Presentation entitled “Major Findings and Recommendations Based on the Outcome of Statistical Analysis of Children’s Exposure Data from the CTEPP Study” by Dr. Robert Lordo

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CTEPP

Major Findings and Recommendations Based on the Outcome of Statistical Analysis of Children's Exposure Data from the CTEPP Study

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Why was the CTEPP Study done?

Achieve a better understanding of children's aggregate exposure to pesticides and semivolatile organic pollutants that are
- Persistent in indoor and outdoor environments
- Shown to have adverse effects on health

- Identify important sources and routes of exposure that contribute to children's exposures to pollutants
- Find improved approaches for estimating children's exposures and potential doses to pollutants

CTEPP Study Features

- 257 children aged 18m-5y + adult caregivers
  - 130 homes and 13 day care centers in NC
  - 127 homes and 16 day care centers in OH
- Monitoring periods
  - 7/2000 to 3/2001 in NC
  - 4/2001 to 11/2001 in OH
- Field samples include: indoor air, outdoor air, floor dust, yard soil, duplicate-plate (solid and liquid food), drinking water, hand wipe, urine
- Personal Exposure Levels (ng/day) were calculated for inhalation, dietary ingestion, and non-dietary ingestion pathways

Conclusions of Children's Exposure Route Apportionment

- **Chlorpyrifos, diazinon (OP pesticides):**
  dietary ingestion ≥ inhalation > indirect ingestion
- **3,5,6-TCP (OP metabolite):**
  dietary ingestion > inhalation > indirect ingestion
- **2,4-D (Acid herbicide):**
  dietary ingestion > inhalation ≥ indirect ingestion
- **Di-*n*-butylphthalate (phthalate):**
  dietary ingestion > inhalation > indirect ingestion
- **Bisphenol-A (phenol):**
  dietary ingestion > inhalation > indirect ingestion
- ***Cis*- and *trans*-permethrin (pyrethroid pesticides):**
  dietary ingestion ≥ indirect ingestion > inhalation

Conclusions of Analyses on Personal Exposure/Dose Measures

- Daycare children > Stay-at-home children
  - Diazinon, PAHs, benzylbutylphthalate via indirect exposure (OH)
  - Benzylbutylphthalate, permethrins via dietary exposure (OH)
- Urban children > Rural children
  - 2,4-D via indirect exposure (NC)
  - PAHs via indirect exposure (OH)
- Mid/High income children > Low-income children
  - 2,4-D via indirect exposure (NC)

Investigating Exposure Pathways from Multiple Media to Biomarkers

- Structural Equation Modeling
  - Standard statistical approach to characterizing association between exposure measures and biomonitoring data
  - Can characterize both direct and indirect effects
  - Multivariate technique involving simultaneous structural equations expressing pollutant levels in one medium (including the biomarker) as a linear function of levels in other media
  - Data are needed for all media; predictor variables assumed known without error
- Hierarchical Bayesian Modeling
  - Accounts for correlation and uncertainty in exposure levels across media and handles missing data efficiently
  - Multivariate statistical modeling framework with prior distributions placed on media-specific measures and on exposure routes

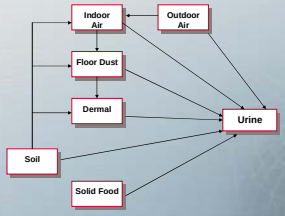
CTEPP Data Considered in SEM and HBM Analyses

- Chlorpyrifos/3,5,6-TCP data for NC and OH children
- Chrysene/1-hydroxypyrene data for OH children

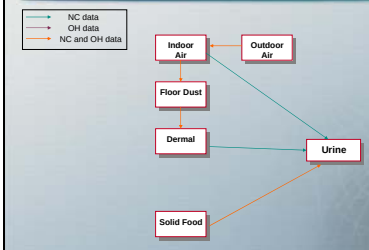
System of linear equations:

- Urine = Outdoor Air + Indoor Air + Floor Dust + Dermal + Soil + Solid Food
- Indoor Air = Outdoor Air + Soil
- Floor Dust = Indoor Air + Soil
- Dermal = Floor Dust + Soil

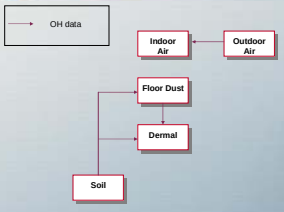
Pathways considered in SEM analysis of CTEPP data



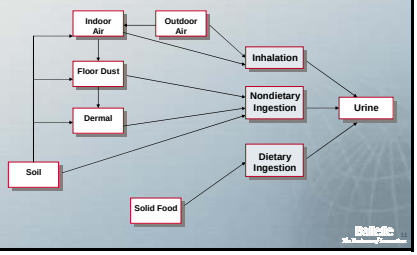
Significant Pathways for Chlorpyrifos/3,5,6-TCP data based on SEM



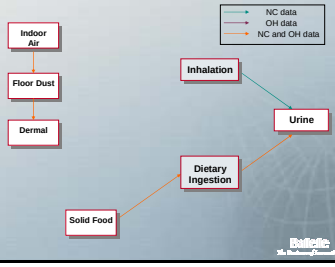
Significant Pathways for Chrysene/1-hydroxypyrene based on SEM



Pathways considered in HBM analysis of CTEPP data



Significant Pathways for Chlorpyrifos/3,5,6-TCP data based on HBM



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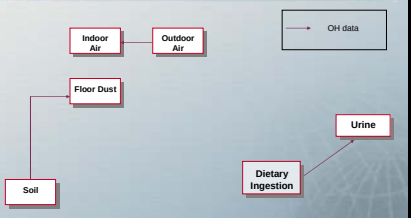

Recommendations for Future Investigation

- Investigate relationship between potential exposure/dose and frequency of adverse human health effects in children
  - Limited data on adverse health effects attributed to dietary ingestion
- Improve methods and inputs for estimating potential exposure/dose and characterizing exposure routes
  - Include data for locations outside of day care and home environments
  - Improve specifications on absorption fractions
  - Include dermal exposure (more information needed on absorption)
  - More information needed on mouthing tendencies and activity patterns
  - Can indirect ingestion and dermal routes be separated for study?

Recommendations for Future Investigation

- Refine analytical techniques to lower detection limits for pollutants in solid and liquid food
  - Limits ability to characterize dietary ingestion
- Compare dietary exposure/dose measures with values derived from EPA's Dietary Exposure Potential Model
- Measure biomarkers that better characterize exposure to a given chemical in the environment
- Investigate how children's exposure varies over time
  - Time frames under one year (e.g., monthly variation)
  - Are consistent low exposures over extended times important?
- Conduct more small-scale pilot studies