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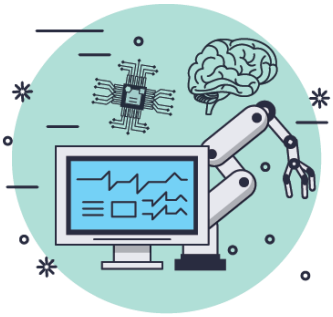
science BRIEF
INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE



Evaluating Developmental Neurotoxicity

About 1 in 6 children in the United States are affected by a neurodevelopmental (brain development) disability such as a lower IQ, learning deficits, and abnormal behavior such as hyperactivity or autism[1]. The exact cause of these effects are not fully understood. EPA is conducting research to determine if exposure to chemicals during early life may produce adverse effects on the nervous system throughout a person's lifetime. Since environmental chemicals can affect children differently than adults, EPA is conducting research to identify chemicals that have the potential to contribute to neurodevelopmental disorders and understand child-specific vulnerabilities.

The Problem

There are thousands of chemicals that have not been studied for their potential effects on neurodevelopment.

The Solution

EPA is developing and incorporating **new approach methods** that are faster, better, and more economical than traditional animal toxicity testing. These new methods help screen and prioritize thousands of chemicals for developmental neurotoxicity.

The Impact

The data produced from these **new approach methodologies** will be important for implementation of the Lautenberg Chemical Safety Act (2016), which requires consideration of susceptible subpopulations including pregnant women and children.

Why is Understanding Developmental Neurotoxicity Important?

- *The developing nervous system can be particularly sensitive to exposure to environmental chemicals.*
- *Less than 1% of chemicals in the environment have been fully evaluated for their potential to be developmental neurotoxicants, or the impact of the chemical on the developing nervous system.*
- *Due to a lack of data, it is not possible to understand the extent or potential contribution of environmental chemicals in neurodevelopmental disease, nor predict the potential developmental neurotoxicity risk for individual chemicals.*

EPA's New Methods for Evaluating Developmental Neurotoxicity

High-Throughput Screening

EPA scientists are growing neural cells in their laboratories. These cells mimic important processes of brain development and can be used to screen and prioritize thousands of chemicals that have not been evaluated for developmental neurotoxicity. For example, one model allows examination of how chemicals might alter the connections between neurons (synaptogenesis), while another measures possible effects on formation of functional networks of neurons.

Virtual Tissue Models

Computational methods are used to create virtual tissue models to simulate how chemicals may affect human development. In early development, a specialized barrier forms to regulate the passage of hormones and nutrients to and from the brain across the blood-brain barrier. EPA scientists are using human cells and computer-based models to construct a virtual fetal blood-brain barrier to look at how neural brain cells grow and interact, and whether chemicals can cause developmental neurotoxicity during this sensitive time frame.

Alternative Animal Models

EPA scientists are investigating the potential of chemicals to be developmental neurotoxicants by testing chemicals in developing zebrafish instead of using laboratory rats. Zebrafish are valuable for studying genetic and other determinants of nervous system development. Scientists expose the fish to chemicals during brain development and then assess if changes in the behavior of the young fish occur.

Adverse Outcome Pathways (AOPs)

Adverse outcome pathways are frameworks that assemble knowledge about biological events that can be used to help interpret how a stressor (e.g. a chemical) can lead to an adverse health effect in an organism. EPA scientists are starting to use these AOP frameworks to organize data from in vitro and higher throughput methods, coupled with existing biological data and information from animal tests, to predict changes in biological pathways and the potential effects of chemicals on the developing nervous system.

[1] https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html

U.S. Environmental Protection Agency
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For more information visit: https://www.epa.gov/chemical-research/evaluating-effects-of-chemicals-nervous-system-development
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