Intra-Individual Variability in Biomarker Concentrations: Phase 1 – Literature Review and Manuscript

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Exposure assessments have typically relied on measuring chemicals in air, water, food, soil, consumer products, etc. and assuming intake/contact rates to estimate the likely intake of a chemical. Increasingly, biomonitoring is serving an important function by measuring the actual chemical (or metabolites) in body fluids (e.g., blood, urine). However, biomonitoring studies have historically relied on spot urine samples or single blood samples. This provides, at best, a snapshot in time of the concentrations of chemicals in a particular person. Because many compounds have short biological half-lives relative to the frequency of exposure, biomarker concentrations will fluctuate. To overcome this, researchers often sample numerous people to get a distribution of levels. While most researchers understand that a distribution of biomonitoring levels contains many sources of variation (including extent of exposure, pharmacokinetics, and temporal variability), it is often assumed that the greatest source of variation is extent of exposure.

We have gathered available literature with datasets that provide empirical data on intra-individual temporal variations in biomarker concentrations both within and across days and summarized these studies. We have obtained key datasets from the U.S. Centers for Disease Control and Prevention explicitly demonstrating such variations. Initial analyses of these datasets demonstrated that population variability in biomarkers of exposure to transient compounds is largely due to within- and across-day temporal variability in biomarker concentrations. This project resulted in a peer-reviewed paper that discusses the factors influencing the variability of biomarker concentrations within individuals and includes modeling and simulation examining the role of exposure frequency and elimination half-life in contributing to such variability. These factors should be considered in the design and execution of biomonitoring-based epidemiological studies that examine potential associations between biomarker concentrations and health outcomes.

**Implications:** An understanding of factors contributing to intra-individual variability in biomarker concentrations will allow design of appropriate sampling strategies to accurately characterize exposures based on biomarker concentrations. Such understanding will improve exposure characterization in environmental epidemiology studies and will inform interpretation of population-based biomonitoring data sets. Identified data gaps can be used to design additional studies to inform the assessment of intraindividual variability in biomarker concentrations.

**Key words:** biomonitoring, pharmacokinetics, intra-individual variability, exposure characterization

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This abstract was prepared by the principal investigator for the project. Please see [www.americanchemistry.com/lri](http://www.americanchemistry.com/lri) for more information about the LRI.