Assessment Methods for Community Based Risk Assessment

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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. Longitudinal Cohort Study

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Estimated Organophosphate and Carbamate Usage on Apples and Potatoes in Washington State, 2001

Pounds of Organophosphates and Carbamates Applied
- 0 - 10000
- 10001 - 50000
- 50001 - 150000
- 150001 - 250000
- 250001 - 500000

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Study Counties for the Center for Child Environmental Health Risks Research

Study Counties
- Community Based Participatory Research Project
- Pesticide Pathways Project

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Examples of Chemicals Applied to Washington State Crops, 2001

Chemical class	crop	Chemical	Pounds applied
Organophosphates	Apples	Azinphos-methyl	241,000
		Chlorpyrifos	234,000
		Phosmet	138,000
	Potatoes	Ethoprop	119,000
		Metamidophos	143,000
N-Me Carbamates	Apples	carbaryl	202,000
	Potatoes	Aldicarb	153,000
Dithiocarbamate	Apples	Mancozeb	82,000
	Potatoes	Mancozeb	343,000

Source: "Agricultural Chemical Usage (PCU-BB)" National Agricultural Statistics Service, Agricultural Statistics Board, U.S. Department of Agriculture
(http://jan.mannlib.cornell.edu/reports/nassr/other/pcubb Accessed 05/03)

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

G.C. Coronado, I. Islas, S.A. Snipes, J. Grossman, and B. Thompson

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Slide 7: 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

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

Labor Camps

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

Thompson et al 2003

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Slide 8
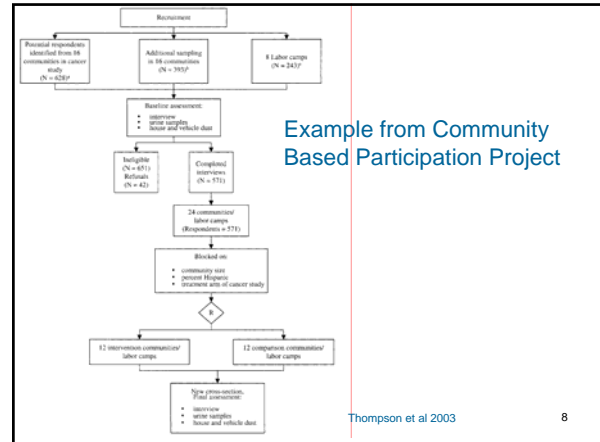
Example from Community Based Participation Project

Thompson et al 2003

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Slide 9: Environmental Public Health Continuum

- Individual
- Community
- Population

Adapted from Hal Zenick

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Slide 10
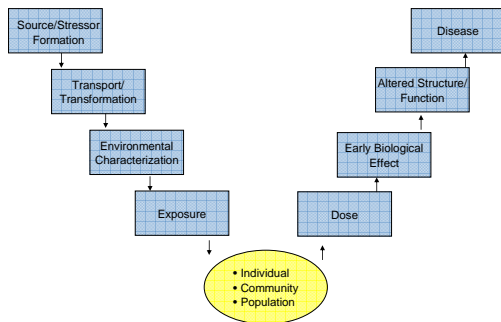
Over 250 community-wide events occurred.
This Community Health Fair is an example.

Photo: Gloria Coronado

Total number of participants at community-wide events is greater than <u>6,000</u>!

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Slide 11

Over 1,800 total events took place in the communities.

Approx. 1,000 Home Health Parties such as this occurred.

Photo: Gloria Coronado

Total number of participants in all levels of community activities was over <u>18,000</u>!

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Slide 12: Community Intervention

Handing out toys such as frisbees and basketballs draws kids to the Community Intervention project's table where they learn simple things to help reduce their exposure to pesticides.

Photo: Gloria Coronado

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Community Intervention

After a series of presentations made in second and third grade classrooms, students were invited to enter a coloring contest. Winning entries were included in a calendar. In this drawing the woman tells the man to wash his own clothes, because she's going to a dance…and she reminds him to leave his boots outside.

Photo: Gloria Coronado

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Images courtesy of JE Grossman
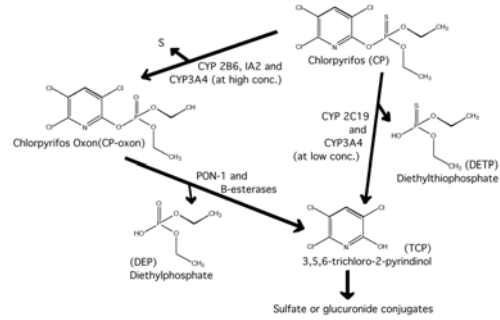

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Images courtesy of JE Grossman

Agricultural Pesticides: Contributions of Occupational Factors to Home Contamination

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Metabolic Scheme for CP

Faustman et al. (2006)

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Metabolites of Organophosphate Pesticides

- Biomarkers of exposure
- 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
- Specific metabolites
  - Chlorpyrifos metabolites
    - TCP, DEP, DETP
  - Chlorpyrifos-methyl metabolites
    - TCP, DMP, DMTP

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Metabolites of Organophosphate Pesticides

Selected OPs and DAP metabolites

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

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Metabolites of Organophosphate Pesticides

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Diethyl OPs			
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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

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Monitoring Results

Evidence of pesticides in environment

- 36% of homes and 42% of cars had quantifiable levels of 2 or more OPs in dust.
- 60% of households (home and vehicles together) had evidence of 2 or more OPs in collected dust.

Vigoren EM, Griffith WC 2006

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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.

Vigoren EM, Griffith WC 2006   23

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.

Vigoren EM, Griffith WC 2006   24

Slide 25

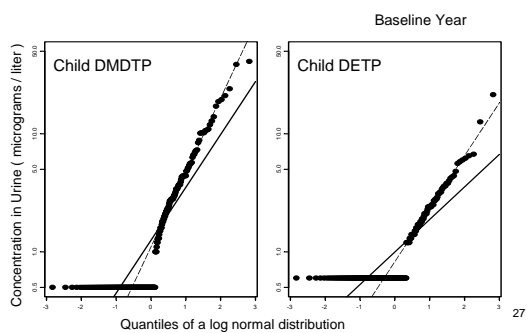# What do these values mean for my Children?

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Slide 26

Samples Collected in Studies of Farmworker Families

- Types of samples collected from individuals 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 analyzed for gene expression—collected 2 times in 1 week
- Dust is collected from homes and autos in thinning and non-spray seasons season and analyzed for parent OPs

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Slide 27
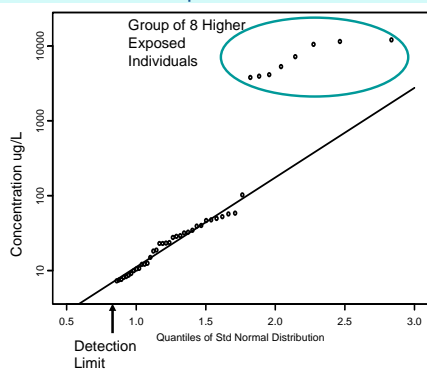
Many Values Are Below Limits of Detection

Baseline Year

Child DMDTP

Child DETP

Concentration in Urine (micrograms / liter)

Quantiles of a log normal distribution

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Slide 28

NHANES Compared to Farmworker Family Data for DMTP in Urine

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Slide 29

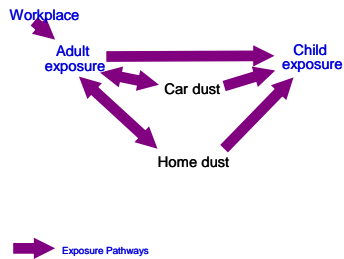# DMP in Adult Urine: QQ Plots to Estimate Population Distribution

Group of 8 Higher Exposed Individuals

Concentration ug/L

Detection Limit

Quantiles of Std Normal Distribution

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Slide 30

Distribution of Adult DMTP from year 1: Impact of Crop

Baseline Year

ctl, no pome   n=29
ctl, pome   n=79
int, no pome   n=29
int, pome   n=68

sample quantiles

Metabolite concentrations in urine (ug/L)

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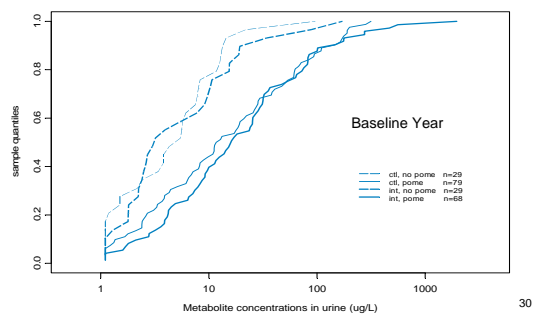
Assessing Children's Pesticide Exposure via the Take-home Pathway

Workplace

Adult exposure → Child exposure

Car dust

Home dust

Exposure Pathways

Vigoren et al 2007   31

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

Adult DMTP in Urine

Non-Pome Fruit

Pome Fruit

$P<0.001$

Child DMTP in Urine

Non-Pome Fruit

Pome Fruit

$P=0.003$

Urinary DMTP µg / liter
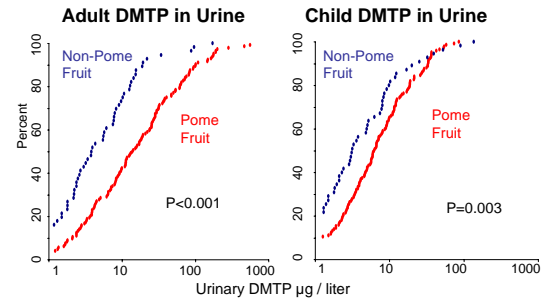
Coronado et al., Env. Hlth. Persp., 2004, 2006   32

Two longitudinal studies of OP metabolites used to estimate within and between variability

- Multiple measurements in the same person across time permit estimation of both within and between person variability
  - Within and between person variability treated as a random effect and other variables such as age, gender, residence, season treated as fixed effects
- TCP had a low percentage below limits of detection

- Measurements below limit of detection (LOD) were treated as being left censored in statistical analyses

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Predictive Value Positive for Identifying Persons in the Upper 10% of the Population
The predictive value positive is the percent of the population assigned to a group that are correctly classified.

Minnesota

Maryland

High Rate of Misclassification

Number of Measurements per Person
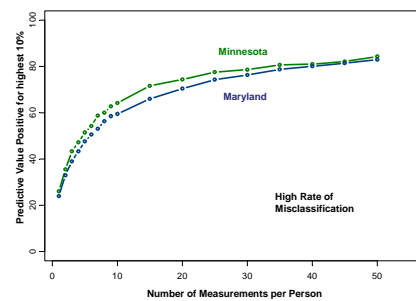
Based upon large within person variances it will require a large number of samples of urinary metabolites to correctly identify persons in a population who are more highly exposed to CP and CPM.
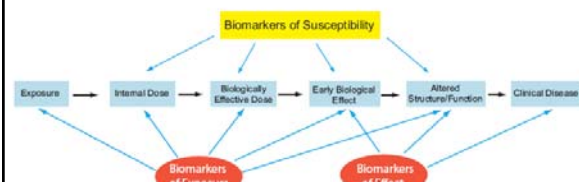
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Sources of Uncertainty

Stochasticity
  - Characterization of Within and Between Person Variability

Parameter Uncertainty
  - Year-to-Year Variability
  - Observations below Limits of Detection (LOD)

Model Uncertainty
  - Crop vs. Agricultural Job Task
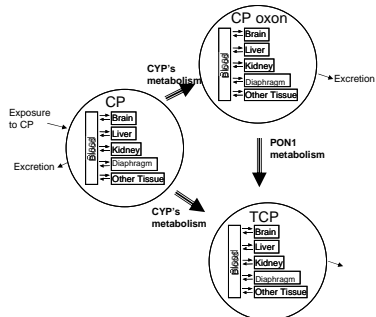 - Identification of Highly Exposed Individuals

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Biomarkers for Monitoring Exposure and Effect in Populations

Biomarkers of Susceptibility

Exposure → Internal Dose → Biologically Effective Dose → Early Biological Effect → Altered Structure/Function → Clinical Disease

Biomarkers of Exposure

Biomarkers of Effect

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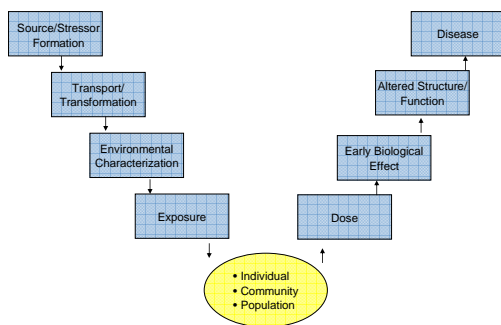## Physiologic Based Toxicokinetic Models of CP Metabolism

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Methodology Underlying Integrated Framework Tool

- Bayesian Based Mixed Effects Model
  – Correlational structure of a multivariate distribution used to estimate correlations between pesticide concentrations, metabolites, gene expression levels, and other variables
  – Markov chain Monte Carlo methods used for parameter estimation

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Environmental Public Health Continuum

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Adapted from Hal Zenick