Making Sense of Biomonitoring Data

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ACC Long-range Research Initiative (LRI)

Biomonitoring California Workshop
March 17, 2011, Oakland, CA

American Chemistry Council

Why Should Industry Care

- Industry is a part of this issue and has a vital role to contribute;
- ACC represents chemistry companies, employing over 800,000 people and representing over a $670 billion per year enterprise; and
- The business of chemistry is a science-based industry whose future product innovations (and hence the health of the public) will be influenced by discussions such as this.

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What is the LRI?

- Chemical industry's program to sponsor research to increase knowledge about health and environmental issues
- Issues are highest priority to the chemical industry and society
- Program seeks to advance understanding of biological mechanisms affected by chemicals

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Scientific Integrity: Principles

Scientific Excellence. The best research proposals and most-qualified scientists will be selected for funding.

Transparency. Research will be conducted openly and the results will be publicly available.

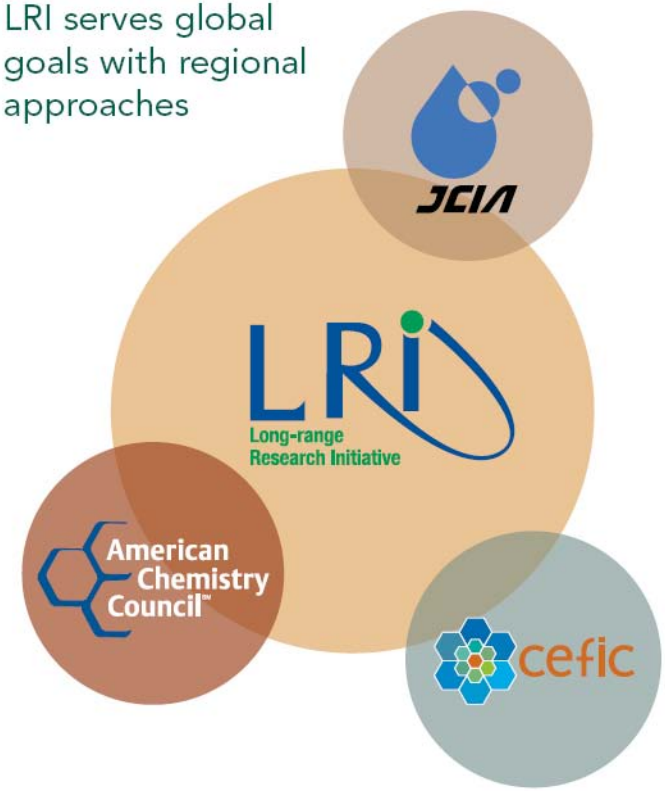
Fair and Unbiased Conduct. Potential conflicts of interest will be rigorously evaluated.

Relevance to the Chemical Industry. Research will address the potential health and environmental impacts of chemicals.

A Global Program

INTERNATIONAL COUNCIL OF CHEMICAL ASSOCIATIONS

LRI serves global goals with regional approaches



Extends the impact of the regional programs through global outreach

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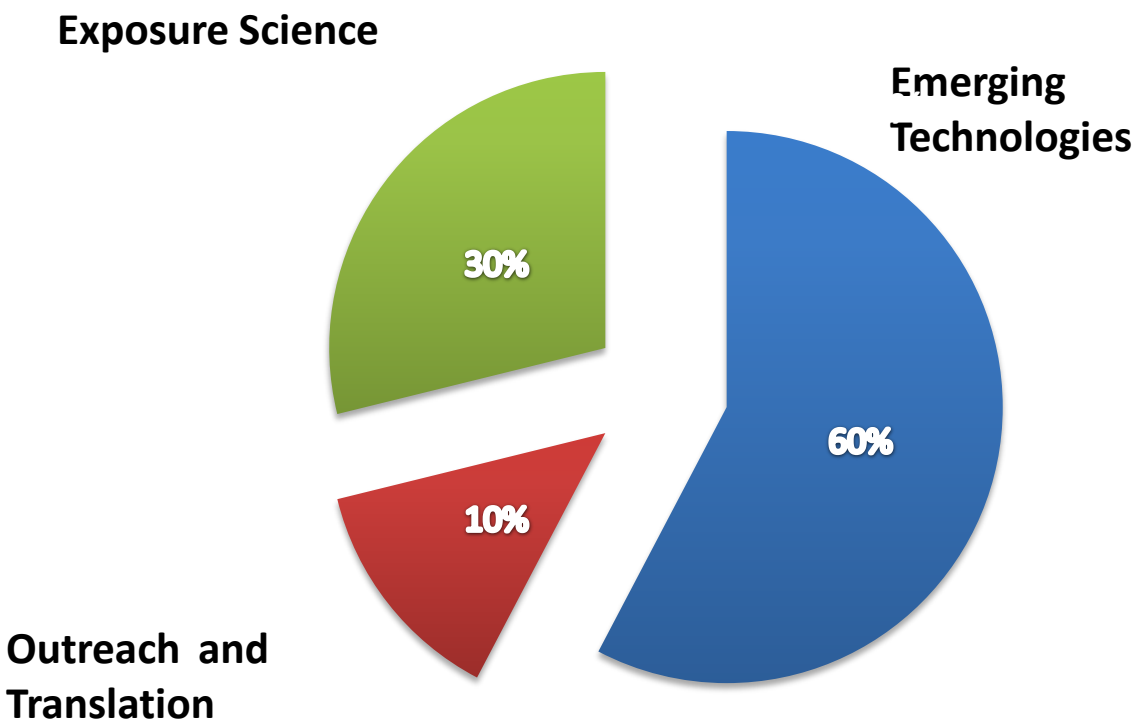
Research Investment



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What Is Exposure Science?

- The bridge between the sources of chemical, physical and biological agents and human health
  - A foundational element for understanding the interactions among the environment, genetics, and health.
  - Crucial information to estimate real-life risks to health and to identify the most effective ways to prevent and reduce these risks.

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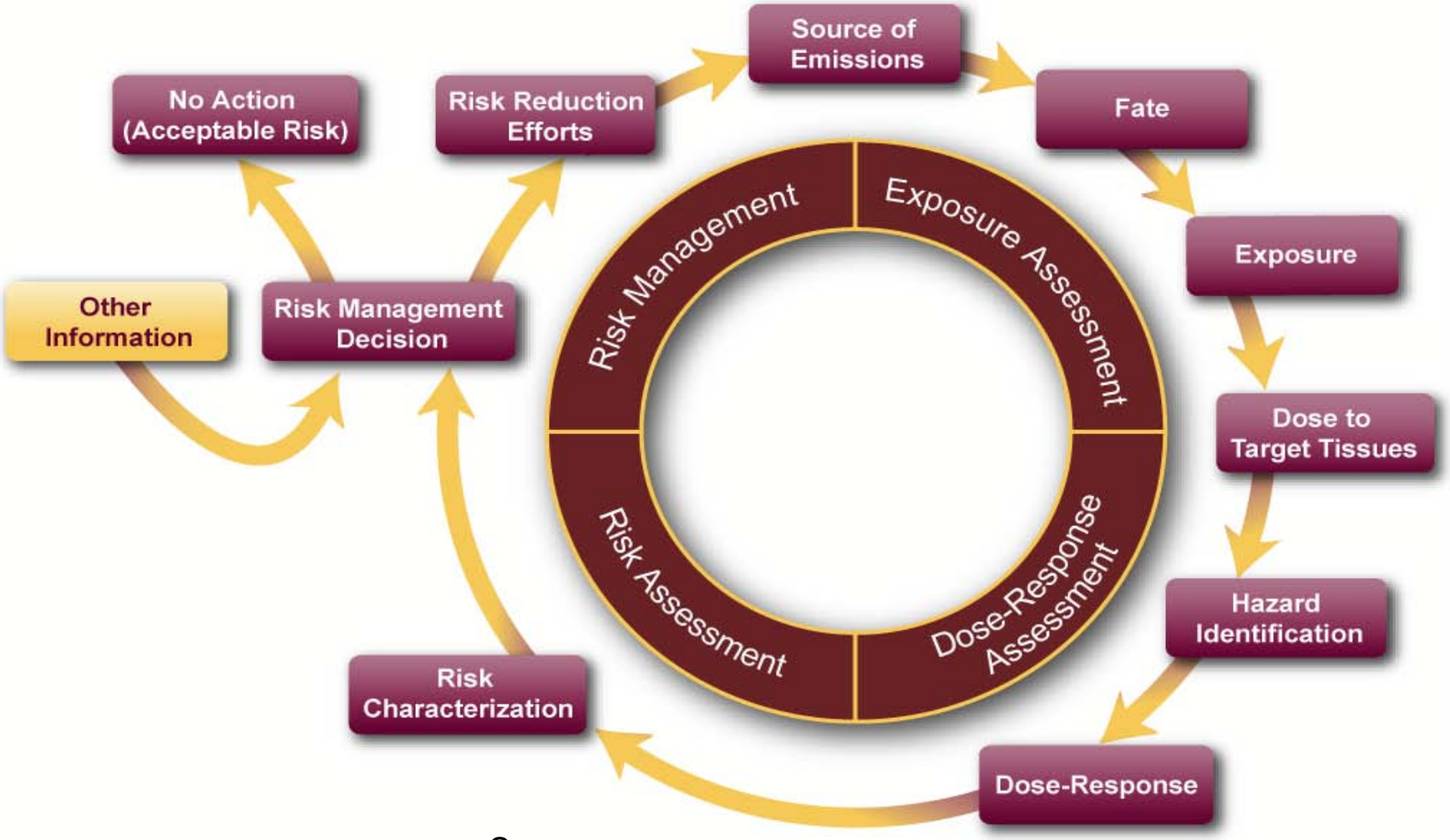
Human Health Risk Assessment and Management



Exposure -- Why Does it Matter?

- Crucial to protecting health
- Required to put hazard data into perspective
- Fundamental to identifying emerging trends and preventing and reducing public health risks from environmental agents in the upcoming decades
- Supporting exposure science *now* will pay major dividends in the future

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Why it matters?

- Efficient and effective public health policy requires a better understanding of key environmental risk factors and a renewed focus on health protection and disease prevention.

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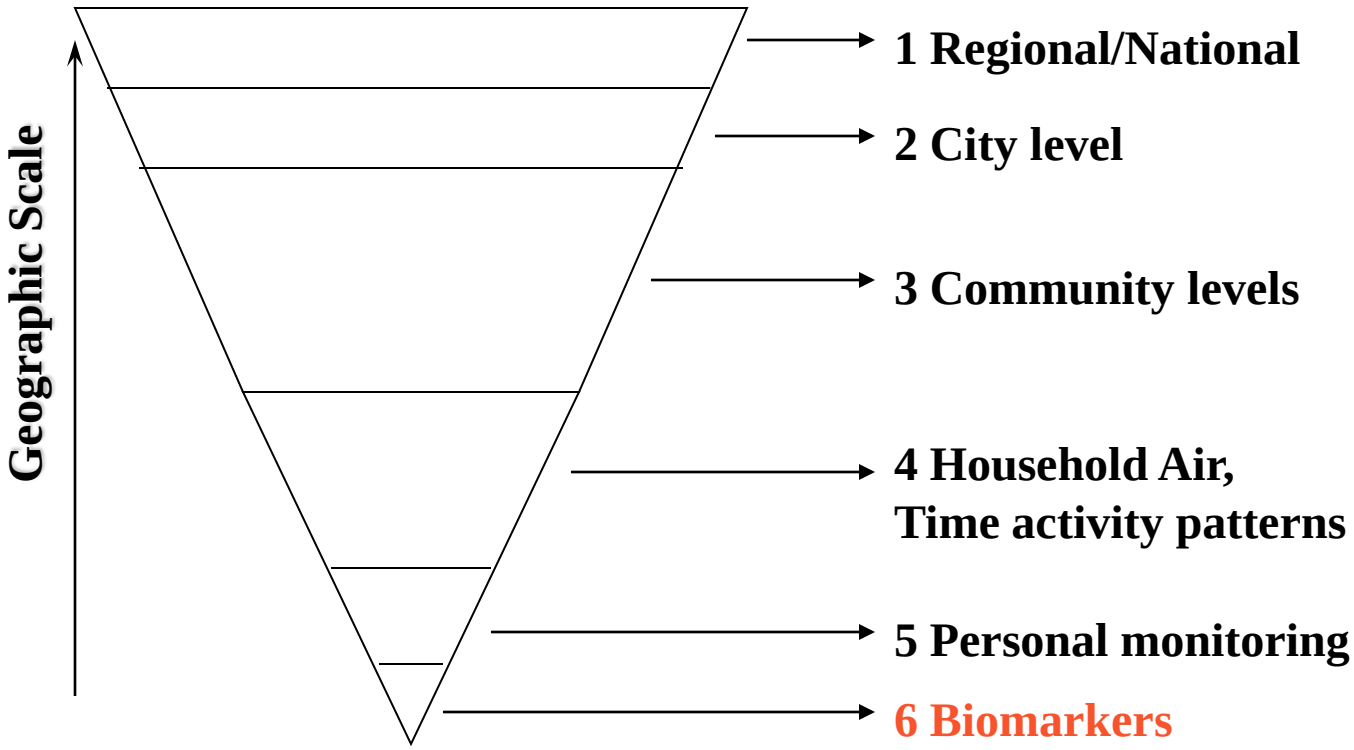
Tiers in Exposure Assessment



Today

Source/
Emissions

↓ ?

Concentrations

↓ ?

Exposures

↓ ?

Dose

Lagging Science

- Not many efficient and effective tools available to provide exposure information that are biologically relevant to health outcomes.
- In the meantime, biomonitoring has provided some much needed insight into environmental exposures
- But it has been very difficult to use the information to create effective and health protective interventions.

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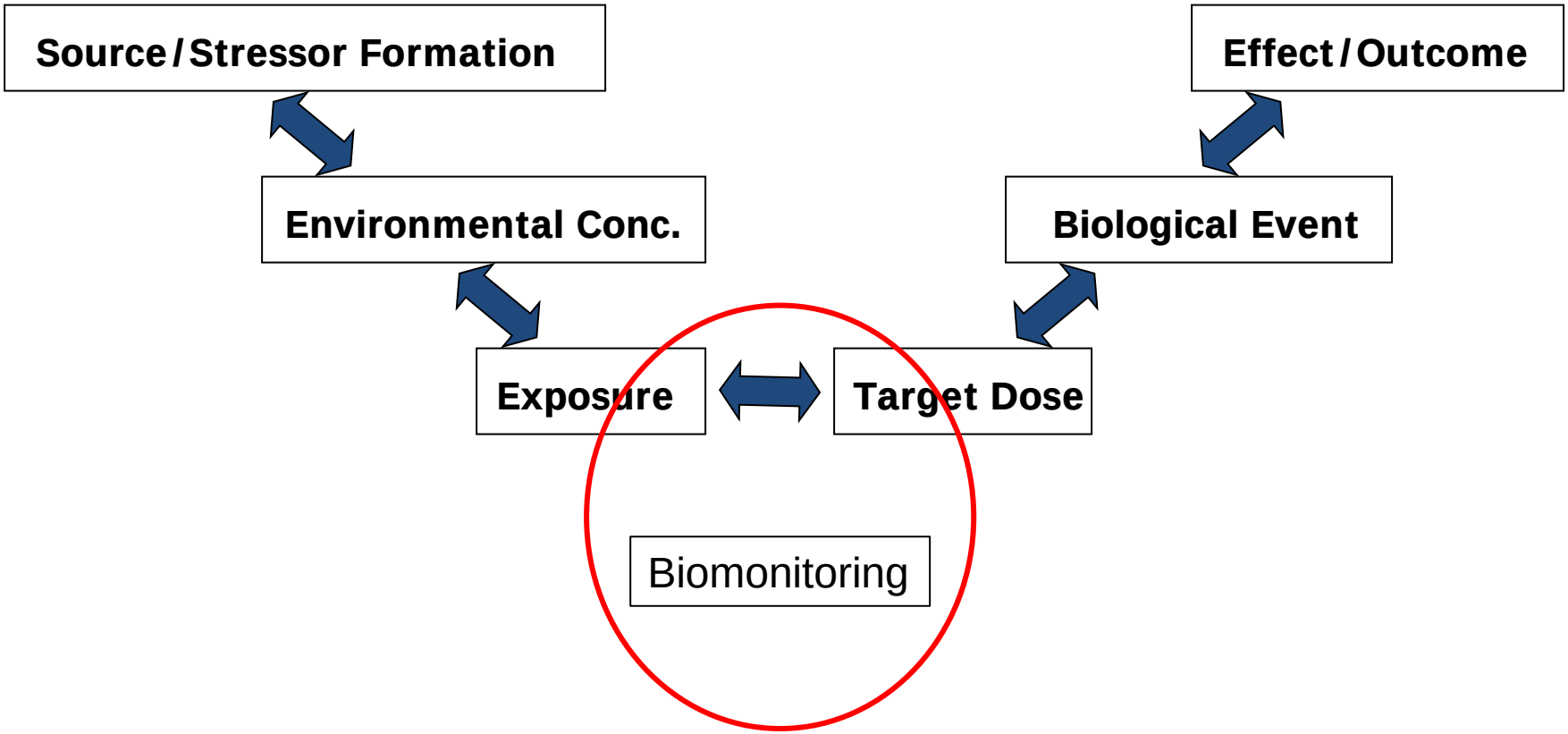
Risk Paradigm



Promise of Biomonitoring

- A powerful surrogate for exposure measurements.
- Reveals if exposure has occurred and whether levels are changing over time

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Challenges of Biomonitoring

- Relevance to health risks
- Relevance to exposure frequency, concentration and pathway
- Relevance of timing of measurement to actual exposures

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An Opportunity

- Biomonitoring allows us to populate the ‘exposure information’ black box
- New technologies have the potential to significantly enhance this capability
- Better, faster, cheaper, and more prevalent

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Exposure is dynamic

- Levels of both exogenous and endogenous chemicals vary within and between persons and across populations
  - The scale of variability ranges from 10-fold to 10,000-fold, depending upon the context
- Such variability makes it impossible to accurately predict exposure levels without empiric data
  - Exposure assessment should emphasize measurement-based rather than deterministic models
  - Studies should employ longitudinal designs (repeated measurements)

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The Concern

- These programs will easily generate volumes of ‘presence data’
- Comparable investments to interpret the data are lacking
- Without investment in the **science of interpretation**, it will be difficult to realize the full potential of these data

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Making Sense of Human Biomonitoring Data

An International Workshop on Interpreting Biomonitoring Data

26th – 27th July 2006

Minneapolis, Minnesota

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EPA United States Environmental Protection Agency

ICCA International Council of Chemical Associations

PUBLIC HEALTH APPLICATIONS OF HUMAN BIOMONITORING

An International Workshop sponsored by the U.S. Environmental Protection Agency and the International Council of Chemical Associations

September 24-25, 2007
U.S. EPA, Main Campus--Auditorium, Research Triangle Park, NC

The U.S. Environmental Protection Agency (USEPA) and the International Council of Chemical Associations (ICCA) will co-sponsor a meeting on the public health applications of human biomonitoring. International scientists from academia, government and industry – from the U.S., Canada, Europe and Japan – will meet to exchange information on the state of the science for using biomonitoring in a public health context, evaluate the available approaches, and discuss the issues associated with the public health applications of biomonitoring.

Advances in measurement technology have made widespread application of biomonitoring for health tracking, trends monitoring, and other public health management purposes potentially possible. There are efforts at the federal, state and international levels to collect information on human exposure to environmental pollutants and to be able to assess public health outcomes resulting from policy decisions.

This workshop will focus on three themes:

- Advances in interpreting human biomonitoring data;
- Application of biomonitoring data for characterizing and prioritizing vulnerable populations; and
- Challenges faced in communicating biomonitoring information

Posters will be presented from current research funded by the EPA's Science to Achieve Results (STAR) grants program and the ICCA's Long-Range Research Initiative (LRI), showcasing projects related to the interpretation of biomonitoring data.

Attendees will include scientists from EPA, other federal agencies, state and international governments, academia, industry, and NGOs. The meeting is open to the public.

For more information, please contact:

Tina Bahadori (tina_bahadori@americanchemistry.com)
Kacee Deener (deener.kathleen@epa.gov)

Registration opens on July 2, 2007. You may register for the workshop online at:
http://es.epa.gov/ncer/events/#sep2407

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Path Forward?

- Requires a priori and commensurate consideration of the totality of the paradigm:
  - Contextual relevance, i.e. real world
  - Human element, including intra- and inter-individual variability
- How will biomonitoring data be translated to assess potential for real-world human health risk?
- Population-based data and human exposure information critical for guiding development and use of biomonitoring information

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LRI Research

- Identify ways to understand predominant sources and pathways of exposure
- Characterize the relationship between exposure to environmental contaminants and biomonitoring data
- Identify holistic ways to elucidate the relationship among biomonitoring data, dose, and health outcomes.

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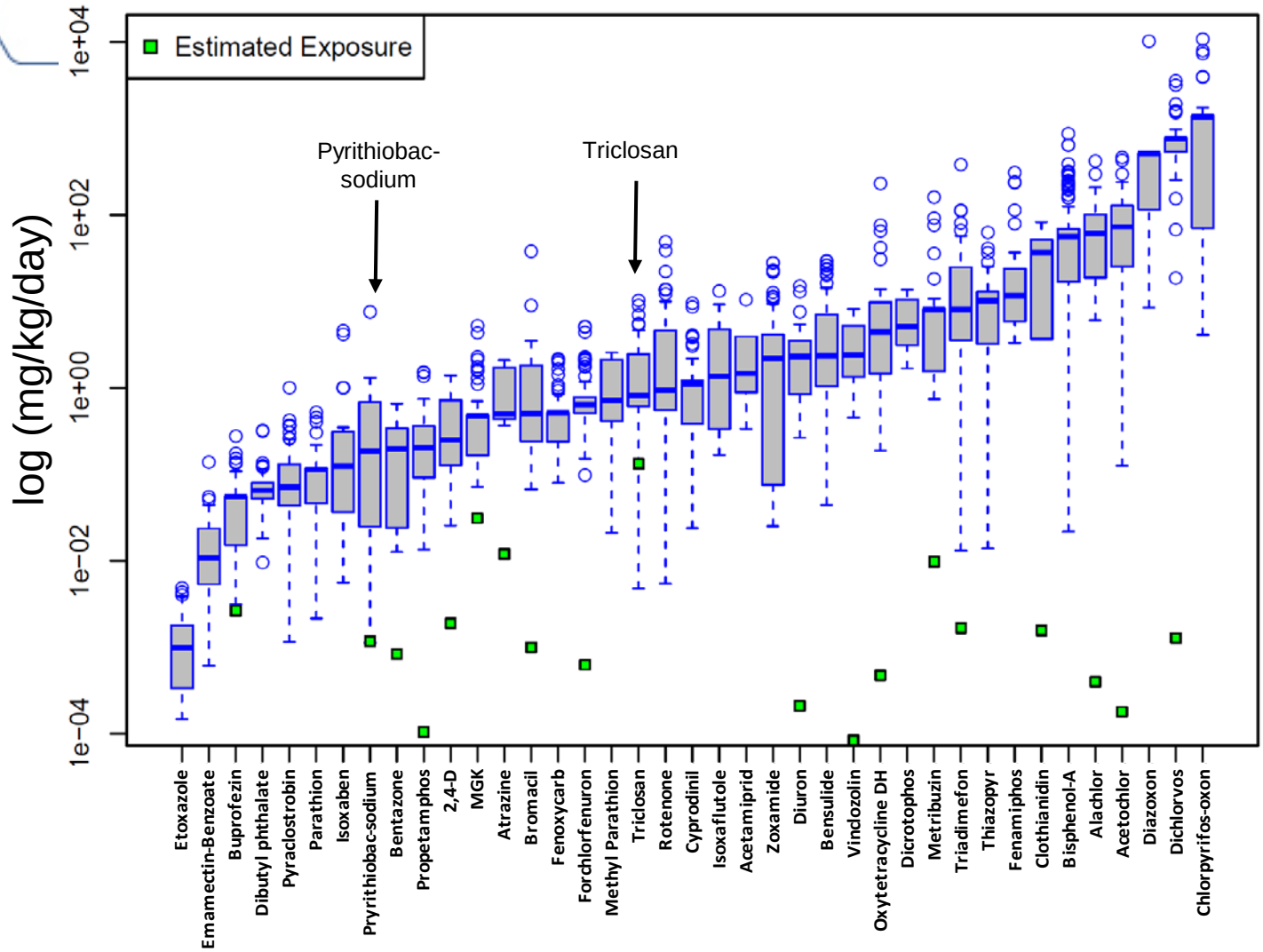
The Exposure Ontology (ExpOnt)

- Collaborate directly with EPA, NIEHS, NGOs, and academia
- Builds on NIEHS-sponsored $1M/year database
- Tools to ‘translate’ exposure information into a language useable in automated computer databases
- Provide essential exposure information in large databases that currently contain only hazard and disease information for chemicals

ToxCast Reverse Dosimetry Project



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Interpreting HTS Data

Incorporating Human Dosimetry and Exposure into High-Throughput *In Vitro* Toxicity Screening

Daniel M. Rotroff,*,† Barbara A. Wetmore,‡ David J. Dix,* Stephen S. Ferguson,§ Harvey J. Clewell,‡ Keith A. Houck,* Edward L. LeCluyse,§ Melvin E. Andersen,‡ Richard S. Judson,* Cornelia M. Smith,§ Mark A. Sochaski,‡ Robert J. Kavlock,* Frank Boellmann,‡ Matthew T. Martin,* David M. Reif,* John F. Wambaugh,* and Russell S. Thomas‡,[1]

*National Center for Computational Toxicology, Office of Research and Development, United States Environmental Protection Agency, Research Triangle Park, North Carolina 27711; †Department of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, North Carolina 27514; ‡The Hamner Institutes for Health Sciences, Research Triangle Park, North Carolina 27709; and §CellzDirect/Invitrogen Corporation (a part of Life Technologies), Durham, North Carolina 27703

Published May 2010: “Integrating both dosimetry and human exposure information with the high-throughput toxicity screening efforts provides a better basis for making informed decisions on chemical testing priorities and regulatory attention.”
Importantly, these tools are necessary interpret the results from these new tools.

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The Exposome – A Unifying Concept

- Recognizing the disparity in current knowledge between genes and environmental exposures, Chris Wild defined the "exposome," representing all environmental exposures (including those from diet, lifestyle, and endogenous sources) from conception onwards, as a quantity of critical interest to disease etiology.

Wild, C.P., Complementing the genome with an "exposome": the outstanding challenge of environmental exposure measurement in molecular epidemiology. Cancer Epidemiol Biomarkers Prev 14 (8), 1847-1850 (2005).

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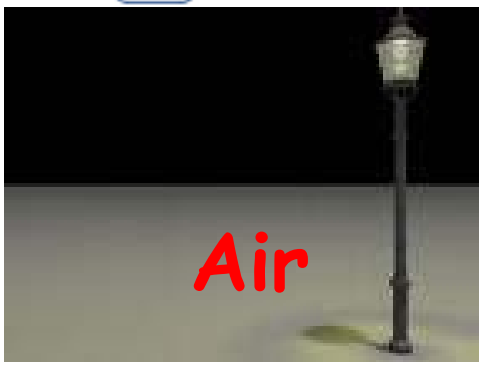
The Exposome Shifts the Paradigm



The exposome is everything - from all sources - all the time

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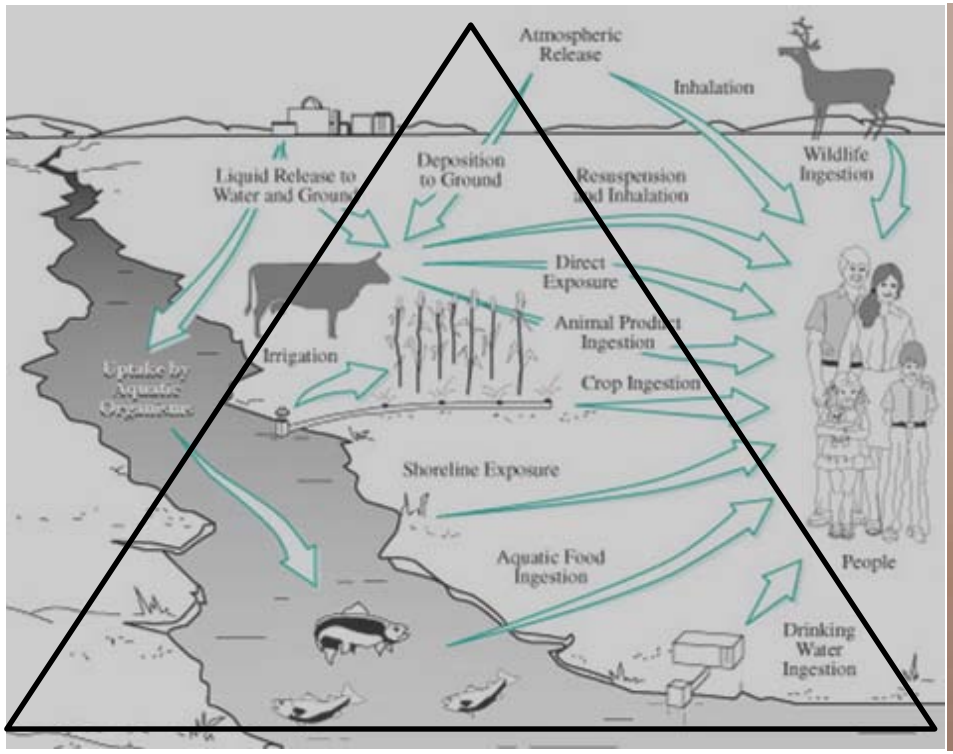
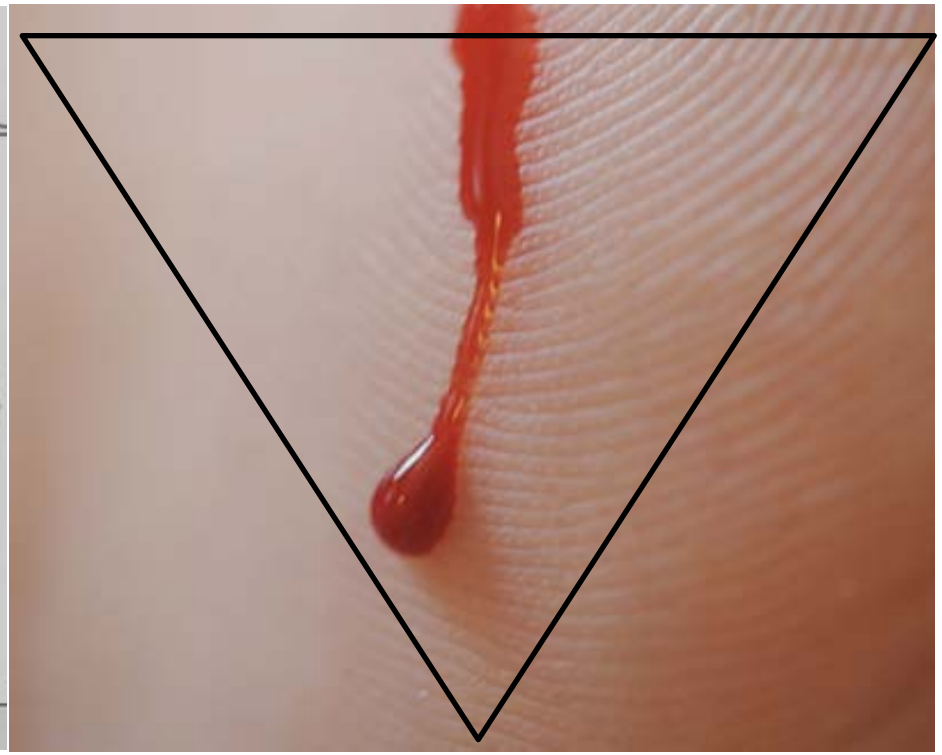
Bottom-up Exposomics

Top-down Exposomics

Identify important exogenous exposures

Measure endpoints in blood





Measure chemicals in air, water & food

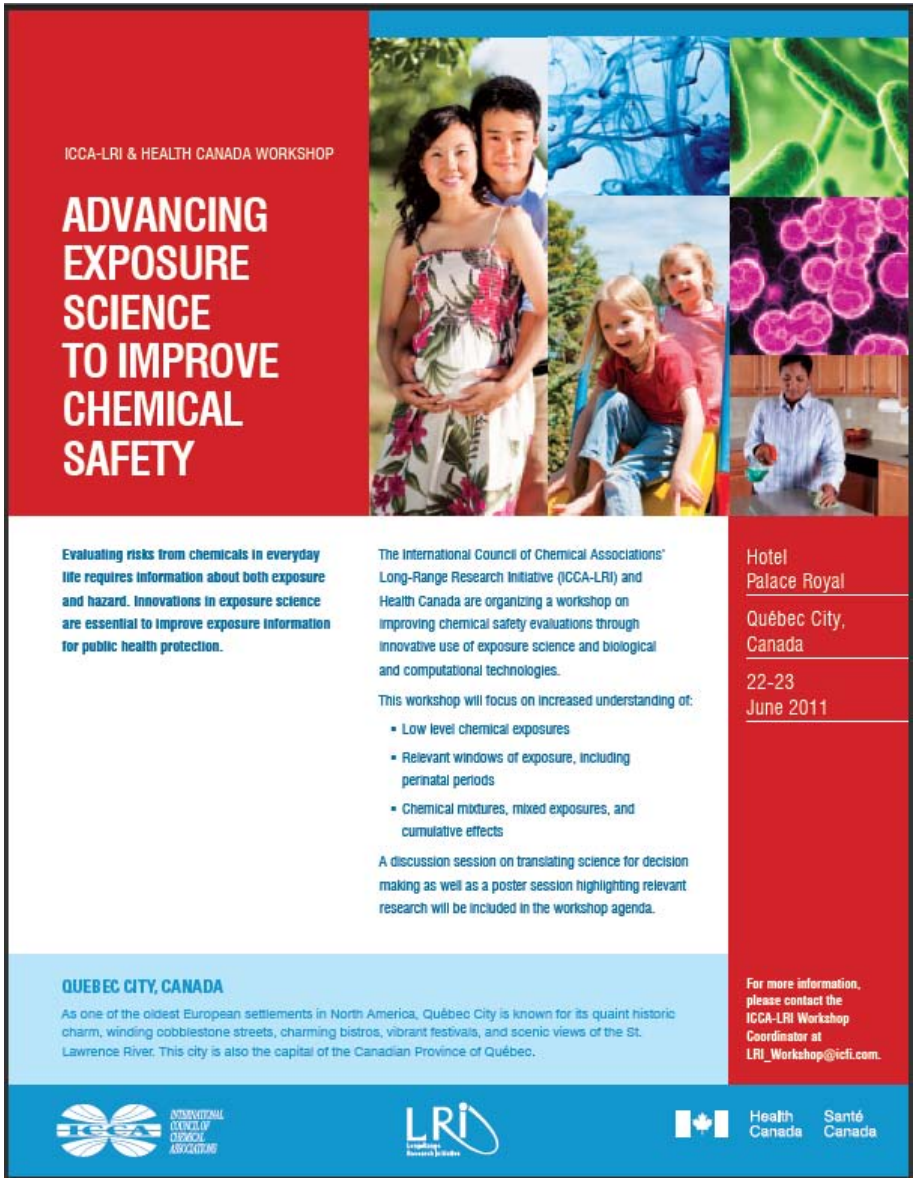
Identify all important exposures

Background graphic: United States Department of Energy, Hanford site

Background graphic: http://www.flickr.com/photos/paulieparker/246707763/

SM Rappaport & MT Smith, 6/2010

ICCA-LRI 2011 Workshop



ICCA-LRI & HEALTH CANADA WORKSHOP

ADVANCING EXPOSURE SCIENCE TO IMPROVE CHEMICAL SAFETY

Evaluating risks from chemicals in everyday life requires information about both exposure and hazard. Innovations in exposure science are essential to improve exposure information for public health protection.

The International Council of Chemical Associations' Long-Range Research Initiative (ICCA-LRI) and Health Canada are organizing a workshop on improving chemical safety evaluations through innovative use of exposure science and biological and computational technologies.

This workshop will focus on increased understanding of:

- Low level chemical exposures
- Relevant windows of exposure, including perinatal periods
- Chemical mixtures, mixed exposures, and cumulative effects

A discussion session on translating science for decision making as well as a poster session highlighting relevant research will be included in the workshop agenda.

Hotel Palace Royal

Québec City, Canada

22-23 June 2011

QUEBEC CITY, CANADA

As one of the oldest European settlements in North America, Québec City is known for its quaint historic charm, winding cobblestone streets, charming bistros, vibrant festivals, and scenic views of the St. Lawrence River. This city is also the capital of the Canadian Province of Québec.

For more information, please contact the ICCA-LRI Workshop Coordinator at LRI_Workshop@icfi.com.

ICCA International Council of Chemical Associations

LRI Long-Range Research Initiative

Health Canada Santé Canada

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Information about LRI program and research projects published in ***public*** website

www.americanchemistry.com/LRI

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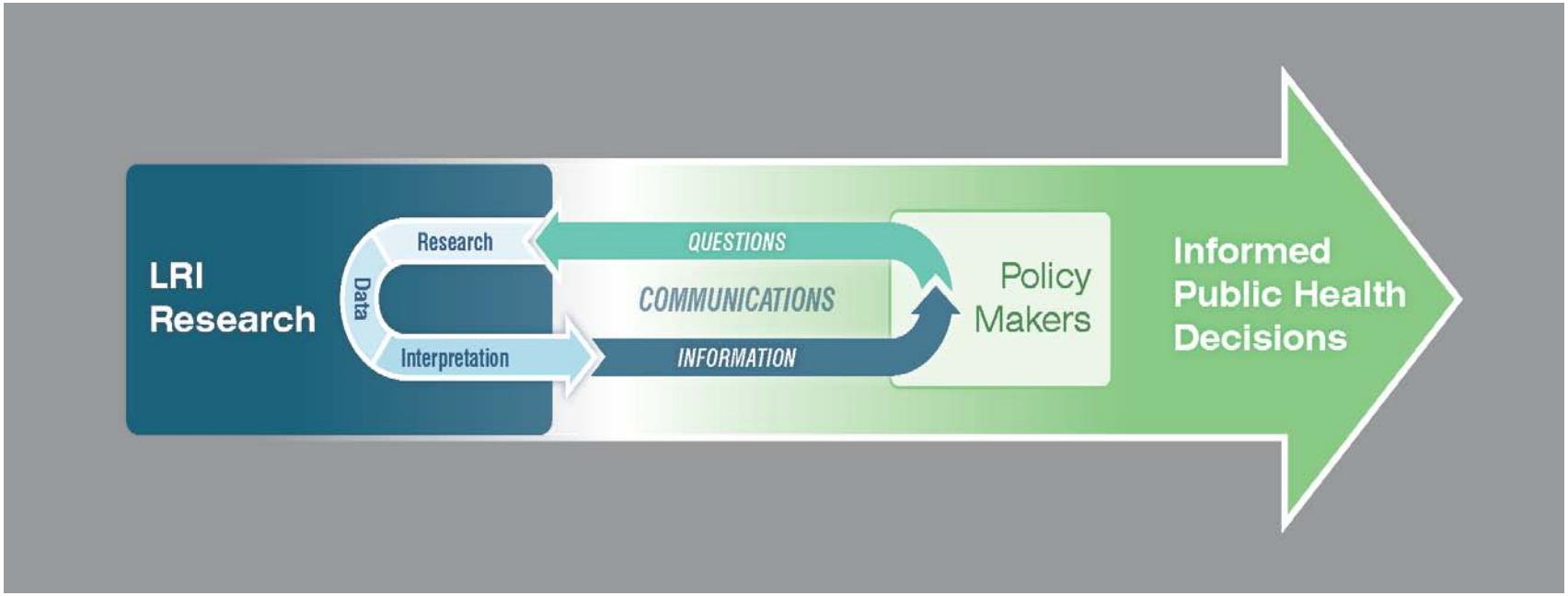
From Data to Decisions



www.AmericanChemistry.com/LRI

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