Testimony
Before the Subcommittee on Superfund, Toxics and Environmental Health
Committee on Environment and Public Works
United States Senate

"Oversight Hearing on the Federal Toxic Substances Control Act"

Statement of
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For Release on Delivery
Expected at 2:30 p.m.
December 2, 2009

Mr. Chairman and distinguished members of the Subcommittee—I am pleased to appear before you today to present testimony on our current understanding regarding chemical hazards. My name is Linda Birnbaum; I am the Director of the National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health, as well as of the National Toxicology Program (NTP).

Environmental health science has made tremendous strides since the original passage of the Toxic Substances Control Act, or TSCA. Our understanding of chemical toxicity has been challenged by the new science of epigenetics, which is the study of changes to the packaging of the DNA molecules that influence the expression of genes, and hence the risks of diseases and altered development. Studies indicate that exposures that cause epigenetic changes can affect several generations. This new understanding heightens the need to protect people at critical times in their development when they are most vulnerable to this kind of toxicity.

The concept of "windows of susceptibility" is an important area. Research has revealed the heightened vulnerability of fetal, infant and child developmental processes to disruption from relatively low doses of certain chemicals. Established first for neurodevelopmental toxicants like PCBs, and lead and other metals, this concept also applies to hormonally active agents (endocrine disrupting chemicals). In our NIEHS Breast Cancer and Environment Research Program, co-funded with the National Cancer Institute, researchers are investigating whether periods of susceptibility exist in the development of the mammary gland, when exposures to environmental agents may impact the breast and endocrine systems that can influence breast cancer risk in adulthood.

There are unanticipated effects of exposure to toxic chemicals, and our research must extend to health endpoints beyond cancer and birth defects. NIEHS is supporting research on the developmental origins of obesity and the theory that environmental exposures during development play an important role in the current epidemic of obesity, diabetes, and metabolic syndrome. There are data showing weight gain in rats and mice after developmental exposure to a number of different substances. Thus we need to start thinking about obesity not just in terms of genetics and lifestyle but also in terms of exposures. These kinds of outcomes will need to be considered in assessment of toxicity.

There are other susceptibilities to consider. For some types of chemicals and health effects, there may be excess risk from specific genes or chronic diseases. For example, the level of a person's risk of bladder cancer from smoking has been shown to depend in part on whether or not that individual's genome contains variants in specific detoxification enzymes. The existence of these subtle variations in susceptibility must be factored into overall toxicity assessments.

Furthermore, exposures do not occur singly, the way they are usually tested in the lab. All of us are exposed to many different chemicals at the same time. Scientists have labored to come up with ways to estimate risk from combinations of exposures. One example was the method used for dioxin and related compounds. Dioxin is an environmental contaminant and known human

carcinogen. Scientists believe that other chemicals such as some PCBs and furans may cause cancer in a similar manner. The question for public health officials was how health standards could be adjusted to take into account the fact that people are always exposed to mixtures of dioxin-like compounds, not just one at a time.

To address this problem, a large body of work led to the development of a method to estimate toxicity of mixtures of dioxin-like compounds based upon toxic equivalency factors, or TEFs. To estimate the overall toxicity of a mixture, the contaminants' weighted contributions are added together, adjusting for the fact that some compounds are more toxic than others. The additive methodology has been tested and confirmed by studies done by the NTP, EPA, and others. TEF methodology has also been extended to other health endpoints, including reproductive and developmental, immune, and neurological.

Differences in routes of exposure must also be considered. For example, hexavalent chromium compounds have been shown to cause lung cancer in humans when inhaled, but it was not known how these compounds behaved when ingested. Hexavalent chromium was tested by the NTP because of concerns over its presence in drinking water. The NTP studies showed that a compound containing hexavalent chromium causes cancer in laboratory animals following oral administration in drinking water, confirming the need to protect people from oral routes of exposure.

The impact of new scientific information we have on effects of environmental chemicals can be seen in the EPA's arsenic standards for drinking water implemented in 2006. The NIEHS Superfund Research Program, which is authorized by this Committee, funded scientists who played a vital role in the process through research on health effects of arsenic in drinking water. This research included studies of arsenic metabolism, mechanistic research on disease pathogenesis by arsenic, and both molecular and traditional epidemiology with detailed exposure assessment. These studies provided the scientific underpinnings for a standard that protects the health of Americans against long-term effects of arsenic exposure such as cancer, diabetes, neurological and cardiovascular disease.

We are poised to move forward into an era of a new kind of toxicological testing that is less expensive and also gives us an improved understanding of the actual effects on humans. Toxicology is advancing from a mostly observational science using disease-specific models to a better predictive science focused upon a broad inclusion of target-specific, mechanism-based, biological observations. This means using alternative assays targeting the key pathways, molecular events, or processes linked to disease or injury, and incorporating them into a research and testing framework. The NTP is laying the foundation for this testing paradigm in partnership with the National Human Genome Research Institute and the EPA. They are using quantitative high throughput screening assays to test a large number of chemicals. The resulting data are being deposited into publicly accessible relational databases. Analyses of these results will set the stage for a new framework for toxicity testing.

Reform of TSCA needs to account for the ways in which our understanding of the effects of chemical exposures has deepened and improved over the past 33 years. We must have the ability to harness new technologies and a growing knowledge base of underlying biology, receptor and

other host pathways, variations in susceptibility, and routes and timing of exposure, to obtain a clearer and more accurate picture of the risks posed by these chemicals. Our new tools under TSCA must provide for research and development to create the comprehensive testing envisioned.

Thank you. I would be happy to answer questions.