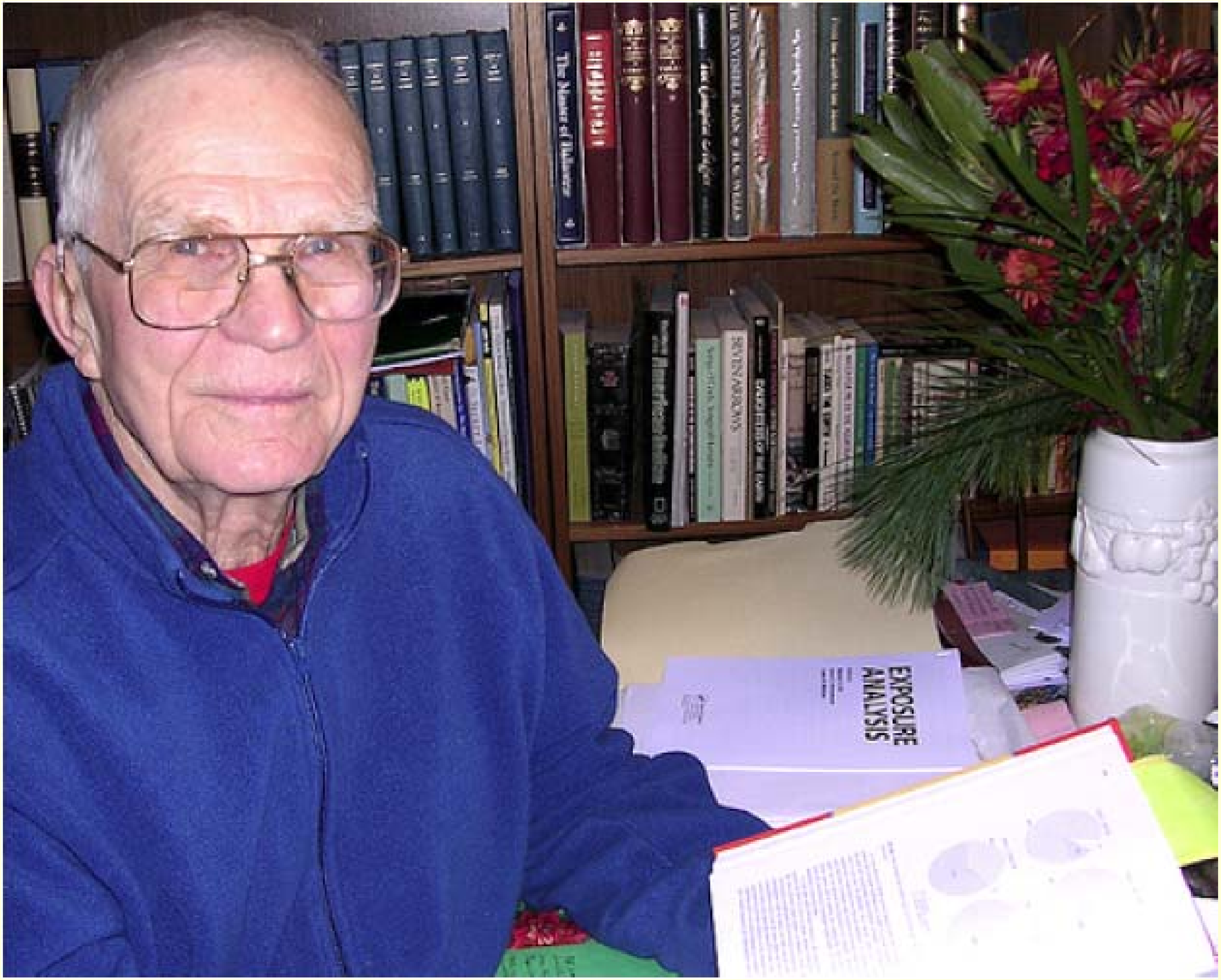
What does dust have to do with it? Lessons Learned from our Children's Environmental Health Risks Research Center

Elaine M. Faustman, Ph.D.
Institute for Risk Analysis and Risk Communication
USEPA/NIEHS Center for Child Environmental
Health Risks Research
University of Washington

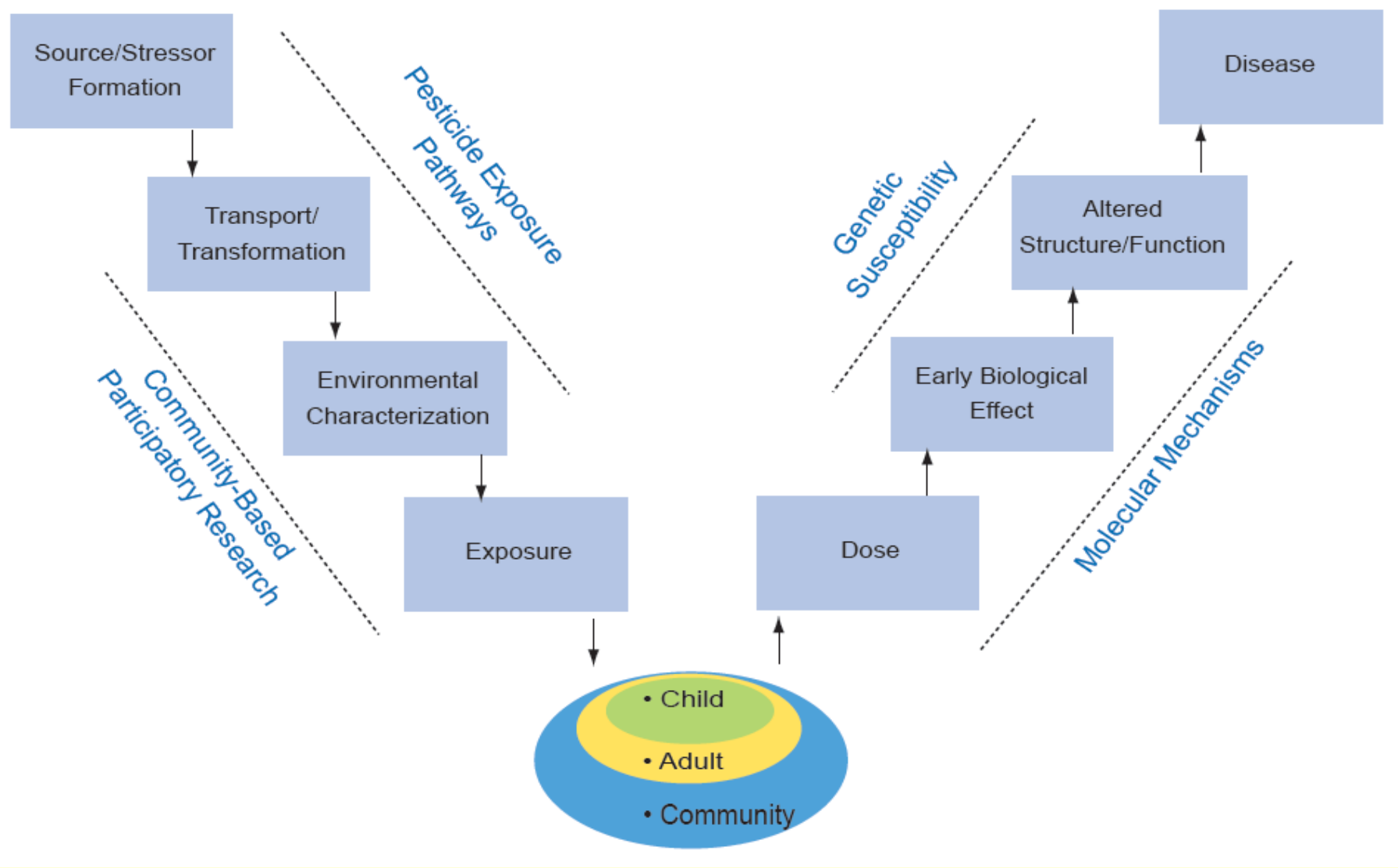

EXPOSURE
ANALYSIS

Second title for today's talk:

Much Ado About Dust - A tribute to John Roberts, Dr. Dust, and what he inspired

NIEHS/EPA Center for Child Environmental Health Risks Research

University of Washington



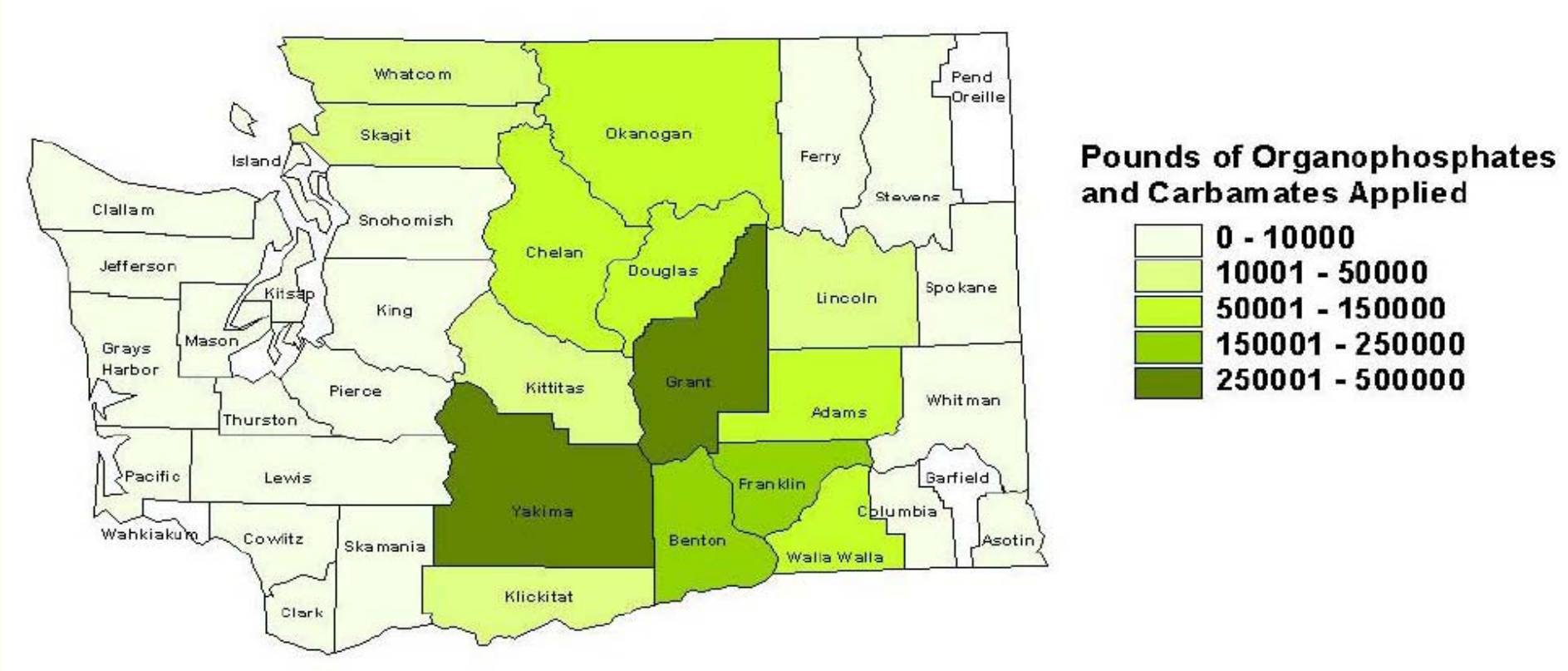
Three types of studies were examined in order to understand what pesticide exposures were occurring in children

1. Community Based Participatory Research project (CBPR)
2. Longitudinal multiple sampling project aimed at understanding between and within family variability
3. Community Intervention Project (CIP)

The Take-home Pathway for Agricultural Pesticides: Contributions of Occupational Factors to Home Contamination

B. Thompson,G.C. Coronado, I. Islas, S.A. Snipes, J. Grossman, W.C. Griffith, E.M. Vigoren, R.A. Fenske, and E.M. Faustman

Example of Yearly Use of Organophosphate and Carbamate Usage on Apples and Potatoes in Washington State

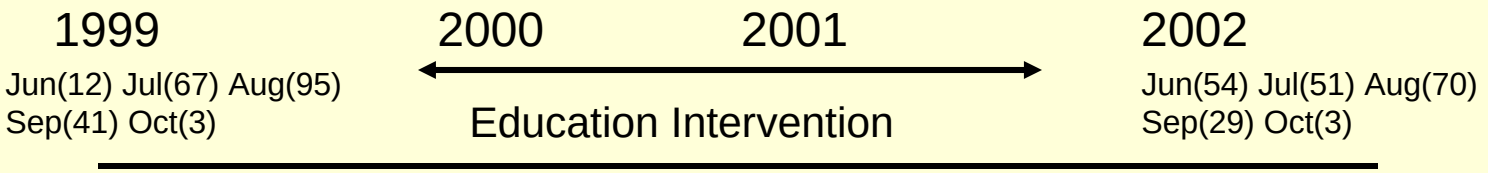


Yakima Valley Cohort

- Since 1999 – Over 800 families have been contacted and surveyed.
- Unique features include:
- Agricultural Region Relevant for most agricultural regions in US with four seasons
- Balance of towns and labor camps.
- Farmworker and non-farmworker families identified with adult and child household.
- 80% of cohort has been retained for over 10 years
- CAB found in 1999 and continues to be involved in design and participation in CIP and CBPC program.

Community Intervention Project (CIP)

Study Designed to Evaluate the effect of an Education Intervention to decrease the take-home pathway



Study Design to Evaluate the effect of an Education Intervention to decrease the take-home pathway

Communities in the Yakima Valley were randomized either to receive an education intervention or to be a control

- Households with an adult working in orchards and a young child were selected within the community (1 adult & 1 child / household)

- **Urinary metabolites of OPs** from adults &children and **house and vehicle dust** were collected before the intervention (1999) and after the intervention (2002)

- Different households were recruited in control and intervention years

Example Samples Collected in Studies of Farmworker Families

Types of household samples collected from adults and their children in 3 seasons

- Urine analyzed for metabolites of OPs—collected 3 times in 1 week
- Blood analyzed for parent OPs, metabolites of OPs, AChE in RBCs and plasma,
- Genotypes and phenotypes of metabolizing enzymes—collected once
- Buccal Cells
- Dust

  Vehicle

  Home

Communities in the CBPR Project

- Community was defined as either a town or a labor camp
- Pairing of an intervention community with a control community was performed separately for towns and labor camps
- All Communities are in the Yakima Valley of Eastern Washington

Towns (16)

Intervention	Control
Sawyer	Harrah
Donald	Tieton
Buena	Outlook
Moxee	Zillah
Cowiche	Wapato
Mabton	Whitstran
Granger	Prosser
Toppenish	Grandview

Labor Camps (8)

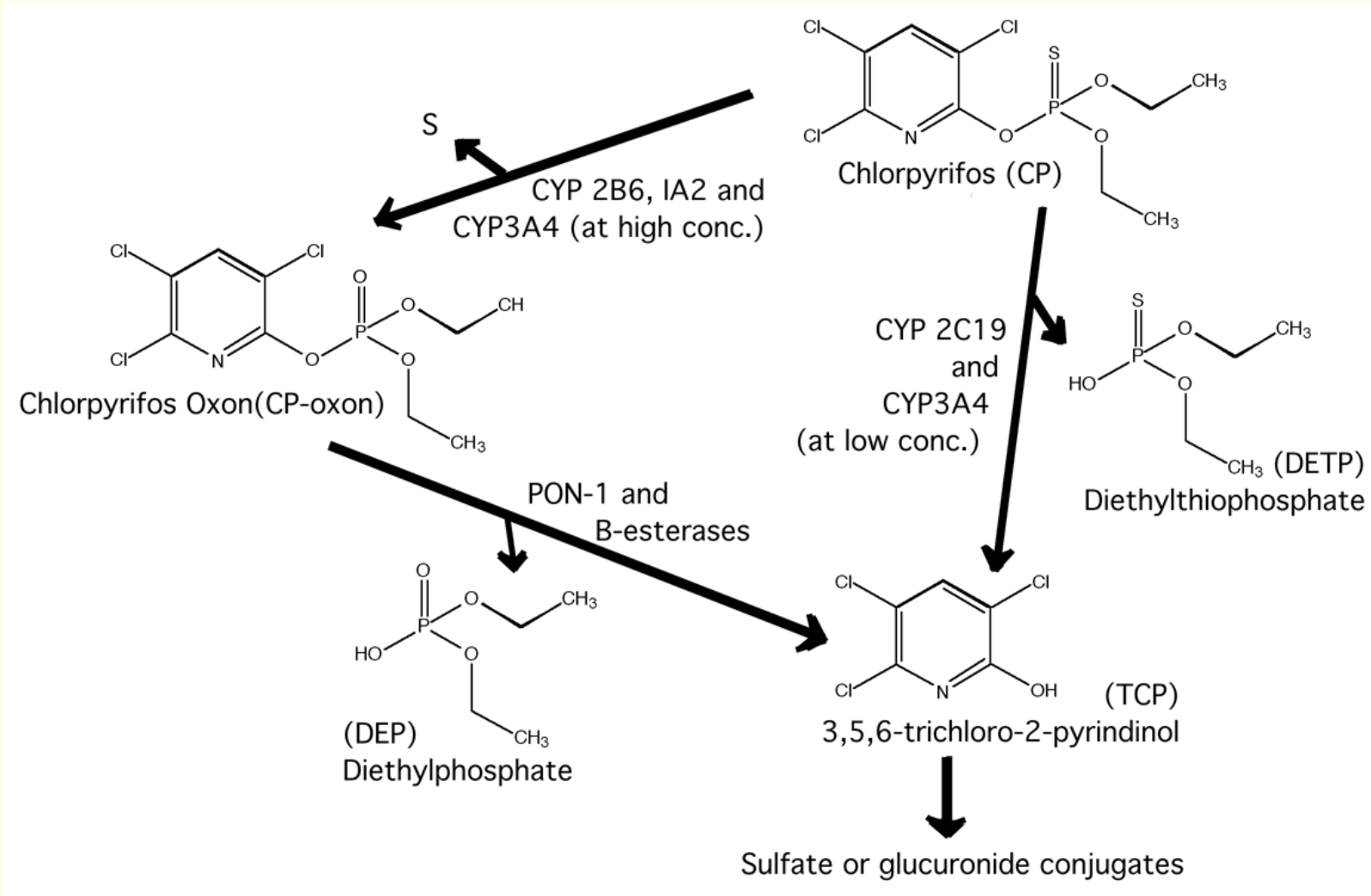
Intervention	Control
Bond Varner Camp	Golding Farms Camp
Green Giant Camp	Crewport
Willow Park	Rainbow court
Yakima Golding Farms	Horse Heaven Mobile Park

Location of Control and Intervention Towns

Organophosphate Pesticides

- Metabolites are Biomarkers of exposure—measured in urine
- Nonspecific Diakyl Phosphate (DAP) metabolites
  - Six DAP Metabolites
  - Each metabolite can be produced by multiple OPs
  - Divided into two groups
    - Dimethyl metabolites
      - **DMP, DMTP, DMDTP**
    - Diethyl metabolites
      - **DEP, DETP**, DEDTP
- Measured 6 Organophosphate Pesticides
  - House dust from location where child frequently played
  - Vehicle dust
  - Dimethyls– azinophos-methyl, phosmet, malathion, methyl-parathion
  - Diethyls– chlorpyrifos, diazinon

Metabolic Scheme for CP



Faustman et al. (2006)

Metabolites of Organophosphate Pesticides

Selected OPs and DAP metabolites

Diethyl OPs			
chlorpyrifos		DEP	DETP
diazinon		DEP	DETP
parathion		DEP	DETP
disulfoton	DEDTP	DEP	DETP
ethion	DEDTP	DEP	DETP
Dimethyl OPs			
dichlorvos (DDVP)		DMP	
trichlorfon		DMP	
naled		DMP	
chlorpyrifos methyl		DMP	DMTP
methyl parathion		DMP	DMTP
azinophos methyl	DMDTP	DMP	DMTP
malathion	DMDTP	DMP	DMTP
phosmet	DMDTP	DMP	DMTP

What lessons have we learned from this community and its children?

Monitoring Results

Most children are exposed

- 86% of children had quantifiable levels of at least one dialkyl metabolite.
- 95% of adults had quantifiable levels of at least one dialkyl metabolite.

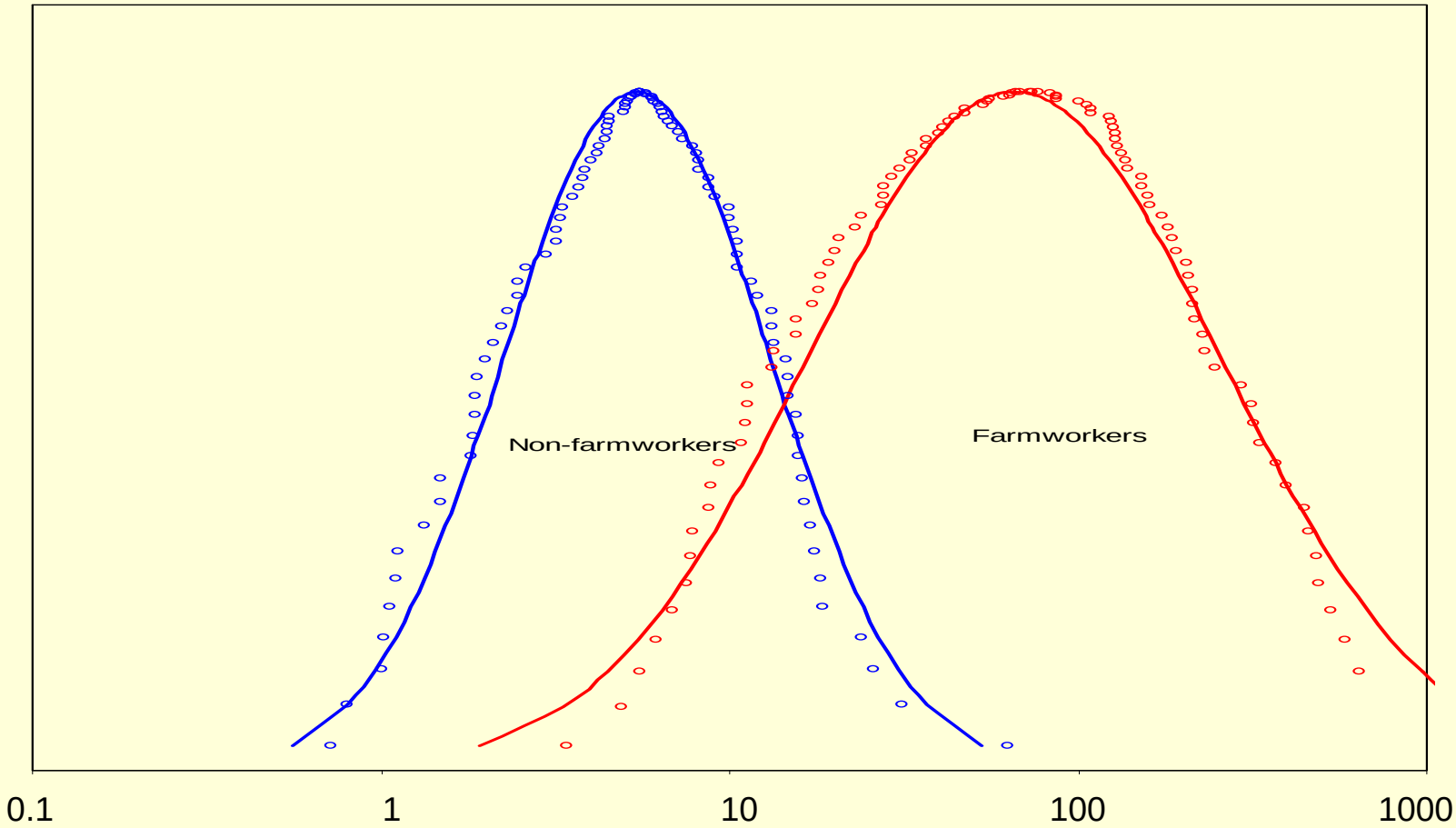
Evidence of **multiple** exposures

- 36% of children had quantifiable levels of both dimethyl and diethyl metabolites.
- 45% of adults had quantifiable levels of both dimethyl and diethyl metabolites.

Evidence of Take-home Pathway

- **Workers** who thinned were more likely than those who did not thin to have detectable levels of azinophos-methyl in their house dust and vehicles.
- **Children** of thinners were more likely to have detectable levels.
- **Contrary to expectations,** workers who reported mixing, loading or applying pesticides had lower incidence of detectable pesticide residues in their homes, vehicle dust, and in their children's urine.

Distribution of Adult DMTP Metabolite Concentrations



Distribution of Child Urinary DMTP Metabolite Concentrations

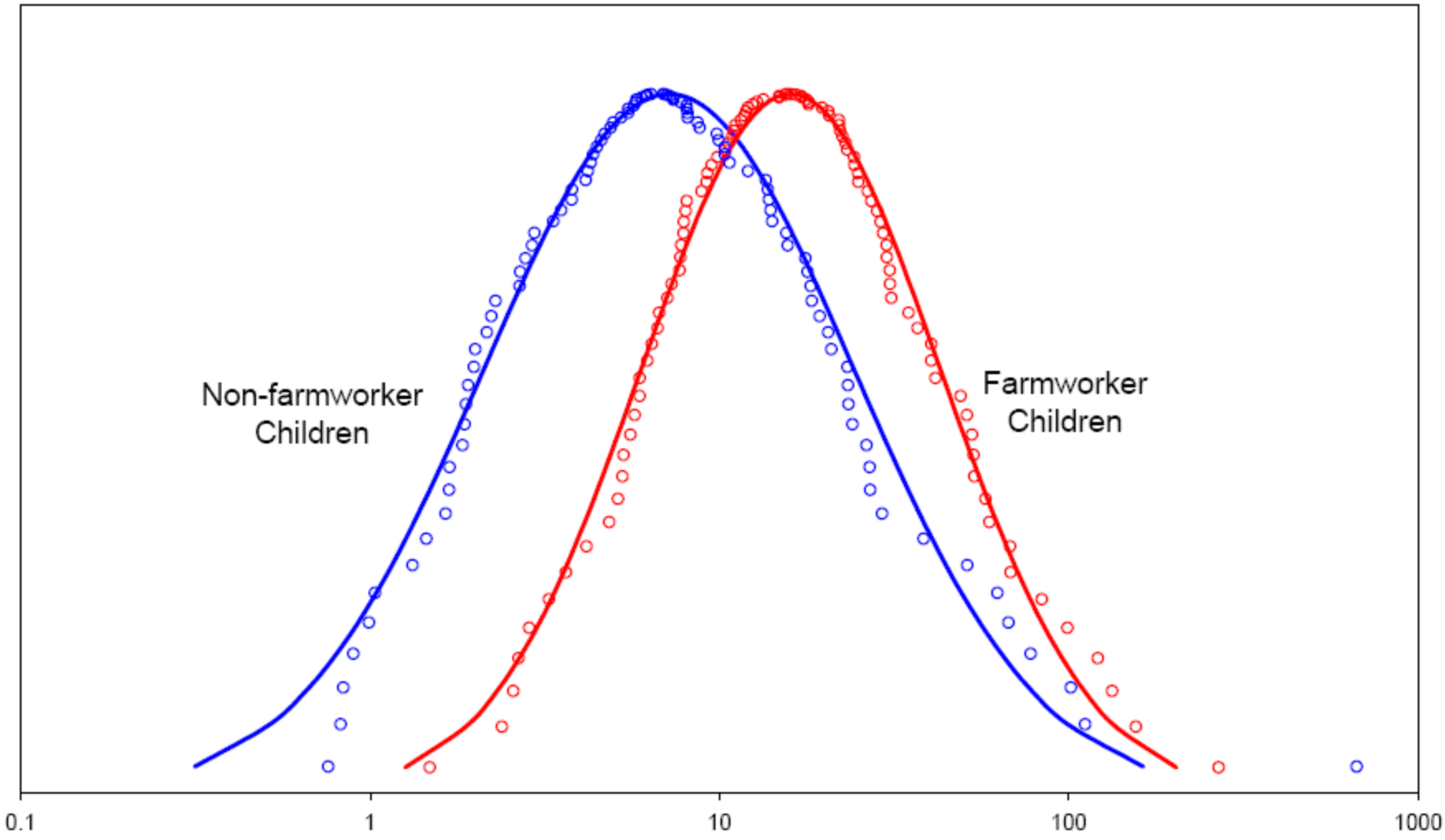
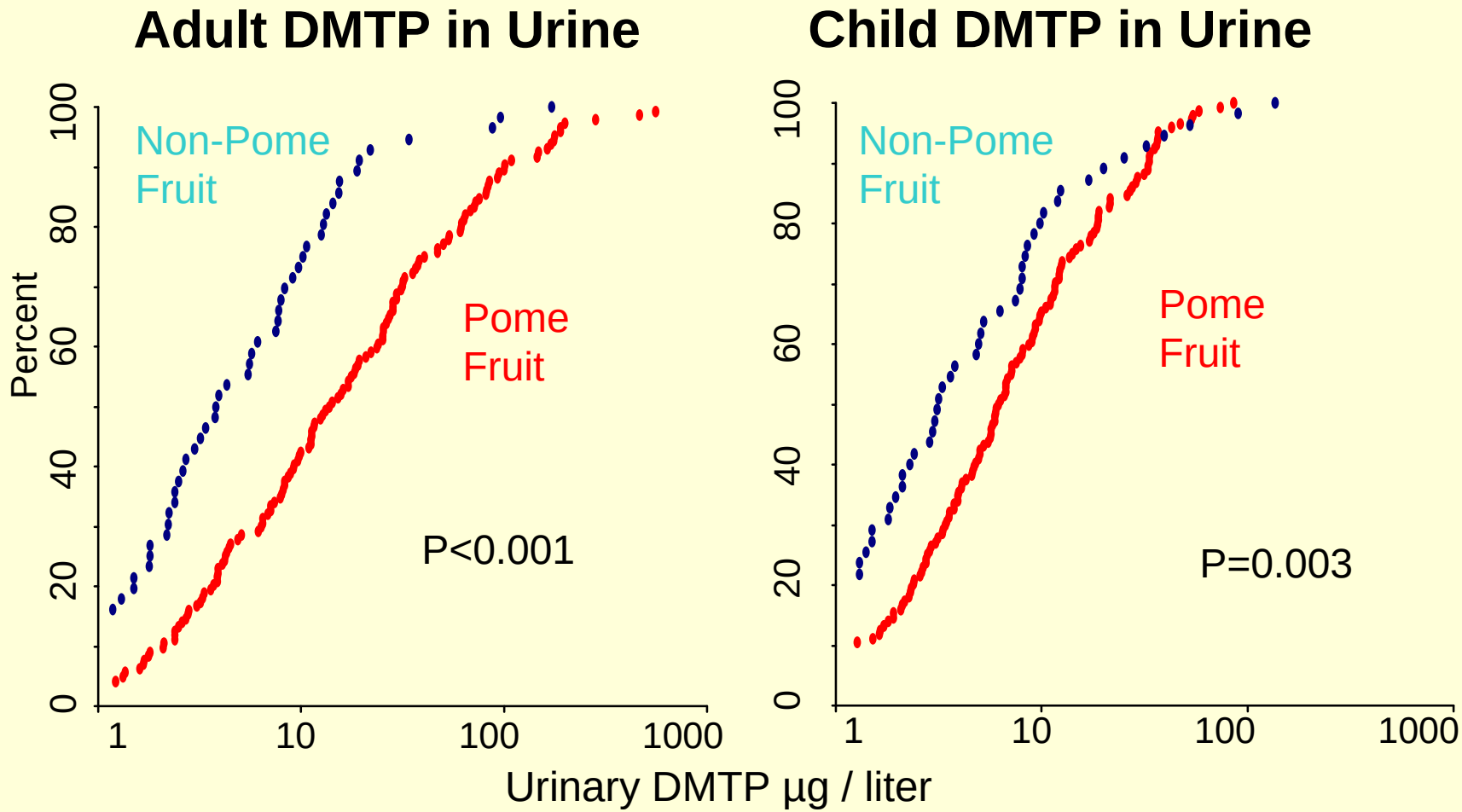


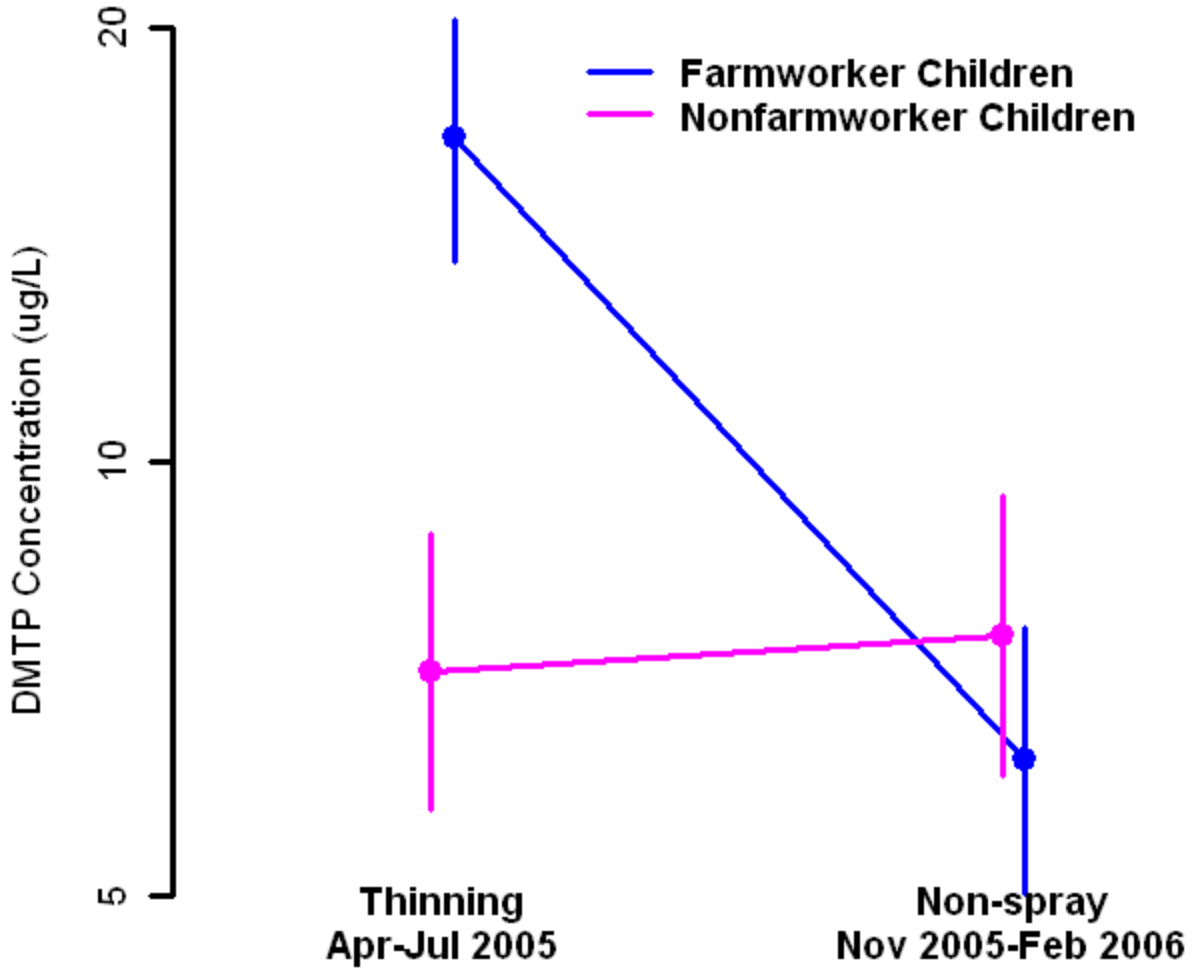
Photo courtesy of G.D. Coronado

Urinary metabolites higher in adults who worked in pome fruit and their children

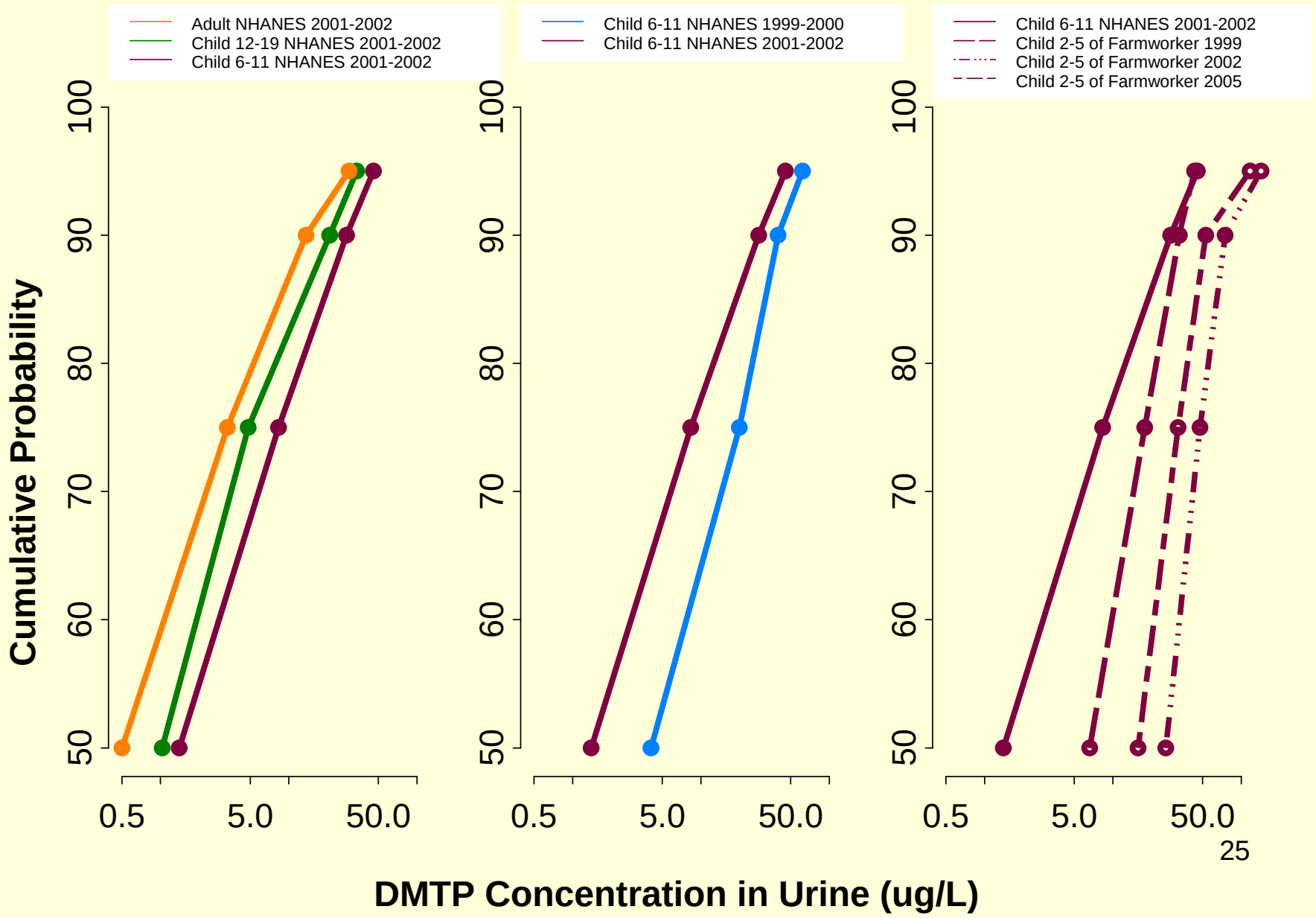


Coronado et al., Env. Hlth. Persp., 2004, 2006

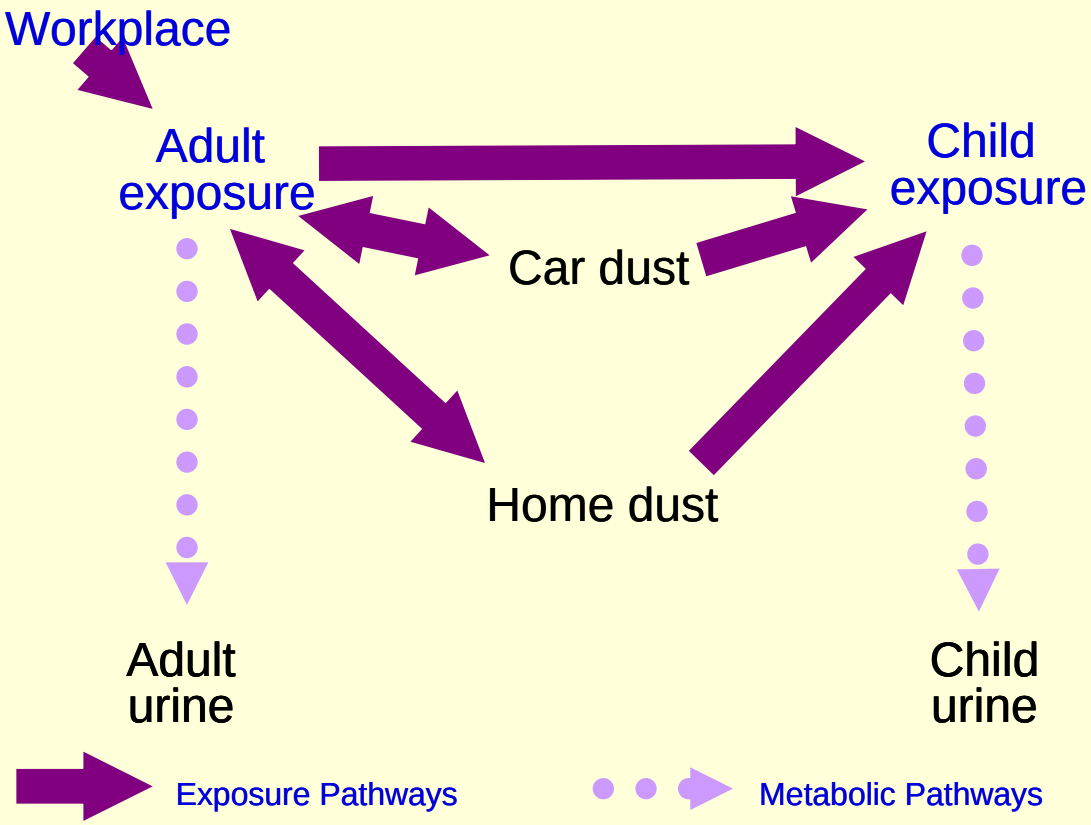
Children : Seasonal Changes in DMTP



DMTP in Urine: Comparison of Farmworker Children to National Survey



Assessing Children's Pesticide Exposure via the Take-home Pathway

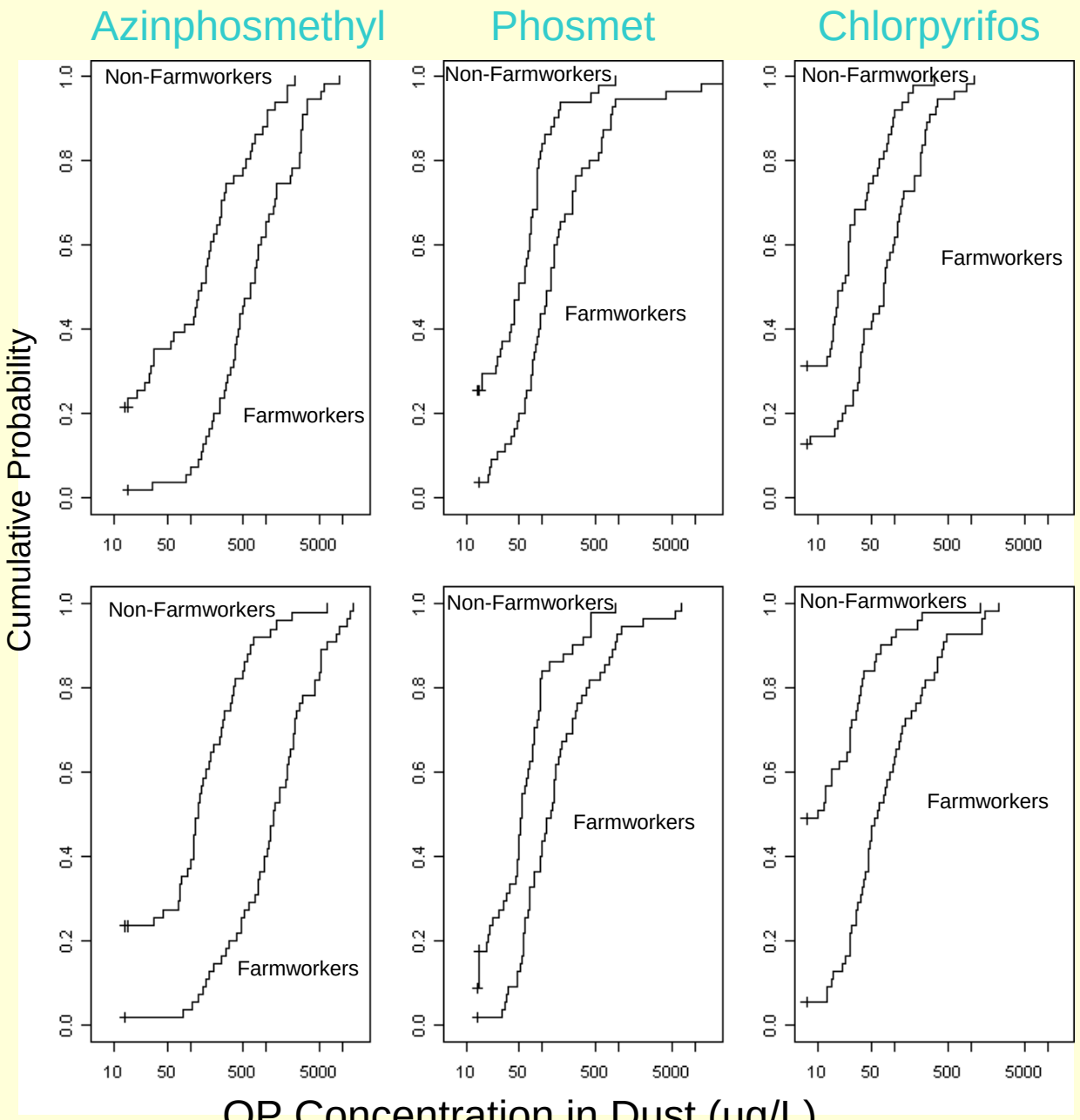


Number of OPs detected in house and vehicle dust samples

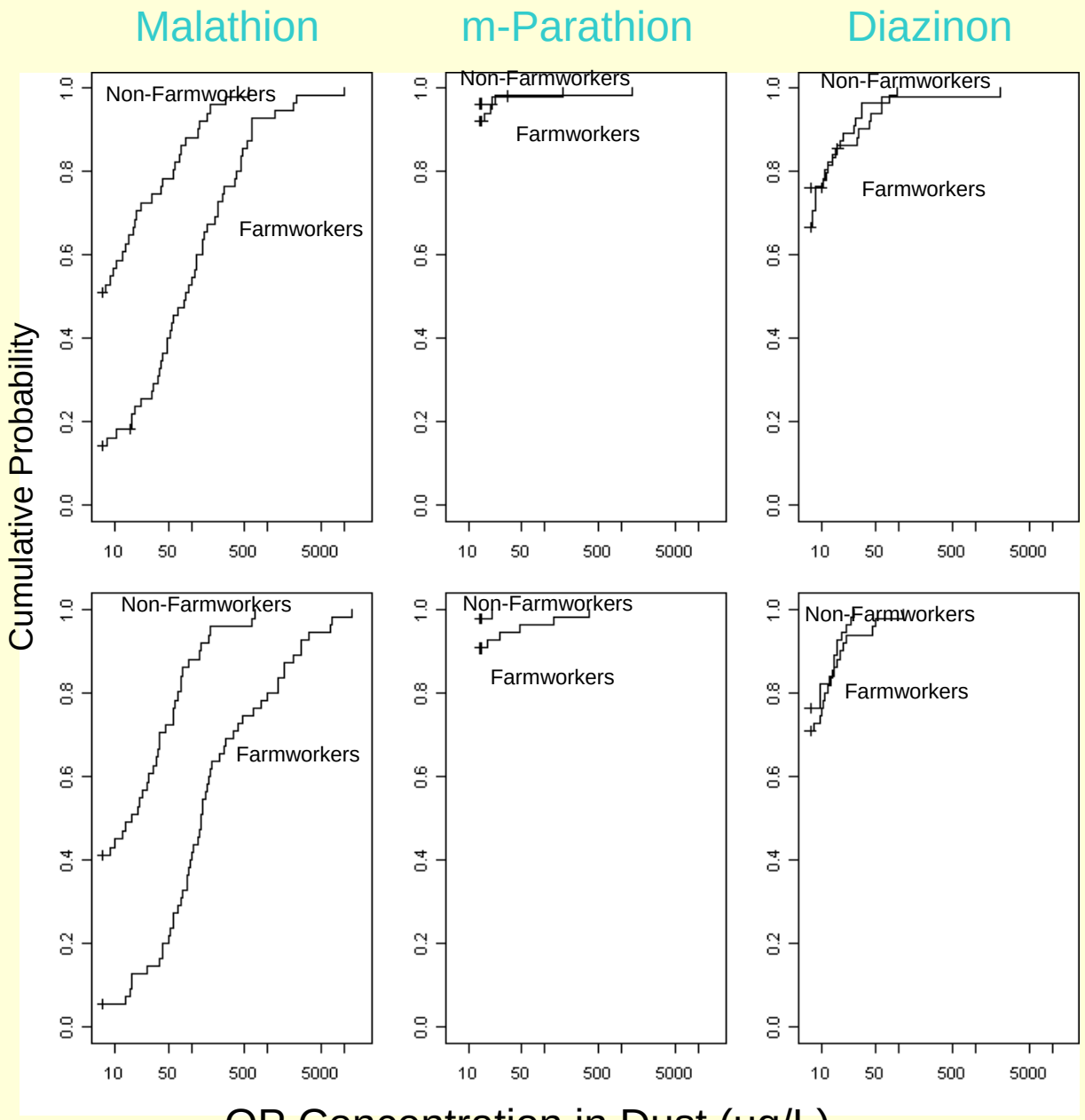
Percent of Households Sampled

Number of OPs in house or vehicle*	0 OPs	1 OP	2 OPs	3 OPs	4+ OPs
CIP Pre-intervention (Jun-Oct 1999)	3%	33%	40%	19%	5%
CIP Post-intervention (Jun-Oct 2002)	11%	24%	34%	26%	5%
CBRP Farmworker (Apr-Jul 2005)	2%	5%	20%	39%	34%

OP in House and Vehicle Dust (2005-06)

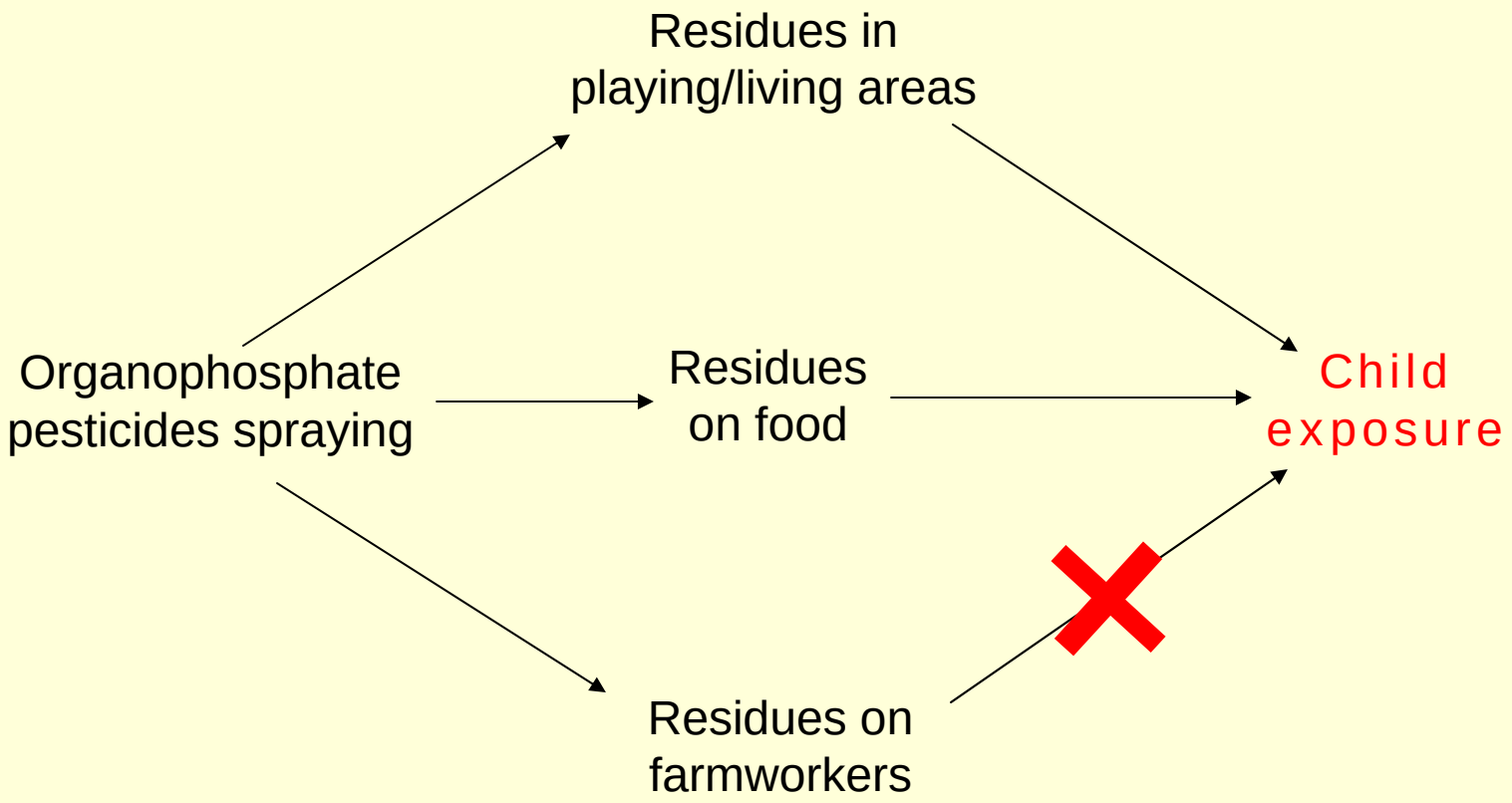


OP in House and Vehicle Dust (2005-06)

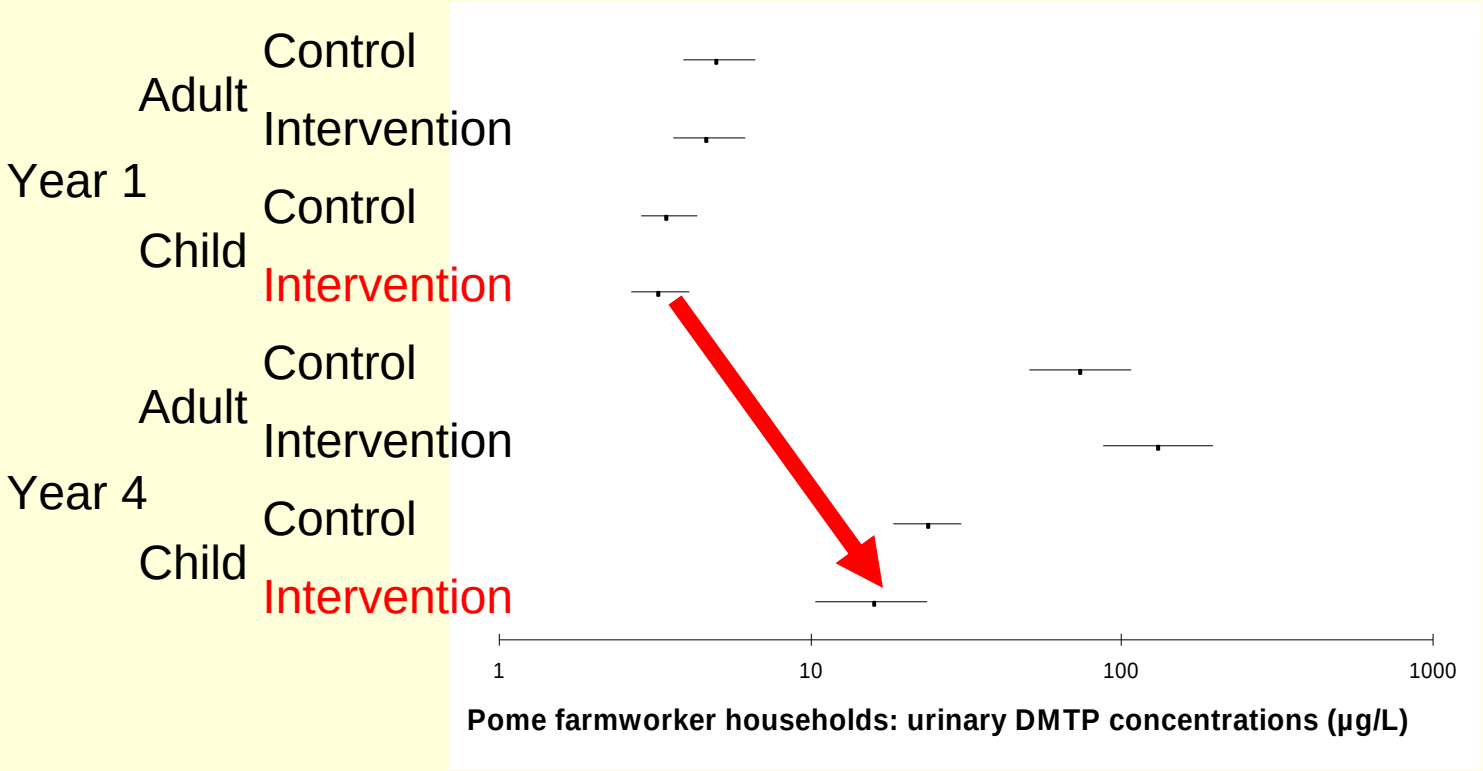


Can we make a difference?

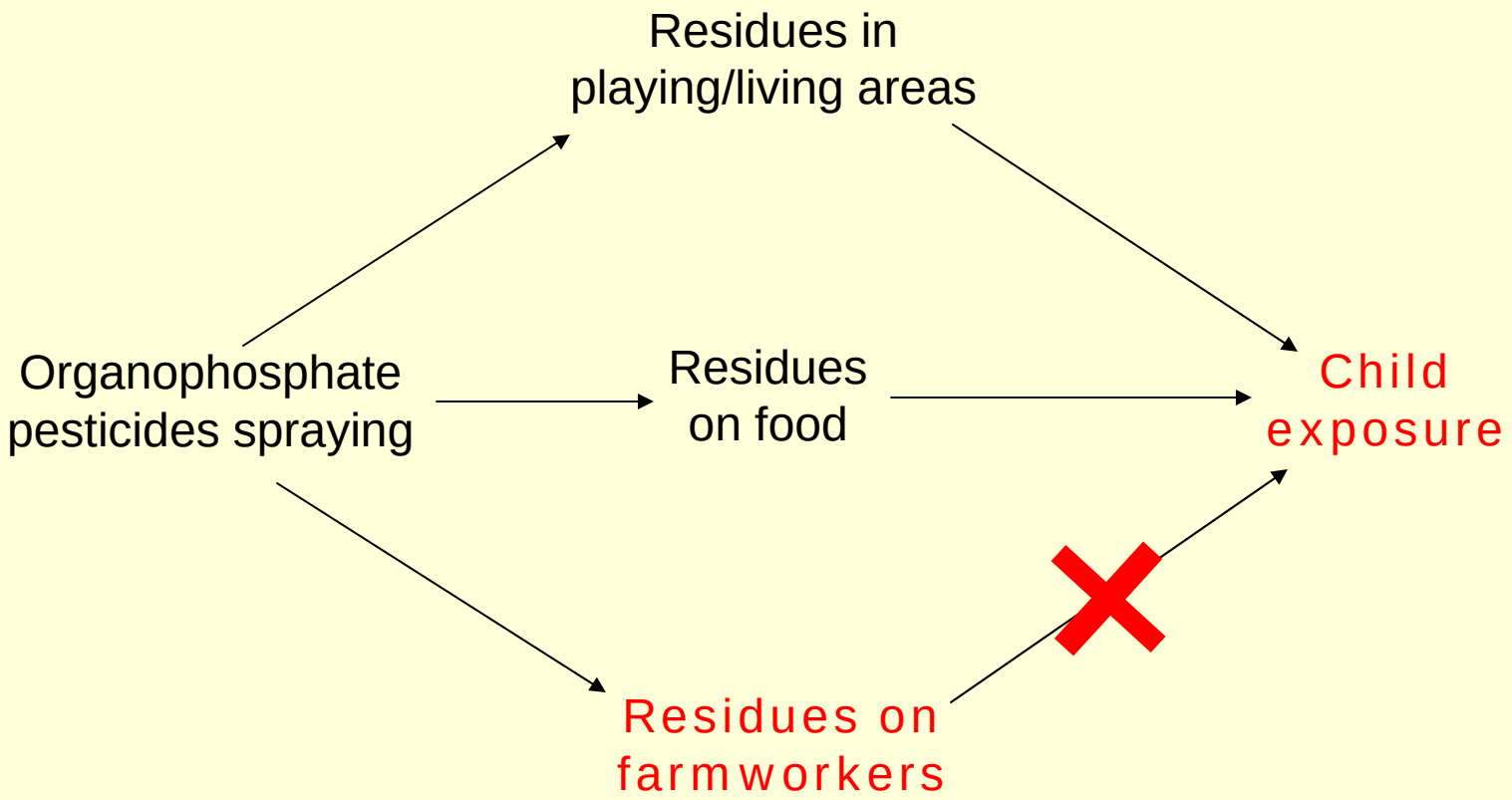
We want to know whether intervention reduced child exposure



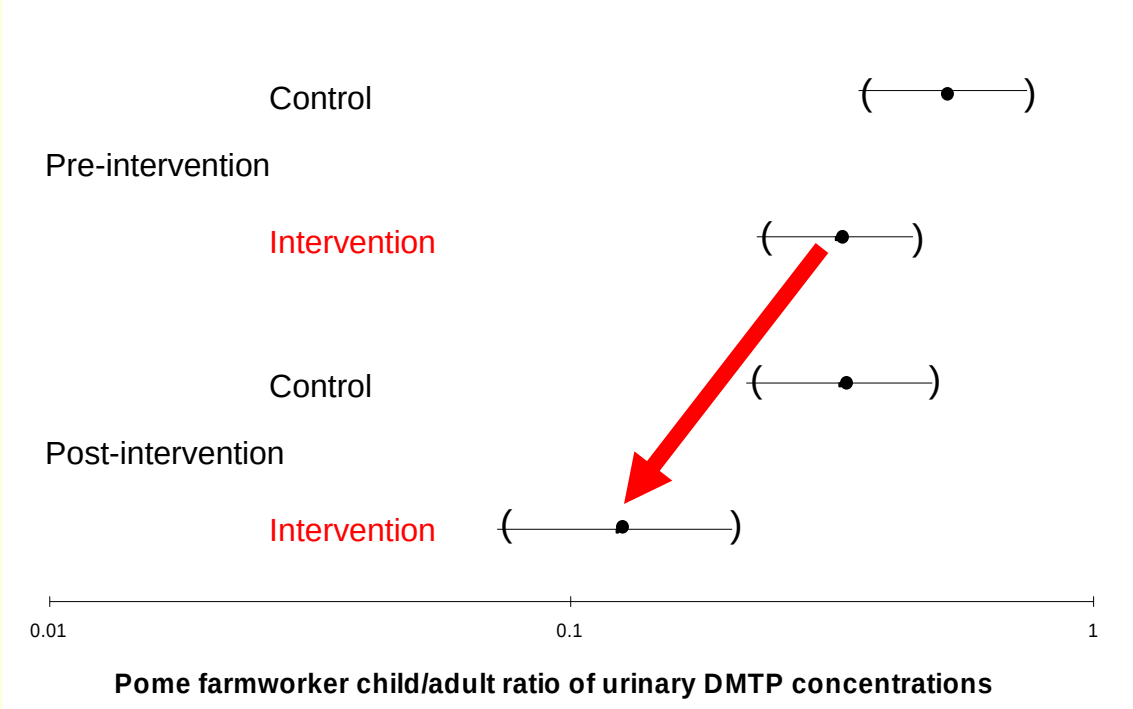
But measured exposure was higher after intervention



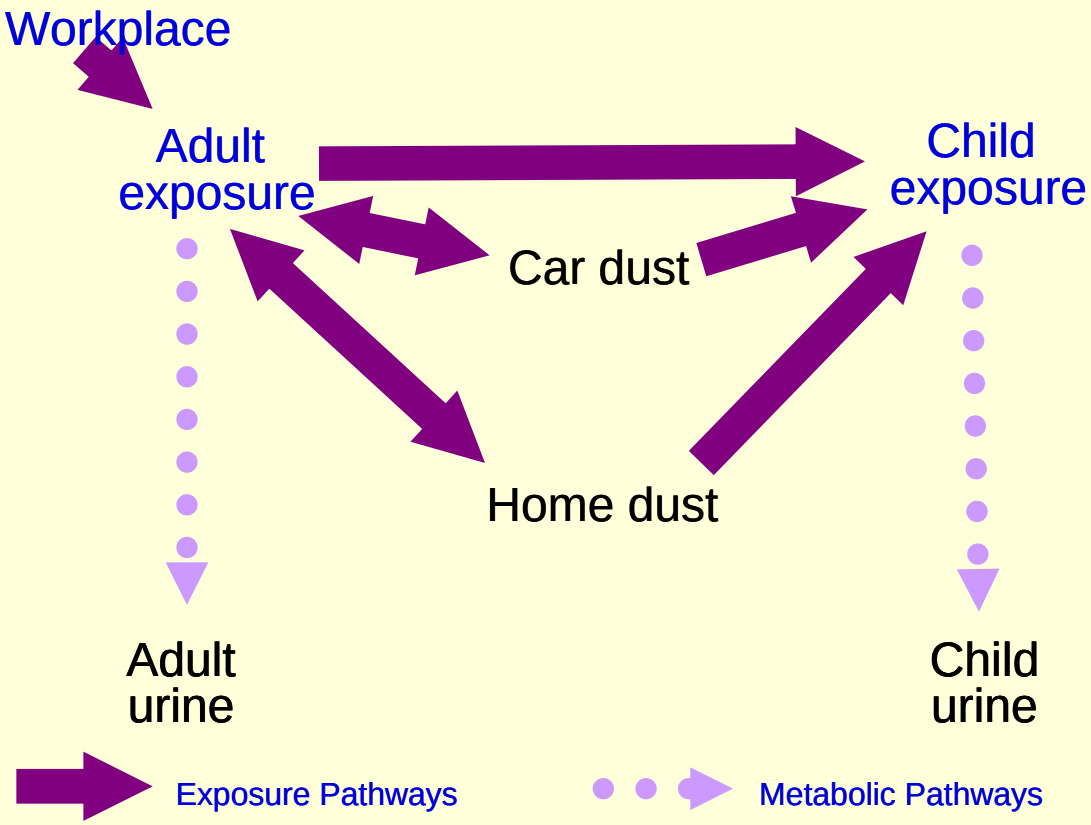
A successful intervention would reduce the fraction of adult exposure taken home to children



This child/adult fraction declined significantly after intervention



Assessing Children's Pesticide Exposure via the Take-home Pathway



Predictors of Organophosphate Pesticide Residues in Home Environment Dust of Farmworkers

- Azinphos-methyl was the OP in the highest concentrations in homes and vehicles
  - Most commonly used pesticide in Yakima Valley during season when samples collected
  - Also measured phosmet, malathion, chlorpyrifos, diazinon, and m-parathion
- Large differences between homes were found in the total amounts of pesticides present in the dust
  - Mass of azinphos-methyl ranged over four orders of magnitude, about 100 ng to 1 mg
  - Similar variation was found for vehicles
  - Large variation was reflected in large geometric standard deviations (10 to 41)
- Markov Chain Monte Carlo Methods are effective in analyzing data with a large number of values below the limit of detection
  - Measurements below the limit of detection treated as being left-censored
  - Correlations among measurements important for simulating values below the limit of detection

- Thick or thin carpeted surfaces had statistically significant greater mass of azinphosmethyl per square meter than smooth surfaces
  - Geometric means: thick carpets 1430 ng/m^2, thin carpets 1550 ng/m^2, smooth surfaces 110 ng/m^2
- Mass of azinphos-methyl in the living room was not significantly different from other rooms
  - Geometric means: living room 3450 ng/m^2, other rooms 1000 ng/m^2
- No significant differences for the mass of azinphos-methyl when vehicles classified by type
  - Geometric means: auto 3630 ng, truck 6260 ng, other 2570 ng
- No significant differences for the mass of azinphos-methyl for vehicle floor surfaces coverings
  - Geometric means: plush mat 3220 ng, hard mat 4190 ng, or no mat 5100 ng
- Intervention efforts to reduce in-home exposure should target carpeted surfaces and frequent cleaning of all areas where young children play in the home
  - Although smooth floors in general had significantly lower concentrations of pesticides large amounts were still found in some homes

Choose From Two Plans for Getting the Dust Out

THREE MONTH PLAN

Vacuum carpets thoroughly every week for three months to remove deep dust. Make 25 passes over the door mat and the carpet within four feet of the entrance doors, 16 passes over high traffic areas, and 8 passes over the rest of the carpet. After the three-month period, continue to vacuum on a regular basis.

ONE WEEK PLAN

Use a vacuum with a dirt detector to show you where the dirt is and when the carpet is clean. The dirt detector can save time. A vacuum with a dirt detection system has a light that is red until deep dust is removed; once removed, the light changes to green (or another appropriate color). Check consumer product guides in the library before you buy. Vacuums with dirt detectors start around $165, but top-rated vacuums cost between $300 and $370 in 2002. Clean one 4'x4' square before you move to the next area. Spread the work over several days.

Deep dust affects everyone in the home and usually contains dust mites, mold, other asthma triggers, lead, cadmium, pesticides, soot, bacteria, and cancer-causing agents (carcinogens).

Normal vacuuming of carpets removes surface dirt but does not get out deep-down dust that builds up in carpets. A crawling infant may breathe in or swallow this dust when it comes to the surface of the carpet.

Household dust is the main source of lead exposure for most infants and toddlers. Even small amounts of lead can reduce the intelligence, hearing, and growth of children. The highest lead risks are found in homes built before 1950. Extra care must be taken when remodeling an old home. See *www.watoxics.org/thbl.htm* to protect your children.

Other Resources

Everyone, especially those with small children or chronic health conditions such as allergies, asthma, and immune deficiencies, may arrange for a free home environmental assessment by a Master Home Environmentalist (MHE) by calling one of the numbers listed below.

American Lung Association of Washington
- Seattle, (206) 441-5100 (www.alaw.org)

Clean Air for Kids
- Tacoma, (253) 798-2954

American Lung Association of Washington
- Yakima, (509) 248-4384

Master Home Environmentalists can survey risks from moisture, dust mites, mold, indoor air quality, lack of ventilation, and smoke, as well as lead and dust. They can also recommend a professional resource if they find high risks or remedies that may have higher costs.

For serious environmental health problems such as severe health complaints, more than one square foot of mold, or sewage backup, call your doctor, the Seattle-King County Hazard Line at (206) 296-4692 or 1-800-633-7585, or the Environmental Health Division at (206) 205-4394.

ON-LINE RESOURCES

Lead Control in Old Homes
- www.watoxics.org/thbl.htm

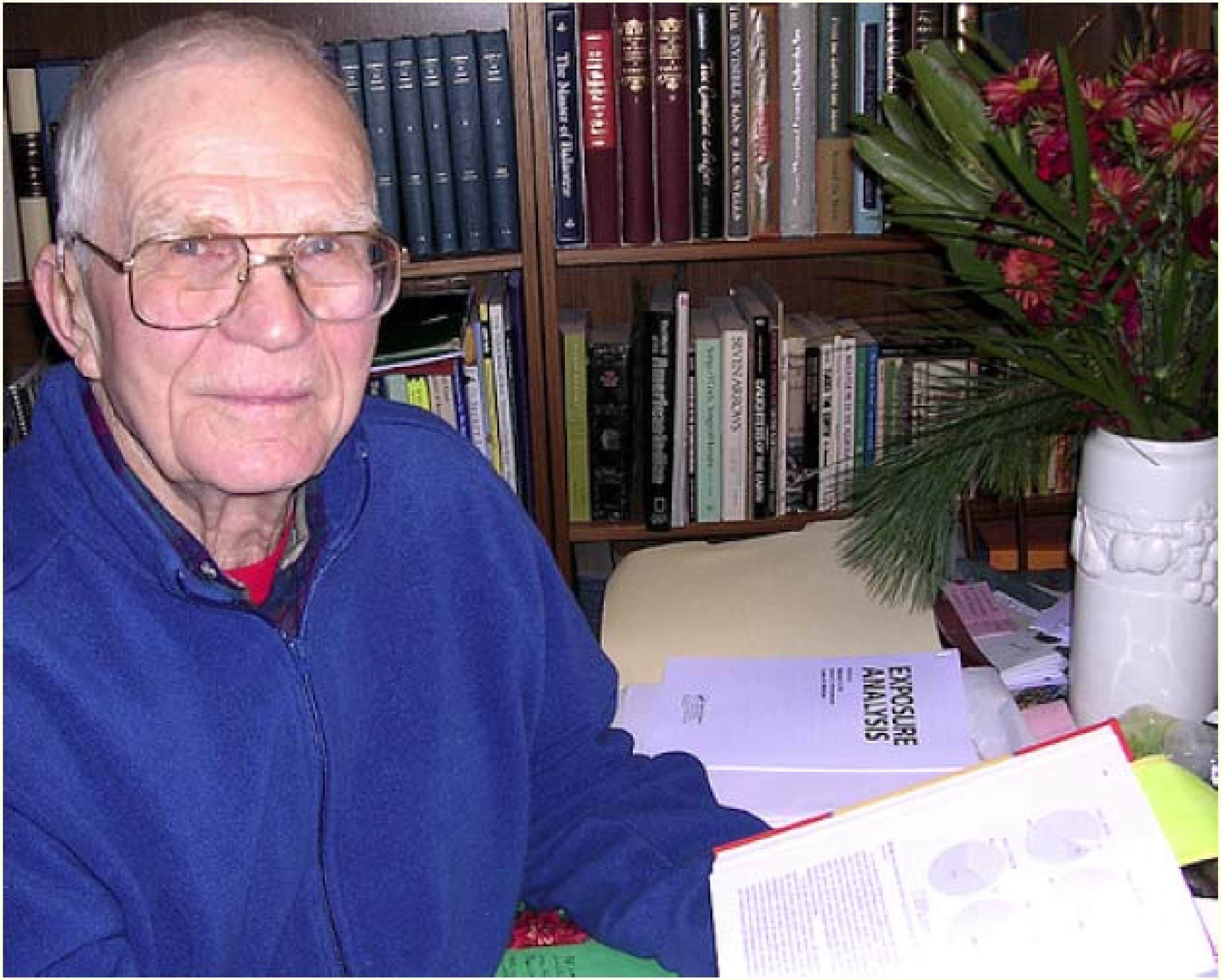
Protecting Infants from Other Home Toxics
- www.lwvwa.org/advocacy/home-environment

Get the Deep Dust Out of Carpets

Protecting Small Children from Dust, Lead, Allergens, and Mold

Natural Resources Committee
League of Women Voters of Seattle
1402 Eighteenth Avenue
Seattle, WA 98122
Tel: (206) 329-4848
Fax: (206) 329-1273
E-mail: LWVSeattle@aol.com

Supported by the
Northwest Air Pollution Authority


EXPOSURE
ANALYSIS