

# Ex Priori: A Screening-Level Chemical Prioritization Dashboard for Consumer Exposures

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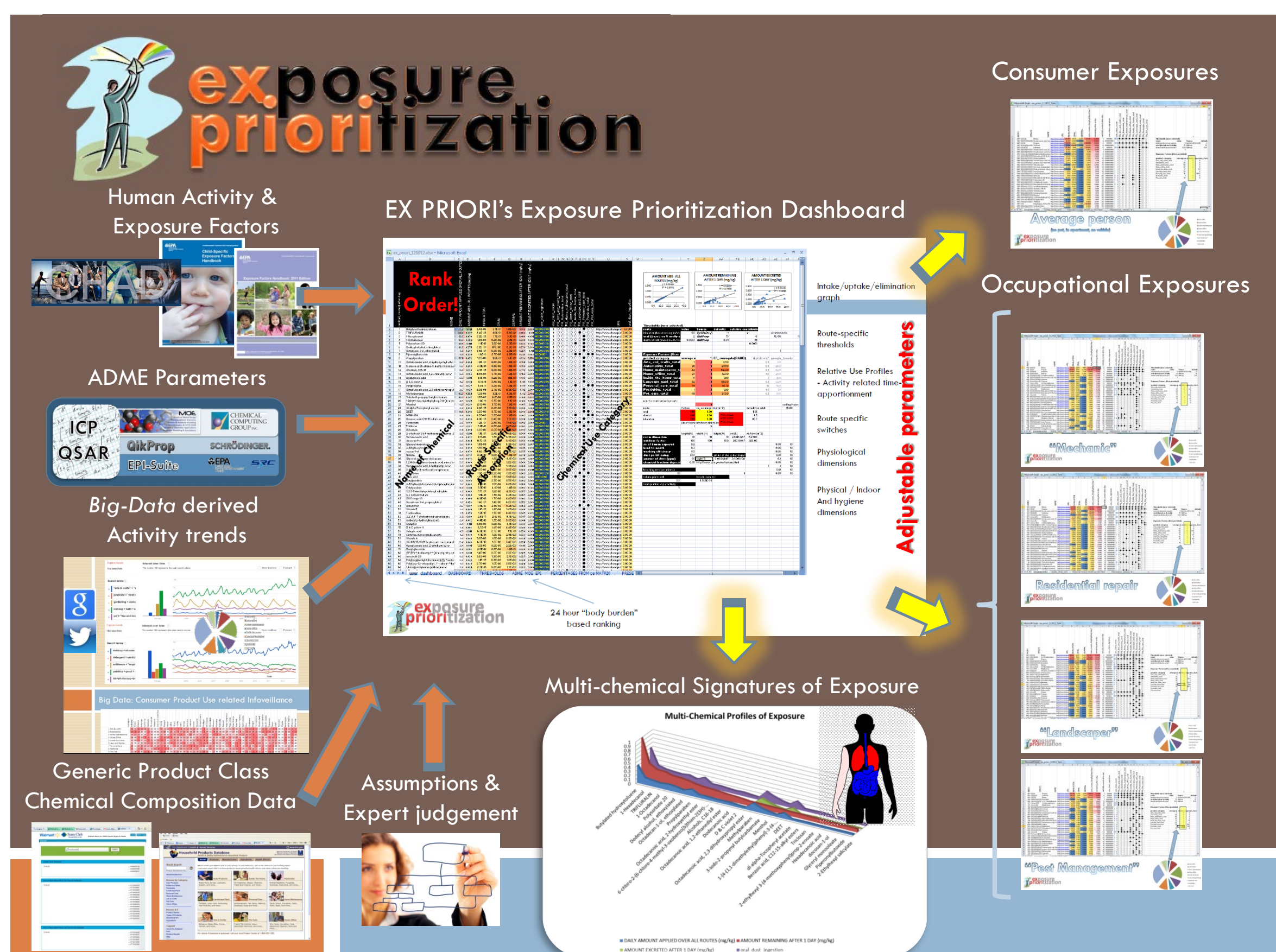
## Abstract

- Exposure to a wide range of chemicals through our daily interaction with consumer products is ubiquitous and largely unavoidable. Due to the breadth of consumer product formulations of chemical ingredients and the diversity of consumer-specific habits and practices the task of quantifying one's chemical exposure profile can be overwhelming.
- The U.S. EPA's Exposure Prioritization (Ex Priori) tool is a simplified, quantitative visual dashboard that makes use of data from various inputs to provide rank-ordered internalized dose-metric and to address the very question of one's personal chemical exposure to all chemicals in consumer products.
- Developed as a screening level flexible dashboard-type chemical prioritization tool, Ex Priori provides a scenario-specific ranking of multiple chemical exposures from consumer products while accounting for physico-chemical properties (e.g., partitioning coefficients); exposure factors; and variations in product formulations, activity patterns, and product use profiles (e.g. habits and practices). Additionally, Ex Priori extends traditional exposure models by incorporating chemical-specific predictions of ADME processes to estimate route- and chemical-specific internal doses.

## Background

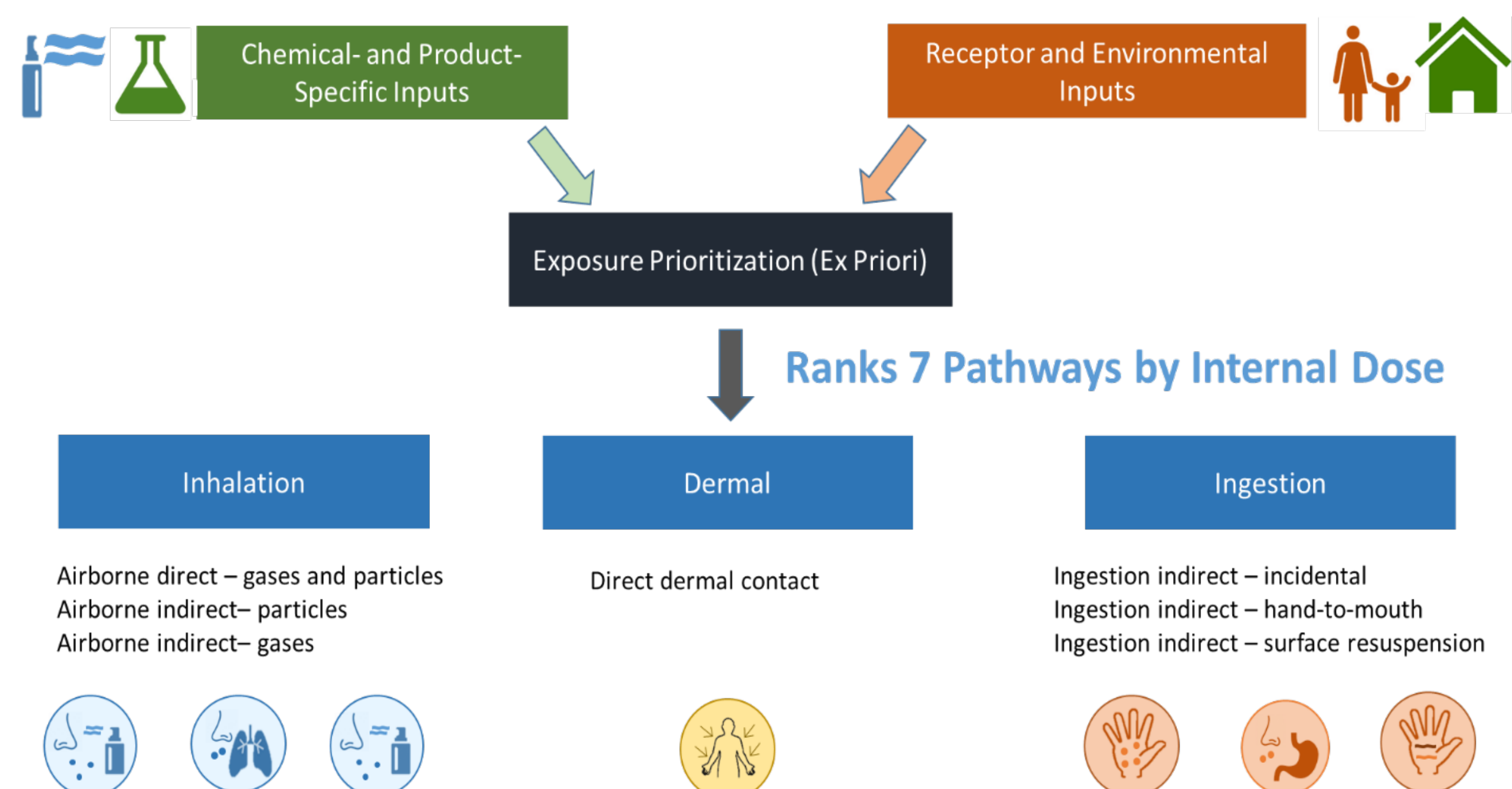
**Ex Priori** was developed to capture “algorithmically” (model) the near-field consumer-product derived “exposome” and set the groundwork for an adaptable framework that synthesizes knowledge from various domains and amenable to new knowledge/information exploration:

- Exposure Scenarios:** geographical/temporal scales mined from infoveillance sources (i.e., Google Trends, Big Data informatics)
- Chemical Factors:** consumer product profile maps, QSAR derived PC & ADME parameters
- Exposure factors:** use, amount, frequency, area, form and route of exposure



**Figure 1.** Original Ex Priori (Exposure Prioritization Framework) prototype from 2014. The Ex Priori “tinker-toy” model worksheet enabled one to: (1) didactically explore a distribution of exposure scenarios, physiological and other physical exposure factors (2) explore occupational exposures, life-stage specific exposures and exposures from multi-chemicals from many activities/sources simultaneously (3) couple Big Data derived exposure scenarios that capture geospatial and temporal (i.e., seasonal) discrepancies as well as chemical products database derived informatics.

## Components of Ex Priori



**Figure 1.** Schematic plot of Ex Priori

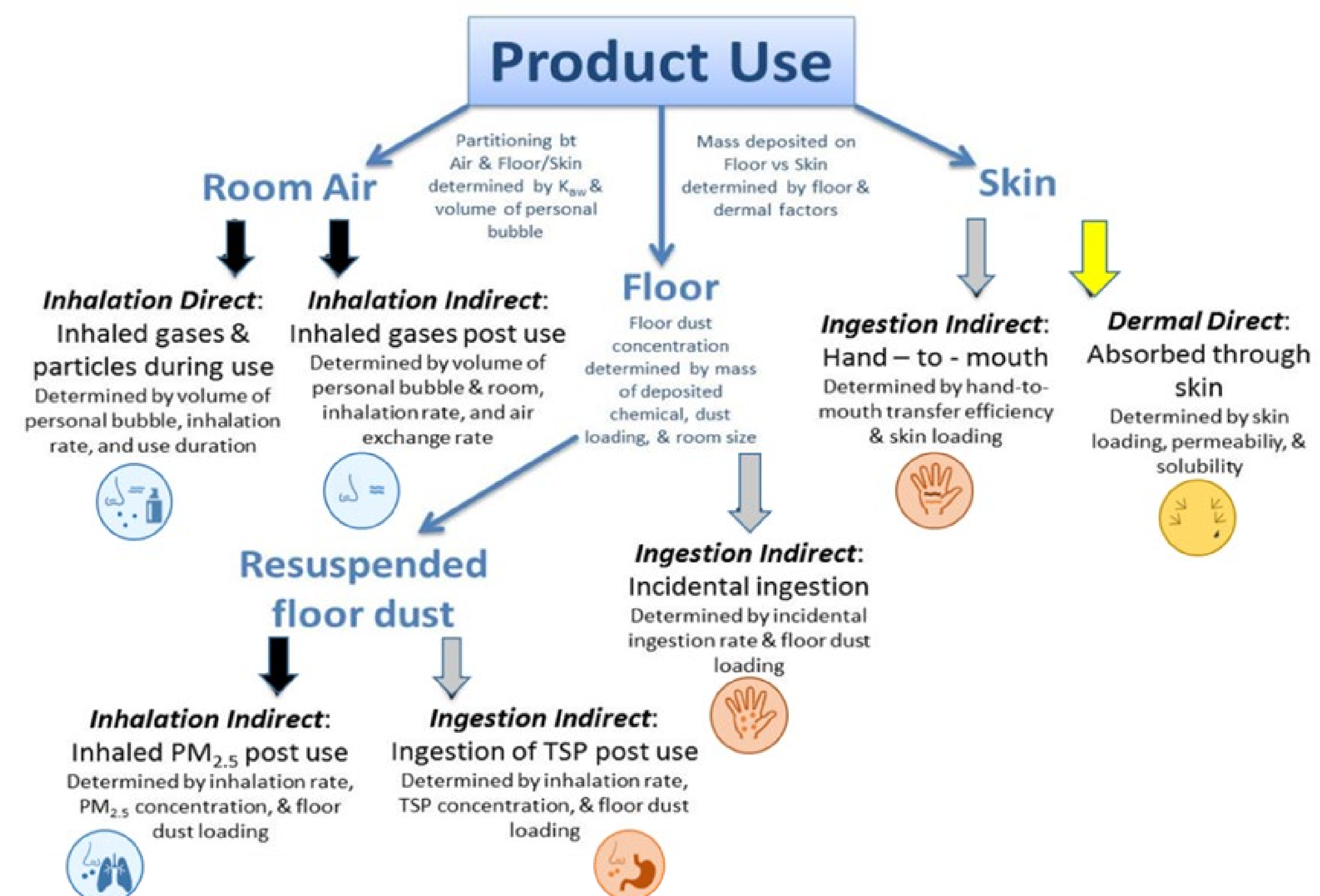
## Model Inputs / Outputs

### Model inputs :

- Product to Chemical signature table (228 consumer product categories with a total of 1634 chemical ingredients of known chemical structure)
- Exposure Factors (Amount, frequency, duration, mode) assigned by user
- Assumptions on indirect chemical transfer
- Scaling factors (physiological, biomechanical and/or activity related)

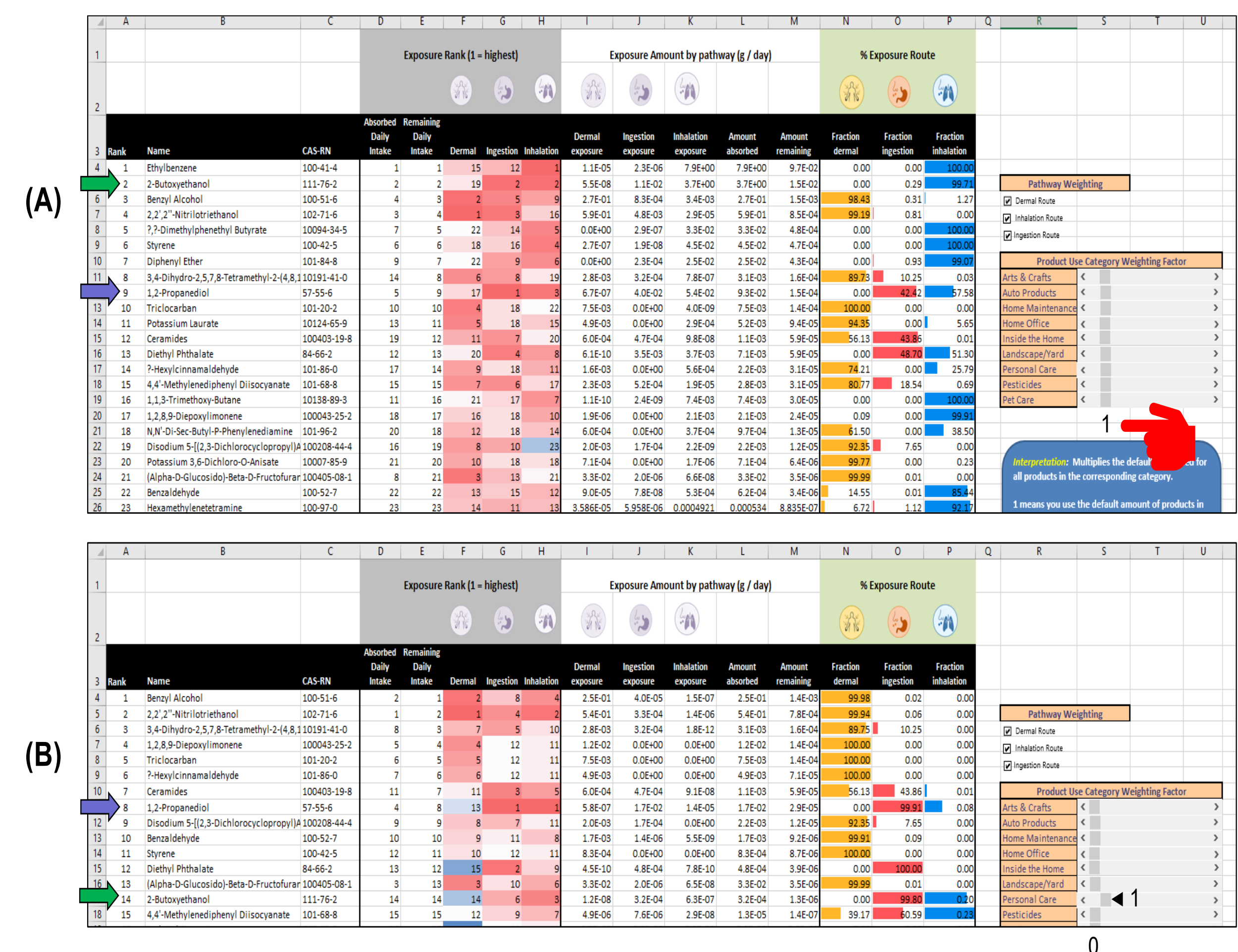
### Model outputs:

- Generate multi-chemical signatures of exposures based on exposure factors and consumer product composition
- Body-burden signature as an internal consumer product exposure biomarker signature
- Breakdown of body-burden by route of exposure (dermal, ingestion, inhalation routes)



**Figure 2.** Apportionment of mass by exposure pathway in Ex Priori.

## Demonstration of Exposure Signature



**Figure 3.** (A) Demonstration of how a sample set of only 50 chemicals in consumer products (i.e. not all chemicals in consumer products) will rank order differently as a function of activity patterns in the dashboard tab of the Ex Priori worksheet. (B) By tuning down all other activity categories one can recognize that certain chemistries have “flipped” in terms of exposure potential, and that others have either disappeared or become de-prioritized. In theory, each person/population relative setting will result in a slightly different chemical exposure prioritization list.

## Discussion & Conclusion

**“If these are the things I do and the products I use, then which chemicals am I being exposed to?”**

- Ex Priori translates personal chemical exposure from seven exposure pathways for 1634 chemicals present in 228 consumer product categories to a rank-ordered interactive visual representation of body burden.
- Ex Priori contains customizable controls (i.e., sliders) to vary user-specific activity which can be updated by the user to account for particular exposures such as hobbyist or occupational users who have higher exposure potential.
- By adjusting Ex Priori controls for different scenarios, all 1634 consumer product ingredients are simultaneously reprioritized on anticipated body-burden, enabling a fast representation of one's day-to-day personal multi-chemical exposures from consumer products.
- We are working to develop a public release of the Ex Priori spreadsheet model in 2021, and a “lighter” web-enabled version that does not require third-party software (i.e. Excel or R-Studio, etc...) that will allow any user (general public, exposure scientists, risk assessors) to estimate their own personal chemical exposures as a function of their own habits and practices, providing a personal prioritized list of chemical exposure.

[ This abstract does not necessarily represent the views or policies of the U.S. Environmental Protection Agency.]

