DEPARTMENT OF HEALTH AND HUMAN SERVICES

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Hearing on “The Federal Role in the Toxic PFAS Chemical Crisis”

Testimony before the
Senate Committee on Homeland Security and Government Affairs
Subcommittee on Federal Spending Oversight and Emergency Management

Linda S. Birnbaum, Ph.D., D.A.B.T., A.T.S.
Director, National Institute of Environmental Health Sciences and National Toxicology Program
National Institutes of Health

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systems, *in silico* approaches, and high throughput toxicological screening, we cannot ethically conduct prospective mechanistic studies in humans.

The most conclusive human health research isolates a single variable to understand the cause and effect of that variable, whether it be a drug, microorganism, or a mutated gene. With possibly toxic chemicals, we are largely limited to natural history and population-based studies that attempt to find connections between populations exposed and health effects in the real world.)RU WKDW UHDVRQ \RX ZLOO WKHQ certain health effects happened to ³DVVR more people than normal in populations that are exposed.

The research conducted to date reveals associations between human PFAS exposures and specific adverse human health outcomes. These include potential effects on

bioaccumulate, leading to concentrations in animals and plants that are significantly higher than the surrounding environment, and they can enter the human food chain.

Decreased Immune System Function

As early as 1978, scientists observed immunotoxicity in non

were found for PFOA, PFOS, PFHxS, PFDeA, and PFUA, but not for PFNA.[23] Animal studies are consistent with the human epidemiologic studies of cancer endpoints.

Child Development

PFOA and PFOS cause developmental toxicity in animals.[23,24,25] Human epidemiology studies also show associations between some PFAS and developmental effects.[26] One human study found that PFAS exposure during pregnancy was associated with decreased birth weight and head circumference only in males.[27] Similar decreases in birth weight have been reported in rodents for over a decade.[28] Recent findings from NIH-supported epidemiological studies of a cohort of mothers and babies showed that prenatal exposure to PFOS is associated with cognitive effects and decreased ability to regulate behavior in school-aged children. However, no similar association was observed in this study for PFOA exposure.[29]

A review of the epidemiological literature by an NIEHS-funded scientist summarized findings from several prospective cohorts on the relationship between prenatal exposure to certain PFAS and neurodevelopmental and neurobehavioral outcomes, for example, cognitive abilities, psychomotor development, attention-deficit hyperactivity disorder, and cerebral palsy. So far, the available body of evidence is inconsistent with respect to these associations, both with respect to which compounds may have adverse effects and timing of potential windows of vulnerability. Additional studies are needed to resolve these questions.[30]

Endocrine Disruption

Studies suggest that some PFAS may interfere with healthy hormonal function in the body. Our endocrine system control

development. Studies suggest that early life exposure to some PFAS may contribute to the development of metabolic diseases, including obesity and type 2 diabetes, which are major public health problems. Although further confirmation is required, the findings from one study suggest that exposures to some PFAS during pregnancy may influence lipid metabolism and glucose tolerance[31]. A study of pregnant women in Cincinnati found that those with higher prenatal PFAS levels had children with higher body fat levels at age eight,[32] a finding reinforced by other epidemiological studies,[33,34] and similar effects on excessive body weight gain reported for experimental animals[35]. It appears that some PFAS may also affect body weight later in life. Scientists at the Harvard School of Public Health have found that adults with higher blood levels of some PFAS have lower resting metabolic rates, meaning they burn fewer calories while resting, which makes it difficult for them to maintain weight loss[36]. Effects on weight gain have been seen in numerous animal studies,[37,38,39] supporting this association in humans. It is particularly concerning that some PFAS alter thyroid hormone homeostasis that regulates metabolism and growth[40,41,42].

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[35] Hines EP, White SS, Stanko JP, Gibbs-Flournoy EA, Lau C, Fenton SE. Phenotypic dichotomy following developmental exposure to perfluorooctanoic acid (PFOA) in female CD-1 mice: Low doses induce elevated serum leptin and insulin, and overweight in mid-life. *Mol Cell Endocrinol*. 2009 May 25;304(1-2):97-105. DOI: 10.1016/j.mce.2009.02.021

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[37] Grün F, Blumberg B. Endocrine disrupters as obesogens. *Mol Cell Endocrinol*. 2009 May 25;304(1-2):19-29. DOI: 10.1016/j.mce.2009.02.018

[38] Shi Z, Zhang H, Ding L, Feng Y, Xu M, Dai J. The effect of perfluorododecanoic acid on endocrine status, sex hormones and expression of steroido 1 456.79in BT /F1 9.96 Tf .00912 0 612 792 re] TJ E1 Gc0 1 72.021 Gc0 1 72.021

Fertility is another outcome related to endocrine effects. A literature review of recent human epidemiologic evidence on the association between exposure to PFAS and measures of human fertility show the potential for effects on female fecundability (i.e., the probability of conception).[43] In addition, several recent studies have shown an association between women with higher PFAS exposure and the length of time they are able to nurse their child after birth, although not at all levels of exposure.[44,45] This is similar to 2006 findings in animals reporting impaired breast development and breastfeeding during and after pregnancy in mice.[46]

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water.[48] In another SBIR project, EnChem Engineering, Inc. is developing and demonstrating an innovative combined in-situ / ex-situ technology to cost-effectively expedite treatment of PFAS at Superfund sites. The EnChem approach combines (1) a non-toxic cyclic sugar (CS) to flush sorbed PFAS from the in-situ soil, (2) extraction of the CS-PFAS complex with groundwater and treatment in a high efficiency ex-situ reactor that simultaneously degrades, removes, and concentrates (100-1000 times) the PFAS, (3) ultimate on-site destruction by alkaline ozonation (99+ percent removal), and (4) returns the treated water with low concentration CS amendment to injection wells for continued flushing. The ex-situ treatment reactor can also be used as pre-treatment to existing granular activated carbon.[49] Additionally, the Michigan State University Superfund Research Center is developing energy efficient nanoreactors capable of breaking the carbon-fluorine bond.[50] Also of note, t

potential toxicity, how it is stored in the body, and how long it remains in the environment.[54,55] Initial results from nearly 200 homes show detectable levels of GenX in treated tap water from the Cape Fear River but none above 140 parts per trillion, the current North Carolina public health goal for GenX in drinking water. Many other PFAS were also measured in treated Cape Fear River tap water. GenX was not detected in the tap water of homes whose groundwater was treated with granular activated carbon filtration. Additional analysis, including testing of blood and urine samples from study participants, is ongoing. NTP is also studying how GenX moves through the body and whether it is toxic to the placenta, immune system, liver, and other tissues.

NTP REACT Program

The NTP Responsive Evaluation and Assessment of Chemical Toxicity, or REACT, Program is studying subclasses of PFAS, due to potential similarities in chemical properties and toxicity within subclasses. Scientists will be able to compare one PFAS to another, determine the relationship between chain length, branching, and toxicity, and work toward understanding a common basis for toxicity.

REACT uses a combination of methods. First, the project analyzes the chemical structure of PFAS compounds to see what information is available in databases for that compound or others with similar structure. Chemical structure plays a major role in how chemicals interact and chemicals with similar structure often have similar toxicity. This computer-based step is known as *in silico* screening. Based on *in silico* results, chemicals are prioritized for further laboratory testing with cells, known as *in vitro* testing. Examples include testing whether PFAS cause cells to die or substantially alter the function of human liver, placenta, or mammary gland derived cells. Some of these tests are conducted through the automated Toxicology in the 21st Century (Tox21) Program, a Federal collaboration among the NIH, the U.S. Environmental Protection Agency (EPA), and the U.S. Food and Drug Administration (FDA).[56] The *in vitro* data are then examined to prioritize select chemicals for toxicity testing in animals, known as *in vivo* studies, so the data can be considered all together. REACT is a collaborative program with EPA. The Program plans to test over 100 individual PFAS across the PFAS class. Both NTP and EPA are generating chemical libraries to consolidate and share what is known about individual chemicals.

Current Challenges

Real-world human exposures to PFAS involve complex mixtures, not individual chemicals. This fact complicates both the science of exposure and the assessment of health risks.[57] Currently, analytical techniques are limited for determining which specific PFAS are contained in a given

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[54] NIH Grant No. R21ES029353. Assessing Impact of Drinking Water Exposure to GenX (Hexafluoropropylene Oxide Dimer Acid) in the Cape Fear River Basin, North Carolina. Hoppin, Jane. North Carolina State University, Raleigh. Awarded on October 31, 2017. NIH RePORTER Link.

[55] Researchers [illegible] ided on October [illegible]

complex mixture. Furthertoxicological information on these combined

Leadership Summit hosted by EPA in May 2018.[61] Within the Department of Health and Human Services and primarily through NTP, NIEHS works closely with FDA and the Centers for Disease Control and Prevention (CDC) on PFAS matters. Additionally, NIEHS is specifically being consulted by ATSDR on the execution of exposure assessments and health studies authorized by the National Defense Authorization Act for Fiscal Year 2018, as amended.[62]

Conclusion

Thank you again for allowing me to share a scientific perspective on this important topic. In closing, I note that NIEHS is well positioned to continue contributing essential scientific knowledge about this complex and large class of chemicals. This knowledge can help regulators make sound, science-based decisions and informs the medical and public health communities about the potential health effects associated with exposure to PFAS. I welcome your questions.

[61] EPA PFAS National Leadership Summit and Engagement. May 22, 2018. Internet: https://www.epa.g