BIOMONITORING

Biomonitoring involves the measurement of a wide range of chemicals and chemical metabolites in humans and other species. Biomonitoring improves our understanding of risks that chemicals may pose to humans and ecosystems by quantifying a wide range of chemical occurrences and effects that may manifest in humans and other organisms. Biomonitoring also provides a basis to evaluate the success of sustainable molecular design and safer alternatives, control technology and cleanup efforts over time and to identify trends that may be of concern as a basis for mitigation. (NRC 2006)

Biomonitoring may have its greatest value in evaluating chemicals that alter the development of living things. Both animal and human studies link altered cellular signaling to developmental impairments. In recent years, it has become clear that many anthropogenic chemicals, including some that are widely used, can interfere with the cellular signaling mechanisms that control development, even at the low levels of environmental exposure experienced by a population.

Advances in analytical chemistry now allow affordable measurement of environmental chemicals in tissues, blood, urine, hair, milk, and other biological samples. Newly developed measurement devices that facilitate sample collection and analysis will continue to advance our scientific understanding of exposures and risk. Such biomonitoring produces data that provide public health officials, environmental scientists, policymakers, and the general public with information about patterns of human and ecological exposure to chemicals. Biomonitoring can also identify populations of humans or other organisms that are at risk of high exposure, detect previously unknown exposures, quantify and track trends, and guide prevention strategies. The information obtained by biomonitoring provides an invaluable resource to government and industry on where to focus regulatory and management efforts to reduce exposure to chemicals and identify opportunities for better products. Moreover, such information can provide valuable evidence for evaluating how to regulate and manage concerns such as endocrine disruptors, major oil spills, as well as pharmaceuticals and pesticides in drinking water.

Germany and Canada have well established biomonitoring programs, and several U.S. states have initiated them also. In addition, there have been efforts in the United States to establish a national agenda for biomonitoring.

- The National Research Council issued Human Biomonitoring for Environmental Chemicals. (July 2006)
- The U.S. Centers for Disease Control and Prevention released the Fourth National Report on Human Exposure to Environmental Chemicals. (December 2009)
- The Institute of Medicine published Evaluation of Biomarkers and Surrogate Endpoints for Chronic Disease. (May 2010)
- The US EPA features biomonitoring as a useful tool in monitoring children's health America's Children and the Environment, Third Edition 2013 (ACE3) https://www.epa.gov/ace

Important biomonitoring issues for identifying and understanding potential environmental and human health risks associated with chemical exposures are:

- Continued development of biomonitoring as a methodology for tracking the fate of chemicals, their exposure pathways, uptake mechanisms, and trends in human and environmental exposures.
- Improvements in our ability to design, interpret, and communicate biomonitoring studies that ensure a coordinated strategy for the selection of target chemicals and biomarkers.
- Continued development of tools to interpret and communicate the meaning of biomonitoring data to individuals and stakeholders.
- Improvements in analytical methodology to assure accuracy, precision, sensitivity, specificity, and speed for all chemicals of concern and the availability of blood, urine, hair, milk, and other biological samples.
- Use of biomonitoring data to help guide the funding of experimental toxicological research to better understand atypical dose responses, toxicity thresholds, endocrine disruption and its mechanisms of action, and other health implications of low-level chemical exposure to flora, fauna, and humans.
- Development of biomonitoring-based epidemiologic, toxicologic, and exposure-assessment methods to enhance public health surveillance and the scientific community's ability to interpret the risks posed by exposure to environmental chemicals.
- Use of biomonitoring data in conjunction with other appropriate health and environmental data to foster research and development of greener alternatives guiding the transition of chemical processes and products away from hazardous substances.
- Expanded educational opportunities for the scientific community (especially chemists), as well as the general public, emphasizing the importance of biomonitoring, its strengths and limitations, and how it can be used to advance the development of a less hazardous technology base.

References

- The National Research Council issued *Human Biomonitoring for Environmental Chemicals*. (July 2006)
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- America's Children and the Environment, Third Edition 2013 (ACE3) https://www.epa.gov/ace
- Exposure Assessment Tools by Approaches - Exposure Reconstruction. www.epa.gov/expobox/exposure-assessment-tools-approaches-exposure-reconstruction-biomonitoring-and-reverse

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