficiency". Breakfast Seminar. American Academy of Allergy, Asthma, and Immunology. Annual meeting. New Orleans, LA. 2001. Presenter.

"Antigen Specific Antibody Deficiency". Breakfast Seminar. American Academy of Allergy, Asthma, and Immunology.58th Annual meeting. New York, NY. 2002. Presenter.

"Update on HIV Vaccines"
"Work up for a patient with suspected immunodeficiency"
"Facts and controversial issues in allergy treatment".
Pediatric Society of Puerto Rico. San Juan, PR. 2003. Presenter.

"Use and Abuse of Antihistaminics"
"Bone Marrow Transplantation in Primary Immunodeficiency"
Pediatric Society of Puerto Rico Annual meeting . San Juan, PR. 2005. Presenter.

" Immune evaluation of patients with primary immunodeficiency" . Pediatrics residency program. University Pediatric Hospital. San Juan, PR. 2006. Presenter.

"Update in Primary Immunodeficiency Diseases"
59th Excellence in Pediatrics Meeting. San Juan, PR, 2012.
Presenter and pediatric residents abstract juror.

" Adverse effects of Climate Change for the Southeast US". National Climate Assessment Health Sector Workshop. Charleston, SC. 2012. Presenter.

"The Immunology of Mitochondrial Disease". United Mitochondrial Disease Foundation National Meeting. Washington, DC, 2012. Presenter.

"Climate change and respiratory health". Mothers Clean Air Force Miami Town Hall. Miami, FL, 2014. Presenter.

American Lung Association Hispanic spokesperson for the Environmental Protection Agency Clean Power Plan release. Houston, TX. 2015.

"Volviendo a mis raices". Training on Climate change and the Latino community. Sachamama and Climate Reality Project. Houston, Texas. 2015. Presenter.

"Volviendo a mis raices". Training on Climate change and the Latino community. Sachamama and Climate Reality Project. Los Angeles, California. 2015. Presenter.

"Children in a Changing World: The silent victims of Climate Change. Woman's world and Climate Action Network (WECAN). Webinar.
(https://wecaninternational.wordpress.com/tag/susan-e-pacheco/) 2015. Presenter.

"Understanding the Connection Between Climate Change and Asthma: Building a Sense of Urgency". Massachusetts Asthma Action Partnership". Boston, MA. 2016. Keynote speaker:

"Climate change: A look at the impact on Latinos" . National Association of Latino Elected and Appointed Officials (NALEO) NALEO 33rd Annual Conference. Washington, DC. 2016. Presenter.

Communicating the Climate-Health Connection, Climate and Health. Presenter. Atlanta, GA, 2017.

"Climate change and Human Health". Presentation for the University of Puerto Rico Medical Society. 2018

Union of Concerned Scientists Teleconference: "Scientists, Policy Experts, Environmental Justice Leaders Discuss Hurricane Harvey". Role: Presenter. 2017

"Climate Change and Infectious Diseases: A pediatricians perspective" for the 2018 National meeting of the American Academy of Pediatrics. Role: Presenter. *Forthcoming.*

"Climate change and Children's Health" for the 2018 Pediatric Academic Society meeting. Role: Presenter. *Forthcoming.*

International presentations

"Milk Protein Allergy" Hospital General de Occidente. Centro Médico Nacional de Occidente IMSS. Guadalajara, Mexico. 2005. Presenter.

"Update in Primary Immunodeficiencies". Presenter.
"Severe Combined Immunodeficiency and the Newborn Screening". Presenter.
"Use of Immunomodulators in the Pediatric Population". Round table.
First international Congress of Pediatrics. Toluca, Mexico, 2012.

"Children in a Changing World: The Silent Victims of Climate Change" . Presenter.
"Use and abuse of long acting bronchodilators". Round table.
Second International Congress of Pediatrics. Toluca, Mexico. 2013.

"Climate Change and Human Health". Climate Conference, Academic Sector. University of Peru at Lima, Peru. 2014. Presenter.

2. Letters to the Editor

"Our children need clean air". Open letter to the editor. (Houston Chronicle). (http://www.chron.com/opinion/outlook/article/Pacheco-Our-children-need-cleaner-air-6342627.php}. 2015.

"No longer any debate over climate change". Open letter to the editor (Houston Chronicle), 2015. (http://www.chron.com/opinion/outlook/article/Pacheco-6427238.php). 2015.

"Medio ambiente: Una medida para combatir el asma infantil". Open letter to the editor, (Diario La Opinion). 2016. (https://laopinion.com/2016/04/29/medio-ambiente-una-medida-para-combatir-el-asma-infantil/)

"Let's face it: There is a human cost to climate change". Open letter to the editor (Houston Chronicle) (http://www.houstonchronicle.com/opinion/outlook/article/Pacheco-Let-s-face-it-There-s-a-human-cost-to-9156241.php)

3. **Interviews:**

"Understanding Climate Change". University of Puerto Rico Radio Station. San Juan, PR. 2007.

"Facing the Consequences of Climate Change in Puerto Rico". Univisión, Channel 2. San Juan, PR. 2007.

"Hot Air" The Effects of 'Climate Change' on our Children's Lungs" (https://www.uthealthleader.org/story/hot-air). Houston, TX. 2011.

"Need to take action against climate change". El Vocero Newspaper. San Juan, PR. 2012.

"Understanding the American Lung Association Report on the Burden of Asthma in Hispanics". Latina Voices-Smart Talk". Houston, TX, 2012.

"Global Moms in Action: Dr. Susan E. Pacheco Protecting Children and Families". Global Mom's Challenge Spotlight. (http://www.globalmomschallenge.org/2015/07/global-moms-action-dr-susan-e-pacheco-protecting-children-families/). 2014.

"Heal the Planet with Climate Reality Leader Susan Pacheco. Climate Reality Project Spotlight. (https://www.climaterealityproject.org/blog/heal-planet-climate-reality-leader-susan pacheco). 2016.

"Inspired by Al Gore, Houston pediatrician strives for climate awareness" (http://texasclimatenews.org/?p=12672). 2016.

"The Clean Power Plan" Univision. 2015

4. **Other**

Institutional Review Board, Baylor College of Medicine, Houston, TX. 2002-2005.

Bio Ethics Committee, Department of Pediatrics, Texas Children's Hospital Baylor College of Medicine, Houston, TX. 2004 – 2005.

"Metabolism, Infection and Immunity in patients with mitochondrial disease and inborn errors of metabolism". National Human Genome Research Intitule (NUGRI), NIH, Bethesda, Maryland. PI: Dr. Peter McGuire). Associate investigator and consultant immunologist. 2014 – present.

"Immunomodulatory effect of IVIG in the neurological status of children with primary mitochondrial disease". National Human Genome Research Intitule (NUGRI), NIH, Bethesda, Maryland. PI: Dr. Peter McGuire). Associate investigator. 2016.

EXHIBIT B: CURRICULUM VITAE

JEROME A. PAULSON, MD, FAAP

1) Personal Data

Name	Jerome A. Paulson
Home address, telephone	1113 N Howard St Alexandria, VA 22304-1627 703-461-7683
Office telephone	202-471-4891
Fax number	NA
e-mail address	jpaulson@childrensnational.org
Place of birth	Baltimore, MD
Citizenship	US

2) Education

a) Undergraduate Education

University of Maryland
College of Arts & Sciences
College Park, MD 20742
1967-1971
BS in Biochemistry with Honors and with General Honors

b) Medical Education

Duke University
Durham, NC 27710
MD Degree
1971-1974

c) Post-Graduate Training (Internship, Residency, Fellowship)

Johns Hopkins Hospital
Baltimore, Maryland 21205
Pediatrics PGY1 and PGY2
1974-1976

Sinai Hospital
Baltimore, MD 21209
Pediatrics PGY3 – 1976-1977
Fellowship, Ambulatory Pediatrics – 1977-1978

3) Employment

02/2015 – present
Principal, EnviroHealthDoctor
Consultant in Environmental Health

01/2012 to 01/2015

Professor of Environmental & Occupational Health
George Washington University School of Public Health & Health Policy

11/2011 to 01/2015
Professor of Pediatrics
George Washington University School of Medicine and Health Sciences

09/2010 to 01/2015
Director, Mid-Atlantic Center for Children's Health & the Environment
Washington, DC

08/2009 to 09/2013
Director, Environmental Health Track
George Washington University School of Medicine and Health Sciences

08/2008 to 01/2015
Medical Director for National & Global Affairs
Child Health Advocacy Institute
Children's National Health System

08/2003 to 01/2012
Associate Research Professor
Department of Environmental & Occupational Health
School of Public Health & Health Services
George Washington University
Washington, DC

07/2002 – 07/2004
Medical Advisor, Children's Environmental Health Network
Washington, DC

10/2002 to 08/2008
Pediatrician, Children's Pediatricians & Associates
Washington, DC

10/2000 to 09/2010
Co-Director, Mid-Atlantic Center for Children's Health & the Environment
Washington, DC

07/2000 to 06/2001 & 10/2001 to 09/2002
Soros Advocacy Fellow (1/2 time)
Based at Children's Environmental Health Network
Washington, DC

07/1999 to 06/2000

Partial leave of absence
Served as Special Assistant to the Director
National Center on Environmental Health, Centers for Disease Control & Prevention
US Department of Health & Human Services
Washington, DC

07/1997 to 07/2003
Associate Professor
07/2003 to 2011
Associate Research Professor
Department of Prevention & Community Health
School of Public Health & Health Services
George Washington University
Washington, DC

06/1991 to 06/2000
Fellow, Center for Health Policy Research
George Washington University
Washington, DC

07/1990 to 07/2003
Associate Professor
Department of Pediatrics
School of Medicine & Health Sciences
George Washington University
Washington, DC

07/1990 to 09/2002
Associate Professor
Department of Medicine (Department of Health Care Sciences prior to 06/1999)
School of Medicine & Health Sciences
George Washington University
Washington, DC

07/1990 to 09/2002
Pediatrician
George Washington University
Washington, DC

08/1989 to 06/1990
Executive Director, Research!America
Alexandria, Virginia

12/1987 to 07/1989
Director of Pediatrics
Regional Institute for Children & Adolescents
Rockville, Maryland

05/1987 to 07/2000

Clinical Associate Professor
Department of Pediatrics
School of Medicine Georgetown University
Washington, DC

11/1986 to 10/1987
Director of Scientific Research & Public Policy Development
Joseph P. Kennedy, Jr. Foundation
Washington, DC

09/1986 to 10/1986
Consultant, Office on Smoking and Health
U.S. Public Health Service
Rockville, Maryland

08/1985 to 08/1986 – Sabbatical Year
Robert Wood Johnson Health Policy Fellow
Office of Congressman Fortney Stark
Chairman, Health Subcommittee
Ways and Means Committee
US House of Representatives
Washington, DC

01/1984 to 08/1985
Chief, Division of General Pediatrics
Rainbow Babies and Children's Hospital
Cleveland, Ohio

07/1983 to 08/1985
Medical Director, Pediatric Family Clinic
School of Medicine
Case Western Reserve University
Cleveland, Ohio

07/1981 to 08/1985
Medical Director, Rainbow Ambulatory Practice
Rainbow Babies and Children's Hospital
Cleveland, Ohio

07/1980 to 08/1985
Medical Director, High Risk Infant Project Rainbow Ambulatory Practice and Rainbow Babies and Children's Hospital Cleveland, Ohio

07/1980 to 08/1986
Visiting Assistant Pediatrician
Department of Pediatrics
Cleveland Metropolitan General Hospital, Highland View Hospital (Cuyahoga County Hospital)
Cleveland, Ohio

07/1978 to 06/1984

Supervising Pediatrician
Red Team Practice
Rainbow Babies and Children's Hospital
Cleveland, Ohio

07/1978 to 08/1986
Assistant Pediatrician
Rainbow Babies and Children's Hospital
Cleveland, Ohio

07/1978 to 08/1986
Assistant Professor
Department of Pediatrics
School of Medicine
Case Western Reserve University
Cleveland, Ohio

4) Professional Registrations, Licenses, Certifications

1987 to 2014
Licensed, District of Columbia - MD16347

1987 to 1994
Licensed, State of Virginia – 0101041814

1978 to 1986
Licensed, State of Ohio - 42040

1978
Certified, American Board of Pediatrics -23040

1976
Certified, National Board of Medical Examiners - 146944

1976 to 1991
Licensed, State of Maryland - D19766

5) Societies and Honors

2017 – Carol Strobel Memorial Award for Children's Environmental Health Advocacy, Children's Environmental Health Network

2017 – John Rosen Memorial Lecture, Montefiore Medical Center, Albert Einstein College of Medicine

2017 – Founding member, Virginia Clinicians for Climate Action

2015 – Named Emeritus Professor of Pediatrics, George Washington University School of Medicine and Health Sciences

2015 – Named Emeritus Professor of Environmental & Occupational Health, George Washington University Milken Institute School of Public Health

2014 – Elected a Fellow of the Collegium Ramazzini

2014 – National Healthy Schools Hero Award, Healthy Schools Network

2013 - 11th Annual George J. Ginandes, M.D. Visiting Lectureship in Pediatrics, Mount Sinai School of Medicine, New York, NY

2011 – Elected to the American Pediatric Society

2000-2001, 2001-2 – Soros Advocacy Fellowship

1999 - 2001 - Medical Society of the District of Columbia

1998–present – Who's Who in America, Marquis Publishing

1997–present – Who's Who in Health & Medicine, First (and subsequent) Edition, Marquis Publishing Co,

1997 – Award for service, dedication and commitment to George Washington University Hospital

1993–1999 – Packard Roundtable for Children, the Center for the Future of Children of the David & Lucile Packard Foundation and the Center for Health Policy Research of the George Washington University

1990–Present – Member, Physicians for Social Responsibility
1996–1999 – Member, Violence Committee
1999–2007 – Member, Environmental Health Committee

1989–1990 – Member, Virginia Chapter, American Academy of Pediatrics
1989 – Certificate of Appreciation, Regional Institute for Children and Adolescents, Rockville, Maryland

1987–Present – Member, Washington, DC Chapter, American Academy of Pediatrics
1988–1989 – Chairman, Government Affairs Committee
1992–1994 – Chairman, Injury & Poison Prevention Committee

1985–1986 – Robert Wood Johnson Health Policy Fellowship

1985 – Certificate from Ohio State Senate for Educational and Public Policy Contribution

1985 – Certificate from Ohio House of Representatives for Educational and Public Policy Contribution

1984 – Citation from Cleveland City Council for activities in motor vehicle safety

1983 – Certification of Appreciation, American Academy of Pediatrics for Serving as First Ride/Safe Ride Coordinator

1982 & 1984 – Certificate of Appreciation, National Safety Town Center, Cleveland, Ohio

1981–1987 – Member, National Passenger Safety Association

1979–1987 – Member, American Association for Automotive Medicine

1978–1987 – Member, Ohio Chapter, American Academy of Pediatrics
1980–1985 – Chairman, Accident Prevention Committee

1978–1987 – Member, Physicians for Automotive Safety 1978–

1986 – Member, Northern Ohio Pediatric Society

1978 – Certificate of Appreciation, Martin Luther King, Jr. Elementary School, Baltimore, Maryland

1977–Present – Member, Academic (Ambulatory) Pediatric Association
1980–1990 – Member, Committee on Public Policy
1983–1986 – Chairman, Committee on Public Policy
1986–Present – Member, Injury Interest Group
2000–Present – Member, Environmental Health Interest Group 2005–
2010 – Co-Chair of Environmental Health Interest Group

1976–Present – American Academy of Pediatrics (119705)
1976–1979 – Candidate Member
1979–Present – Fellow
1987–1992 – Member, Council on Government Affairs 1987–
1988 – Chairman, Subcommittee on Election '88
1991–Present – Member, Section on Injury and Poison Prevention
1992 – Member, Ad Hoc Task Force to review the oncogenic potential of Vitamin K
2003–Present – Member, Council (formerly Nexus) on Environmental Health 2007–
2015 - Member, Executive Committee of the Council on Environmental Health
07/2011–06/2015 Chairperson, Executive Committee of the Council on Environmental Health

1971 – Graduated from University of Maryland, College Park, Maryland with Honors and General Honors

1971 – Sklar Award, University of Maryland General Honors Program

6) Administrative Duties & University Activities

a) Departmental
Department of Health Care Sciences, GWUSMHS
1991 – 1994 Member, Appointment Promotion & Tenure Committee,
1992 – 1994 Chair of Committee

b) SMHS/SPHHS
2008 – 2009 Member, Committee to Recruit Chair of Department of Environmental & Occupational Health, GWUSPHHS

c) University

2010 – Present Member, Steering Committee, Sustainability Institute, GWU
2010 – 2012 Member, Steering Committee, GW Collaborating Committee for Global Health & Development
2010 – 2010 Member Collaborative Working Group on Factors Impacting the Success of English Language Learners
2010 – 2012 Member Steering Committee, GW ACCESS Institute (Advancing Cross-disciplining Collaboration for English language Learner's School Success)

7) **Educational Achievements**.

a) Courses Taught

- Summer 2001 Introduction to Children's Health & The Environment (PubH 290 – 25), Course director, 1 credit Topics Course
- Summer 2002 Introduction to Children's Health of the Environment (PubH 290 – 25), Course director, 1 credit Topics Course
- Spring 2005 Introduction to Children's Health of the Environment (PubH 290 – 48), Course director, 2 credit course
- Fall 2005 Policy Issues Related to Children's Health & the Environment (PubH 290 – 22), Course director, 2 credit course
- Summer 2006 Environmental & Occupational Health (Core course for all MPH students) (PubH 204 – 11). Course director, 2 credit course
- Spring 2007, Introduction to Children's Health of the Environment (PubH 290 – 48), Course director, 2 credit course
- Fall 2007, Policy Issues Related to Children's Health & the Environment (PubH 290 – 48), Course director, 2 credit course
- Spring 2009, Introduction to Children's Health of the Environment (PubH 225 – 10), Course director, 2 credit course
- Spring 2010, Introduction to Children's Health of the Environment (PubH 225 – 10), Course director, 2 credit course
- Summer 2010, Child Health Advocacy (PubH 6399) Course Director Tasmeen Weik, Department of Health Policy, My portion: Environmental toxins (1hr); Climate Change (1hr)
- Summer 2011, Child Health Advocacy (PubH 6399) Course Directors Tasmeen Weik & Chaya Merrill, Department of Health Policy, My portion: Environmental toxins (1hr); Climate Change (1hr)
- Fall 2011, Introduction to Children's Health of the Environment (PubH 6125), Course director, 2 credit course
- Fall 2012, Introduction to Children's Health of the Environment (PubH 6125), Course director, 2 credit course
- Fall 2013, Introduction to Children's Health of the Environment (PubH 6125), Course director, 2 credit course
- Fall 2014, Introduction to Children's Health of the Environment (PubH 6125), Course director, 2 credit course

b) New Courses or Programs Developed

- Introduction to Children's Health & the Environment
  See above. Developed initially as a Topics course. Subsequently evolved into 2 separate 2-credit courses and now exists as a single 2-credit course.
- Environmental Health Track, GWUSMHS

c) Students or post-doctoral fellows for whom I served as primary advisor

- Alyson Follenius, MPH candidate, Department of Environmental & Occupational Health, GWSPHHS, Special Project – Lead Poisoning in Children
  2007 – 2008
- Timothy Otten, MPH candidate, Dept EOH, GWSPHHS, Speech Project – Is Nitrite Exposure or Health Risk in Chlorinated Drinking Water? An Investigation of Water Quality in Childcare Centers in the District of Columbia – 2007
- Kathryn Marshall, MPH candidate, Dept EOH, GWSPHS, Special Project, Understanding Asthma: A Needs Assessment for District of Columbia Residents
  Age 18 – 29 years old. 2008 – 2009
- Alison Wilson, MPH candidate, Department of Environmental and Occupational Health, GWSPHHS, Special Project.
  An educational Environmental Health Intervention to Enhance Physician Capability to Address Environmental Health Concerns 2008 – 2009
- Camille Gray, MPH candidate, DEOH, GWSPHHS, Culminating Experience, Needs Assessments of School Nurses Regarding Children's Environmental Health 2010 - 2012

d) Educational Awards

None

e) Student or participant evaluations

None available

8) Consultant Appointments

- Visiting Professorship
  October 2004 – Dozor Fellow – Visiting Professor, Ben Gurion University, Beer Sheva Israel
- Paid consulting
  2000 – present Multiple law firms on the topic of childhood lead poisoning
  2011 Ashcraft & Gerel, LLP on the topic possible child health effects of shale gas recovery and hydraulic fracturing
  2012 – 2014 Sullivan, Ward, Asher & Patton, P.C. on flame retardant chemicals
  2014 – present American Academy of Pediatrics, to serve as medical director of the PEHSU-East Program
  2015 Natural Resources Defense Council
  2015 – 2016 Healthy Schools Network
  2015 – 2016 Clean Air Council, Philadelphia, PA

9) Grants Awarded or Pending

- 1982 – Adolescent Weight Control Program. Northeast Ohio Affiliate American Heart Association. $14,000 (TDC)

- 1982 – Residency Training in General Pediatrics. U.S. Department of Health & Human Services. $105,000 TDC for sixth year continuation. Assistant Project Director

- 1982-84 – Seat Restraint Contamination Study. Several small grants from Gerber Products Co., Questor Juvenile Furniture Co., International Manufacturing Co. $6,000 (TDC)
- 1985 – Robert Wood Johnson Health Policy Fellowship. Robert Wood Johnson Foundation. $43,276 (TDC)

- 1991-1994 – Child Health Supervision. Maternal and Child Health Bureau, Health Resources and Services Administration, Medicaid Bureau of the Health Care Financing Administration (MCJ-117023). (TDC unknown)

- 1996 – 1997 – Consortia Development for Health Professions Training in Community-Based Settings. Health Resources and Services Administration. Delivery Order No. 240-96-0702. Principal Investigator, George Washington University Center for Health Policy Research. (TDC unknown.)

- 1996 – 1998 – What Constitutes "Appropriate" Use of EMSC in Managed Care. Emergency Medical Services for Children, Maternal and Child Health Bureau, Health Resources and Services Administration. 1 MCH-114004-01-0. George Washington University Center for Health Policy Research. (TDC unknown.)

- 07/2000 to 06/2001 & 10/2001 to 09/2002 – Soros Advocacy Fellowship. Open Society Institute, Soros Foundation. 50% salary support. (TDC unknown)

- 2000 – 2002 – Development of Primary Care Research Training Program. Health Resources and Services Administration. (TDC unknown)

- 2000 – 2015 – Pediatric Environmental Health Specialty Unit. Association of Occupational & Environmental Clinics. Co-PI or PI. TDC variable.

10) Publications

a) Papers in Refereed Journals

1. **Paulson JA,** The Case for Mandatory Seat Restraint Laws. *Clinical Pediatrics*, 1981;20: 285-290
2. **Paulson JA,** Injury prevention in children. *Journal of Family Practice*, 1981: 13;123-124
3. **Paulson JA,** Thomas L. Case Studies in Bioethics: Should States Require Child Passenger Protection? *Hastings Center Report*, 1981; 11: 21-22. Reprinted in *Cases in Bioethics from the Hastings Center Report.* C. Levine and R. M. Veatch (eds.). Institute of Society, Ethics and the Life Sciences Hastings-on-Hudson, NY 1982, pp. 109-110
4. **Paulson JA,** Injury Prevention in Children. *Journal of Family Practice,* 1981; 13: 123-124
5. **Paulson JA**, Patient Education *Pediatric Clinics of North America*, 1981, 28: 627-691
6. **Paulson JA,** Wellman S, Baby Walker Related Injuries. *Clinical Pediatrics*, 1984;23: 98-99
7. **Paulson JA,** Seat Restraint Contamination and Cleaning. *Pediatrics*, 1986; 78: 113-114
8. **Paulson JA,** Rushforth NB. Violent Death in Children in a Metropolitan County: Changing Patterns of Homicide 1958-1982. *Pediatrics*, 1986; 78: 1013-1020
9. **Paulson JA**. Epidemiology of Injuries in Adolescents. *Pediatric Annals*, 1988; 17: 84-96
10. **Paulson JA**. Injuries: The Leading Cause of Death in Children. *Current Opinion in Pediatrics*, 1989; 1: 192-202
11. **Paulson JA**. Injury Prevention. *State of the Art Reviews: Adolescent Medicine*, 1990;1: 97-112

12. Christoffel KK, Scheidt PC, Agran PF, Kraus JF, McLoughlin E, **Paulson JA**.. Standard definitions for childhood injury research: excerpts of a conference report. *Pediatrics*, 1992; 89: 1027-1034
13. Vitamin K Ad Hoc Task Force (Merenstein GB, Hathaway WE, Miller RW, **Paulson JA**, Rowley DL). Controversies concerning vitamin K and the newborn. *Pediatrics*, 1993; 91: 1001-1003.
14. **Paulson JA** . Diguiseppi C, Adolescent Injury Prevention In Primary Care. *State of the Art Reviews: Adolescent Medicine*, 1995; 6: 215-231.
15. **Paulson JA,** Jackson RJ, Sussman D. Expanding the physician's role in pediatric environmental health Journal of the Medical Association of Georgia 1999; 88: 13-17
16. **Paulson JA.** Children's Environmental Health Policy and Advocacy. *Pediatric Clinics of North America.* 2001;48:1307-18
17. McCurdy LE, Roberts J, Rogers B, Love R, Etzel R, **Paulson J**, Obot Witherspoon N, and Dearry A. Incorporating Environmental Health into Pediatric Medical and Nursing Education. Environmental Health Perspectives 2004; 112(17):1755-60
18. Spernak SM, Mintz M, **Paulson J**, Burke HB, Gadkari M, Faselis C, Joseph JG.. Neighborhood racial composition and availability of asthma drugs in retail pharmacies. J Asthma 2005; 42:731-355
19. Lanphear BP, **Paulson JA.** Beirne S, Trials and Tribulations of Protecting Children from Environmental Hazards. Environmental Health Perspectives 2006.114:1609-1612
20. **Paulson JA.** An Exploration of Ethical Issues in Research in Children's Health and the Environment. Environmental Health Perspectives 2006.114:1603-1608
21. **Paulson JA,** Arnesen S**.** The Use of the Internet for Children's Environmental Health *Pediatric Clinics of North America.* 2007; 54: 135-54
22. Ebi K, **Paulson JA.** Global Climate Change and Its Impact on Children. *Pediatric Clinics of North America.*2007; 54: 213-226
23. **Paulson JA**, Karr CJ, Seltzer JM, Sheffield PE, Cifuentes E, Buka I, Amler RW. Development of the Pediatric Environmental Health Specialty Unit Network: The North American Experience Am J Public Health 2009; 99:S511–S516.
24. Committee on Environmental Health. The Built Environment: Designing Communities to Promote Physical Activity in Children. Pediatrics. 2009; 123: 1591-1598
25. Committee on Environmental Health, Committee on Substance Abuse, Committee on Adolescence, and Committee on Native American Child Health. Policy Statement – Tobacco Use: A Pediatric Disease Pediatrics. 2009; 124: 1474-1487.
26. Best D. Committee on Environmental Health. Committee on Native American Child Health Committee on Adolescence. Technical report--Secondhand and prenatal tobacco smoke exposure. Pediatrics 2009; 124:e1017-44
27. Committee on Environmental Health and Committee on Infectious Diseases Rogan WJ. Brady MT. Drinking Water From Private Wells and Risks to Children. Pediatrics. 2009; 123:1599-1605.
28. Committee on Environmental Health. Tester JM. The built environment: designing communities to promote physical activity in children. Pediatrics. 2009; 123:1591-8
29. Ebi, KL, and **Paulson JA**. Climate Change and Child Health in the United States. Current Problems in Pediatric & Adolescent Health Care. 2010; 40: 2-18.
30. **Paulson JA,** Barnett C. Who's In Charge of Children's Environmental Health at Schools? New Solutions. 2010; 20: 3-23.
31. **Paulson JA**. Gordon L. Clinical services in environmental pediatrics. Mount Sinai Journal of Medicine. 2011; 78:11-21

32. Balk SJ. Council on Environmental Health. Section on Dermatology. Ultraviolet radiation: a hazard to children and adolescents. Pediatrics. 2011; 127(3):e791-817.
33. Forman J, Silverstein J, AAP Committee on Nutrition and Council on Environmental Health. Clinical Report: Organic Foods: Health and Environmental Advantages and Disadvantages. Pediatrics 2012; 130:5 e1406-e1415
34. AAP Council on Environmental Health. Policy Statement: Pesticide Exposure in Children. Pediatrics 2012; 130:6 e1757-e1763
35. James R. Roberts, Catherine J. Karr, and AAP Council on Environmental Health. Technical Report: Pesticide Exposure in Children. Pediatrics 2012; 130:6 e1765-e1788
36. Orenstein WA, **Paulson JA**, Brady MT, Cooper LZ, Seib K. Global Vaccination Recommendations and Thimerosal. Pediatrics. 2013; 131:149-151
37. Rogan, WJ., **Paulson, JA**., Baum, C., et al., 2014. Iodine deficiency, pollutant chemicals, and the thyroid: new information on an old problem. Pediatrics, 133, 1163-1166.
38. Tinney VA; **Paulson JA**; Bathgate SL; Larsen JW. 2015. Medical education for obstetricians and gynecologists should incorporate environmental health. American Journal of Obstetrics & Gynecology. 212:163-6.e1.
39. Amoah AA, Witherspoon NO, Pérodin J, **Paulson JA.** 2015. Findings from a pilot environmental health intervention at early childhood centers in the District of Columbia. J Public Health doi:10.1093/pubmed/fdv135
40. **Paulson JA**, Zaoutis TE, the Council on Environmental Health, the Committee on Infectious Diseases. 2015. Nontherapeutic Use of Antimicrobial Agents in Animal Agriculture: Implications for Pediatrics. Pediatrics 136, e1670-e1677
41. Fisk, WJ, **Paulson, JA**, Kolbe, LJ, & Barnett, CL. 2016. Significance of the School Physical Environment–A Commentary. Journal of School Health, 86, 483-487.
42. Paulson JA, Barnett CL. Public Health Stops at the School House Door. Environmental Health Perspectives. 124: A171-A175.
43. Council on Environmental Health. 2016. Prevention of Childhood Lead Toxicity. Pediatrics, e20161493
44. Tinney VA, Denton JM, Sciallo-Tyler L, Paulson JA. 2016. School Siting Near Industrial Chemical Facilities: Findings from the U.S. Chemical Safety Board's Investigation of the West Fertilizer Explosion. Environ Health Perspect; 124:1493–1496

b) Chapters in books

1. **Paulson JA**. Accidents. *Pediatrics Update Review for Physicians*, 1979 Edition. A. J. Moss (ed.) Elsevier North Holland, NY, 1979, pp. 920-939.
2. **Paulson JA**, Gordon IB, Mortimer E. Prophylactic Antibiotics. *Antimicrobial Therapy*, Third Edition. B. Kagen (ed.) W. B. Saunders, Philadelphia, PA, 1980, pp. 468-480.
3. **Paulson JA**. Accidental Injuries. *Nelson's Textbooks of Pediatrics*. Twelfth Edition. R. E. Berhman and V. C. Vaughan (eds.) W. B. Saunders, Philadelphia, PA, 1983, pp. 261-263. Revised for Thirteenth Edition, 1987, pp. 211-213.
4. **Paulson JA**. Mammalian Bites and Spider Bites. *Nelson's Textbook of Pediatrics*. Twelfth Edition. R. E. Berhman and V. C. Vaughan (eds.). W. B. Saunders, Philadelphia, PA, 1983, pp. 1808-1809. Revised for Thirteenth Edition, 1987, pp. 1514-1516.
5. **Paulson JA**. Falls. *Injury Control for Children and Youth*. M. S. McIntire (ed.) American Academy of Pediatrics. Elk Grove Village, IL, 1987, pp. 215-219.
6. **Paulson JA**. Firearm Injuries. *Injury Control for Children and Youth*. M. S. McIntire (ed.) American Academy of Pediatrics. Elk Grove Village, IL, 1987, pp. 136-144.

7. **Paulson JA**. Animal and Human Bites and Bite Related Infections. *Current Pediatric Therapy*. Thirteenth Edition, S. S. Gellis and B. M. Kagen (eds.) W. B. Saunders, Philadelphia, PA, 1990, pp. 678 - 682.
8. **Paulson JA** and Solloway M. A Twenty Year Retrospective of Child Health Supervision in Ambulatory Pediatric Settings. *Child Health Supervision. Analytical Studies in the Financing, Delivery, and Cost-Effectiveness of Preventive and Health Promotion Services for Children.* MR Solloway and PP Budetti (eds). George Washington University Center for Health Policy Research. Prepared for the Bureau of Maternal and Child Health, Health Resources and Services Administration, Department of Health and Human Services, 1994. Reprinted in: Solloway MR and Budetti PP (eds). *Child Health Supervision: Analytical Studies in the Financing, Delivery, and Cost-Effectiveness of Preventive and Health Promotion Services for Infants, Children and Adolescents.* Arlington, VA: National Center for Education in Maternal & Child Health. 1995.
9. **Pine BR, Paulson JA,** and Solloway M. Environmental Health and Child Health Supervision: A Case Study of Childhood Lead Poisoning. *Child Health Supervision. Analytical Studies in the Financing, Delivery, and Cost-Effectiveness of Preventive and Health Promotion Services for Children.* MR Solloway and PP Budetti (eds). George Washington University Center for Health Policy Research. Prepared for the Bureau of Maternal and Child Health, Health Resources and Services Administration, Department of Health and Human Services, 1994. Reprinted in: Solloway MR and Budetti PP (eds). *Child Health Supervision: Analytical Studies in the Financing, Delivery, and Cost-Effectiveness of Preventive and Health Promotion Services for Infants, Children and Adolescents.* Arlington, VA: National Center for Education in Maternal and Child Health. 1995.
10. **Paulson, JA**. The Pediatrician as a Community Advocate. *Injury Control for Children and Youth*. M. D. Widome (ed.) American Academy of Pediatrics. Elk Grove Village, IL, 1997.
11. **Paulson, JA.** Resources for Children's Environmental Health. *Handbook on Children's Environmental Health.* R Etzel and S. Balk (eds). American Academy of Pediatrics. Elk Grove Village, IL, 2003
12. **Paulson, JA.** Harvey C. Animal Safety in School. in *Safe and Healthy School Environments.* H Frumkin, R Geller, IL Rubin (eds.). Oxford University Press. NY, NY 2006.
13. **Paulson, JA** and Sandel M. Healthy Homes – The Role of Health Care Professionals. in *Healthy and Safe Homes: Research, Practice, and Policy.* R Morley, A Mickalide and KA Mack (eds) American Public Health Association Washington, DC. 2010.
14. **Paulson, JA.** Environmental Toxicants and Neurocognitive Development. in *Children with Disabilities, 7th Edition*. ML Batshaw, NJ Roizen and GR Lotrecchiano. Paul Brooks Publishing, Baltimore, MD 2012
15. **Paulson JA.** and Gordon L. The Environmental History and Examination. Key to Diagnosis of Environmental Disease. in *Textbook of Children's Environmental Health*. P Landrigan and R Etzel (eds). Oxford University Press. London, UK. 2013.
16. **Paulson JA** and Barnett C. Who's In Charge of Children's of Children's Environmental Health in Schools. In *The Toxic Schoolhouse*. M K Scammell and C Levenstein (eds). Baywood Publishing Co, Inc. Amityville, NY 2014.
17. **Paulson, JA** and V Tinney, Potential & Known Health Impacts Associated with Unconventional Natural Gas Extraction. In *The Rush to Drill: The Human and Environmental Costs of Shale Gas Extraction.* ML. Finkel (Ed). Praeger Press, 2015

d) Books

1. **Paulson, JA**. *Pediatrics: Review for New National Boards.* J & S Publishing Co., Inc. Alexandria, VA. 2000

e) Abstracts

1. **Paulson JA**, Avsec D, Gordon IB. The high risk infant project: The use of a perinatal coordinator to facilitate neonatal follow-up. Ambulatory Pediatric Association Abstracts, 1981, pg. 78.
2. **Paulson JA**. Infant seat restraint contamination. Ambulatory Pediatric Association Abstracts, 1984, pg. 132.
3. **Paulson JA**. Injuries related to all-terrain vehicles. Ambulatory Pediatric Association Abstracts, 1985, pg. 105.
4. **Paulson JA**, Rushforth NB. Violent Death in Children in a Metropolitan County: Changing patterns of Homicide 1958-1982. Ambulatory Pediatric Association Abstracts, 1985, pg. 60. (Paper presented orally at APA meeting, Washington, D. C., May 9, 1985)
5. **Paulson JA**, Rushforth NB. Violent Death in Children in a Metropolitan County: Homicide of Children Less than One Year of Age. AJDC, 1986; 140: 309 (Paper presented orally at APA meeting, Washington, D. C., May 8, 1986)
6. Solloway MR, **Paulson JA**, Weiss KB, Moore T, Green H. Variations in ambulatory care for infants in the US. American Public Health Association 122nd Annual Meeting & Exhibition, October 30 - November 3, 1994, Washington, DC, Public Health & Diversity, Opportunity for Equity, Abstract Volume, pg. 124, session 2037.

f) Invited Publications

1. **Paulson, JA.** The State of Children's Health & the Environment. *Archives of Environmental and Occupational Health.* 2007. 62: 53-57. DOI: 10.3200/AEOH.62.2.53-57

h) Book Reviews

1. **Paulson JA**. *Saving Children: A Guide to Injury Prevention.* Wilson MH, Baker SP, Teret SP, and Garbarino J (eds). JAMA 1992; 268: 2441-2442.
2. **Paulson JA**. *Formative Years: Children's Health in the United States 1880-2000*. Stern AM, Markel H (eds) JAMA 2003; 289: 2725-2726.

i) Any Other Publications

- Monographs

1. **Paulson JA** and Solloway M. A Twenty Year Retrospective of Child Health Supervision in Ambulatory Pediatric Settings. George Washington University Center for Health Policy Research. Prepared for the Bureau of Maternal and Child Health, Health Resources and Services Administration, Department of Health and Human Services, December, 1992.
2. Pine BR, **Paulson JA** and Solloway M. Environmental Risk Factors and Child Health Supervision: Childhood Lead Poisoning. George Washington University Center for Health Policy Research. Prepared for the Bureau of Maternal and Child Health,

Health Resources and Services Administration, Department of Health and Human Services, December, 1992.

3. Shaw K, **Paulson JA** and DeGraw C. Consortium Development for Health professions Training in Community-Based Settings. Center for Health Policy Research, School of Public Health & Health Services, George Washington University Medical Center. Prepared for the Bureau of Health Professions, Health Resources and Services Administration, Department of Health and Human Services, September, 1998.
4. **Paulson JA.** Coxsackie Virus and Type I Diabetes Mellitus. Drinking Water Assessment. Department of Environmental & Occupational Health, School of Public Health & Health Services, George Washington University Medical Center. Prepared for the US Environmental Protection Agency, 1999.
5. Embry M. **Paulson, JA.** Helicobacter pylori. Drinking Water Assessment. Department of Environmental & Occupational Health, School of Public Health & Health Services, George Washington University Medical Center. Prepared for the US Environmental Protection Agency, 1999.

- Journals

1. Gordon, IB; **Paulson JA**. (eds.) *Pediatric Clinics of North America*, Vol. 28, No. 3, "Issues for the Practicing Pediatrician." W. B. Saunders, NY, August, 1981.
2. **Paulson JA** (ed) *Pediatric Clinics of North America* "Children's Environmental Health" W. B. Saunders, Philadelphia, October, 2001.
3. **Paulson JA**, Gitterman BG (eds.). *Pediatric Clinics of North America* "Children's Health & the Environment: Part 1" W. B. Saunders, Philadelphia. February, 2007
4. **Paulson JA**, Gitterman BG (eds.). *Pediatric Clinics of North America* "Children's Health & the Environment, Part 2" W. B. Saunders, Philadelphia. April, 2007

- Proceedings

1. Christoffel KK; Scheidt PC; Agran PF; Kraus JF; McLoughlin E; **Paulson JA**. Standard definitions for childhood injury research. Report of NICHD Conference March 20-21, 1989. US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Child Health and Human Development, NIH Publication No. 92-1586. January, 1992.

- Newspaper Editorial Articles

1. **Paulson JA**. Ohio's Child Safety-Seat Law Would Curb Greatest Scourge. Cleveland Plain Dealer, July 16, 1981, pg. 25A.
2. Mahowald M, **Paulson JA**. The Baby Does' Two Different Situations. Cleveland Plain Dealer, December 31, 1981, pg. 25A.
3. **Paulson JA**. U. S. Car-Safety Ruling is Hard to Take Seriously. Cleveland Plain Dealer, July 18, 1984, pg. 25A.

11) Presentations

a) Regional

Date	Organization	Location	Title of Presentation
04-09-2002	Geisinger Medical Center Department of Family Medicine	Danville, PA	Grand Rounds – An Introduction to Children's Health & the Environment
05-17-2002	INOVA Alexandria Hospital Department of Pediatrics	Alexandria, VA	Grand Rounds – An Introduction to Children's Health & the Environment
05-20-2002	Pennsylvania State Department of Public Health	Harrisburg, PA	The Use of the Internet for Children's Health & the Environment
06-14-2002	West Virginia University Women's & Children's Hospital	Charleston, WV	Grand Rounds – An Introduction to Children's Health & the Environment
08-13-2002	Montgomery County Maryland, Department of Public Health	Silver Spring, MD	What is a Pediatric Environmental Health Specialty Unit?
08-28-2002	Montgomery Family Practice Residency	Norristown, PA	Grand Rounds – An Introduction to Children's Health & the Environment
09-23-2002	St Francis Hospital Family Medicine Residency	Wilmington, DC	Grand Rounds – An Introduction to Children's Health & the Environment
09-23-2002	Delaware State Department of Public Health	Wilmington, DC	What is a Pediatric Environmental Health Specialty Unit?
09-26-2002	George Washington University Department of Internal Medicine	Washington, DC	Environmental Antecedents of Adult Disease
10-30-2002	Children's Hospital of Philadelphia	Philadelphia, PA	Grand Rounds – An Introduction to Children's Health & the Environment
03-27-2003	Columbia Road Health Services	Washington, DC	Lead Poisoning in the 21st Century
06-10-2003	Agency for Toxic Substances & Disease Registry Regional Meeting	Philadelphia, PA	What is a Pediatric Environmental Health Specialty Unit?
10-08-2003	Jefferson Medical College Departments of Family Medicine & Pediatrics	Philadelphia, PA	Grand Rounds – An Introduction to Children's Health & the Environment
10-15-2003	York Hospital Department of Pediatrics	York, PA	Grand Rounds – An Introduction to Children's Health & the Environment
11-06-2003	INOVA Fairfax, Department of Pediatrics	Fairfax, VA	Grand Rounds – An Introduction to Children's Health & the Environment

04-01-2004	Children's National Medical Center	Washington, DC	Professorial Rounds – Carbon Monoxide Poisoning
05-11-2004	Departments of Pediatrics & Family Medicine Mercy Children's Medical Center	Pittsburgh, PA	Grand Rounds – An Introduction to Children's Health & the Environment
05-17-2004	Altoona Family Medicine Residency	Altoona, PA	Grand Rounds – Lead and Indoor Air Pollution
07-14-2004	Department of Pediatrics, Thomas Jefferson University	Philadelphia, PA	Grand Rounds – Lead Poisoning & Advocacy
09-09-2004	INOVA Fairfax Hospital Department of Pediatrics	Fairfax, VA	Grand Rounds – Lead Poisoning in the 21st Century
09-14-2004	Virginia Hospital Center Department of Pediatrics	Arlington, VA	Grand Rounds – Lead Poisoning in the 21st Century
11-18-2004	Altoona Family Medicine Residency	Altoona, PA	Grand Rounds – Pesticides & Children's Health
06-02-2005	Physicians for Social Responsibility Student Environmental Health Advocacy Conference	Washington, DC	The Role of the Physician in Environmental Activism
04-11-2005	Altoona Family Medicine Residency	Altoona, PA	Resident Conference – Children's Environmental Health in the Home
05-25-2005	Primary Care Track, Children's National Medical Center	Washington, DC	Resident Conference – An Introduction to Children's Health & the Environment
08-04-2005	Maryland Department of Health & Mental Hygiene	Baltimore, MD	Mercury in the School Setting
08-04-2005	Maryland Department of Health & Mental Hygiene	Baltimore, MD	Mold & Damp Buildings
09-29-2005	The Mid-Atlantic Lead & Mold Conference	Philadelphia, PA	Mold & Damp Buildings
01-10-2006	Arlington Hospital Center, Department of Pediatrics	Arlington, VA	Grand Rounds – Mold & Damp Buildings
03-02-2006	York Hospital, Department of Family Medicine	York, PA	Grand Rounds – Lead Poisoning
03-02-2006	Pennsylvania State Department of Health	York, PA	An Introduction to Children's Health & the Environment
05-10-2006	Arlington County Health Department	Arlington, VA	Mold & Damp Buildings
06-30-2006	Roanoke Memorial Hospital	Roanoke, VA	Mercury & Pesticide Toxicity in Children
08-17-2006	York Hospital Department of Family Medicine	York, PA	Grand Rounds - An Introduction to Children's Health & the Environment

05-15-2007	US EPA, Indoor Environments Division, Office of Air & Radiation	Washington, DC	Pediatric Environmental Health Specialty Units.
08-28-2007	EPA Regional Environmental Health Meeting	Richmond, VA	An Introduction to Children's Health & the Environment
08-13-2010	Department of Pediatrics Joan C. Edwards School of Medicine	Huntington, WV	Grand Rounds – Introduction to Children's Health & the Environment

08-13-2010	Department of Pediatrics Joan C. Edwards School of Medicine	Huntington, WV	Noon conference – Lead Poisoning in the 21st Century
09-17-2010	INOVA Alexandria Hospital Department of Pediatrics	Alexandria, VA	Noon conference - Environmental Tobacco Smoke – Alexandria, VA No Smoking Pledge
10-05-2010	Albert Einstein Medical Center Department of Pediatrics	Philadelphia, PA	Grand Rounds - Environmental Health in the Home
10-05-2010	Albert Einstein Medical Center Department of Pediatrics	Philadelphia, PA	Noon conference - Introduction to Children's Health & the Environment
10-08-2010	Georgetown University Department of Pediatrics	Washington, DC	Grand Rounds – Introduction to Children's Health & the Environment
10-11-2010	Children's School Services Educational Seminar	Washington, DC	Is Autism an Environmentally Related Disease
10-26-2010	Virginia Hospital Center Department of Pediatrics	Arlington, VA	Grand Rounds - Questions that Parents Ask About Children's Environmental Health
11-09-2010	Crozier Medical Center Department of Pediatrics	Chester, PA	Grand Rounds – Introduction to Children's Health & the Environment
11-09-2010	Crozier Medical Center Department of Pediatrics	Chester, PA	Lead Poisoning in the 21st Century
11-18-2010	University of West Virginia Medical Center Department of Pediatrics	Morgantown, WV	Noon conference - Endocrine Disrupting Chemicals and Human Health
01-18-2011	Sinai Hospital Department of Pediatrics	Baltimore, MD	Grand Rounds – Introduction to Children's Health & the Environment
05-05-2011	Children's Hospital of the King's Daughters	Norfolk, VA	Grand Rounds – An Introduction to Children's Health & the Environment

05-05-2011	Children's Hospital of the King's Daughters	Norfolk, VA	Noon conference – The Home & Environmental Issues
05-09-2011	Family Medicine Residency, Altoona Regional Medical Center	Altoona, PA	Asthma as and Environmental Disease
05-09-2011	Juniata College Community Presentation	Huntington, PA	Potential Child Health Impacts of Natural Gas Extraction with Hydraulic Fracturing
05-10-2011	Family Medicine Residency Program at Conemaugh Medical Center	Johnstown, PA	An Introduction to Children's Health & the Environment
05-18-2011	Harbor Hospital	Baltimore, MD	Annual Department of Pediatrics CME meeting - The Home & Environmental Issues
05-20-2011	CAMC-Women's & Children's Hospital	Charleston, WV	Grand Rounds – Frequently Asked Questions about Children's Health & the Environment
05-20-2011	CAMC-Women's & Children's Hospital	Charleston, WV	An Introduction to Children's Health & the Environment
05-24-2011	Franklin Square Hospital	Baltimore, MD	An Introduction to Children's Health & the Environment
06-01-2011	Family & Community Medicine Residency Program	Hershey, PA	An Introduction to Children's Health & the Environment
06-01-2011	Family & Community Medicine Residency Program	Hershey, PA	Job Related Environmental Exposures in Adolescents
07-20-2011	Family Medicine Residency, Howard University Hospital	Washington, DC	Introduction to Children's Health & the Environment
08-10-2011	WV Asthma Coalition	Charleston, WV	Asthma from an Environmental Perspective (Keynote address + breakout sessions)
09-15-2011	Shenandoah National Park Climate Friendly Parks Workshop	Via Skype	The Impact of Climate Change on Children's Health
09-21-2011	WV Public Health Assoc Annual Mtg	Morgantown, WV	Keynote Address: The Potential Health Impacts of Natural Gas Extraction and Hydraulic Fracturing
09-23-2011	Delaware Nurses Association Environmental Health Conference	Newark, DC	An Introduction to Children's Health & the Environment

11-07-2011	Pennsylvania State-Wide Asthma Partnership Fall Mtg	Via webinar	Environmental Aspects of Asthma Management
11-22-2011	Pennsylvania Chapter, American Academy of Pediatrics	Via webinar	The Potential Health Impacts of Natural Gas Extraction and Hydraulic Fracturing
12-05-2011	Montgomery County-Prince Georges County Pediatric Society	Bethesda, MD	Responding to Parents Questions about Environmental Health Issues
01-05-2012	Georgetown University Department of Family Medicine	Washington, DC	Grand Rounds – Lead Poisoning in the 21st Century
01-11-2012	Children's National Outpatient Center @ Good Hope Rd	Washington, DC	Healthy Homes
01-17-2012	Lancaster General Hospital Department of Family Medicine	Lancaster, PA	Grand Rounds – An Introduction to Children's Health & the Environment
01-17-2012	Lancaster General Hospital Department of Family Medicine	Lancaster, PA	Noon Conference – Potential Health Impacts of Natural Gas Extraction
01-17-2012	Philadelphia Chapter, Physicians for Social Responsibility	Philadelphia, PA	Potential Health Impacts of Natural Gas Extraction
01-18-2012	Abington, Memorial Hospital	Abington, PA	Hospital Wide Grand Rounds – Potential Health Impacts of Natural Gas Extraction
01-25-2012	Wyoming Valley Osteopathic Family Medicine Residency Program	Kingston, PA	Lead Poisoning in the 21st Century
01-25-2012	Wilkes-Barre General Hospital	Wilkes-Barre, PA	Hospital Wide Grand Rounds – Potential Health Impacts of Natural Gas Extraction
02-09-2012	Department of Pediatrics WVU Charleston Division	Charleston, WV	Noon Conference – Environmental Aspects of Asthma Management
02-10-2012	Department of Pediatrics Marshall University School of Medicine	Huntington WV	Grand Rounds – Environmental Aspects of Asthma Management
02-10-2012	Department of Pediatrics Marshall University School of Medicine	Huntington WV	Noon Conference – Potential Health Impacts of Natural Gas Extraction
03-10-2012	MACCHE-EJ Project Community Forum	Washington, DC	Lead Poisoning

05-07-2012	Altoona Family Practice Residency Program	Altoona, PA	Noon Conference – Environmental Aspects of Asthma Management
06-05-2012	Delaware Department of Health Healthy Homes Conference	Newark, DE	Emerging Environmental Threats to Children
06-26-2012	Network for Public Health Law Eastern Regional Symposium	Baltimore, MD	Potential Health Impacts of Natural Gas Extraction
07-17-2012	Meeting at National Center for Healthy Homes (BLL Guidance discussion)	Washington, DC	Lead poisoning
09-06-2012	Briefing for D.C. City Council, Health Homes Issues (EJ Project)	Washington, D.C.	Environmental Justice
09-12-2012	McKeesport Family Practice Program	McKeesport, PA	Introduction to Children's Health & the Environment
09-21-2012	10th Annual MACCHE Meeting	Baltimore, MD	Climate Change & Children's Health
09-28-2012	West Virginia Worksite Wellness Conference	Daniels, WV	Healthy Homes
10-04-2012	Maryland Environmental Health Network	Baltimore, MD	Potential Health Impacts of Unconventional Natural Gas Extraction
11-13-2012	Department of Pediatrics, Hershey Medical Center	Hershey, PA	Potential Health Impacts of Unconventional Natural Gas Extraction
11-13-2012	Department of Pediatrics, Hershey Medical Center	Hershey, PA	Frequently Asked Questions in Children's Environmental Health
02-16-2013	Pennsylvania Chapter of the AAP	Webinar	AAP Policy Statement on Pesticides
02-27-2013	Resident Case Conference Children's National Medical Center	Washington, DC	Healthy Housing
02-21-2013	Leadership of Greater Washington	Washington, DC	Introduction to Children's Health & the Environment
03-07-2013	Children's National Health Network Asthma QI Group	Greater Washington, DC area	Environmental Management of Asthma
04-16-2013	Grand Rounds Lancaster General Hospital	Lancaster, PA	Lead Poisoning in the 21st Century
04-16-2013	Department of Family Medicine, Lancaster General Hospital	Lancaster, PA	Climate Change and Children's Health
05-01-2013	Department of Pediatrics	York, PA	Potential Health Impacts of
	York Hospital		Unconventional Natural Gas Extraction
05-01-2013	Mid-Atlantic Public Health Training Consortium	Washington, DC	Environmental Management of Asthma

05-11-2013	Delaware Nurses' Association	Newark, DC	Environmental Management of Asthma
05-11-2013	Delaware Nurses' Association	Newark, DC	An Introduction to Children's Health & the Environment & PEHSUs
05-29-2013	Mid-Atlantic Public Health Training Consortium	Washington, DC	An Introduction to Children's Health & the Environment
06-02-2013	Children's National Health Network Annual Meeting	Rockville, MD	Lead Poisoning in the 21st Century
06-11-2012	Community Asthma Prevention Program	Philadelphia, PA	Climate Change & Asthma
06-12-2013	Department of Pediatrics Alexandria Hospital	Alexandria, VA	Environmental Management of Asthma
06-25-2013	Children's National Teacher's Summer Institute	Washington, DC	Environmental Health Issues in Schools
08-05-2013	Chestnut Hill Hospital Family Practice	Philadelphia, PA (via webinar)	Environmental Health and the Home
08-19-2013	Bayada School Nurse Development Day	Philadelphia, PA	Environmental Health Issues in Schools
10-03-2013	Department of Pediatrics, INOVA Fairfax Hospital	Fairfax, VA	Asthma & the Home Environment
10-10-2013	Maryland Nurses' Association Annual Conference	Annapolis, MD	Lead Poisoning in the 21st Century
01-10-2014	Garrett County Memorial Hospital	Garrett County, MD	Potential Health Impacts of Unconventional Natural Gas Extraction
03-07-2014	Pennsylvania Chapter, American Academy of Family Practice	Hershey, PA	Potential Health Impacts of Unconventional Natural Gas Extraction
03-07-2014	Pennsylvania Chapter, American Academy of Family Practice	Hershey, PA	An Introduction to Children's Health & the Environment
03-12-2014	Delaware Department of Health Healthy Homes Conference	Newark, DE	Healthy Housing
03-14-2014	Department of Humanities, Pennsylvania State University School of Medicine	Hershey, PA	Potential Health Impacts of Unconventional Natural Gas Extraction
05-09-2014	West Virginia Chapter, American Academy of Pediatrics	Roanoke, WV	An Introduction to Children's Health & the Environment
05-17-2014	Alleghany General Hospital	Pittsburgh, PA	Environmental Aspects of Asthma Management
05-29-2014	Hospitalist Division, Children's National	Washington, DC	Inpatient Management of the Lead Poisoned Child

07-10-2014	Altoona (PA) Family Medicine Residency Program	Altoona, PA	Housing Environment and Impact on Children's Health
02-19-2015	Children's National Primary Care Residents	Washington, DC	An Introduction to Children's Health & the Environment
04-02-2015	Children's National Primary Care Residents	Washington, DC	An Introduction to Children's Health & the Environment
10-12-2015	American University School of Public Affairs	Washington, DC	An Introduction to Children's Health & the Environment
11-03-2015	Maryland State Medical Society Board Mtg	Baltimore, MD	Pesticides and Human Health
11-18-2015	Children's National Primary Care Residents	Washington, DC	An Introduction to Children's Health & the Environment
02-03-2016	Children's National Primary Care Residents	Washington, DC	An Introduction to Children's Health & the Environment
04-18-2016	Break the Cycle Meeting	Atlanta, GA	Environmental Justice in Practice
07-23-2016	AAP District Mtg	Annapolis, MD	PEHSUs & AAP Climate Change Initiative
08-05-2016	Alexandria Hospital Dept of Pediatrics	Alexandria, VA	Lead Poisoning in the 21st Century
08-07-2016	AAP District Mtg	Chattanooga, TN	PEHSUs & AAP Climate Change Initiative
08-14-2016	AAP District Mtg	San Diego, CA	PEHSUs & AAP Climate Change Initiative
10-10-2016	Children's National Primary Care Residents	Washington, DC	An Introduction to Children's Health & the Environment
12-05-2016	American University School of Public Affairs	Washington, DC	An Introduction to Children's Health & the Environment
02-02-2017	Children's National Primary Care Residents	Washington, DC	An Introduction to Children's Health & the Environment
10-02-2017	Children's National Primary Care Residents	Washington, DC	An Introduction to Children's Health & the Environment
10-09-2016	American University School of Public Affairs	Washington, DC	An Introduction to Children's Health & the Environment

b) National

Date	Organization	Location	Title of Presentation

06-11-2003	National Environmental Education and Training Foundation National Forum	Washington, DC	What is a Pediatric Environmental Health Specialty Unit?
04-19-2004	National Minority Health Leadership Summit	Washington, DC	Lead Poisoning in the 21st Century
06-23-2004	Indoor Environmental Health & Technology Conference	Orlando, FL	An Introduction to Children's Health & the Environment
09-21-2005	National Children's Study Federal Advisory Committee	Rockville, MD	Clinical Benefits of the National Children's Study
10-07-2005	12th Annual NY Conference on Lead Poisoning	Westchester, NY	An Introduction to Children's Health & the Environment
03-30-2006	Environmental Health & Technologies Conference	Orlando, FL	Asthma as an Environmental Health Problem
09-15-2010	CDC/AAMC Meeting Patients and Populations: Public Health in Medical	Cleveland, OH	Part of panel: Chronic Curricular Challenges: Environmental Health, Occupational Medicine, Global Health & Health Policy
10-15-2010	Ecological Society of America/National Education Association Ecology & Education Summit	Washington, DC	Part of Panel: Expanding Funding, Strengthening Public Policy
10-18-2010	Pediatric Environmental Health Specialty Units Annual Meeting	Washington, DC	The National Commission on Children & Disasters
10-19-2010	Joint Pediatric Environmental Health Specialty Unit – Environmental Health Research Center Meeting	Washington, DC	The Role of Pediatric Environmental Health Specialty Units
11-17-2010	University of West Virginia Medical Center Department of Occupational & Environmental Medicine	Morgantown, WV	Public Health Grand Rounds (National Webcast) - An Introduction to Children's Health & the Environment
11-18-2010	Healthy Schools Network	National webinar	Who's In-Charge of Environmental Health Issues in Schools
05-10-2011	American Association for Intellectual & Developmental Disabilities	Webinar	Who's In charge (of Children's Health & the Environment in Schools)?

06-09-2011	Uniformed Services University of the Health Sciences (USUHS), 25th Annual Pediatric/Pediatric Surgery Symposium	Bethesda, MD	An Introduction to Children's Health & the Environment
06-30-2011	National Association of School Nurses Annual Meeting	Washington, DC	Pediatric Environmental Health Specialty Units – A Resource for the School Nurse
09-24-2011	Union of Concerned Scientists National Advisory Board Meeting	Washington, DC	The Impact of Climate Change on Children's Health
11-01-2011	American Public Health Association Annual Meeting	Washington, DC	Session 33302 "How is the natural gas industry affecting communities in the Marcellus Session 4379.0
12-01-2011	National Library of Medicine	Bethesda, MD	Presentation to the Special Information Services Group on Pediatric Environmental Health Specialty Units
01-09-2012	Physicians, Scientists and Engineers for Healthy Energy	Arlington, VA	Opening Plenary Presentation – Why Are We Here?
01-09-2012	Physicians, Scientists and Engineers for Healthy Energy	Arlington, VA	Designing a Data Collection Instrument
05-02-12	ATSDR-GW meeting on Unconventional Gas Extraction	Washington, DC	Potential Health Impacts of Unconventional Gas Extraction
06-19-2012	National Council of Churches	National Webinar	Introduction to Children's Health & the Environment
08-06-2012	National Council of State Legislators	Chicago, Ill	Introduction to Children's Health & the Environment
12-05-2012	National Journal	Washington, DC	Legacy of the Clean Air Act
12-07-2021	Physicians, Scientists & Engineers for Healthy Energy	Video recording for posting on PSE website	Potential Health Impacts of Unconventional Gas Extraction
12-08-2012	Annual national meeting of Pediatric Environmental Health Fellows	Reston, VA	Potential Health Impacts of Unconventional Gas Extraction
01-08-2013	Annual meeting – Healthy Schools Network	Washington, DC	No One is in Charge of Children's Environmental Health in Schools
01-24-2013	11th Annual Ginandes' Lecture. Department of Pediatrics, Mt Sinai Medical Center	New York, NY	Potential Health Impacts of Unconventional Gas Extraction

02-13-2013	Grand Rounds, Department of Pediatrics, Stony Brook University	Stony Brook, NY	Lead Poisoning in the 21st Century
02-13-2013	Primary Care Faculty Group, Department of Pediatrics, Stony Brook University	Stony Brook, NY	The Home & Environmental Health
02-13-2013	4th year medical student rounds, Department of Pediatrics, Stony Brook University	Stony Brook, NY	Advocacy & Children's Environmental Health
09-12-2013	Pennsylvania Public Health Training Center	Webinar	Environmental Management of Asthma
09-17-2013	Noon Conference, Department of Pediatrics Maria Fareri Children's Hospital	Valhalla, NY	Advocacy in Pediatrics
09-18-2013	Grand Rounds, Department of Pediatrics Maria Fareri Children's Hospital	Valhalla, NY	Climate Change
10-27-2013	AAP National Conference	Orlando, FL	Potential Health Impacts of Unconventional Gas Extraction
10-29-2013	EPA Protecting Children's Health for a Lifetime: Environmental Health Research Needs Clinical Practice and Public Policy Meeting	Washington, DC	Chemical Management Policy: Into the Black Hole?
11-05-2013	American Public Health Annual Meeting	Boston, MA	Healthy learning places for children: Achieving justice and equity
12-04-2013	American Lung Association	Webinar	Air Pollution & Children's Health
04-28-2014	Center for Environmental Health	Webinar	Introduction to Children's Health and the Environment and Potential Health Impacts of Unconventional Gas Extraction
05-07-2014	Physicians for Social Responsibility	Webinar	Potential Health Impacts of Unconventional Gas Extraction
05-08-2014	National Nursing Centers Consortium	Webinar	The Home and Human Health
06-25-2014	NRDC, Harvard & MACCHE	Webinar	Air & Water Monitoring of Unconventional Natural Gas Extraction Sites

06-26-2014	NRDC, Harvard & MACCHE	Webinar	Air & Water Monitoring of Unconventional Natural Gas Extraction Sites
11-10-2015	Health Schools Network	Washington, DC	Children's Environmental Health in Schools
05-16-2016	Congressional Staff Briefing	Rayburn House Office Building, Washington, DC	Clean Drinking Water & Human Health
06-07-2016	Health Schools Network	Washington, DC	Children's Environmental Health in Schools
06-09-2016	EPA Tribal Science Meeting	Washington, DC	PEHSUs and Native American Health
06-22-2016	PEHSU Annual Meeting	Chicago, Il	Status of the PEHSU System
09-13-2016	Healthy Schools Network	Webinar	Lead in Water
10-26-2016	AAP	Elk Grove Village, IL	Climate Change Symposium
01-16-2017	Institute on Medicine as a Profession, Columbia University	New York, NY	Climate Change & Advocacy
04-23-2017	AAP Legislative Conference	Washington, DC	Climate Change & Advocacy
10-04-2017	John Rosen Memorial Lecture, Montefiore Medical Center, Albert Einstein College of Medicine	Bronx, NY	Climate Change & Advocacy

c) International

Date	Organization	Location	Title of Presentation
10-13-2004	Department of Pediatrics, Soroka Medical Center	Beer Sheva, Israel	An Introduction to Children's Health & the Environment
10-17-2004	Heschel Center for Environmental Learning & Leadership	Tel Aviv, Israel	An Introduction to Children's Health & the Environment
10-18-2004	Dana Children's Hospital, Sourasky Medical Center	Tel Aviv, Israel	An Introduction to Children's Health & the Environment
10-18-2004	Shatil Training Center	Haifa, Israel	An Introduction to Children's Health & the Environment & Advocacy
10-20-2004	Department of Pediatrics, Soroka Medical Center	Beer Sheva, Israel	Asthma & Air Pollution
10-21-2004	Israeli Association of Public Health Physicians	Binyamina, Israel	Keynote Address, Annual Meeting - An Introduction to Children's Health & the Environment & PEHSUs

10-22-2004	Israeli Association of Public Health Physicians	Binyamina, Israel	Panel Discussion – The Role of the Physician in Environmental Activism
10-26-2004	Department of Pediatrics, Soroka Medical Center	Beer Sheva, Israel	Ultraviolet Light Exposure
06-10-2007	International Network on Children's Health & the Environment	Vienna, Austria	Pediatric Environmental Health Specialty Units.
06-12-2007	International Network on Children's Health & the Environment	Vienna, Austria	The Use of the Internet for Children's Health & the Environment
05-23-2013	Gertrude's Children's Hospital – Paediatric Grand Rounds	Nairobi, Kenya	An Introduction to Children's Health & the Environment
07-12-2013	Blizzard Institute of Barts and The London School of Medicine & Dentistry	London, England	Should paediatricians be advocates for children's environmental health?
11-20-2013	International Network on Children's Health & the Environment	Jerusalem, Israel	Pediatric Environmental Health Specialty Units – A Global Model?
11-21-2013	International Network on Children's Health & the Environment	Jerusalem, Israel	Global Climate Change

12) **Service to Community** (P – paid; UP – unpaid; R – regional; N – national; I – international)

1977 to 1978 Consulting Pediatrician - Martin Luther King, Jr. Elementary School, Baltimore, Maryland (UR)

1978 - Present Occasional reviewer: Pediatrics, JAMA, Archives of Pediatrics & Adolescent Medicine, Academic (Ambulatory) Pediatric Association Journal, Archives of Environmental & Occupational Health, American Journal of Industrial Medicine, Environmental Health Perspectives and other journals (UN)

1980 - 1982 As chairman of the Accident Prevention Committee of the Ohio Chapter of the American Academy of Pediatrics, I was instrumental in having the Ohio Child Passenger Safety Law passed. (UR)

1981 - 1985 Member, Professional Advisory Board, National Safety Town Center, PO Box 39312, Cleveland, Ohio 44139 (UN)

1982 - 1985 Member, Cleveland Public Relations Committee, National Safety Town Center

1982 - 1985 Member, Ad hoc Committee on Child Health Services of Cuyahoga County Welfare Department (UR)

1982 External Grant Reviewer, The Hospital for Sick Children Foundation, Toronto, Ontario, Canada (UI)

1982 - 1985 Member, Professional Advisory Board, Cleveland Childbirth Education Association (UR)

1985 National Institutes of Health, National Institute of Child Health and Human Development, Grant Reviewer for Human Development, Grant Reviewer for Human Development and Aging - 3 (AHR-51) Study Section - Injury Prevention Grants, 12/2 - 4/1985 (UN)

1986 National Institutes of Health, National Institute of Child Health and Human Development, Observer at Workshop on Behavioral Research Toward Prevention of Childhood Injuries, September 10 - 12, 1986. (UN)

1987 - 1990 Department of Pediatrics, Georgetown University School of Medicine. Teaching (medical students and residents) and patient care in hospital-based pediatric practice. One-half day per week. (UR)

1989 National Institutes of Health, National Institute of Child Health and Human Development, Conference on Methodology: Standard Definitions for Childhood Injury Research. March 20 - 21, 1989. Group leader. (UN)

1990 Maternal and Child Health Bureau, Call to Action: Better Nutrition for Mothers, Children and Families. Washington, DC December 6 - 8, 1990. Representative of the American Academy of Pediatrics. (UN)

1991-1994 Washington Lawyers' Committee for Civil Rights Under Law, Advisory Committee on Childhood Lead Poisoning. (UR)

1992-1994 Health Advisory Committee, Congressman James Moran (D-8, Virginia), US House of Representatives. (UR)

1992 American Academy of Pediatrics, Ad Hoc task force to review the oncogenic potential of Vitamin K (UR)

1994-1997 Advisor to Health Pages. A consumer oriented health publication produced in several cities in the US. (UN)

1995 Steering Committee, Washington, DC Lead Summit, National Lead Information Center, Environmental Health Center, National Safety Council. (UR)

1995-2000 Advisor, George Washington University Student Chapter of Physicians for Social Responsibility (UR)

1997-1999 DC Coalition for Environmental Justice/DC Department of Human Services Lead Poisoning Prevention Bureau Speakers Bureau - instructor and volunteer (UR)

1998-1999 Steering Committee for the Environmental Wellness Initiative, National Environmental Education Foundation. (UN)

1998 Member, Benefits Working Group, National Drinking Water Advisory Council (NDWAC). US Environmental Protection Agency. (UN)

1999-present Member, Washington, D.C. Statewide Lead Screening Advisory Committee (UR)

2000 Liaison representative from the National Center on Environmental Health, CDC/USDHHS to Committee on Environmental Health, American Academy of Pediatrics (UN)

2002-2007 Member, Board of Directors, Washington, DC Lactation Center. (UR)

2007-2013 Member, Children's Health Protection Advisory Committee, US Environmental Protection Agency (UN)

2009-2012 Chair of Task Group for America's Children & the Environment (ACE) report

2007-2015 Member, Executive Committee of the Council on Environmental Health of the American Academy of Pediatrics (UN)

2009-2015 Chair of Executive Committee

2009-2012 Member, Environmental Health Working Group, City of Alexandria, VA (UR)

2009-2010 Member, Education and Communication Work Group, National Conversation on Public Health & Chemical Exposures, CDC/ATSDR (UN)

2010-2011 Member, Pediatric Medical Care Subcommittee, National Commission on Children & Disasters (UN)

2010-2011 Member, Metropolitan Washington Council of Governments Advisor Panel on Climate Change Adaptation (UR)

2011-2016 Editor, Journal of Health & Pollution (UI)

2012-2013 Member, Steering Committee, International Network on Children's Environmental Health meeting, Jerusalem, Israel

EXHIBIT C: STATEMENT OF PREVIOUS TESTIMONY WITHIN PRECEDING FOUR YEARS AS AN EXPERT AT TRIAL OR BY DEPOSITION

JEROME A. PAULSON, MD, FAAP

Based on my records, I provide this list of expert testimony given in the past four years:

2018

Kenneth Jefferson, Jr., et al. v. Mary Kaufman, et al., Case No.: 16SL-CC00879 (Circuit County of St. Louis County, 21st Judicial Circuit).

William Slaughter, et al. v. Jerald S. Friedman, et al., Case No.: 2011 CA 006976 B

2017

Turhan Brown v. Calomiris Group Ltd Partnership, Case No.: 2015 CA 009254 B (Superior Court of the District of Columbia).

2016

Delaware Riverkeeper Network, Clean Air Council, et al., v. Commonwealth of Pennsylvania, Department of Environmental Protection, and R.E. Gas Development, LLC., EHB Docket No.: 2014-142-B (Pennsylvania Environmental Hearing Board).

2015

Sarah Keener & Robert Green v. C. Jack Pearce, et al., Case No.: 24-C-14-001705 (Circuit Court for Baltimore City, 2016)
Mekayla Caruthers, et al. v. Gerald Orr, Case Number: 1622-CC09555

2014

Gregory Ash, Jr v. Albert A Sturdivant, et al., Case No. 24-C-12-004598 (Circuit Court for Baltimore City, 2014)

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