ICCA-LRI and NCATS Workshop
Santa Fe, NM · June 11-12, 2013 · La Posada de Santa Fe

What Is Normal?
Implications for Chemical Safety Assessment

This may sound like an unusual question, but the answers have important implications for the chemical industry. The majority of all manufactured goods contain products of the chemical industry and, as a result, exposures to chemicals occur as part of consumers' everyday lives. How can we better understand the range of normal regarding our responses to these exposures? What are the potential implications for decisions related to chemical safety assessment and public health?

The question of what is normal was the theme for the **2013 workshop of the International Council of Chemical Associations' Long-Range Research Initiative (ICCA-LRI)** that was held in Santa Fe, New Mexico on June 11th and 12th. Organized in collaboration with the U.S. National Institutes of Health's National Center for Advancing Translational Sciences, workshop participants considered this question as well as the potential impacts of factors such as age, genetics, and nutrition on human responses to chemical exposures. Presentations by toxicologists, exposure scientists, physicians, and epidemiologists all provided a variety of viewpoints that evaluated our understanding of what is normal, particularly with regard to environmentally-relevant exposures.

Presentation Highlights. Speakers on the first day introduced the concept that exposures, whether to chemicals or other stressors, can produce responses in humans that result in adaptive rather than adverse outcomes, leading to a "new state of normal" without impaired function. Biological systems continually use this process, called homeostasis, to maintain stability after a challenge. Normal is really a dynamic state that can be impacted by many variables, including age and health status, so it is appropriate to think about a range for what is normal among human populations.

Human biomonitoring data were also discussed as an important source of information about the presence of chemicals in our systems, but the discussions also noted that the data lack information about the when, where, and how for chemical exposures. How do data from one-time measurements compare with averages from repeated measurements taken over time? How do personal behaviors, environmental factors, and life styles impact biomonitoring results? What is the range of normal for these biomonitoring data? These questions, methods to improve how the data are collected and analyzed, as well as aspects of the analytical procedures that may compromise the integrity of the results, were also discussed. Such improvements are essential for evaluating whether a sound scientific basis exists for the ongoing reports in media that link results from biomonitoring studies for chemicals to potential adverse health outcomes.

The ICCA-LRI is a global research program under the auspices of the ICCA and includes LRI programs supported by the American Chemistry Council, the European Chemical Industry Council and the Japan Chemical Industry Association. A hallmark of the annual ICCA-LRI workshops is to bring together a diverse range of stakeholders, including governmental and regulatory agencies, academia, and industry, and promote dialogue and advance thinking on issues of mutual interest in chemical safety.

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The second day opened with presentations on the interactions among genetics, diet, and age that can impact susceptibility to chemical exposures by altering the capacity for homeostasis and increasing the likelihood for adverse outcomes. The attendees were introduced to epigenetics, the study of changes in gene expression caused not by alterations in the DNA sequence itself but by modifications in materials around the DNA; these changes may be passed on to future generations. The Dutch Hunger Winter during World War II was discussed as an interesting example of epigenetic changes that were observed in the children of mothers who, before giving birth, experienced the stress of food deprivation during the famine; remarkably, the observed epigenetic changes persisted throughout the children's lives. This example illustrated how stress can cause epigenetic changes – whether the stress from chemical exposures causes epigenetic changes is not known but it presents an important question for research in chemical safety assessment.

Age can have important impacts on what is normal, again by affecting the capacity for homeostasis. The timing and the amounts for exposures to chemicals is a critical factor for determining adaptive or adverse outcomes, particularly during windows of susceptibility such as the time periods before and after birth. Several speakers described new *in vitro* and modeling approaches as useful tools for examining differences in enzyme levels, the metabolism of chemicals, and understanding the potential responses to chemical exposures related not only to age but also diet, genetics, and ethnicity. The potential health effects due to everyday exposures to chemicals among the elderly, both fit and frail, with consideration for the physical and psychological aspects of aging was also discussed as a current challenge.

Summary. The diverse topics and perspectives presented by the speakers on this year's workshop theme of "what is normal" and the interactive discussions among the attendees serve to inform the LRI's research agenda. An overall view was that it will be important to think broadly about normal as a continuum during development of chemical risk assessments and for decision making related to chemical safety. Outcomes from this workshop facilitate identification of key research questions to advance our understanding of responses to everyday exposures to chemicals as well as relevant directions for future ICCA-LRI research in chemical safety assessment.