Exposure models fall into two categories, descriptive (mostly statistical) and predictive (mostly physical or probabilistic).

Consumer exposure refers to the constituents of consumer products resulting from the use (exposure scenario) of these products.

This Workshop focuses on predictive models for consumer exposure assessment.
Topics

- Generic Modelling Framework, *Muhilan Pandian*, Infoscientific.com, USA
- Model needs and applications - America, *Mike Dellarco*, USEPA, USA
- Requirements for consumer exposure models by regulatory applications, *Otto Hänninen*, KTL, Finland
- Modelling experiences using Notitia, *Muhilan Pandian*, Infoscientific.com USA
- Modelling experiences using ConsExpo, *Jacqueline van Engelen and Christian Delmaar*, RIVM, the Netherlands
- Modelling experiences using BEAT, *Nick Warren*, UK
- Model harmonisation potentials and benefits, *Haluk Özkaynak*, USEPA, USA

**General Model Description**
1. Description of the purpose of the model and its components
2. Individual- or population-level analysis (level of aggregation)
3. Modelled time resolution
4. Applicability to diverse exposure scenarios

**Model inputs**
5. Description of data inputs

**Model processes**
6. Modelling tool methodology
7. Model code and platform
8. Model performance and evaluation summaries

**Model outputs**
9. Description of model outputs
1. Model sensitivity and uncertainty
A simple model of NO₂ exposure from gas stove shown as concentric shell structure: Core defines the modelling framework, inner shell the applied equations, program algorithms, and outer shell the input and output data.

\[ E_{\text{TWA}} = \sum E_i \]

\[ E_i = \frac{t_i}{T} * X_i \]

\[ X_{\text{NO}_2} = e^{-\frac{1}{at}q/V(a+k)} \]

User interface

Gas stove NO₂ release DB

Residential room number and size DB

Gas stove prevalence and use DB

Ventilation rate DB

Outdoor air exchange
Muhilan Pandian: Generic Modelling framework

Conceptual multi-route consumer exposure model
Mike Dellarco: Model needs and applications, US

U.S. Consumer Exposure Models include
- PROMISE, American Chemistry Council
- DERM, Stanford University, USA
- (CALENDEX, Novigen Science, Inc., database not available)
- CARES, CropLife America
- LIFELINE, LifeLine Group

U.S. EPA Consumer Exposure Models are
- E-FAST, Versar for US EPA
- SCIES, Office of Prevention, Pesticides, and Toxic Substance
- DERMAL, Office of Prevention, Pesticides, and Toxic Substances
- MCCEPA, Office of Research and Development
- SHEDS, Office of Research and Development
What does E-FAST Do?
Screening-level estimates of chemical concentrations released into air, surface water, landfills, and from consumer products.

How does E-FAST Work?
Calculates appropriate human potential dose rates for a wide variety of chemical exposure routes

E-FAST requirements
Type of product, weight fraction, vapor pressure, molecular weight

E-FAST output
Summary sheet with multimedia concentrations from multiple release activities
Potential dose estimate can be used for screening level exposure and risk assessments
Person Oriented Modelling provides the framework that organizes:
- Databases
- Algorithms
- Interim values
- Outputs
- Populations of interest
Modeling A Person’s Lifetime Exposures To Two Pesticides in Multiple Products
Muhilan Pandian: Notitia – a library of databases and models

Databases currently in Notitia:

- REJV (Residential Exposure Joint Venture) – 12-Month Pesticide Product Use Diary Survey
- NHGPUS (National Home and Garden Pesticide Use Survey; US EPA)
- ORETF (Outdoor Residential Exposure Task Force) – Outdoor Pesticide Product Use Recall Survey
- CHAD (Consolidated Human Activity Database)
- PPIS (Pesticide Product Information System; US EPA)
- PHED (Pesticide Handler Exposure Database; US EPA)
- CSFII (Continuing Survey of Food Intakes by Individuals; USDA)
- FCID (Food Commodity Intake Database; US EPA)
- PDP (Pesticides Data Program; USDA)
- Drinking Water Consumption Database (US EPA)
- Drinking Water Source Database (USGS)
- United States Watershed Database (USGS)
- United States 200 Census summarized Database (US Bureau of Census)
- IRIS (Integrated Risk Information System; US EPA)
Models currently in Notitia

- CARES (Cumulative & Aggregate Risk Evaluation System)
  - Non-Dietary component
    - Dietary (Food) component
    - Dietary (Drinking water) component
- 2-Zone Indoor Environment Air Dispersion Model (similar to SCIES (U.S. EPA OPPT))
- 4-Zone House Air Dispersion Model (similar to MCCEM (U.S. EPA OPPT))
- Indoor Source Models
  - Multiple Exponential Decay (includes Constant Source, …)
    - Wall Paint
    - Surface Spill
- PBPK/PD Models
CONSEXPO Factsheets available for consumer products

- Pest control products
- Cosmetics
- Children’s Toys
- Paint (to be translated)
- General
- Cleaning products
- Disinfectants
- Do-it-yourself products
Fuzzy decision logic (BEAT)

Input data → Parallel path rule base → Database of measured exposures → Integration using Bayesian statistics → Predicted exposure distribution (variability & uncertainty)
Task-based occupational exposure modelling

Components of the BEAT model

Dermal exposures determined by the task and product, not the chemical

Similar conditions give similar exposure
Stochastic Human Exposure and Dose Simulation (SHEDS)

Incorporates both variability and uncertainty in predicted exposure distribution using 2-stage Monte Carlo sampling technique.
In Summary

- Exposure control is virtually the only risk management alternative also for **consumer risk management**. Validated predictive exposure models are the only source of science based information for consumer risk management.

- **A model is not a model is not a model.** Consequently model comparisons are, albeit desirable, far from straightforward.

- **Modelling tools** consist of (and/or link) model algorithms, exposure scenarios, databases, user interface. They range from rigid (non-selectable scenarios, algorithms, databases, point value inputs and outputs) and easy to highly flexible and demanding computerised model and database libraries (e.g. Notitia) which allow – and require – the user to select the scenarios, databased and model algorithms for each application.

- **Model transparency** requires that scenarios, databases and algorithms can be viewed and modified by the user, and that the model can be validated against realistically obtainable intermediate and or final monitored data.

- **Model harmonisation** should focus on reporting model characteristics, capabilities and validation/application results. See: WHO/IPCS Exposure Harmonisation WG Report: Principles of Characterising and Applying Human Exposure Models (to be published in the winter of 2005-6.)