EPA Science Forum 2003
Partnering to Protect Human Health and the Environment

Applying An Innovative Model
(SHEDS: Stochastic Human Exposure And Dose Simulation Model)
To Assess Children's Exposures To Pesticides

Moving Science into Action

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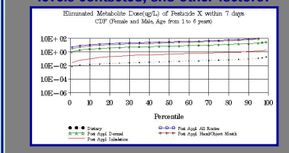
Issue being Addressed

- Accurately quantifying children's aggregate exposures to pesticides is critical for the Agency to make regulatory decisions on pesticide usage
- Not feasible to measure actual personal exposures for entire populations of children with different age and behavior dependent characteristics
- Regulatory decisions often use scenario-based models with varying levels of sophistication
- Risk assessors and managers need more realistic exposure and dose prediction tools beyond the currently available screening level methods

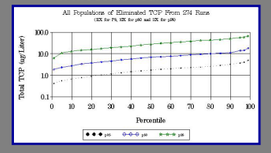
Scientific Approach to Resolve Issue

SHEDS is a state-of-the-science model for simulating contact with and uptake by pesticides that can answer the following questions:

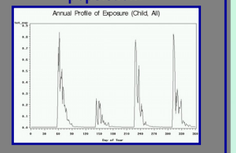
What is the population distribution of exposure and dose, accounting for variability in activities, pesticide levels contacted, and other factors?



What is the uncertainty in modeled estimates?



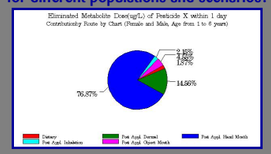
What is the time profile of exposures and doses for an individual in the population?



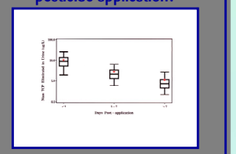
Which model inputs are most important?

Independent Variables	Partial R^2	Model R^2
Residue Decay Rate in Treated Rooms (1/day)	0.27	0.27
Mass of Pesticide Applied Indoors (grams)	0.06	0.33
Effective Surface Area of Treated Rooms (m2)	0.05	0.38
Fraction of Time in Treated Rooms (while indoors & awake)	0.04	0.42
Freq. of Hand-Mouth Activity (events/hr)	0.04	0.46
Maximum Dermal Loading for Hands (Children)	0.01	0.47
Dermal Absorption Rate for Liquids(1/sec)	0.01	0.48
Untreated Derived Residue Rate after Max. Day	4.E-03	0.48
Day Number of Untreated Room Maximum	2.E-03	0.49
Maximum Dermal Loading for Body (Children)	8.E-04	0.49
Fraction of Time in Untreated Rooms (with windows while indoors & awake)	2.E-04	0.49
GI Absorption Rate (1/sec)	2.E-04	0.49
Lawn Application Rate (lb/acre)	1.E-04	0.49
Indoor Air Decay Rate in Treated Rooms (1/day)	9.E-05	0.49
Freq. of Object-to-mouth Activity (events/hr)	8.E-05	0.49
Initial Air Concentration in Treated Rooms (ug/m3)	8.E-05	0.49

Which are the most important routes and pathways of exposures and doses for different populations and scenarios?



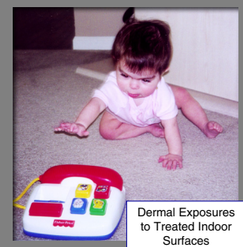
How do exposures and doses change after a pesticide application?



Case Studies to Date

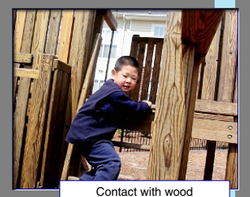
Modeling Children's Exposures to Organophosphate Pesticides from Lawn, Garden, and Indoor Crack and Crevice Treatments

- Relative abundance of data allowed for initial model development and evaluation (publication in *Environmental Health Perspectives* 2000).
- Results of aggregate assessment indicated hand-to-mouth and dermal routes appear more important for highly exposed individuals; dietary and inhalation routes for lower exposed individuals.
- Initial sensitivity and uncertainty analyses helped prioritize additional data needs.
- Modeled estimates of urinary levels compared well to field measurements, but additional data and model evaluation are needed.
- 2001 Aggregate Residential Exposure Model Comparison Workshop led by ORD/NERL provided guidance for OPP to conduct model comparisons as part of their regulatory process.


Dermal Exposures to Treated Indoor Surfaces


Dermal Exposures to Lawn Residues

Modeling Children's Exposures to Wood Preservatives on Playsets and Home Decks


Contact with wood preservatives on playsets

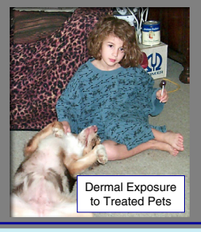
- Collaboration between ORD and OPP led to successful review of SHEDS wood preservative exposure assessment methodology by OPP Science Advisory Panel (SAP) August 2002.
- SAP comments being addressed to refine model and conduct SHEDS application for CCA (chromated copper arsenate)-treated wood.
- SHEDS-generated exposure and dose estimates for CCA will be used by OPP as part of public health risk assessment.
- SAP review of arsenic and chromium exposure and risk assessment scheduled for December 2003.
- Consumer Product Safety Commission (CPSC) deferred action on petition to ban CCA-treated wood for use in playground equipment until EPA's CCA assessment is complete.


Contact with wood preservatives on decks

Modeling Children's Exposures to Pyrethroid Pesticides from Lawn, Garden, Crack and Crevice, Fogger, and Pet Treatments


Hand-to-Mouth Exposure Pathway


Object-to-Mouth Exposure Pathway


Dermal Exposure to Treated Pets


Dietary Ingestion Exposures

- Collaborative effort among ORD Labs and Centers, and OPP as part of ORD Safe Foods Project.
- Aggregate SHEDS model will be enhanced to simulate real-world uses of multiple pesticides and application methods for cumulative exposure and dose assessment.
- Model predictions to be compared against several real-world measurement studies.
- SHEDS exposure estimates intended for use in OPP regulatory-decision making process for pyrethroids under the Food Quality Protection Act of 1996.
- SAP review of SHEDS model for pyrethroids assessment planned for late 2004.

Impact on Science

- Modeling tool for Agency to improve pesticide-related risk assessment and management decisions and to prioritize data needs
- Produces population exposure distributions to enhance Agency risk assessments
- Helps identify areas of critical data needs for measurement programs
- Utilizes innovative computational techniques to address emerging issues

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