EARTHJUSTICE

Testimony in Support of HB 229
Pesticides – Use of Chlorpyrifos - Prohibition

Environment and Transportation Committee
Maryland House of Delegates
February 12, 2020

Chairman Barve and Members of the Committee,

Thank you for the opportunity to testify. My name is Tyler Smith. I am a scientist appearing on behalf of Earthjustice, the largest nonprofit, environmental law organization in the country. Earthjustice strongly supports **HB 229**, which would ban chlorpyrifos in Maryland.

EPA Proposed Banning Chlorpyrifos

In 2015, EPA concluded that using chlorpyrifos on food does not meet the federal safety standard of a "reasonable certainty of no harm" and proposed a ban.[1] This ban would have eliminated nearly all uses of this pesticide across the country.

EPA's conclusion is consistent with decades of scientific research. Indeed, almost 20 years ago, EPA banned home and garden uses of chlorpyrifos because studies indicated harm to children.[2] But at that time, EPA allowed the continued use of chlorpyrifos on our food and for other applications, such as pest control on turf grass at golf courses.

After years of further study, EPA's scientists concluded that there is no safe use of chlorpyrifos.[3] They reviewed thousands of studies and examined the hundreds of ways that chlorpyrifos may be used under current law. They found that all of these uses result in unsafe levels of exposure — even when handlers follow pesticide labels and wear personal protective equipment.[4]

EPA's scientists also found that the continued use of chlorpyrifos on food can harm those who eat the food. The uses on food expose infants to 93 times what the agency considers safe and expose children 1 to 2 years of age to 140 times what the agency considers safe.[5] Moreover, according to agency, there is no safe level of chlorpyrifos in drinking water.[6]

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EPA's scientists likewise found that using chlorpyrifos on turf grass at golf courses puts the adults and children who visit these courses at risk.[7] Their analysis indicates that exposures to chlorpyrifos on golf courses are hundreds of times what the agency believes is safe.[8]

EPA's Proposal to Ban Chlorpyrifos Followed a Rigorous Process

EPA's conclusions followed years of careful study. The evidence that exposure to chlorpyrifos harms children[9] was reviewed again and again by EPA's scientists and by independent experts who serve on the agency's Scientific Advisory Panel. The agency and the Panel found that the weight of the evidence — that is, the best available science weighed and judged by experts — supports the conclusion that chlorpyrifos is a neurodevelopmental toxicant. Specifically:

- In 2012, the Panel concluded that epidemiologic and animal studies "suggest that chlorpyrifos can affect neurodevelopment at levels lower than those associated with" acute poisoning.[10]

- In 2016, the Panel stated, "The Panel agrees that both epidemiology and toxicology studies suggest there is evidence for adverse health outcomes associated with chlorpyrifos exposures below levels that result in" acute poisoning.[11]

- In 2016, EPA wrote, "The agency agrees with the 2016 [Panel] (and previous [Panels]) that there is a potential for neurodevelopmental effects associated with chlorpyrifos exposure to occur at levels below" those associated with acute poisoning.[12]

In short, even low levels of exposure to chlorpyrifos can harm the developing brain.

The Panel praised a study of chlorpyrifos exposure in children conducted by scientists at Columbia University. The Panel stated, "the Columbia study is the most robust and appropriate for informing risk assessment", "the Columbia study is epidemiologically sound", and "the Columbia study was indeed quite strong and provided extremely valuable information."[13]

The Panel also concluded that the results of the Columbia study were generally consistent with those reached by other scientists across the country. The Panel stated that, overall, epidemiologic studies have found "consistent associations relating exposure measures to abnormal reflexes in the newborn, pervasive development disorder at 24 or 36 months, mental development at 7-9 years, and attention and behavior problems at 3 and 5 years of age."[14]

Yet, despite these studies and the conclusions of experts, in March 2017, the Trump administration announced that it would not finalize the proposed ban.[15] The administration did not present any new scientific evidence. It disregarded the best available science and left millions of people exposed to a toxic chemical.

Any Possible Federal Action to Ban Chlorpyrifos Has Been, and Likely Will Continue to be, Delayed by Litigation

A coalition of environmental, health, labor, and civil rights organizations has sued the Trump administration, challenging its refusal to ban chlorpyrifos.[16] In August 2018, a federal appeals court ordered the administration to ban all uses of chlorpyrifos, but the agency appealed further.[17] The litigation is ongoing and may continue for years.

For more than two years, EPA political appointees did not even try to dispute the conclusions reached by agency scientists and instead based their legal arguments on unrelated procedural issues. As a federal court observed in August 2018, "The EPA presents no arguments in defense of its decision. Accordingly, the EPA has forfeited any merits-based argument."[18]

There simply is no debate about the science of chlorpyrifos — except from the people who make money off chlorpyrifos. But unless Maryland takes action, chlorpyrifos will remain on the market and people here will remain exposed while the federal litigation continues. Given the tactics available to the Trump administration, it may take years to resolve all of the potential litigation even if the plaintiffs ultimately prevail.

Maryland Farmers Have Less Toxic Alternatives

Maryland farmers and businesses have alternatives to chlorpyrifos. These include less toxic options for controlling borers and spotted lantern fly at orchards, cabbage maggots and onion maggots at vegetable farms, and annual bluegrass weevil on turf grass at golf courses.[19] To the extent a ban would present challenges to growers, the best response is to assist their transition to safer production methods, not to continue jeopardizing children's health.

Maryland Should Ban Chlorpyrifos Now

Frankly, we should not be here today. In 2015, EPA concluded that chlorpyrifos did not meet the federal safety standard and proposed to ban this toxic pesticide. The agency should have finalized the proposed ban, and that should have been the end of it.

Politics, pure and simple, stands in the way. It is only because the Trump administration has abandoned science and abdicated its responsibility to public health that Maryland and other states now must consider bills to prohibit the use of chlorpyrifos. But we *should* take action.

HB 229 would prohibit the use of chlorpyrifos and make this state a safer place for kids to live. I urge your support and am happy to answer your questions. Thank you.

References

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[1] EPA wrote, "At this time, the agency is unable to conclude that the risk from aggregate exposure from the use of chlorpyrifos meets the safety standard of [a "reasonable certainty of no harm" contained in] section 408(b)(2) of the Federal Food, Drug, and Cosmetic Act (FFDCA). Accordingly, EPA is proposing to revoke all tolerances for chlorpyrifos." Chlorpyrifos; Tolerance Revocations, 80 Fed. Reg. 69,080 (November 6, 2015), https://www.federalregister.gov/documents/2015/11/06/2015-28083/chlorpyrifos-tolerance-revocations.

[2] As EPA explained, "This action comes after completing the most extensive scientific review of the potential hazards from a pesticide ever conducted. This action -- the result of an agreement with the manufacturers -- will significantly minimize potential health risks from exposure to Dursban, also called chlorpyrifos, for all Americans, especially children." EPA, Dursban Announcement (2000), https://archive.epa.gov/epa/aboutepa/dursban-announcement.html.

[3] EPA wrote, "[A]ll agricultural occupational handler scenarios, all primary seed treatment handler scenarios, and all secondary seed treatment (planter) scenarios are of concern with label-specified and maximum levels of personal protective equipment (PPE) or engineering controls[.]" EPA, Chlorpyrifos: Revised Human Health Risk Assessment for Registration Review 7 (2016), https://www.regulations.gov/document?D=EPA-HQ-OPP-2015-0653-0454.

[4] *Id*.

[5] *Id*. at 23.

[6] *Id*. at 24.

[7] EPA wrote, "All residential post-application exposure scenarios assessed for playing golf on chlorpyrifos-treated courses, including all relevant populations and in consideration of all TTR data state sites, result in risks of concern (i.e., MOEs are < 100)." EPA, *supra* note 3 at 27.

[8] *Id*. In EPA's risk assessment, the factor by which exposure at a golf course exceeded the safe level ranged from 373 to 923. The factor may be calculated from inputs in EPA's risk assessment as follows: Factor = Dose / (Point of Departure / Uncertainty Factor), where Dose is given by Table 7.2.2, Point of Departure is given by Table 5.3.3.3, and Uncertainty Factor is stated on page 5.

[9] For recent reviews of the evidence that chlorpyrifos harms children, *see* Irva Hertz-Picciotto, Jennifer B. Sass, Stephanie Engel, *et al.*, Organophosphate Exposures During Pregnancy and Child Neurodevelopment: Recommendations for Essential Policy Reforms, 15 *PLoS Medicine* e1002671 (2018), https://journals.plos.org/plosmedicine/article/file?id=10.1371/journal.pmed.1002671&type=printable; Maria Teresa Munoz-Quezada, Boris A. Lucero, Dana B. Barr, *et al*., Neurodevelopmental Effects in Children Associated with Exposure to Organophosphate Pesticides: A Systematic Review, 39 *NeuroToxicology* 158 (2013), https://www.sciencedirect.com/science/article/pii/S0161813X13001514.

[10] EPA, Transmittal of Meeting Minutes of the FIFRA Scientific Advisory Panel Meeting held April 10-12, 2012 on "Chlorpyrifos Health Effects" 53 (2012), https://www.epa.gov/sites/production/files/2015-06/documents/041012minutes.pdf.

[11] EPA, Transmittal of Meeting Minutes of the April 19-21, 2016 FIFRA SAP Meeting Held to Consider and Review Scientific Issues Associated with "Chlorpyrifos: Analysis of Biomonitoring Data" 18 (2016), https://www.epa.gov/sites/production/files/2015-06/documents/041012minutes.pdf.

[12] Chlorpyrifos; Tolerance Revocations; Notice of Data Availability and Request for Comment, 81 Fed. Reg. 81,049, 81,050 (November 17, 2016), https://www.federalregister.gov/documents/2016/11/17/2016-27552/chlorpyrifos-tolerance-revocations-notice-of-data-availability-and-request-for-comment.

[13] EPA, Transmittal of Meeting Minutes of the FIFRA Scientific Advisory Panel Meeting Held September 16-18, 2008 on the Agency's Evaluation of the Toxicity Profile of Chlorpyrifos 31, 32, 35 (2012), https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0274-0064.

[14] EPA, *supra* note 10 at 17.

[15] Eric Lipton, "E.P.A. Chief, Rejecting Agency's Science, Chooses Not to Ban Insecticide," *The New York Times* (March 29, 2017), https://www.nytimes.com/2017/03/29/us/politics/epa-insecticide-chlorpyrifos.html.

[16] The organizations are: Pineros y Campesinos Unidos del Noroeste, League of United Latin American Citizens, United Farm Workers, Farmworker Association of Florida, Labor Council for Latin American Advancement, Farmworker Justice, GreenLatinos, National Hispanic Medical Association, Learning Disability Association of America, California Rural Legal Assistance Foundation, Pesticide Action Network North America, and Natural Resources Defense Council. For more information, *see* Earthjustice, Groups Appeal EPA's Refusal to Ban Dangerous Pesticide (June 6, 2017), https://earthjustice.org/news/press/2017/groups-appeal-epa-s-refusal-to-ban-dangerous-pesticide.

[17] League of United Latin American Citizens et al. v. Wheeler (2018), https://earthjustice.org/sites/default/files/files/chlorpyrifos%20opinion%208.9.2018.pdf.

[18] *Id*. at 30.

[19] Please contact me for a summary of information obtained from state extensions in the Northeast.

DECEMBER 10, 2019
Albany, NY

Governor Cuomo Directs DEC to Ban the Use of Chlorpyrifos

DEC Will Take Immediate Action to Ban Aerial Use of Chlorpyrifos

Regulations to Ban Chlorpyrifos Will be in Effect by December 2020 for all Uses Except Spraying Apple Tree Trunks, Which Will be Banned by July 2021

New Restrictions on Pesticide Will Protect New Yorkers from Significant Adverse Public Health Impacts, Especially for Children

Governor Andrew M. Cuomo today directed DEC to take immediate action to ban aerial use of chlorpyrifos. DEC will also have regulations in place to ban chlorpyrifos for all uses, except spraying apple tree trunks, by December 2020. Chlorpyrifos will be banned for all uses by July 2021. These actions will protect New Yorkers from significant adverse public health impacts, especially for children.

"Chlorpyrifos is a pesticide that has the potential to cause serious health problems in people who ingest it," **Governor Cuomo said**. "I am directing the state department of environmental conservation to ban the use of this toxic substance to help ensure New York families aren't needlessly exposed to a dangerous chemical."

While organophosphate pesticide chlorpyrifos has been banned for residential use since 2001, it is still currently approved for use in fifty different products, the majority of which are registered for use in agricultural production. The largest agricultural market for chlorpyrifos in terms of total pounds of active ingredient is corn. It is also used on soybeans, fruit and nut trees, Brussels sprouts, broccoli, and cauliflower, seed treatments, as well as other row crops. Non-agricultural uses include golf courses, turf, green houses, and on non-structural wood treatments such as utility poles and fence posts. Scientific research has shown that chlorpyrifos can harm the development of nervous systems of infants and young children. Prenatal exposure to organophosphates can result in diminished cognitive ability, delays in motor development and Attention Deficit/Hyperactivity Disorder (ADHD).

Chlorpyrifos is in some cases the only product available labeled for use against certain pests. It is particularly effective against the American plum borer and rosy apple aphid. Chlorpyrifos can also be used in rotation with other methods of pest management, such as treated seeds, as a means to manage pesticide resistance. As New York and nearby states are infiltrated by invasive species, such as the black stem borer, pest management tools are needed to prevent their spread and the ensuing damage.

The application of pesticides must be done in a manner that is protective of public health and the environment and New York State is one of a few states in the country with a regulatory program designed specifically to review and register pesticides, implement regulatory controls, and enforce worker protection standards. State law affords DEC with a broad range of regulatory powers including the ability to restrict the use of a pesticide to certain crops, limit application to specific conditions, and revocation of a product's registration.

Contact the Governor's Press Office
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Agreement Reached to End Sale of Chlorpyrifos in California by February 2020

Use in agriculture to be prohibited after next year

Alternatives to Chlorpyrifos Work Group to hold public meeting in January

For Immediate Release:
October 9, 2019

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SACRAMENTO – The California Environmental Protection Agency announced today that virtually all use of the pesticide chlorpyrifos in California will end next year following an agreement between the Department of Pesticide Regulation (DPR) and pesticide manufacturers to withdraw their products.

"For years, environmental justice advocates have fought to get the harmful pesticide chlorpyrifos out of our communities," said Governor Gavin Newsom. "Thanks to their tenacity and the work of countless others, this will now occur faster than originally envisioned. This is a big win for children, workers and public health in California."

"The swift end to the sale of chlorpyrifos protects vulnerable communities by taking a harmful pesticide off the market," said California Secretary for Environmental Protection Jared Blumenfeld. "This agreement avoids a protracted legal process while providing a clear timeline for California farmers as we look toward developing alternative pest management practices."

Earlier this year, DPR announced it was acting to ban use of chlorpyrifos by canceling the pesticide's product registrations. The decision follows mounting evidence that chlorpyrifos is associated with serious health effects in children and other sensitive populations at lower levels of exposure than previously understood, including impaired brain and neurological development.

At the same time, DPR and the California Department of Food and Agriculture (CDFA) have established a cross-sector working group to identify, evaluate and recommend safer, more sustainable pest management alternatives to chlorpyrifos. It will hold its first meeting this month and will hold three public workshops beginning in January.

The agreement with Dow AgroSciences and other companies means that use of chlorpyrifos will end sooner than anticipated had the companies pursued administrative hearings and potential appeals process, which could have taken up to two years. Under the settlement, the companies agreed that:

- All sales of chlorpyrifos products to growers in California will end on Feb. 6, 2020.
- Growers will no longer be allowed to possess or use chlorpyrifos products in California after Dec. 31, 2020.
- Until then, all uses must comply with existing restrictions, including a ban on aerial spraying, quarter-mile buffer zones and limiting use to crop-pest combinations that lack alternatives. DPR will support aggressive enforcement of these restrictions.

To ensure consistency for growers and for enforcement purposes, DPR is applying the terms and deadlines in the settlements to seven other companies that are not part of the settlement agreement but are subject to DPR's cancellation orders.

A few products that apply chlorpyrifos in granular form, representing less than one percent of agricultural use of chlorpyrifos, will be allowed to remain on the market. These products are not associated with detrimental health effects. DPR will continue to monitor for any exposures associated with these products. The development of safe, more sustainable alternatives to chlorpyrifos is being supported through the current state budget, which appropriates more than $5 million in grant funding for the purpose.

- DPR will award more than $2.1 million in grants to fund projects that identify, develop, and implement safer, practical, and sustainable pest management alternatives to chlorpyrifos.
- CDFA will award approximately $2 million in grants to expand outreach about innovative, biologically integrated farming systems that reduce chemical insecticide inputs. Crops that have used chlorpyrifos will be a priority.
- CDFA will also fund approximately $1.5 million in research to develop alternatives to chlorpyrifos that provide safer, more sustainable pest management solutions.

Quick facts:

- Chlorpyrifos is used to control pests on a variety of crops, including alfalfa, almonds, citrus, cotton, grapes and walnuts. It has declined in use over the past decade as California growers have shifted to safer alternatives.
- Use of the pesticide dropped more than 50 percent from two million pounds in 2005 to just over 900,000 pounds in 2017.
- In 2015, DPR designated chlorpyrifos as a "restricted material" that requires a permit from the county agricultural commissioner for its application. In addition, application of chlorpyrifos must be recommended by a licensed pest control advisor and supervised by a licensed certified applicator.
- Following DPR's designation of chlorpyrifos as a toxic air contaminant in 2018, DPR recommended that county agricultural commissioners apply additional permit restrictions, including a ban on aerial spraying, quarter-mile buffer zones and limiting use to crop-pest combinations that lack alternatives.

# # #

February 10, 2020

The Honorable Paul G. Pinsky
Senator
Miller Senate Office Building, 2 West Wing
11 Bladen Street
Annapolis, MD 21401

The Honorable Kumar P. Barve
Delegate
House Office Building, Room 251
6 Bladen Street
Annapolis, MD 21401

Re: SB 300 / HB 229; Pesticides – Use of Chlorpyrifos – Prohibition
Scientific Evidence of the Relationship Between Prenatal Exposure to Chlorpyrifos and Neurodevelopmental Harm in Children

Dear Chairman Pinsky and Chairman Barve,

We are scientists and health professionals with expertise in toxic chemicals that harm the developing brain. Many of us are affiliated with Project TENDR, a collaboration of leading scientists, health professionals, and children's health and environmental advocates who came together out of concern over the substantial evidence linking toxic chemicals to neurodevelopmental disorders, such as autism spectrum disorder, attention deficits, hyperactivity, intellectual disability, and learning disorders.[1]

In 2016, Project TENDR published a consensus statement that reviewed the scientific evidence and identified organophosphate pesticides, such as chlorpyrifos, as prime examples of chemicals that contribute to intellectual impairments and specific neurodevelopmental disorders.[2] There is clear evidence that the continued use of chlorpyrifos is harmful to brain development, with persistent consequences.

Many studies in the United States and other countries, spanning diverse populations in both urban and agricultural settings, have linked low-level exposure to chlorpyrifos and other organophosphates during pregnancy with poorer cognitive, behavioral, and social development in children.[3,4,5] In one review, adverse effects on neurodevelopment were seen in all but one of the 27 studies evaluated.[6]

The toxic effects of organophosphate pesticides include abnormal reflexes in newborns; mental and psychomotor delays in preschoolers; and decreases in working and visual memory, processing speed, verbal comprehension, perceptual reasoning, and IQ in elementary school-age children. These pesticides are associated with symptoms or diagnoses of attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorder. A study has identified changes in the brain structure of children exposed to chlorpyrifos in the womb, and these changes are consistent with neurodevelopmental deficits reported previously.[7] In many of these studies, there was no evidence of a threshold or "safe" level of exposure.

In addition to the epidemiologic findings in children, effects on cognition, motor activity, and social behaviors were repeatedly demonstrated in rodents dosed with low levels of chlorpyrifos and other organophosphates in early life.[8,9] The weight of the scientific evidence clearly indicates that chlorpyrifos is a neurodevelopmental toxicant.

Importantly, the developmental toxicity of chlorpyrifos occurs at levels of exposure that do not cause acute poisoning.[10] The absence of poisoning symptoms does *not* mean that neurologic damage has not occurred.[11] As explained above, the developmental effects do not manifest until months or years after prenatal exposure. The evidence therefore indicates that chlorpyrifos can interfere with brain development at levels previously thought to be safe.

In 2016, US EPA concluded that exposure to chlorpyrifos from food or drinking water could lead to unacceptably high exposures and determined that some reproductive-aged women, infants, and children consume levels of chlorpyrifos on food that are substantially above what the agency deemed an acceptable level for these vulnerable life stages.[12] The agency reviewed hundreds of uses of chlorpyrifos and determined that all of them could result in unsafe exposures for agricultural workers.[13]

US EPA concluded that chlorpyrifos does not meet the federal safety standard of a "reasonable certainty of no harm" and proposed banning uses of chlorpyrifos on food crops.[14] This would have eliminated nearly all of the remaining uses of this pesticide. However, in March 2017, despite the overwhelming evidence of harm and US EPA's own conclusions, the Trump administration announced that it would not ban any uses of chlorpyrifos.[15] It is unfortunate that US EPA did not finalize the proposed ban. However, states can act to protect children where the federal government has stalled.

For additional information, please see a review of the scientific evidence that organophosphates harm child neurodevelopment, which was published in October 2018 by eight scientists affiliated with Project TENDR.[16] This letter draws primarily from that review. If you have any questions, please contact Maureen Swanson, MPA, Co-Director, Project TENDR, at swanson@thearc.org.

Sincerely,

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References

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Re: HB 229– Pesticides –Use of Chlorpyrifos - Prohibition
Submitted to: The Maryland House of Delegates Environment and Transportation Committee
Position: In support of HB 229

Chairman Barve and members of the committee,

I am an Assistant Professor with the Maryland Institute for Applied Environmental Health and the Department of Epidemiology and Biostatistics within the University of Maryland School of Public Health. My areas of expertise are children's environmental health, risk assessment and environmental health policy. Prior to joining the faculty at the School of Public Health, I worked for the U.S. Environmental Protection Agency for 12 years. While at U.S. EPA, I managed the human health extramural research portfolio that included cohort studies on how environmental factors, including organophosphate pesticides (OP) such as chlorpyrifos, affect children's health. I refer to this research, which was reviewed by EPA's FIFRA Scientific Advisory Panel (SAP), in my testimony. In addition, I have conducted my own research assessing the neurodevelopmental risks to children from cumulative exposures to OP pesticides.

I am providing this written testimony as an environmental health expert and in my role as a member of Project TENDR (Targeting Environmental Neuro-Developmental Risks). TENDR is an alliance of more than 50 leading scientists, health professionals, and children's health advocates with expertise on chemicals and brain development. In 2016, TENDR published a Consensus Statement as a national call to action to significantly reduce exposures to chemicals, including chlorpyrifos and other OP pesticides, that are contributing to neurodevelopmental disorders in America's children (Bennett et al., 2016). Project TENDR concluded that the evidence of significant risks to children's neurodevelopment from exposure to chlorpyrifos and other OPs pesticide warrants strong regulatory action. The TENDR consensus statement (see attached) is supported by leading health care, medical, scientific organizations such as the American College of Obstetricians and Gynecologists, the American Public Health Association, the American Nurses Association, and the National Medical Association.

Consistent with the TENDR recommendations, I strongly support the passage of House Bill 229 to ban all uses of chlorpyrifos in the State. I believe that this bill is essential to help protect the health of Maryland's most vulnerable populations, pregnant women and children.

The main points I will cover briefly are the following: 1) scientific evidence accumulated over nearly two decades that shows chlorpyrifos is a powerful developmental neurotoxicant; 2) EPA's 2016 Revised Human Health Risk assessment for Chlorpyrifos documents that current levels chlorpyrifos exposures from food and drinking water are unsafe for pregnant women and children and 3) Maryland's children deserve "reasonable certainty of not harm".

Chlorpyrifos is a powerful developmental neurotoxicant. Exposures to even very low doses of chlorpyrifos during critical windows over pregnancy can result in child cognitive problems and motor delays (Rauh et al., 2006, 2011, 2015; Whyatt et al. 2005). Further, effects appear to be persistent and potentially life-long. Specifically, chlorpyrifos in umbilical cord blood at birth has been associated with mental and motor delays in preschool age children; with reductions in IQ and working memory when the children reach elementary school age; and with moderate to mild hand tremor hand tremors among the children at age 11 years. The association with reductions in working memory are of particular concern as working memory skills in the elementary school years are a strong predictor of learning outcomes and academic achievement

in later years *(*Alloway et al. 2010). Higher versus lower umbilical cord chlorpyrifos concentrations was also associated with maternal report of behavioral problems including attention, ADHD and pervasive developmental disorders (Rauh et al., 2006). Further, application of chlorpyrifos to agricultural fields within 1.5 km of the home during pregnancy has been associated with an increased incidence of autism spectrum disorders in a recent study (Shelton et al., 2014). It should be noted that pregnant women and children living near agricultural fields as well as children of farmworkers are exposed to chlorpyrifos through drift and volatilization (Coronado et al. 2011; Bradman et al., 2005; Thompson et al., 2014; Wofford et al., 2014; Calvert et al., 2008). Additionally, in a pilot study high versus low umbilical cord chlorpyrifos concentrations were associated with changes in brain volume measured using magnetic resonance imaging among children at ages 6-11 years (Rauh 2012). The changes were seen in regions of the brain responsible for attention, receptive language processing, social cognition, and regulation of inhibition. The neuroanatomic alterations may constitute a pathway from pesticide exposure to the associated behavioral and cognitive deficits.

The epidemiologic results are consistent with data from toxicological studies which found disruption in neuronal development, neurotransmitter systems and synaptic formation as well as behavioral and cognitive impairments in test animals following low-dose perinatal chlorpyrifos exposure (Slotkin 2004; Aldridge et al. 2004, 2005; Slotkin and Seidler, 2005, Levin et al 2001; Roy et al., 2004; Garcia et al., 2002).

Current levels of chlorpyrifos residues in fruits, vegetables, and drinking water are unsafe. In 2016, the U.S. EPA carefully and thoughtfully followed the recommendations of its FIFRA Scientific Advisory Panel (SAP) and improved the risk assessment for chlorpyrifos to account for prenatal exposures that result in adverse neurodevelopmental effects. The SAP concluded that the negative effects seen in children across multiple studies were occurring below a dose that causes acetylcholinesterase **(**AChE) inhibition in adults (EPA 2014, 2016). The SAP agreed that these effects were also supported by animal (toxicological) studies. EPA's 2016 revised human health risk assessment uses neurodevelopmental effects as the critical effect, taking into account the SAP recommendations on deriving a point of departure, a level of chlorpyrifos exposure in blood that is considered protective for children's neurodevelopment, for estimating risk. (EPA 2016) In comparing target risk level to protect the developing brains and nervous systems of children, EPA concluded that the current residues (amount) of chlorpyrifos on fruits and vegetables regularly consumed by women and children, as well as concentrations in drinking water were above "acceptable levels". The analysis found that current exposures are at 62 times above acceptable levels for women of reproductive ages and 140 times acceptable levels for young children. Additionally EPA confirmed that chlorpyrifos is estimated to be at unsafe levels in air in residential areas adjacent to agricultural fields because of spray drift from pesticide applications. Following the requirements under the federal Food Quality Protection Act, EPA concluded that all food tolerances should be banned and therefore agricultural uses of chlorpyrifos should be eliminated.

Maryland's children deserve "reasonable certainty of no harm." Children experience greater exposure to organophosphate pesticides due to their increased hand-to-mouth action, and relative to adults they eat more fruits and vegetables, drink more, and breathe more. The 1996 Food Quality Protection Act specifically requires EPA to take into account specific risks to infants and children, including the developing fetus, when setting standards. In setting or revising tolerances for pesticides in food, EPA must determine that "there is a reasonable certainty that no harm will result from aggregate exposure to the pesticide chemical residue, including all anticipated dietary exposures and all other exposures for which there is reliable information."

Although the 9th Circuit Court of Appeals has ordered U.S. EPA to "to revoke all tolerances and cancel all registrations for chlorpyrifos" based on the scientific evidence and requirements under the law, U.S. EPA's appeal of this ruling will likely mean a resolution will not be reached for years. Maryland should act now on the mounting evidence of neurodevelopmental risk following chlorpyrifos exposures and the EPA 2016 risk assessment that exposure to pregnant women and children are well above levels of health concern and thus should enact HB 229 to eliminate all uses of chlorpyrifos in order to ensure "reasonable certainty of no harm" and protect all of Maryland's children.

In closing, chlorpyrifos is an organophosphate insecticide, a member of class of chemicals deliberately engineered to be toxic to the brain and nervous system. **Twenty years ago**, chlorpyrifos was banned from residential use because exposure from residential use, particularly to children, was determined by the U.S. EPA to be above safe levels.(Browner 2000) Yet it still widely today used on fruits and vegetables and other crops across the U.S. and in Maryland specifically and the use has resulted in concentrations in both food and drinking water that are not safe for pregnant women and children and to substantial exposures to women and children from air contamination resulting from volatilization off agricultural fields. I strongly urge Maryland General Assembly to pass HB 229 to provide needed protection of Maryland residents.

Respectfully,
Devon Payne-Sturges, DrPH
Assistant Professor

Addendum: Regarding length of time it took EPA to propose revocation of all remaining uses of chlorpyrifos in 2015 and 2016. I am well versed on the issue given my work at EPA and specifically my work on chlorpyrifos and other organophosphates as noted in my submitted testimony.

It is important to put the 16 year timeframe for chlorpyrifos into perspective by comparing to other pesticide revocation decisions. EPA has banned only 141 (less than 1%) of about 16,000 registered pesticides. Here are timelines from first limitations on use to cancellation of all approved uses for a few example pesticides that are currently banned: DDT (14 years); Chlordane (10 years); 1,2-Dibromo-3-chloropropane (8 years); and Sodium Fluoroacetate (18 years). DDT is probably the most well-known among these examples. In 1958, USDA began to phase out the department's own use of DDT. But it was Rachel Carson's 1962 book *Silent Spring* that brought the public's attention to the harms caused by DDT. From that point, specific uses for DDT were cancelled overtime until in 1972, when EPA canceled all remaining crop uses of DDT in the United States. EPA was sued by manufacturers of DDT and but prevailed in federal court.

Chlorpyrifos followed a similar path. In 2000, EPA entered a negotiated settlement with the manufacturers of chlorpyrifos to end uses deemed the most harmful to children (e.g. in-home use) but allowed other uses deemed to be less harmful (e.g. in agriculture) to continue. This was, in my opinion, response to pressure from the manufactures so they could continue selling their product. However, in 2007 a petition was filed by the Pesticide Action Network and the Natural Resources Defense Council against EPA seeking a ban on chlorpyrifos based on the growing evidence of risks and harms to children's brains. EPA delayed in responding to this petition and instead used the time to seek advice from the FIFRA Scientific Advisory Panel (SAP) on review of the science. When EPA began to review the studies correlating chlorpyrifos exposures with damage to children's brains in response to the 2007 petition, it found such a correlation. It submitted its analysis to EPA's SAP on multiple occasions beginning in **2008,** and each time, the SAP confirmed EPA's conclusion that early life exposures to chlorpyrifos pose a risk of long-lasting, adverse cognitive, behavioral, and motor impairments. And both EPA and the SAP found that the exposures associated with **serious damage to children's brains were far below the regulatory endpoint used by EPA in its 2001 and 2006 re-registration determinations** which established the chlorpyrifos tolerances currently in effect.

In July 2011, EPA released its Preliminary Human Health Risk Assessment, which confirmed the need to address drift, volatilization, and health impacts to children at low doses. The assessment expressed concern

that current tolerances may not afford sufficient protection to children from drinking water. *(EPA, Reader's Guide to the Preliminary Human Health Risk Assessment for Chlorpyrifos at 1-3 July 1, 2011; EPA-HQ-OPP-2008-0850-0027.*

In 2012, EPA convened its SAP to review EPA's more comprehensive analysis of the neurotoxicity of chlorpyrifos. In its report, the SAP noted significant, long-term adverse effects on neurobehavioral development from chlorpyrifos in laboratory animal studies. It found that the epidemiology "studies show some consistent associations relating exposure measures to abnormal reflexes in the newborn, pervasive

development disorder at 24 or 36 months, mental development at 7-9 years, and attention and behavior problems at 3 and 5 years of age.") The Panel concurred with EPA and the 2008 SAP that "chlorpyrifos likely plays a role in impacting the neurodevelopmental outcomes examined in the three cohort studies, drift exposures, particularly infants. (https://www.regulations.gov/document?D=EPA-HQ-OPP-2012-0040-0029)

Seven years after the original petition by Pesticide Action Network and Natural Resources Defense Council and following several lawsuits and delays, EPA had still not acted on the petition. In September 2014, on behalf of PAN and NRDC, Earthjustice filed a petition in the 9th Circuit Court of Appeals to compel EPA to act on the petition.

2014: **In December 2014, EPA released its *Revised Human Health Risk Assessment*** *for Chlorpyrifos ("2014 RHHRA")* and acknowledged the strong convergence in the findings from the animal studies and the three mother-child cohort studies. It found that the laboratory animal studies indicated "that gestational and/or postnatal exposure may cause persistent behavioral effects into adulthood ...upon review of the published literature a pattern of neurodevelopmental adverse outcomes emerges." It called the cohort studies strong studies which **support a conclusion that chlorpyrifos causes long-lasting damage to children's brains at exposures lower than EPA's regulatory endpoint**. The 2014 risk assessment also documented unsafe chlorpyrifos exposures from drinking water contamination. *(Chlorpyrifos: Revised Human Health Risk Assessment for Registration Review; Dec. 29, 2014 ; EPA- HQ-OPP-2008-0850-0195).*

The following year, while criticizing EPA's delays, the 9th Circuit Court of Appeals court ordered EPA to issue a final response to the petition by October 31, 2015.

2015: In 2015, EPA proposed to revoke all chlorpyrifos tolerances based on the findings from the 2014 risk assessment (Nov. 6, 2015). In the proposed revocation rule, EPA explicitly and repeatedly found chlorpyrifos unsafe.

EPA recognized that its 2014 risk assessment and 2015 proposed tolerance revocation did not address the greatest risks and most sensitive endpoint, as EPA policy requires and therefore, continued to explore ways to establish an exposure limit that would protect children from neurodevelopmental harm. Each method it explored revealed more serious risks from chlorpyrifos than the 2014 risk assessment.

2016: In November 2016, EPA released its second revised human health risk assessment using a regulatory endpoint designed to guard against damage to children's brains**. That risk assessment found unsafe exposures from every way that people come into contact with chlorpyrifos—on food, in drinking water, through pesticide drift, and from applying the pesticide or working in fields that had recently been sprayed. EPA indicated it had found no chlorpyrifos uses that meet the FQPA safety standard and all chlorpyrifos tolerances would need to be revoked.** *(Revised Human Health Risk Assessment for Registration Review; Nov. 3, 2016; EPA- HQ-OPP-2015-0653-0454)*

In summary, the delays on chlorpyrifos are related to industry pressure, the EPA Office of Pesticide Programs pursuing multiple reviews of the science before responding to petitions, court involvement and slow acceptance by EPA's Office Pesticide Programs that indeed acetylcholinesterase inhibition in adults, the

regulatory endpoint used by EPA in its 2001 and 2006 re-registration determinations, was not protective of children's neurodevelopment.

Respectfully,

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A Section 508–conformant HTML version of this article is available at **http://dx.doi.org/10.1289/EHP358**.

Neuro-Developmental Risks. The TENDR Consensus Statement

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Summary: Children in America today are at an unacceptably high risk of developing neurodevelopmental disorders that affect the brain and nervous system including autism, attention deficit hyperactivity disorder, intellectual disabilities, and other learning and behavioral disabilities. These are complex disorders with multiple causes—genetic, social, and environmental. The contribution of toxic chemicals to these disorders can be prevented. Approach: Leading scientific and medical experts, along with children's health advocates, came together in 2015 under the auspices of Project TENDR: Targeting Environmental Neuro-Developmental Risks to issue a call to action to reduce widespread exposures to chemicals that interfere with fetal and children's brain development. Based on the available scientific evidence, the TENDR authors have identified prime examples of toxic chemicals and pollutants that increase children's risks for neurodevelopmental disorders. These include chemicals that are used extensively in consumer products and that have become widespread in the environment. Some are chemicals to which children and pregnant women are regularly exposed, and they are detected in the bodies of virtually all Americans in national surveys conducted by the U.S. Centers for Disease Control and Prevention. The vast majority of chemicals in industrial and consumer products undergo almost no testing for developmental neuro- toxicity or other health effects. Conclusion: Based on these findings, we assert that the current system in the United States for evaluating scientific evidence and making health-based decisions about environmental chemi- cals is fundamentally broken. To help reduce the unacceptably high preva- lence of neurodevelopmental disorders in our children, we must eliminate or significantly reduce exposures to chemicals that contribute to these conditions. We must adopt a new framework for assessing chemicals that have the potential to disrupt brain development and prevent the use of those that may pose a risk. This consensus statement lays the foundation for developing recommendations to monitor, assess, and reduce exposures to neurotoxic chemicals. These measures are urgently needed if we are to protect healthy brain development so that current

A Call to Action

The TENDR Consensus Statement is a call to action to reduce exposures to toxic chemicals that can contribute to the prevalence of neurodevelopmental disabilities in America's children. The TENDR authors agree that widespread exposures to toxic chemicals in our air, water, food, soil, and consumer products can increase the risks for cognitive, behavioral, or social impairment, as well as specific neurodevelopmental disorders such as autism and attention deficit hyperactivity disorder (ADHD) (Di Renzo et al. 2015; Gore et al. 2015; Lanphear 2015; Council on Environmental Health 2011). This preventable threat results from a failure of our industrial and consumer markets and regulatory systems to protect the developing brain from toxic chemicals. To lower children's risks for developing neurodevelopmental disorders, policies and actions are urgently needed to eliminate or significantly reduce exposures to these chemicals. Further, if we are to protect children, we must overhaul how government agencies and business assess risks to human health from chemical exposures, how chemicals in commerce are regulated, and how scientific evidence informs decision making by government and the private sector.

Trends in Neurodevelopmental Disorders

We are witnessing an alarming increase in learning and behavioral problems in children. Parents report that 1 in 6 children in the United States, 17% more than a decade ago, have a developmental disability, including learning disabilities, ADHD, autism, and other developmental delays (Boyle et al. 2011). As of 2012, 1 in 10 (> 5.9 million) children in the United States are estimated to have ADHD (Bloom et al. 2013). As of 2014, 1 in 68 children in the United States has an autism spectrum disorder (based on 2010 reporting data) (CDC 2014).

The economic costs associated with neurodevelopmental disorders are staggering. On average, it costs twice as much in the United States to educate a child who has a learning or developmental disability as it costs for a child who does not (Chambers et al. 2004). A recent study in the European Union found that costs associated with lost IQ points and intellectual disability arising from two categories of chemicals—polybrominated diphenyl ether flame retardants (PBDEs) and organophosphate (OP) pesticides—are estimated at 155.44 billion euros ($169.43 billion dollars) annually (Bellanger et al. 2015). A 2009 analysis in the United States found that for every $1 spent to reduce exposures to lead, a potent neurotoxicant, society would benefit by $17–$221 (Gould 2009).

Vulnerability of the Developing Brain to Chemicals

Many toxic chemicals can interfere with healthy brain development, some at extremely low levels of exposure (Adamkiewicz et al. 2011; Bellinger 2008; Committee on Improving Analysis Approaches Used by the U.S. EPA 2009; Zoeller et al. 2012). Research in the neurosciences has identified "critical windows of vulnerability" during embryonic and fetal development, infancy, early childhood and adolescence (Lanphear 2015; Lyall et al. 2014; Rice and Barone 2000). During these windows of development, toxic chemical exposures may cause lasting harm to the brain that interferes with a child's ability to reach his or her full potential.

The developing fetus is continuously exposed to a mixture of environmental chemicals (Mitro et al. 2015). A 2011 analysis of the U.S. Centers for Disease Control and Prevention's (CDC) biomonitoring data found that 90% of pregnant women in the United States have detectable levels of 62 chemicals in their bodies, out of 163 chemicals for which the women were screened (Woodruff et al. 2011). Among the chemicals found in the vast majority of pregnant women are PBDEs, polycyclic aromatic hydrocarbons (PAHS), phthalates, perfluorinated compounds, polychlorinated biphenyls (PCBs), perchlorate, lead and mercury (Woodruff et al. 2011). Many of these chemicals can cross the placenta during pregnancy and are routinely detected in cord blood or other fetal tissues (ATSDR 2011; Brent 2010; Chen et al. 2013; Lien et al. 2011).

Prime Examples of Neurodevelopmentally Toxic Chemicals

The following list provides prime examples of toxic chemicals that can contribute to learning, behavioral, or intellectual impairment, as well as specific neurodevelopmental disorders such as ADHD or autism spectrum disorder:

- Organophosphate (OP) pesticides (Eskenazi et al. 2007; Fortenberry et al. 2014; Furlong et al. 2014; Marks et al. 2010; Rauh et al. 2006; Shelton et al. 2014).
- PBDE flame retardants (Chen et al. 2014; Cowell et al. 2015; Eskenazi et al. 2013; Herbstman et al. 2010).
- Combustion-related air pollutants, which generally include PAHs, nitrogen dioxide and particulate matter, and other air pollutants for which nitrogen dioxide and particulate matter are markers (Becerra et al. 2013; Clifford et al. 2016; Jedrychowski

et al. 2015; Kalkbrenner et al. 2014; Suades-González et al. 2015; Volk et al. 2013).
- Lead (Eubig et al. 2010; Lanphear et al. 2005; Needleman et al. 1979).
- Mercury (Grandjean et al. 1997; Karagas et al. 2012; Sagiv et al. 2012).
- PCBs (Eubig et al. 2010; Jacobson and Jacobson 1996; Schantz et al. 2003).

The United States has restricted some of the production, use and environmental releases of these particular chemicals, but those measures have tended to be too little and too late. We face a crisis from both legacy and ongoing exposures to toxic chemicals. For lead, OP pesticides, PBDEs and air pollution, communities of color and socioeconomically stressed communities face disproportionately high exposures and health impacts (Adamkiewicz et al. 2011; Engel et al. 2015; Zota et al. 2010).

Policies to ban lead from gasoline, paints and other products have been successful in lowering blood lead levels in the American population (Jones et al. 2009), yet lead exposure continues to be a preventable cause of intellectual impairment, ADHD and maladaptive behaviors for millions of children (CDC 2015). Scientists agree that there is no safe level of lead exposure for fetal or early childhood development (Lanphear et al. 2005; Schnur and John 2014), and studies have documented the potential for cumulative and synergistic health effects from combined exposure to lead and social stressors (Bellinger et al. 1988; Cory-Slechta et al. 2004). Thus, taking further preventive actions is imperative.

Epidemiological, toxicological, and mechanistic studies have together provided evidence that clearly demonstrates or strongly suggests neurodevelopmental toxicity for lead, mercury, OP pesticides, air pollution, PBDEs, and PCBs. The level and type of available evidence linking exposures to toxic chemicals with neurodevelopmental disorders, including the examples in this statement, vary both within and among chemical classes. In light of this extensive evidence and continued widespread exposure, the risks for learning and developmental disorders can likely be lowered through targeted exposure reduction, starting with these example chemicals.

Majority of Chemicals Untested for Neurodevelopmental Effects

The examples of developmental neurotoxic chemicals that we list here likely represent the tip of the iceberg. Of the tens of thousands of chemicals on the U.S. Environmental Protection Agency (EPA) chemical inventory, nearly 7,700 are manufactured or imported into the United States at ≥ 25,000 pounds per year (U.S. EPA 2012). The U.S. EPA has identified nearly 3,000 chemicals that are produced or imported at > 1 million pounds per year (U.S. EPA 2006).

Only a minority of chemicals has been evaluated for neurotoxic effects in adults. Even fewer have been evaluated for potential effects on brain development in children (Grandjean and Landrigan 2006, 2014). Further, toxicological studies and regulatory evaluation seldom address combined effects of chemical mixtures, despite evidence that all people are exposed to dozens of chemicals at any given time.

Need for a New Approach to Evaluating Evidence

Our failures to protect children from harm underscore the urgent need for a better approach to developing and assessing scientific evidence and using it to make decisions. We as a society should be able to take protective action when scientific evidence indicates a chemical is of concern, and not wait for unequivocal proof that a chemical is causing harm to our children.

Evidence of neurodevelopmental toxicity of any type—epidemiological or toxicological or mechanistic—by itself should constitute a signal sufficient to trigger prioritization and some level of action. Such an approach would enable policy makers and regulators to proactively test and identify chemicals that are emerging concerns for brain development and prevent widespread human exposures.

Some chemicals, like those that disrupt the endocrine system, present a concern because they interfere with the activity of endogenous hormones that are essential for healthy brain development. Endocrine-disrupting chemicals (EDCs) include many pesticides, flame retardants, fuels, and plasticizers. One class of EDCs that is ubiquitous in consumer products are the phthalates. These are an emerging concern for interference with brain development and therefore demand attention (Boas et al. 2012; Ejaredar et al. 2015; Mathieu-Denoncourt et al. 2015; Miodovnik et al. 2014; U.S. Consumer Product Safety Commission 2014).

Regrettable Substitution

Under our current system, when a toxic chemical or category of chemicals is finally removed from the market, chemical manufacturers often substitute similar chemicals that may pose similar concerns or be virtually untested for toxicity. This practice can result in "regrettable substitution" whereby the cycle of exposures and adverse effects starts all over again. The following list provides examples of this cycle:
- When the federal government banned some uses of OP pesticides, manufacturers responded by expanding the use of neonicotinoid and pyrethroid pesticides. Evidence is emerging that these widely used classes of pesticides pose a threat to the developing brain (Kara et al. 2015; Richardson et al. 2015; Shelton et al. 2014).
- When the U.S. Government reached a voluntary agreement with flame retardant manufacturers to stop making PBDEs, the manufacturers substituted other halogenated and organophos- phate flame retardant chemicals. Many of these replacement flame retardants are similar in structure to other neurotoxic chemicals but have not undergone adequate assessment of their effects on developing brains.
- When the federal government banned some phthalates in chil- dren's products, the chemical industry responded by replacing the banned chemicals with structurally similar new phthalates. These replacements are now under investigation for disrupting the endocrine system.

Looking Forward

Our system for evaluating scientific evidence and making decisions about environmental chemicals is broken. We cannot continue to gamble with our children's health. We call for action now to prevent exposures to chemicals and pollutants that can contribute to the prevalence of neurodevelopmental disabilities in America's children.

We need to overhaul our approach to developing and assessing evidence on chemicals of concern for brain development. Toward this end, we call on regulators to follow scientific guidance for assessing how chemicals affect brain development, such as taking into account the special vulnerabilities of the developing fetus and children, cumulative effects resulting from combined exposures to multiple toxic chemicals and stressors, and the lack of a safety threshold for many of these chemicals (Committee on Improving Analysis Approaches Used by the U.S. EPA 2009). We call on businesses to eliminate neurodevelopmental toxicants from their supply chains and products, and on health professionals to integrate knowledge about environmental toxicants into patient care and public health practice.

Finally, we call on policy makers to take seriously the need to reduce exposures of all children to lead—by accelerating the clean up from our past uses of lead such as in paint and water pipes, by halting the current uses of lead, and by better regulating the industrial processes that cause new lead contamination.

We are confident that reducing exposures to chemicals that can interfere with healthy brain development will help to lower the prevalence of neurodevelopmental disabilities, and thus enable many more children to reach their full potential.

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Organizations that Endorse or Support the TENDR Consensus Statement

American College of Obstetricians and Gynecologists (ACOG)
ACOG supports the value of this clinical document as an educational tool (March 2016)

Child Neurology

Society Endocrine

Society

International Neurotoxicology Association

International Society for Children's Health and the

Environment International Society for Environmental

Epidemiology

National Council of Asian Pacific Islander

Physicians National Hispanic Medical Association

National Medical Association

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