

# Targeting Environmental Neurodevelopmental Risks to Protect Children

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Pregnant women, infants, and children are continually exposed to chemicals that are toxic to brain development. Yet too little has been done to protect them from the possibility of harm. In 2015, a diverse group of physicians and other health professionals, scientists, and advocates established Project Targeting Environmental Neuro-Developmental Risks (TENDR) to focus awareness and advocate for action against toxic chemicals that contribute to the risk of development of brain-based disorders in children, including intellectual and learning disabilities, autism, and attention-deficit/hyperactivity disorder (ADHD).<sup>1</sup> Ten years ago, this landmark agreement among leading scientists and health professionals would not have been possible, but the accumulated evidence, which illustrates a pattern of toxicity, is credible and convincing. The release of the TENDR consensus statement coincided with the recent signing into law of the Frank R. Lautenberg Chemical Safety for the 21st Century Act. This act is the first update of the Toxic Substances Control Act since the law was adopted in 1976. This legislative effort was an important step toward protecting children from toxic chemicals, but, by itself, provides too little action at too slow a pace. Specific information is given below on how health care providers can respond to this legislation and advocate for safe policies that protect children. Additional information is also provided on advice providers can give to families regarding avoidance of toxic chemicals.

The etiology of neurodevelopmental disorders is complex and multifactorial, but epidemiologic data, along with laboratory studies of animals, clearly indicate that exposures to certain toxic chemicals, even at very low levels of exposure, elevate the risk for children to develop neurodevelopmental disorders, such as intellectual and learning disabilities, autism, and ADHD.<sup>2</sup> Project TENDR identified lead, air pollutants, organophosphate pesticides, and polybrominated diphenyl ether (PBDE) flame retardants as neurodevelopmental toxicants based on the strength of the evidence linking them with neurodevelopmental disabilities; phthalates were identified as suspected neurodevelopmental toxicants.

Over 90% of pregnant women in the United States who were tested had detectable levels of toxic chemicals in their bodies, including the



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neurodevelopmental toxicants identified by Project TENDR.<sup>3</sup> These toxic chemicals cross the placenta and are present in amniotic fluid. Because of their increased metabolism, smaller size, and frequent hand-to-mouth behaviors, young children are often more highly exposed to toxic chemicals than adults and are at greater risk of harm from those exposures.

Evidence accumulated over the past 15 years shows there is no safe level of lead exposure.<sup>4</sup> This should not be surprising; chemicals used to alter brain behavior, like methylphenidate, are biologically active at about the same concentrations at which lead, PBDEs, and other toxic chemicals exhibit their toxic effects. The American Academy of Pediatrics (AAP) has adopted 5 µg/dL (50 ppb) as the action level: the level when clinicians and public health professionals should attempt to determine the source(s) of lead exposure and take action to stop additional exposure.<sup>5</sup> Low-level elevations in children's blood lead concentrations, even at concentrations <5 µg/dL, can result in decrements in cognitive functions and academic performance and an elevated risk for developing ADHD.<sup>5</sup>

Air pollutants, including polycyclic aromatic hydrocarbons, nitrogen dioxide, and fine particulate matter, have been consistently linked with preterm birth, low birth weight, developmental delay, and behavioral problems in children.<sup>6</sup> Exposure to airborne pollutants during fetal brain development has also been associated with increased risk of developing autism.<sup>7</sup>

Organophosphate pesticides, which have been heavily used in agriculture and cockroach control, have been associated with deficits in intellectual abilities, motor function, memory, processing speed, and ADHD in children who were exposed to higher levels during fetal development.<sup>8</sup> Pesticide exposures, including

organophosphates and pyrethroid pesticides, have been associated with an elevated risk for the development of autism in a few epidemiologic studies.<sup>7</sup>

PBDEs, which were used as chemical flame retardants, are no longer being manufactured, but they are still routinely found in furniture, foam insulation, and electronics in children's homes. PBDEs accumulate in adipose tissue and are readily transferred to the fetus or to the infant in breast milk. Three different prospective birth cohort studies of hundreds of pregnant women and children, which adjusted for various confounding factors, reported that higher exposure to PBDE during fetal development was associated with diminished IQ and hyperactivity or ADHD in children.<sup>9</sup>

Phthalates are plasticizers used in food processing and packaging, as well as in common household materials like flooring and personal care products, such as cosmetics and nail polish. Phthalates have not been studied for neurodevelopmental effects as extensively as other chemicals examined by the TENDR Project, but prenatal exposure to phthalates has been associated with the development of ADHD behaviors, deficits in executive function, and impaired cognitive development in several studies.<sup>10</sup>

The newly revised Toxic Substances Control Act requires that the Environmental Protection Agency (EPA) establish a risk-based process to evaluate and prioritize existing chemicals for toxicity. Over 1000 chemicals have been shown to exhibit some neurotoxicity in laboratory studies.<sup>11</sup> Few chemicals have been studied in either humans or animals during critical windows of early brain development, and few studies have examined the cumulative impact of exposure to multiple chemicals, including possible additive or synergistic effects.

A high priority designation triggers a requirement for the EPA to complete a risk evaluation to determine safety. Within the first 180 days, the EPA must begin safety reviews on 10 chemicals; another 20 must begin within 3.5 years. In considering risks, highly susceptible and highly exposed populations must be considered, including pregnant women and children.

The law states that when unreasonable risks to health are identified, the EPA may take up to 2 to 4 years to take any risk management action. Bans and phase-outs should begin as quickly as possible, but may take up to 5 years. The use of non-animal testing methodologies is promoted. For certain persistent, bioaccumulative, and toxic chemicals, a fast-track process bypasses risk evaluation, but use and exposure studies are still needed and action to reduce exposure must be proposed within 3 years and finalized 18 months later.

For new chemicals, there is a requirement that the EPA must determine safety before they are allowed into the marketplace. Confidentiality claims may be reviewed by the EPA and appropriate sharing of information by manufacturers is required. New fees from manufacturers will defray some costs for chemical reviews and implementation activities. If the EPA names a chemical as "high priority" and publishes a document outlining the "scope" (the uses, conditions, health concerns, etc) of the risk evaluation they plan to undertake, states are then prohibited ("preempted") from establishing new restrictions for that chemical. The law permits states to continue to act on any chemical uses or risks that the EPA has not addressed and preserves the states' authority related to air, water, and waste disposal.

The EPA is required to engage stakeholder input. This is where it is vital for pediatric health providers to

**TABLE 1** Resources for Providers and Patients

Project TENDR	<a href="http://www.projecttendr.com">http://www.projecttendr.com</a>
US Centers for Disease Control Pediatric Environmental Health Specialty Units	<a href="http://www.cdc.gov/features/pehsu/">http://www.cdc.gov/features/pehsu/</a>
American Academy of Pediatrics, Council on Environmental Health	<a href="https://www.aap.org/en-us/about-the-aap/Committees-Councils-Sections/Council-on-Environmental-Health">https://www.aap.org/en-us/about-the-aap/Committees-Councils-Sections/Council-on-Environmental-Health</a>
Safer Chemicals Healthy Families	<a href="http://saferchemicals.org/">http://saferchemicals.org/</a>
Children's Environmental Health Network	<a href="http://www.cehn.org/">http://www.cehn.org/</a>
Consumer Reports – Pesticides in Produce	<a href="http://www.consumerreports.org/cro/health/natural-health/pesticides/index.htm">http://www.consumerreports.org/cro/health/natural-health/pesticides/index.htm</a>
Silent Spring Institute – Detox Me (mobile app)	<a href="http://www.silentpring.org/detoxme/">http://www.silentpring.org/detoxme/</a>
National Public Radio	<a href="http://apps.npr.org/find-lead-pipes-in-your-home/#intro">http://apps.npr.org/find-lead-pipes-in-your-home/#intro</a>

respond and participate. The AAP has already provided some input through the Council on Environmental Health. The EPA will be holding briefings, webinars, public meetings, and comment periods. Information on these activities may be found at [www.epa.gov/assessing-and-managing-chemicals-under-tsca/frank-r-lautenberg-chemical-safety-21st-century-act-2](http://www.epa.gov/assessing-and-managing-chemicals-under-tsca/frank-r-lautenberg-chemical-safety-21st-century-act-2).

What else can pediatricians and other health care providers do to protect children from toxic chemicals? Health care providers can respond to questions and provide direction to patients, parents, and the general public. The AAP has established

an office on federal advocacy and one on state advocacy, staffed by experienced professionals in the field. This staff can assist pediatricians wanting to engage in either federal-level or state-level advocacy to strengthen laws to reduce children's exposure to toxic chemicals or chemicals suspected to be toxic.

Educators can work to integrate knowledge about pediatric environmental health into medical school and pediatric residency curricula, as well as advocate for inclusion of the topic into questions for pediatric board certification. Pediatricians and other health care providers can also remind

families to try to avoid pesticides in foods and be conscious of buying products labeled free of toxic flame retardants, and give information about the AAP-sponsored Web site [www.healthychildren.org](http://www.healthychildren.org). A list of tips to reduce exposure at home is found in the supplement, and more information can be found at [www.projecttendr.com](http://www.projecttendr.com). Other useful resources for both providers and consumers are provided below (Table 1). Providers who care for children and families can be part of the solution that protects the especially vulnerable developing fetus and child from harm.

#### ABBREVIATIONS

AAP:	American Academy of Pediatrics
ADHD:	attention-deficit/hyperactivity disorder
EPA:	Environmental Protection Agency
PBDE:	polybrominated diphenyl ether
TENDR:	Targeting Environmental Neuro-Developmental Risks

meetings. Dr Lanphear serves as an expert witness in cases involving lead poisoning, but he receives no personal compensation for his services. Dr Hirtz has indicated she has no potential conflicts of interest to disclose.

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