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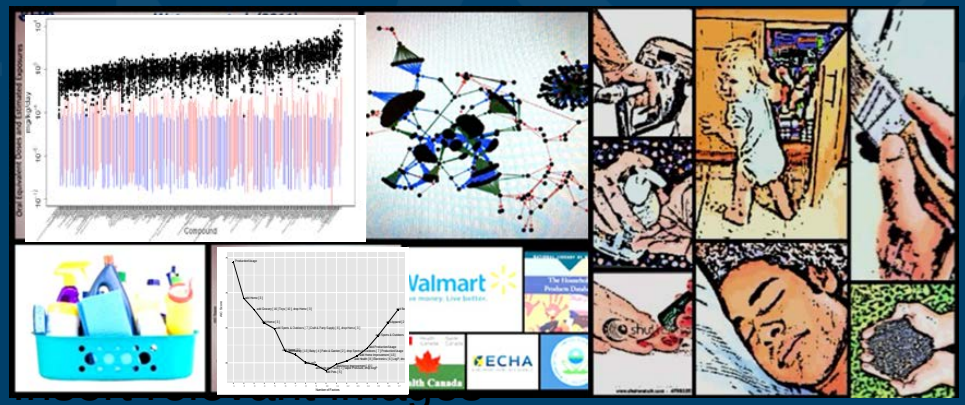
Moving Forward



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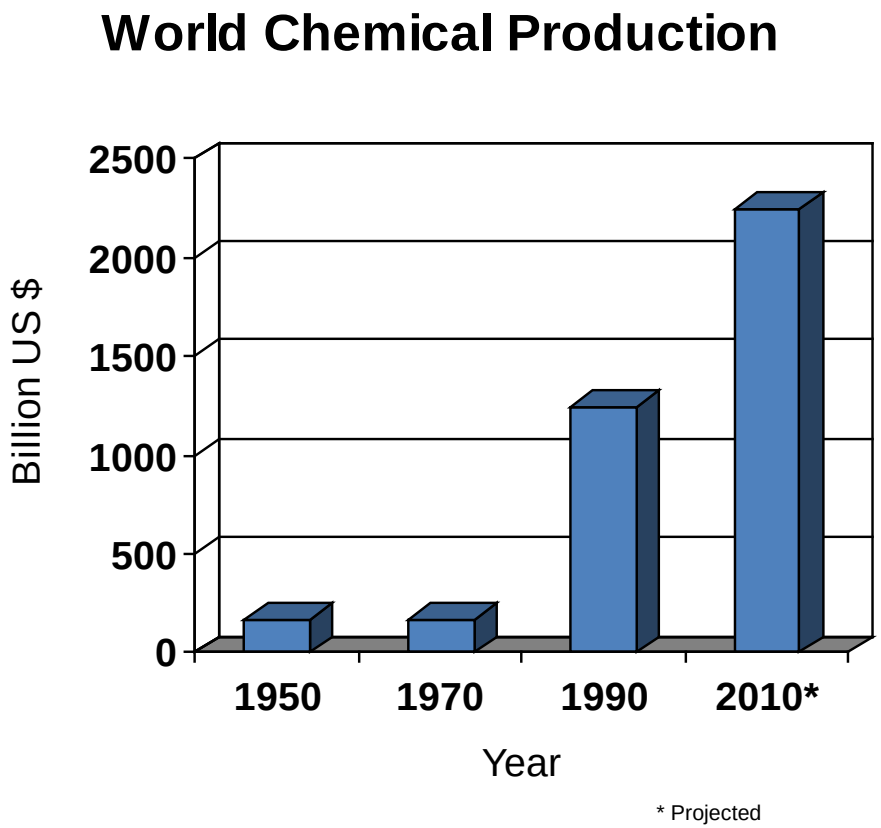
NIEHS Superfund Research Program Annual Meeting
Exposure Symposium

October 24, 2012

United States Environmental Protection Agency

Disclaimer: *The views expressed in this presentation are those of the author and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency.*

Chemical Production Increasing

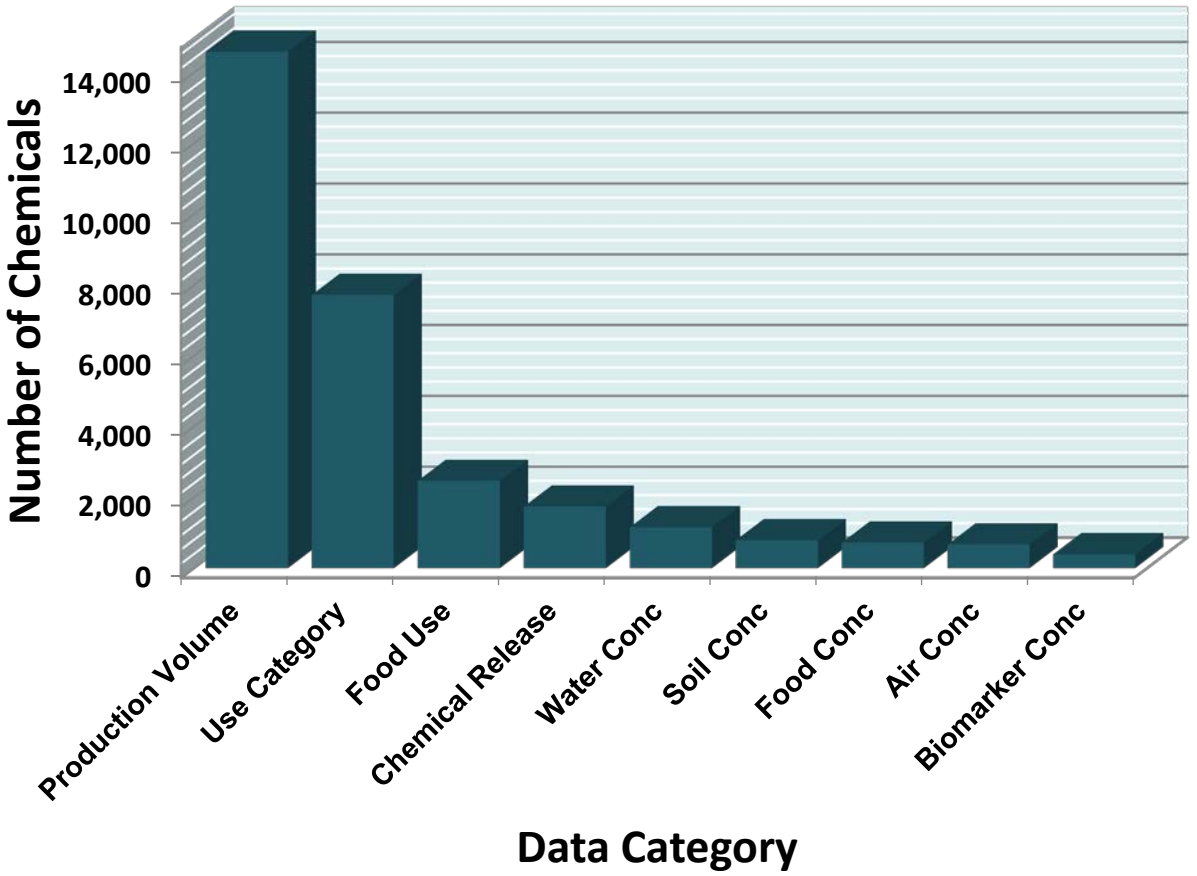


- Chemical production has increased spectacularly since 1970s
  - Expansion of chemical portfolio
  - Expansion of types of products
  - Ubiquitous integration
- Formidable number of chemicals in commercial use
  - 143,000 substances in Europe
  - 100,000 in US
- Approximately 30,000 substances marketed in volumes > 1 t/y
  - About 3,000 HPV chemicals make up 95% of total production

Exposure Information: Chemical Coverage

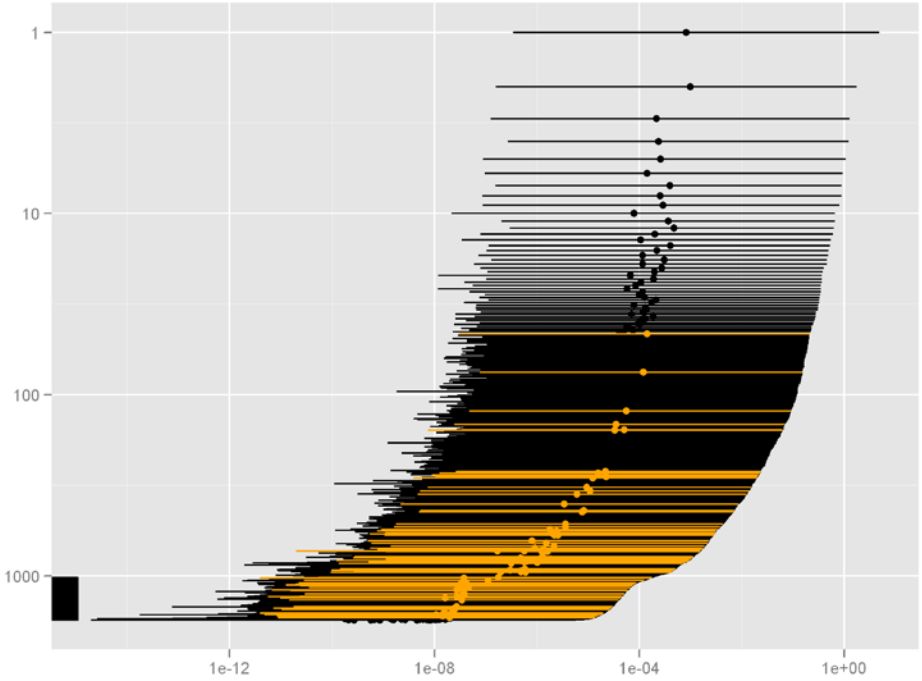
“EPA study reveals barren exposure data landscape”

-EDF Chemicals & Nanomaterials Blog, March 16, 2012

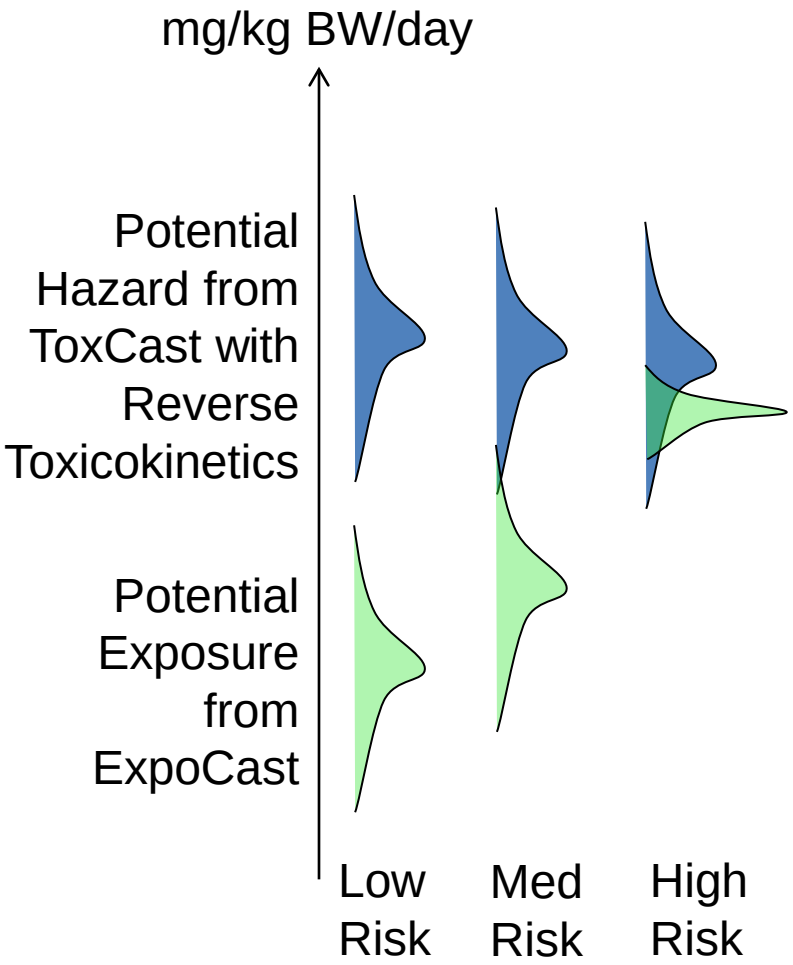


P.P. Egeghy et al. / Science of the Total Environment 414 (2012) 159–166

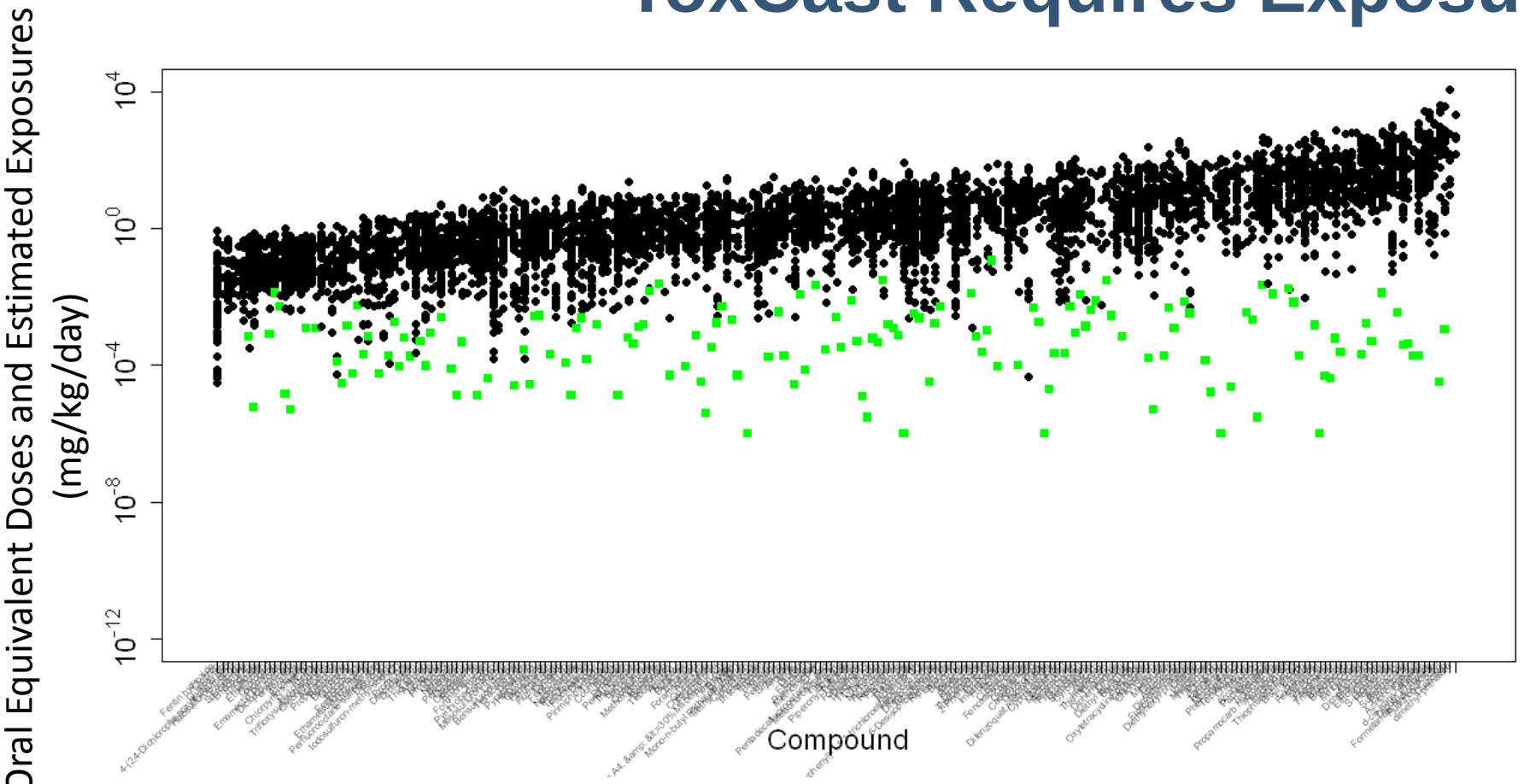
Providing an Exposure Context for ToxCast



ExpoCast Prediction (mg/kg BW/day)

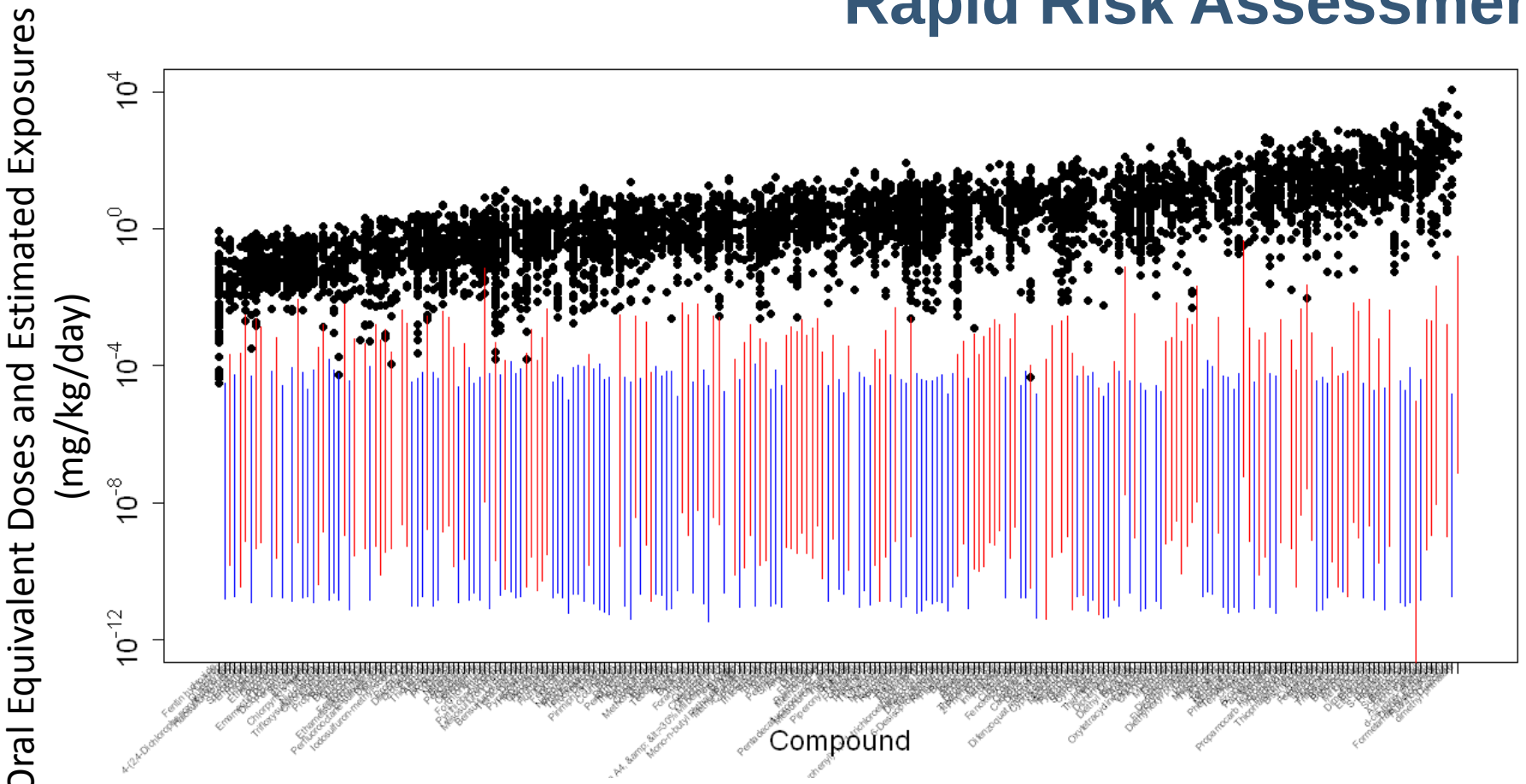


Quantitative Risk Assessment Using ToxCast Requires Exposure



Green squares indicate estimated exposures from EPA REDs or CDC NHANES: ~71% of Phase I
~7% of Phase II

ExpoCast Predictions for Rapid Risk Assessment



~93% Phase I and ~89% Phase II coverage by ExpoCast

Chemicals with Indoor/consumer use in **red**

Chemicals with Far field (industrial/agricultural) release in **blue**


A STEM-CELL GAMBLE ...
technology review
Published by MIT
MIT NEWS
THE QUANTUM FRONTIER
The Measured Life
New self-tracking devices could make us healthier and more productive
The Perfect Malware Scam
Climate-Change Economics
Myhrvold's 40-Pound Cookbook
140/90
My Blood Pressure
My Blood Sugar

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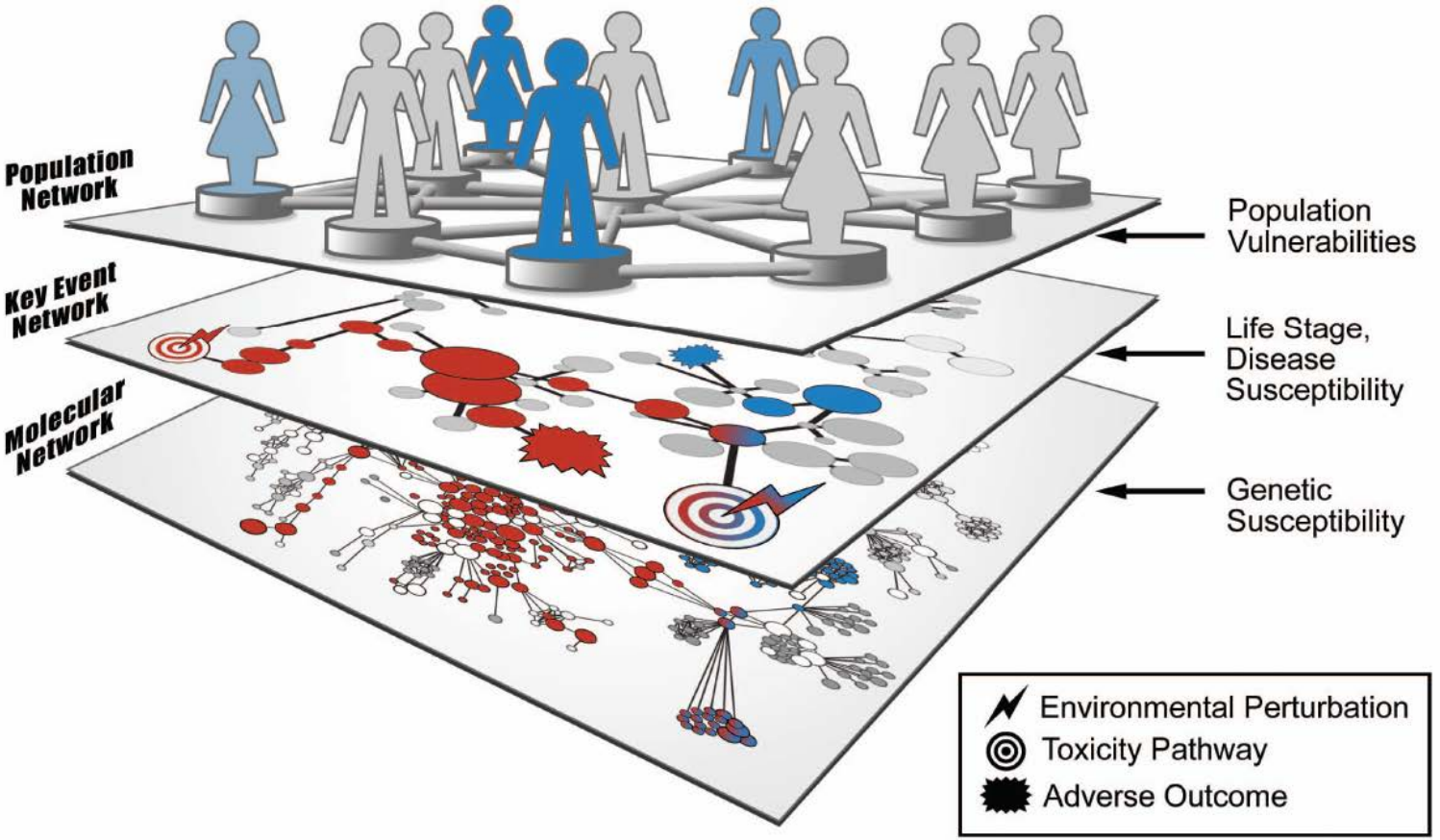
Integration and Translation

- Systems framework
- Biologically-relevant exposure metrics
- Knowledge-base infrastructure

Systems Exposure Science : Extending Network Analysis

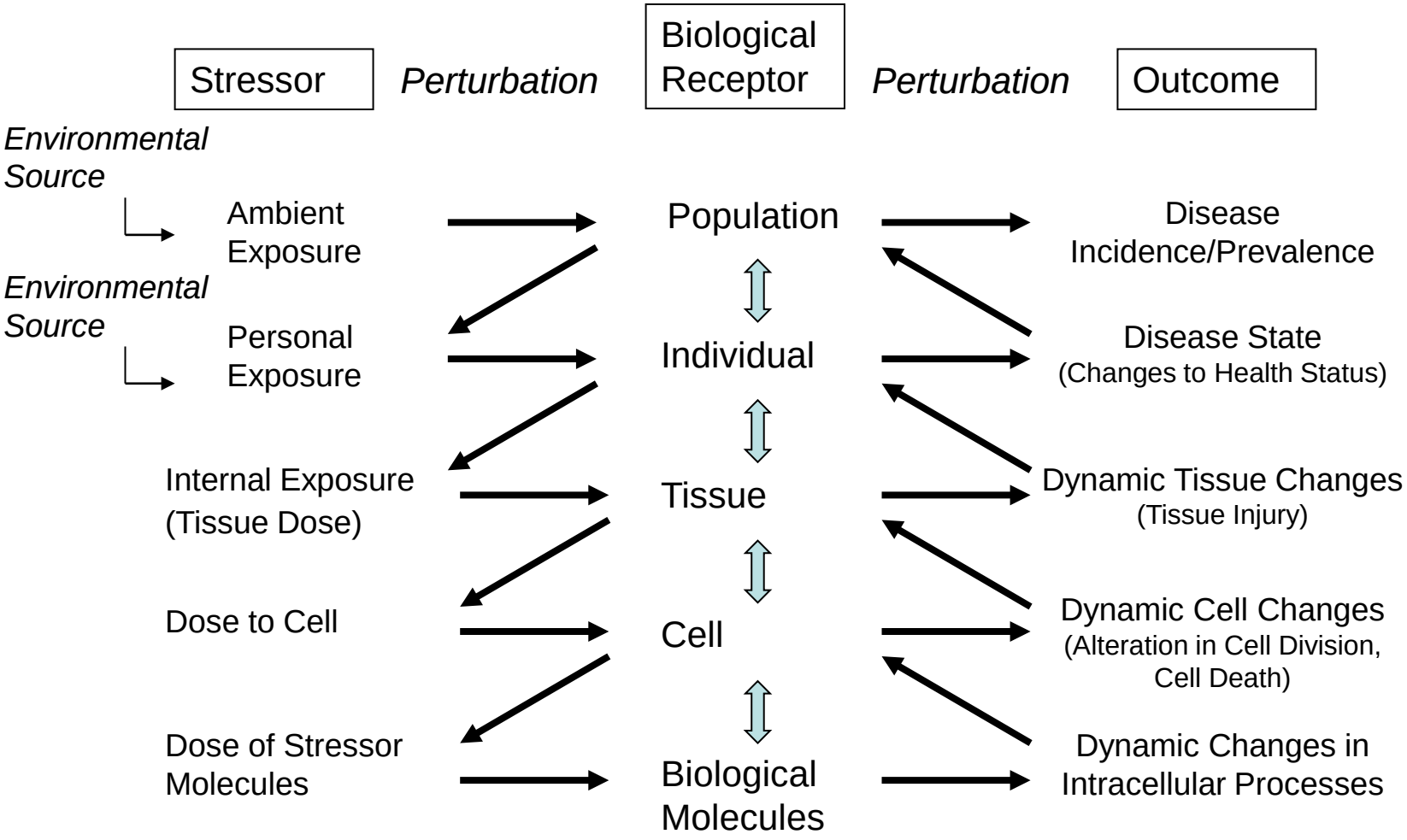
Consider coupled networks spanning multiple levels of biological organization



Adapted from Edwards & Preston (2008), Tox Sci, 106(2):312-318

Integrating Systems Biology and Exposure Science

Exposure at All Levels of Biological Organization



Cohen Hubal, JESEE, 2008

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Biologically-Relevant Exposure Metrics

Markers required that can be directly associated with key events in disease processes and with individual exposure profiles

- 'Omic technologies showing potential to yield a new generation of exposure metrics (Wild, 2009)

  (Altered global gene expression associated with exposures to arsenic, cigarette smoke, benzene, metal fumes and air pollution)

- Better environmental biosensors required to study gene-environment interactions associated with complex disease (Collins 2007)

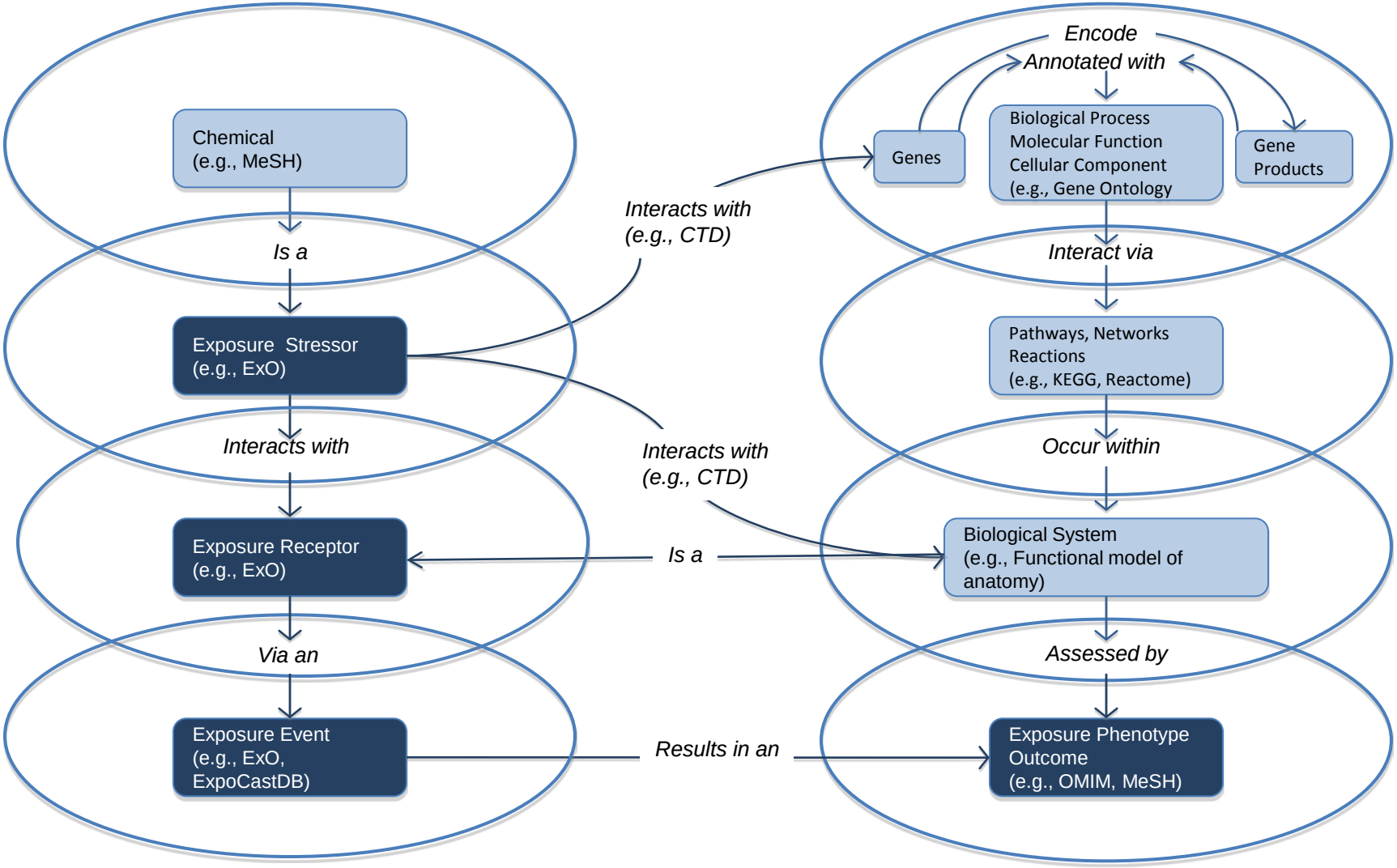
  (Nano-scale sensor arrays can be developed to detect specific sets of environmental agents (Andreescu et al, 2009))

- Characterizing the "internal environment" - strategy for capturing "snapshots" of critical portions of a person's Exposome (Rapport and Smith, Science, 2010)

Investment in this area of research required to provide important approaches for assessing real-world exposures

High-level schematic of Exposure Ontology (ExO)

Integration Within a Broader Biological Context



Mattingly et al, ES&T 2012

The Strategy: Building Capacity

- Research needs: characterize exposures quickly and cost-effectively at multiple levels of integration (time, space, biological scale), for multiple and cumulative stressors
- **Develop advanced exposure infrastructure to forecast, prevent, and mitigate potential impacts and unintended consequences**
  - Non targeted environmental monitoring and surveillance
  - Sensor networks, advanced biomonitoring, activity tracking
  - Data storage and distribution systems
  - Exposure-based predictive screening and modeling systems to anticipate exposures

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Approach

- Pragmatic approach
  - Conduct strategic data-gathering efforts
  - Draw from scientific innovations in fields outside traditional exposure science
  - Leverage active initiatives and planned infrastructure – e.g., CDC National Environmental Public Health Tracking Network (EPHT), National Ecological Observatory Network (NEON)
- Engage stakeholders in development and use of exposure information – including health agencies, regulators, and communities

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