Exposure Data in Environmental Epidemiology:

Guidance for Design and Quality Assessment

Judy S. LaKind, Ph.D.

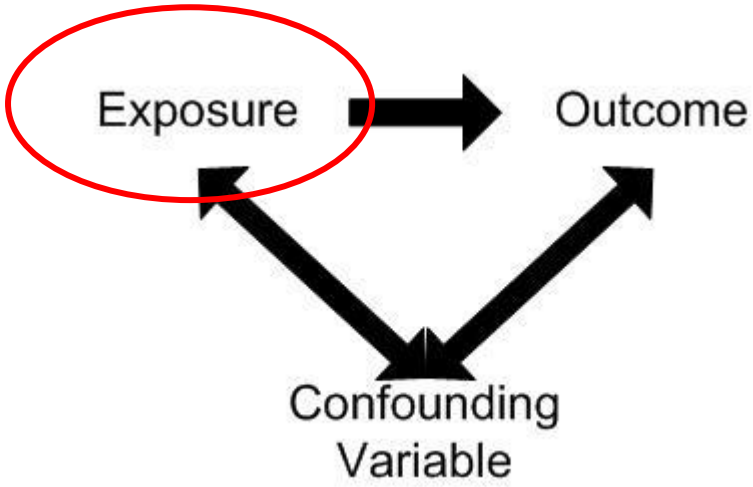
LaKind Associates, LLC
Dept. of Epidemiology and Public Health, U. Maryland School of Medicine

European Food Safety Authority/21 November 2017

Disclaimer

- Support from European Crop Protection Association

- Not an epidemiologist
- Am an exposure scientist



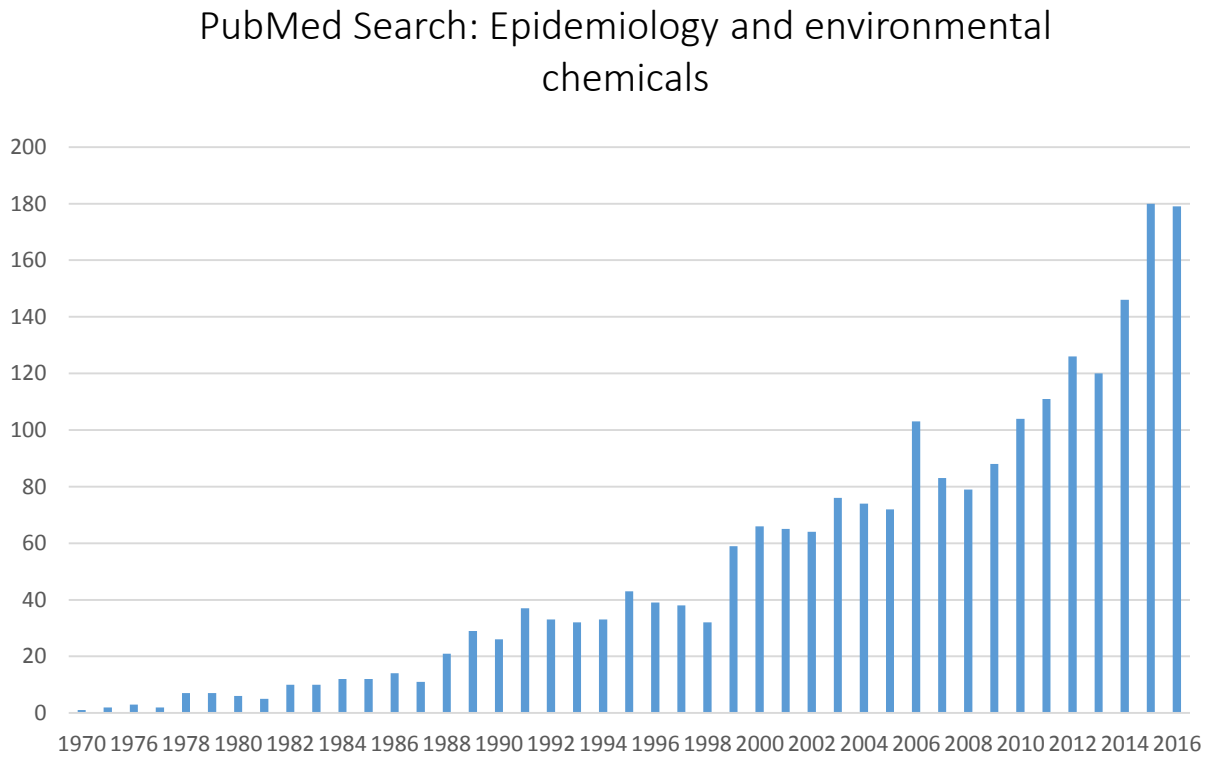
Background

- Issues with exposure data in environmental epidemiology research for decision-making

- Why are we noticing now?

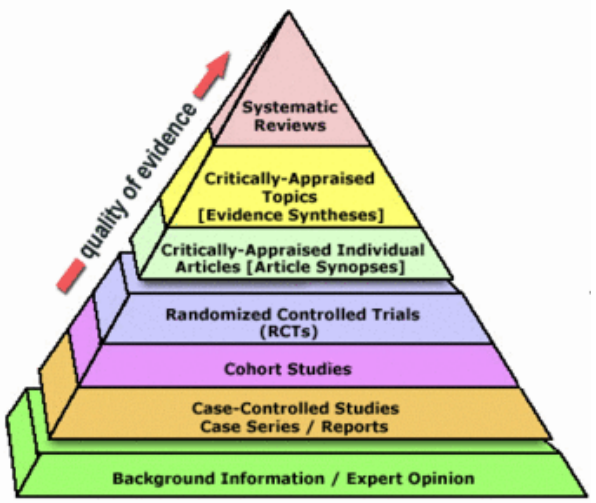
  Need a mature field

  Increased pressure



Study quality assessments are here!

- Dozens of published instruments for assessing study quality
- Often include no – or vague - approaches to evaluating exposure quality; many focus on quality of reporting (STROBE – “clearly define exposures”)



EPA 2016 (pg 22):

- Adequate assessment of exposure over relevant critical windows
- Range of exposure of interest for the risk assessment
- Availability of a dose/exposure-response trend
- “other qualities of exposure assessment”
- Biomonitoring: some specific guidance elements

    No temporality, no variability/misclassification

EFSA 2017 (8.1. Recommendations for single epidemiological studies, pg 22):

- Improved accuracy of exposure measurement
- Use of repeated biologic measures or repeated updates of self-reported exposures.
- Whenever possible, use of direct measurements of exposure to named pesticides
- Results expressed using standardized units to normalize exposure across populations

Office of Pesticide Programs’ Framework for Incorporating Human Epidemiologic & Incident Data in Risk Assessments for Pesticides, December 28, 2016

“reported in a way that minimizes misclassification of exposure and allows for dose-response assessment” (EFSA 2017):

- “…no framework has been established on how to assess such epidemiological information in the regulatory process…” pg 9, EFSA 2017

- Limits opportunity for transparent, consistent and reproducible assessments of exposure data quality

- “Tell us what you need” or “get off my cloud” – both reasonable

- How to engage with “tell us what you need” group?

Environment International 73 (2014) 195–207

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

A proposal for assessing study quality: Biomonitoring, Environmental Epidemiology, and Short-lived Chemicals (BEES-C) instrument

Judy S. LaKind [a,b,c,*], Jon R. Sobus [d], Michael Goodman [e], Dana Boyd Barr [f], Peter Fürst [g], Richard J. Albertini [h], Tye E. Arbuckle [i], Greet Schoeters [j,k], Yu-Mei Tan [d], Justin Teeguarden [l], Rogelio Tornero-Velez [d], Clifford P. Weisel [m]

Exposure Quality Evaluation

- Exposure and biological relevance
- Specificity
- Method sensitivity
- Contamination
- Stability
- Method requirements
- Adjust for matrix dilution
- Temporality
- Variability/misclassification

- PLUS: general epi study design considerations

STUDY ASSESSMENT COMPONENTS	TIER 1	TIER 2	TIER 3
Biomarker Selection and Measurement			
Biological relevance (parent/surrogate relationship):			
Exposure biomarker			
Effect biomarker			
Specificity			
Method sensitivity (detection limits)			
Biomarker stability			
Sample contamination			
Method requirements			
Matrix adjustment			
Exposure-Related Study Design and Execution			
Temporality			
Exposure variability and misclassification			

LaKind et al. Environ Int 73C:195-207.

- Heat map
- No exclusion

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Examples

BEES-C elements

Sample contamination

Variability/misclassification

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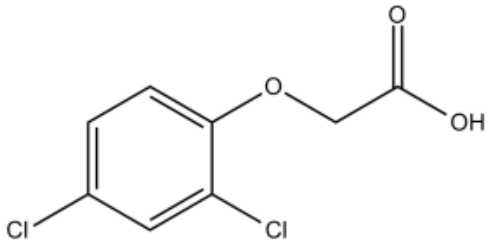
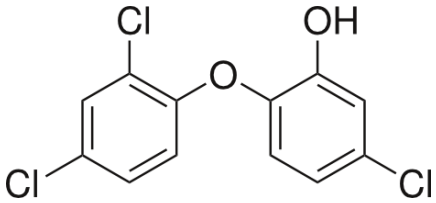
Chemicals

2,4-D

Triclosan





Sample Contamination

Tier 1

Documentation that samples are contamination-free from time of collection to time of measurement

In the field:

- Environmental media: contamination from sampling equipment, humans
- Biomonitoring: Participants keeping their hands and other body parts free of chemical while collecting samples.

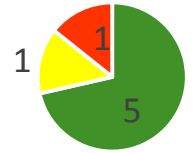
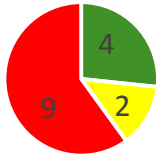
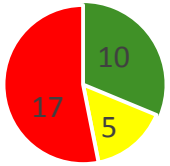
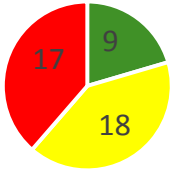
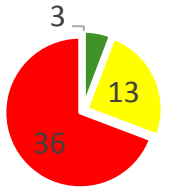
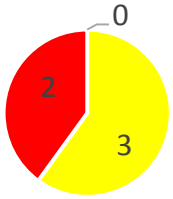
Sample Contamination

In the lab:

CDC: urine samples contaminated by triclosan from analyst use of restroom handsoap; triclosan-containing toothpaste

Ye et al. 2013 Environ Health Perspect 121:283–286

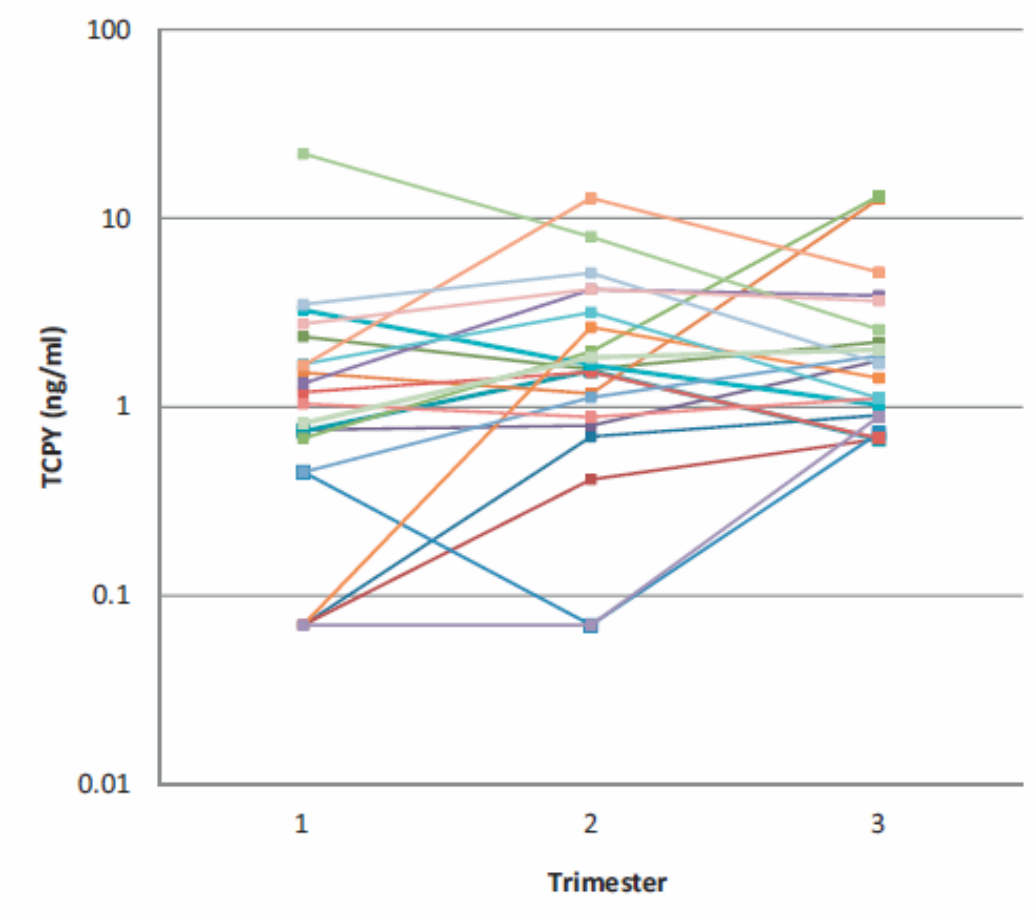
Sample contamination and 2,4-D

Medium/N	Contamination
Foods/beverages: 7	
Soil and dust: 16	
Air: 32	
Water: 44	
Urine: 52	
Blood, semen: 5	

LaKind JS, Burns CJ, Naiman DQ, O'Mahony C, Vilone G, Burns AJ, Naiman JS. J Toxicol Env Health, B. In press.

Exposure Variability and Misclassification

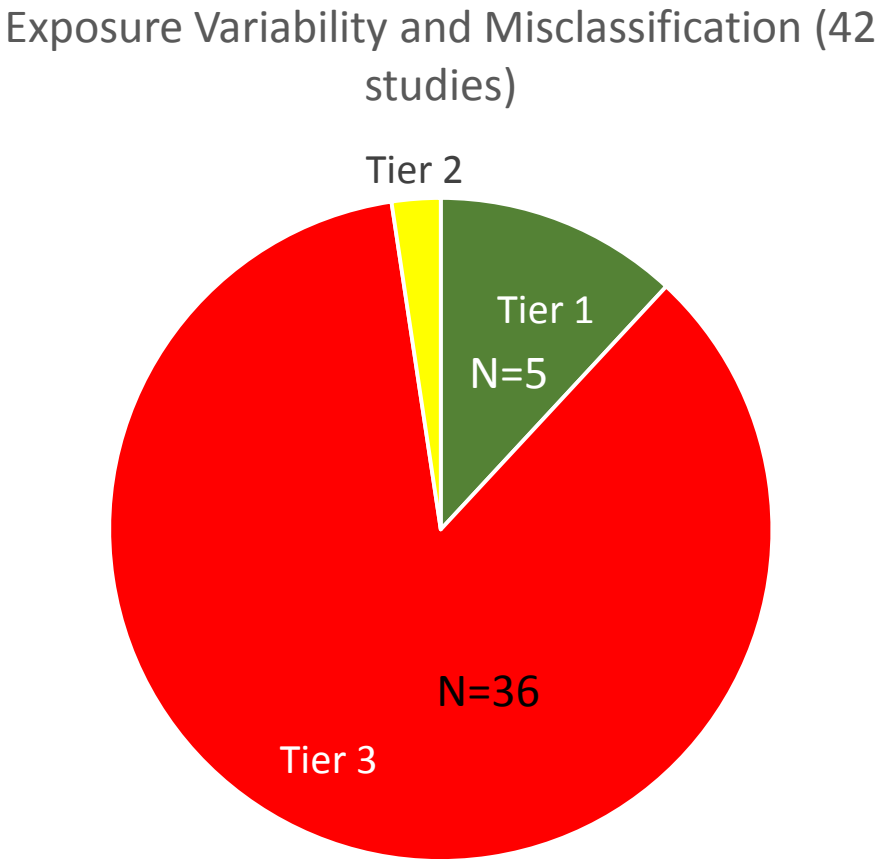
Tier 1: Exposure assessment based on a sufficient number of samples per individual to estimate exposure over the appropriate duration, or few samples but error shown to be negligible



TCPY (3,5,6-trichloro-2-pyridinol) concentrations in maternal spot urine samples (N=21)

Fortenberry et al. 2014. Int J Hyg Environ Health 217:405– 412.

Exposure variability/misclassification and triclosan



Goodman M, Naiman DQ, LaKind JS. 2017. Systematic review of the literature on triclosan and health outcomes in humans. Crit Rev Toxicol

Summary

- Increasing interest in using epidemiology for regulatory decision-making; demand for high quality exposure data will grow.

- Meaningful weight of the evidence assessment difficult due to methodological limitations of individual studies.

- Quality assessments are already underway – need instrument that is transparent and systematic – use for *both study design and quality assessment*

- BEES-C seeing use in US and Europe

- Lessons learned: elements of BEES-C seem straightforward yet bodies of literature show short-comings

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Moving forward:

Goal - comprehensive instrument
(for study planning and assessing/fit-for-purpose)

Measured exposure data:

BEES-C

Modelled exposure data:

Epi design

(temporality, variability, study participants, data analysis, reporting):

BEES-C

Additional modules:

Questionnaire data

Data transparency

Outcome assessment

Closing Points

What exposure data do we need?
What is good enough?
Who is willing to provide it?