
Transforming Exposure Science to Improve Predictive Exposure Capabilities



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**HESI 25th Anniversary Meeting
HESI Emerging Issues Session
June 2014, Washington, D.C.**

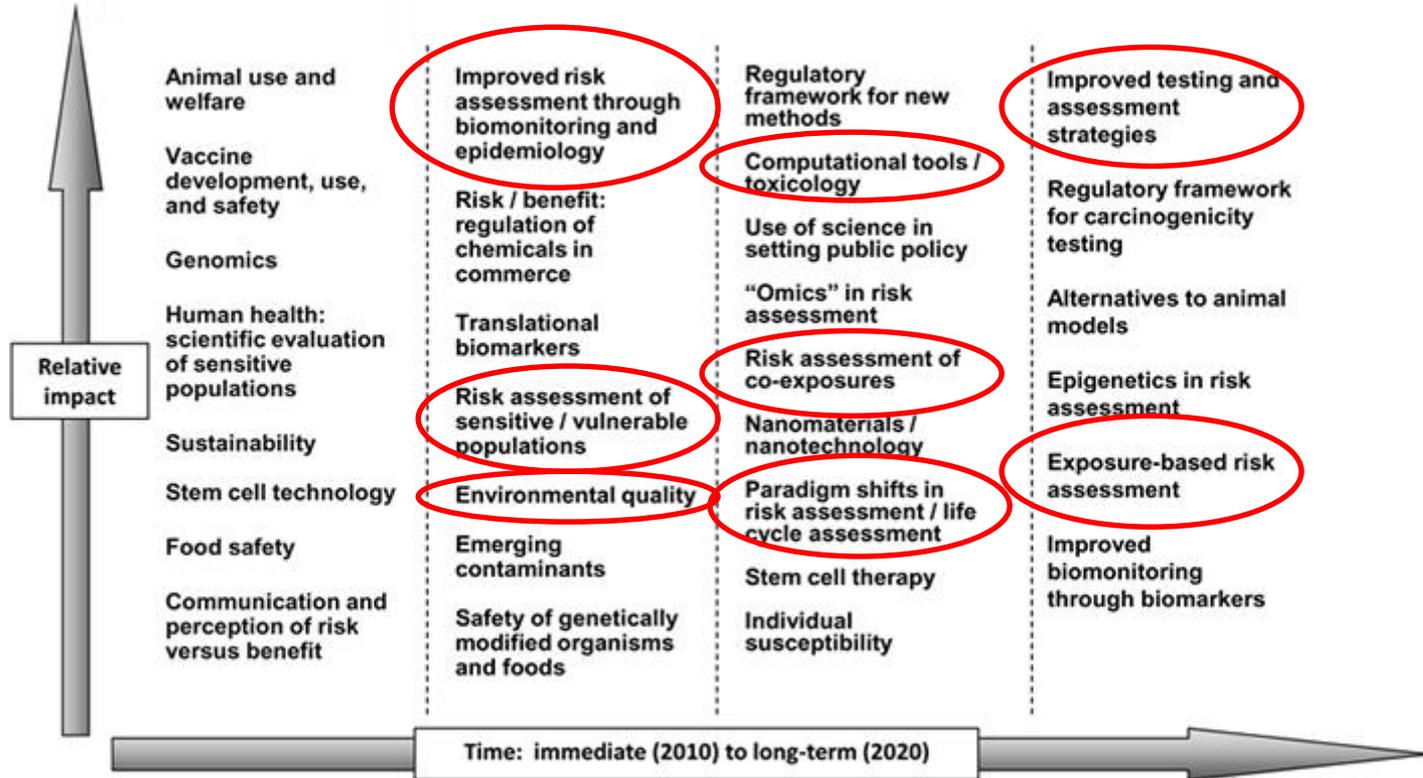
ILSI Health and
Environmental Sciences
Institute



- Relevance of exposure science
- Emerging science/data
- Specifics of HESI proposal – putting it all together
- Envisioned impact of proposed project



2010-2020 HESI COMBINED CHALLENGES MAP



Each axis appearing on the 2010-2020 HESI Combined Challenges Map is a continuum. All issues on the map are of high importance/impact based on prioritization by the participants in the 2009 HESI mapping exercise. "Relative impact" is a qualitative measure of importance among high priority topics. The location of issues along the "time" continuum is an approximation of when the topic is likely to become a major issue in the timeframe from 2010 to 2020.



No exposure, no risk – period.

*International Society of Exposure Science Board
Letter to Science (2011) citation of NRC (1983).*

Risk = Fn (Hazard, Exposure)

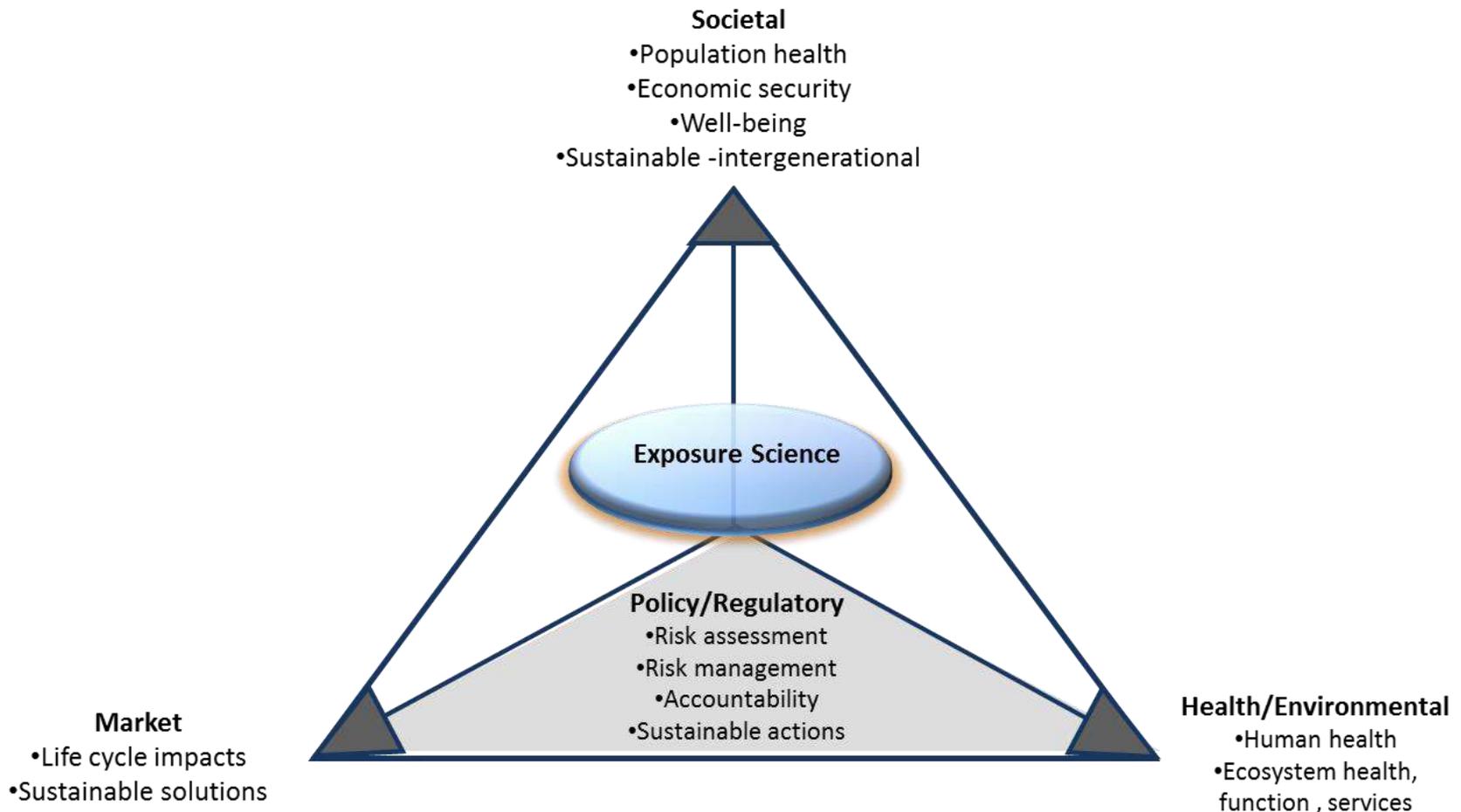
**Exposure is the Achilles heel
of Risk Assessment!**

Expanded needs for exposure information



NRC 2012: Demands for exposure science:

Plays a key role in public health protection, environmental regulation, urban and ecosystem planning, and disaster management



Many exposures - measurement infeasible



Widespread dispersive (air, water, soil)

Point source emissions (facilities)

Direct exposures (food, products)

Expanded predictive capability is key!

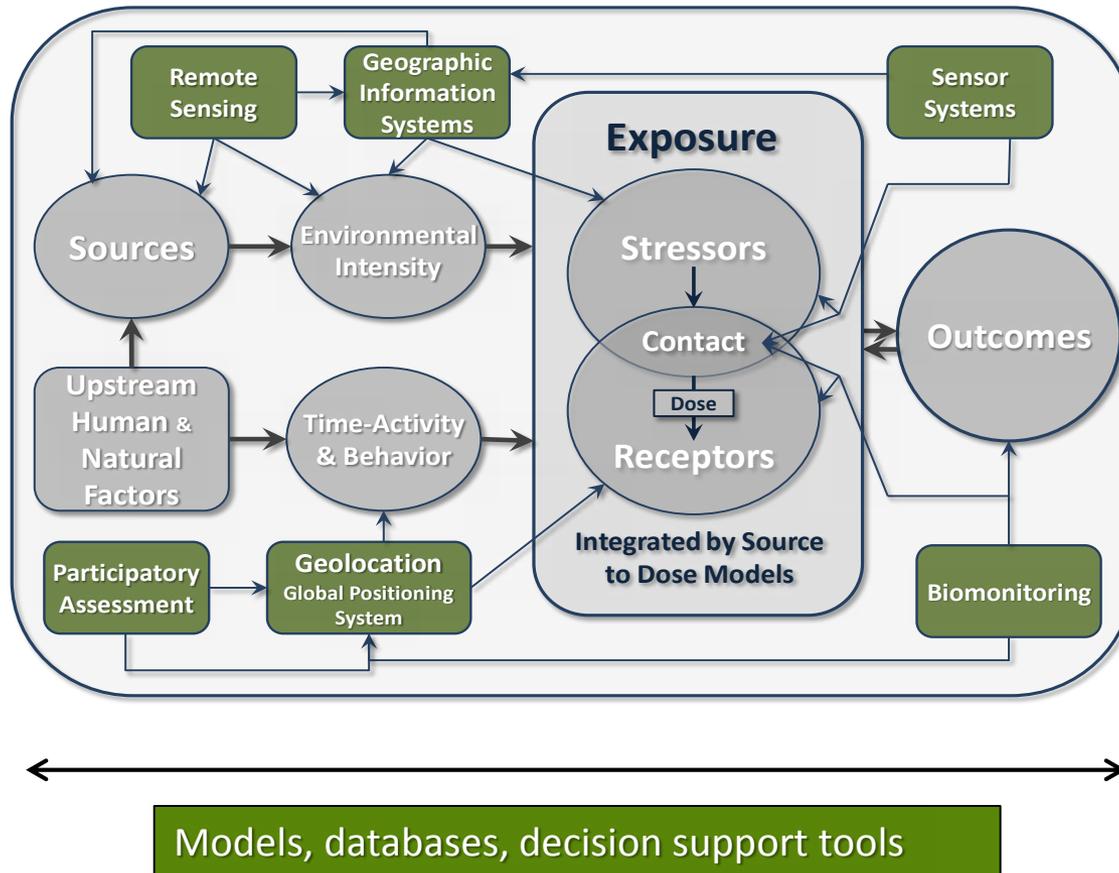
Goal of proposed project:

- increased ability to predict exposures
- greater confidence in predicted estimates

Utilize NRC key concept



Advanced technologies can move exposure science forward



KEY IS TO INTEGRATE ACTIVITIES/DATA /TECHNOLOGIES FOR MAXIMUM IMPACT

Drivers: Advanced understanding of environmental exposure significance and chemical landscape



Former exposure assessment approaches:

What is the exposure to chemical A?

Current exposure assessment approaches:

What are the possible exposures to chemicals A - Z?

Exposome assessment approaches:

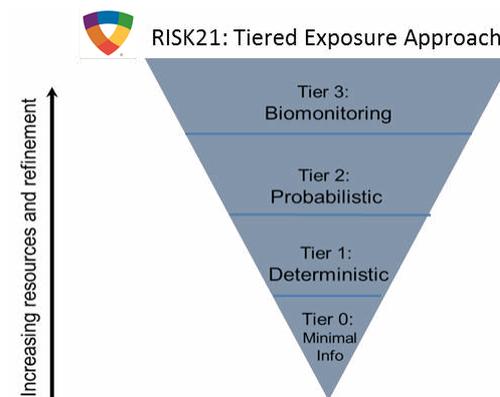
Which exposures are the drivers of disease?

Why now?

Numerous complementary concurrent activities



- CompTox: high throughput hazard studies
 - Generate much data, needs context
- Related “high” throughput” exposure activities
 - EPA ExpoCast
 - HESI RISK21
 - ACC ExpoDat
- Toxics and Risk Subcommittee/Committee on Environment, Natural Resources and Sustainability/NSTC
 - 14 Federal agencies
- ISES Symposium – October, 2014
- NC Environmental Health Collaborative
 - Exposure Science in the 21st Century: Role of Citizens and Communities, November, 2014



HESI, through its tripartite approach, would expand the players and perspectives to be more encompassing

Relevant emerging exposure technologies



- Technology developments to track sources, concentrations and receptors at multiple scales
 - Ubiquitous and embedded sensing
 - Sensor networks
 - Personal exposure monitors
 - Easier data collection via personal devices
 - Analytical methodologies for broad chemical arrays
 - Biomonitoring
 - Measures of internal exposure
 - Biomarkers of exposure

Relevant emerging exposure infrastructure



- Methods and tools for analysis
 - Geographic Information Systems
 - Multi-scale exposure modeling
 - Statistical methods and tools for predictive modeling
- Information management
 - Publicly available systems for data sharing
 - Increased availability of large datasets and integrative methods
 - Exposure Ontology

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Feature

Providing the Missing Link: the Exposure Science Ontology ExO

Carolyn J. Mattingly ^{*†}, Thomas E. McKone [‡], Michael A. Callahan [§], Judith A. Blake ^{||}, and Elaine A. Cohen Hubal [⊥]

ACS | Abstract | ActiveView PDF | Figures

This proposal:



- Focus on consumer exposures:
 - Focus scope to be actionable / achievable
 - Direct product use indicated to be important exposure source (ExpoCast, ExpoDat)
- Design so findings relevant to improving exposure assessment across the spectrum of sources
- Goal: pull emerging technologies, new science, new data together into a common platform that as a whole yields more useful information than the individual pieces
- Information that can be used to:
 - Increase understanding of exposures
 - Test predictive models
 - Expand application of predictive models
 - Provide a framework that can be used in future exposure research

A Logical Progression



- Gather information on emerging technologies, and data sources including strengths and weaknesses
- Examine how these multiple data sources can be integrated using a systems approach
- Provide a case example of such integration (e.g., integrating biomonitoring data with contextual information) in a targeted area (e.g., consumer products)
- Determine if systems approach improves the predictive value of exposure models

Proposed project: Integrating emerging technologies and data to improve predictive exposure capabilities



Part 1. Identify and evaluated relevant emerging technologies and data sources. Propose integration framework to maximize information value.

Steps include:

1. ID and assemble expert committee
2. ID types of useful information
3. ID emerging technologies / data sources that can address these
4. Develop a common platform for data collection and integration

Proposed project: Integrating emerging technologies and data to improve predictive exposure capabilities



Part 2. Test proposed integrated framework, apply learnings to improve predictive capabilities.

Possible steps include:

1. Develop design for a test study. Include consideration of ways to evaluate:
 - Is proposed framework practical
 - Do new technologies ease collection of exposure data sufficiently to deploy in the general population
 - Does proposed framework provide a more complete picture of exposure information
2. Potential outreach to regional biomonitoring program to test ability to incorporate integrated framework, thereby:
 - Providing contextual information to inform biomonitoring data interpretation
 - Enabling comparison of measured data with model predictions
3. Apply results to test/improve model performance.

Potential advancements from project



Findings can be used to:

- Enhance and streamline design of future exposure studies
 - Results of pilot implementation of emerging technologies will be informative for future studies
- Expand utility of biomonitoring programs
 - Add contextual information to place in perspective
- Evaluate and improve exposure models
 - Approach used here will be directly applicable for consumer exposures, could form general basis of approach to assess other exposure sources
 - Potential to expand predictive capability
 - Reduce uncertainty in exposure estimates
- Inform the basis for improved exposure data accessibility
 - Learnings from data platform development/ testing can be applied to future efforts to make exposure information available.

Thank you - Questions?