COMPARISON OF FIELD MEASUREMENTS FROM A CHILDREN’S PESTICIDE STUDY WITH PREDICTIONS FROM A PHYSICALLY BASED PROBABILISTIC MODEL FOR ESTIMATING CHILDREN’S RESIDENTIAL EXPOSURE AND DOSE TO CHLORPYRIFOS

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BACKGROUND

- 90% of all U.S. households use pesticides1.
- 28.5 million kg insecticides and 126.6 million kg antimicrobials are used annually by U.S. homemakers and homeowners to control pests2.

1Savage et al., 1981.
2Robinson et al., 1994.
It is estimated that full-time homemakers and young children spend up to 90% of their time indoors.\(^1\)

Children may be exposed to pesticides via multiple routes and from multiple media.

\(^1\)Nigg et al., 1991.
Young children can be particularly susceptible to pesticides because:

- undergoing development (metabolism & excretion of toxicants)
- greater dermal absorption due to greater surface area to volume ratio
- enhanced hand-to-mouth activities
- intimate contact with toys increasing risk from non-dietary ingestion

Source: Environmental Protection Agency.
OBJECTIVE

- Compare the urinary metabolite concentrations of chlorpyrifos (3,5,6-Trichloropyridinol) estimated by the Pesticides SHEDS (Stochastic Human Exposure and Dose Simulation) Model with results from a Children’s Post Pesticide Application Exposure Study.

CHILDREN’S POST-PESTICIDE APPLICATION EXPOSURE STUDY (CPPAES)

- Field study conducted by EOHSI, N.J.
- Provide information on the distribution and accumulation patterns of chlorpyrifos within a residential environment for a two week period following a crack and crevice application of chlorpyrifos.
- Study was conducted in 10 residential homes (Criteria for selection: With child age 2-5 years and routinely apply pesticides).
- Samples collected (Indoor Air, Dust Wipes, Plush Toys, Handrinse, Urine, Activity Diaries).
STOCHASTIC HUMAN EXPOSURE AND DOSE SIMULATION MODEL (SHEDS - PESTICIDES)

- Under development by EPA/ORD/NERL.
- Population based on CHAD studies weighted by U.S. Census.
- Source -> Concentration -> Exposure -> Dose -> Blood -> Urine (PK Module).
- Inhalation, Dermal, Hand-to-Mouth, Object-to-Mouth, Dietary Routes.
- 2-Stage Monte Carlo Sampling.
- Longitudinal 1-year exposure profiles (Averaging time periods 1 day, 7 day, 30 day, seasonal, annual).
- Macro-activity based approach for all routes (Time steps: Location/Activity durations reported in CHAD diaries).

**Flowchart Diagram:**
- Read in user specified scenario & cohort information
  - Sample an Individual from CHAD diaries
  - Simulate Person’s 1-Year Diary
  - Set Days and Times of Pesticide Applications Over the Year
  - Set Concentrations & Residues for Each Day of the Year
  - Generate Individual’s Route-Specific Exposure Profiles
  - Simulate Corresponding Dose Profiles
  - Compute Desired Metrics for the Indiv.
  - Apply 2-Stage Monte Carlo Sampling for Population Estimates
**INPUT PARAMETERS FOR CRACK & CREVICE APPLICATION (CPPAES)**

Information on Pesticide Usage

Chemical Usage Data
- Mass of pesticide (g)
- Effective surface area of treated rooms (m²)
- Fraction of time in treated/un-treated rooms (while indoors/awake)
- Residue/indoor air decay rate in treated rooms (1/day)
- Initial air concentration in treated rooms (µg/m³)

**Exposure Factors**
- Hand washing events per day (children) (events/hr.)
- Frequency of hand-to-mouth activity (events/hr.)
- Frequency of object-to-mouth activity (events/hr.)

**Dose Factors**
3,5,6-TRICHLOROPYRIDINOL (µG/L URINE) PESTICIDE-SHEDS vs. CPPAES (INITIAL RUNS…)

Model Predicted TCPy (µg/L)

Field Study TCPy (µg/L)

Days Post-Application
(Day 0 - Day of Application)
3,5,6-TRICHLOROPYRIDINOL (µG/L URINE) PESTICIDE-SHEDS vs. CPPAES (INITIAL RUNS…)

Model Predicted TCPy (µg/L) vs. Field Study TCPy (µg/L) over Days Post-Application (Day 0 - Day of Application)

PRELIMINARY OBSERVATIONS

- Model predictions for 3,5,6-TCPy in urine were within a factor of 2 from the measurements made in the CPPAES.

- Using CHAD diaries for activity pattern data and literature values for dermal transfer coefficients may have contributed to some of the discrepancies in exposure & dose estimates between model and CPPAES.
FURTHER ANALYSIS

- Run model using CPPAES diaries instead of CHAD diaries.

- Examine data to see what factors may have affected the TCPy concentrations in the CPPAES to explain for some of the variability observed in the urine concentrations.

  How would the model take these factors into account?

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