The Human Exposure Model (HEM)

HEM

User Guide

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ACKNOWLEDGMENTS AND DISCLAIMER

1. Overview

The Human Exposure Model (HEM) was developed to assess product-specific near-field exposures to chemicals that occur in consumer products. The model is implemented as a modular system that will produce estimates of population distributions of chemical exposure (dose) by route, and releases to the environment. The model determines longitudinal (daily doses over a period of one year) aggregate doses for more than 1,000 chemicals from the use of over 300 categories of consumer products. At this time, the model is limited to consumer product formulations, e.g. shampoo, surface cleaner spray, etc., and excludes articles such as couches or mattresses.

To develop a model to assess exposure to chemicals in consumer products, five key components are required:

1. A simulated population (together with demographic information, and characteristics of their family members and home)

2. Behavior diaries, indicating how individuals in the simulated population spend their time, including which consumer products they use

3. Data on the chemical composition (including quantitative weight fraction) of the consumer products used by the population

4. 'Habits and Practices' parameters defining how the simulated population uses the consumer products (e.g. frequency of use, duration of use, mass used, etc.)

5. Algorithms to calculate exposure (or dose, in mg chemical/kg body weight/day) based on the above.

The above components have been developed as semi-independent modules, which, when run together, complete the HEM model as a whole. The model is coded in R, and currently consists of three main modules (a residence and population generator, a product scheduler, and a source-to-dose calculator). The three main modules take in a number of input data sets described herein.

It is important to note that random number control across modules is impractical, however random number control has been implemented within each module. Each time a user runs an HEM module, the control file which includes information on the input files used, the run parameters, and the random number seed should be saved. A new run of any given module using the same control file should produce identical results.

All model code, along with default input files when available, are posted on GitHub (see specific URLs within each section below). Materials posted on GitHub can be viewed directly at the URLs provided, and each repository can be downloaded as a .zip file. However, we recommend cloning each GitHub repository locally, after which input files can be edited in local directories and modules run seamlessly using RStudio. Many helpful tutorials can be found online describing how to use GitHub with RStudio.

2. Installation and Running HEM

This section is a brief guide to installing and running HEM, a model to estimate longitudinal population distributions of exposure to near-field releases of chemicals found in consumer product formulations. To run HEM, the user must have R installed on their computer. R is freely available. Optionally, the user may use R Studio as an interface; this may also be obtained for free.

The HEM model currently consists of three semi-independent modules, as shown in Figure 1. To run the complete HEM model, users first run the RPGen residence and person generator (Module 1), to generate a simulated population of interest. This internal data file is used as input to the Product Use Scheduler (Module 2). Output from both the RPGen and Product Use Scheduler modules are used as input to Module 3, the Source-to-dose module. In the following sections, specific instructions for running each of the modules, along with required input files for each, are discussed.
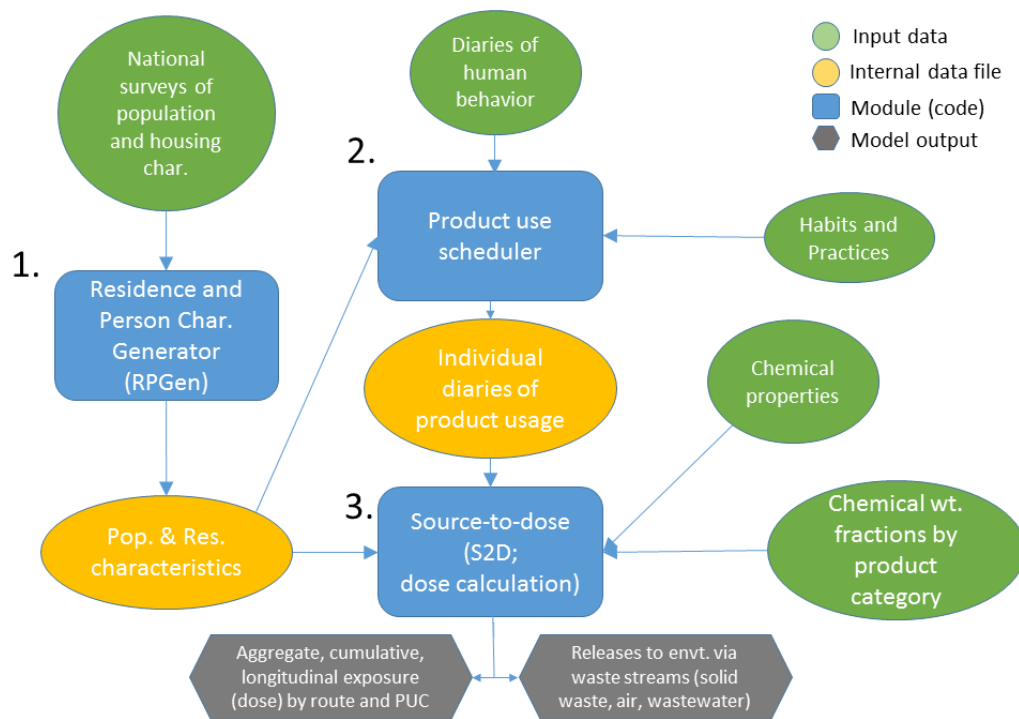
Figure 1: Overview of HEM model

HEM is programmed in the open source R language. Each module of the code is dependent on various standard R packages, available on CRAN. Users should install the packages prior to running model code. Dependent packages for each module are listed below.

RPGen module

- data.table
- stringr
- plyr

- dplyr
- dtplyr
- ggplot2
- Rmpfr
- httk
- msm
- truncnorm
- survey

Additionally, the EPA developed R package httkpop is provided along with model code, and must be installed and loaded in R from a local directory prior to running RPGen. This can be achieved by running the following command in an R command window:

install.packages("M:/Pathtopackage/httkpop_0.0.5.9000.tar.gz", repos=NULL, type="source")

Product Use Scheduler module

- dplyr
- foreach
- doParallel

Source-to-dose module

- data.table
- stringr
- plyr
- dplyr
- dtplyr
- ggplot2

3. RPGen Module

3.1 Overview

The RPGen module randomly samples demographic data from the Public Use Microdata Sample (PUMS) data from the U.S. Census Bureau's American Community Survey, and housing data from the American Housing Survey (AHS) and the Residential Energy Consumption Survey (RECS). The dataset generated links demographic characteristics of each individual to characteristics of their home, including location (defined as region of the country), household income, house type, and household composition. The RPGen output is subsequently used as input for the Product Use Scheduler and Source-to-dose modules. The RPGen module code, along with default input files, are available at: https://github.com/HumanExposure/PopulationHousingGenerator. The hempums.csv input file is posted and available as a download at ftp://newftp.epa.gov/exposure/HEM due to its size.

3.2 Organization of RPGen code and files

The following file structure is required for RPGen (where . . . is the working directory):

- . . ./RPGen/   Location of 4 .R source files
- . . ./RPGen/input/   Location of required input CSV and TXT files
- . . ./RPGen/output/   Location where output files are written; folder created automatically when running RPGen

Additionally, run1.txt and run2.txt are provided as sample control files. In a typical model run, these files would be generated by the user, and would specify the user's desired input parameters. The TXT control file must be located within the /RPGen/input/ folder.

The code subroutines are included in 4 source files:

- **HEMcontrol.R**
  The R script that contains the control file for RPGen. Users will need to edit the working directory only.
- **HEMhousing.R**
  An R script Housing Generator that merges the condensed versions of the RECS and AHS databases to describe the housing in which the generated population resides.
- **HEMpopgen.R**
  An R script Population Generator that merges the condensed versions of the RECS, AHS, and PUMS databases to randomly generate and describe a population.
- **httkpop2.R**
  An R script high throughput toxicokinetic population generator, which assigns information relevant to toxicokinetics to the population generated by the Population Generator.

Required input files for the RPGen module are listed below. These are provided along with the model code.

- **HEMahs.csv**
  A condensed version of the AHS database. Do not modify.
- **hempums.csv**
  A condensed version of the PUMS database. Do not modify.
- **HEMrecs.csv**
  A condensed version of the RECS database. Do not modify.
- **states.txt**
  A list of FIPS code, region of the country, and state name, for each US state

3.3 Running RPGen

User should first set up required file structure defined above, with appropriate input and source files, and install above dependent R packages. Within the HEMcontrol.R file, users should edit the working directory (Line 10, variable 'wd') to reflect the working directory specified in the file structure (i.e., . . ./RPGen/).

User will then 'source' each of the R scripts in the R command line, and call the set-up function, using the following commands (again where . . . is the working directory):

```
> source('. . ./RPGen/HEMcontrol.R')
> source('. . ./RPGen/HEMhousing.R')
> source('. . ./RPGen/HEMpopgen.R')
> source('. . ./RPGen/httkpop2.R')
> HEM.setup(. . .)
```

After the above set-up steps are complete, user should create a 'control' file, including the desired parameters for their model run. The 'run1.txt' and 'run2.txt' files are provided as examples; an example can also be seen in figure 2.

```
Variable,            value
run.name         = test
num.persons      = 1000
min.age          = 0
max.age          = 99
gender           = FM
ethnicity        = NMO
race             = WBNAPO
run.seed         = 876144637
states           =
```

Figure 2. Example control file for RPGen

Options for parameters are detailed below. After creating the control file and saving in the /RPGen/input/ folder, user can run the following command at the R command line:

```
> HEM.run('run1.txt')
```

When the run is complete, user will be able to access the saved output files in the /RPGen/output folder.

3.4 Input options for control file

In the control file detailed in section 3.3 (and Figure 2), multiple options are available to the user, detailed below.

- run.name
  The run.name can be specified to any unique name the user desires to use. Note that RPGen will automatically generate a folder with the name 'run.name' within the /RPGen/output/ folder, to store module output.
- num.persons
  User may specify any number of people to simulate; must be an integer value.
- min.age
  Minimum age of individuals in the simulated population; must be an integer ≥ 0
- max.age
  Maximum age of individuals in the simulated population; must be an integer ≤ 99
- gender
  M = male, F = female
- ethnicity
  N = non-hispanic, M = Mexican-American, O = other-Hispanic

- race
  W = White, B = African American, N = Native American, A = Asian American, P = Pacific Islander, O = Other/mixed
- run.seed
  Random number seed used to initiate run. Users may replicate previous runs by using the exact input parameters, including the run.seed. Value must be an integer from 1 to 2147483646.
- states
  If this parameter is left blank, all states/regions will be included in the model run. Alternatively, the user can specify FIPS codes (for states) or Region codes to run the model for a specific geographic area. FIPS codes should be entered as two digit codes separated by a single space, Region codes should be entered as single digit codes separated by a single space. FIPS and Region codes are provided in Appendix A.

The gender, ethnicity, and race parameters may take on multiple letter codes (as in Figure 2), however options should not include spaces.

3.5 Output

When the run is complete, user will be able to access the saved output files in the /RPGen/output/run.name folder. The RPGen module outputs two files potentially of interest to the user, 'pop.csv' and 'pophouse.csv.' In both files, each row corresponds to a particular individual in the simulated population. The pop.csv file contains demographic and physiologic variables, while the pophouse.csv file contains the demographic, physiologic, and housing related variables. A data dictionary detailing all variables output in the pop.csv and pophouse.csv files is provided in Appendix B.

4. Product Use Scheduler Module

4.1 Overview

The Product Use Scheduler module provides schedules of consumer product use based on behavior diaries defining general behaviors (eating, sleeping, working, commuting, and 'idle' time) for different demographic groups. Product usage is defined for each member of a household, for 364 days (four seasons consisting of 13 weeks each), such that bystander exposure (exposure to a product which you are not the user of) can be taken into account. The Product Use Scheduler takes as input the pophouse.csv file output from the RPGen module, in addition to other required input files. Diaries of product usage output from the Product Use Scheduler are provided as input to the Source-to-dose module.

The Product Use Scheduler module code, along with default input files, are available at: https://github.com/HumanExposure/ProductUseScheduler.

Notes: Throughout this manual, 'product' and 'product category' may be used interchangeably. Note that any use of the term 'product' does not refer to the specific formulation of a product, rather 'product' and 'product category' are used interchangeably to refer to the use of a generic product type (e.g. toothpaste, surface cleaner) by an individual.

4.2 Organization of Product Use Scheduler code and files

The following file structure (case-sensitive) is required for the Product Use Scheduler module (where . . . is the working directory):

- .../ProdSched/CODE/   Location of .R source files detailed below
- .../ProdSched/INPUTS/   Location of required input files detailed below
- .../ProdSched/OUTPUTS/   Location where output files are written

The code subroutines are included in the following source files:

- **AAD.R**
  Disaggregates activities that occur multiple times in succession within an idle time block.
- **ABM_Main.R**
  The main product use schedule control file, which calls and logically integrates the various subroutines, and generates and directs program output within the module. Users will typically interact with this script only.
- **ABS.R**
  Loads input files, and necessary R libraries.
- **CAA.R**
  Aggregates activities that occur in a cluster and computes cluster frequencies and durations.
- **CAD.R**
  Disaggregates activities that occur in a cluster.
- **CPS.R**
  Samples and assigns communal product use according to family labor division rules for products which satisfy communal needs.
- **CSF.R**
  A utility function called by one or more of the subroutines that ensures cluster composition is determined dynamically for consistency with the individual use frequencies of the cluster components.
- **HCP.R**
  Expands the pophouse.csv input file to create one input row containing characteristics of each household member.
- **HUP.R**
  Uses household-level information to filter product-categories to determine each household's universe of possible product usage (based on 'Full_ENT.csv,' defining 'ever/never' rules for use).
- **IIT.R**
  For a specific product category/cluster activity, identifies idle time slots in the individual's behavior diary to accommodate the activity over the full year, considering seasonality as appropriate.
- **INACT.R**
  Expands individual behavior diaries by inserting activities into idle time slots.
- **ISP.R**
  Uses probabilistic sampling to determine the list of product categories each individual interacts with, as well as each product categories associated frequency, duration, and mass parameters.
- **IUP.R**
  Uses individual-level information to filter product categories to determine each individual's universe of product category use.

- **RID.R**
  Randomly selects and pulls an appropriate behavior diary for each individual.
- **UPG.R**
  A utility function called by one or more of the subroutines which creates a user profile of product categories the user interacts with based on probabilistic sampling of mass, duration, frequency, and prevalence for each product category.

Required input files for the Product Use Scheduler module are listed below. With the exception of pophouse.csv, default versions of each of these files are provided along with the model code.

- **activity_diary_pool.rds**
  This file contains sample behavior diaries for different demographic groups (working adults, non-working adults, school-aged children, and pre-school aged children). Files were generated from a related research effort [Brandon et al. 2017, Submitted, 'Simulating Exposure-Related Behaviors Using Agent-Based Models Embedded with Needs-Based Artificial Intelligence', *JESEE*].
- **FullENT.csv**
  This file contains binary data defining if a product category will potentially 'ever' or 'never' be used by an individual or household, based on specific characteristics related to product usage, season, and characteristics of the individual/household (e.g. homes that do not have a pool will 'never' use pool chemicals; pool chemicals are 'never' used in the winter). The file also includes an indicator of product categories which are not currently considered in HEM model outputs.
- **pophouse.csv**
  Demographic and household characteristics for each individual in the simulated population. This file is output from the RPGen module.
- **PUC_use_data.csv**
  This file contains detailed descriptions of each product category covered in the current scope of the HEM model. Information included are: the unique product use category (PUC) ID (used when identifying the PUC(s) of interest in the control file when running the full HEM model), a description of the PUC, and variables identifying if the PUC satisfies personal or communal needs ("personal_communal"), PUC involves activities performed indoors or outdoors ("indoor_outdoor;" indicating the environment in which the associated consumer products will be used), and the cluster the PUC belongs to ("cluster;" if the PUC is a member of a cluster). The file also contains habits and practices parameters (i.e., consumer use patterns) for each PUC, including data on prevalence of use by product category (columns "Prev_M", "Prev_F", and "Prev_child" for males, females, and children respectively), frequency of use ("Freq" and "Freq_CV"), mass of product used ("Mass" and "Mass_CV"), duration of handling time ("HT" and "HT_CV"), and duration of activity time ("AT"). Values are defined by a point value, or a lognormal distribution, which is specified in the file.

4.3 Running the Product Use Scheduler

User should first set up required file structure defined in section 4.2, with appropriate input and source files, and install above dependent R packages. Within the ABM_Main.R file, users should run lines corresponding to the 'ABM_Runner() function (i.e., from line 1 through where the ABM_Main.R file indicates 'End of ABM_Runner.' This will initialize the core function in the script. User should then run the Product Use Scheduler for the population generated in the RPGen Module (i.e., using the pophouse.csv file output from the RPGen Module as the input for the Product Use Scheduler module).

Due to length of time required for running the Product Use Scheduler, the module is set up to take advantage of parallel processing.

User must first edit the 'pth_str' variable in ABM_Main.R to set the working directory variable to the home folder identified above (i.e., . . ./ProdSched/). Further, edit 'house_list' variable in ABM_Main.R to specify the number of households in the pophouse.csv file (e.g., house_list <- 1:1000) – the last number in the house_list should match the num.persons variable on the control file used for the RPGen run. Then, run all lines of code in the 'parallel version' section at the bottom of ABM_Main.R.

4.4 Output

When the run is complete, user will be able to access the saved output files in the /ProdSched/OUTPUTS/ folder. A daily diary over one year of behavior and product use will be saved for each individual generated in RPGen. Note that each 'individual' represents the primary individual whose usage is being modeled in the household. Together with each primary individual's behavior and product use diaries, diaries of the product usage of household members living with the primary individual will also be noted within the same file. Product Use Scheduler output files are saved as 'Household_n.csv' where 'n' refers to the 'household index' in the pophouse.csv input file. A data dictionary detailing all variables output in the Household_n.csv files is provided in Appendix C.

5. Source-to-dose Module

5.1 Overview

The Source-to-dose module takes as input the population generated by the RPGen module, product use diaries generated by the Product Use Scheduler, along with other inputs detailed below. Using this data and predefined exposure scenarios, the module estimates population distributions of exposure to chemicals in consumer products. The module outputs longitudinal exposures accounting for different exposure pathways and routes. It operates on an hourly event time step, retaining daily results over one year.

The Source-to-dose module code, along with default input files, are available at: https://github.com/HumanExposure/source2dose. The composition input file, NEW_composition_for_S2D.csv, is available for download at ftp://newftp.epa.gov/exposure/HEM due to its size.

5.2 Organization of Source-to-dose code and files

The following file structure is required for Source-to-dose (where . . . is the working directory):

- . . ./Dose/   Location of main .R source file
- . . ./Dose/input/   Location of required input files (with the exception of pophouse.csv and Household_n.csv), and control file
- . . ./Dose/output/ABM/   Location of Household_n.csv files output from Product Use Scheduler
- . . ./Dose/output/RPGen/   Location of pophouse.csv file output from RPGen
- . . ./Dose/output/S2D/   Location where output files are written

Additionally, testS2Dcontrol.txt is provided as a sample control file. In a typical model run, the control file would be generated by the user, and would specify the user's desired input parameters. The TXT control file must be located within the /Dose/input/ folder.

The main code for running Source-to-dose is included in one R script, S2D.R.

Required input files for the Source-to-dose module are listed below. These are provided along with the model code.

- **basal_vent.csv**
  Parameters for estimating basal ventilation rate for individuals based on age and sex (identified in control file as 'vent.file' variable).
- **chemical_properties_new.csv**
  Chemical properties relevant to calculating fugacity and human exposure (identified in the control file as 'chem.file' variable).
- **Compartment_fractions.csv**
  Identifies, for each different partitioning group, the parameters which define how the product will partition after use (identified in the control file as 'compart.file' variable)
- **NEW_composition_for_S2D.csv**
  Formulations for products in each product category, includes weight fractions for each chemical present in the formulation. This is a summary of formulations present in the CPDat database (identified in the control file as 'chem.frac.file' variable).
- **fugacity.csv**
  Chemical-independent variables needed for evaluating fugacity equations (identified in the control file as 'fug.file' variable).
- **Household_n.csv**
  Behavior and product-use diaries for each household, output from the Product Use Scheduler module, where 'n' identifies the household number.
- **pophouse.csv**
  Demographic and household characteristics for each individual in the simulated population. This file is output from the RPGen module.
- **NEW_PUC_MET.csv**
  Associated CHAD activity code and mean value of METS associated with product use, as calculated by APEX (identified in the control file as 'puc.met.file' variable).
- **NEW_PUC_product_codes.csv**
  Identification of product category unique IDs (needed for control file), description of product category, and unique codes for the groups to identify how the product will partition after use (identified in the control file as 'puc.type.file' variable).
- **NEW_skinsurfaceareas.csv**
  Identification of body areas exposed to a product category during use. Fraction of the product associated with dermal contact on the body area is defined for adults and children. Variability expected in the amount of dermal exposure the body area will experience is also defined (identified in control file as 'skin.area.file' variable).
- **NEW_PUC_skin_wipe_rinse.csv**
  Defines fractional partitioning of products on the hand and/or body, and how they are affected by rinsing or wiping actions (identified in control file as 'removal.file').

5.3 Running Source-to-dose

User should first set up required file structure defined above, with appropriate input and source files, and install above dependent R packages. Within the S2D.R file, users should edit line 5 to reflect the working directory specified in the file structure (i.e., . . ./Dose/).

After the above set-up steps are complete, user should create a 'control' file, saved in . . ./Dose/input/, which includes the desired parameters for their model run. The 'testS2Dcontrol.txt' file is provided as an example; an example can also be seen in Figure 3.

```
chem             "DTXSID3020596"
puc              "P.PC.020.000"
fug.file         "fugacity.csv"
chem.file        "chemical_properties_HEM.csv"
chem.frac.file   "composition_for_S2D.csv"
puc.type.file    "PUC_product_codes.csv"
compart.file     "Compartment_fractions.csv"
puc.met.file     "PUC_MET.csv"
skin.area.file   "PUC_skin_areas.csv"
removal.file     "PUC_skin_wipe_rinse.csv"
vent.file        "basal_vent.csv"
diary.prefix     "Household_"
run.name         "aftershave"
first.house      1
last.house       1000
init.seed        23
show.progress    yes
parallel         no
comp.method      1
```

Figure 3. Example control file for Source-to-dose

Options for parameters are detailed below.

After saving the control file, user will 'source' the main R script in the R command line, and call the main function, using the following commands (again where . . . is the working directory):

> source('. . ./Dose/S2D.R')
> s2d('testS2Dcontrol.txt')

When the run is complete, user will be able to access the saved output files in the /S2D/output folder, under the sub-folder with the same 'run.name' specified in the control file.

5.4 Input options for control file

In the control file detailed in section 5.3 (and Figure 3), multiple options are available to the user, detailed below. When editing the control file, be sure to use spaces and not the tab key to indent the values associated with each variable. At least one space should be used between the variable name and the value, though more may be used.

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- chem
  List of the chemicals of interest to include in the model run. Chemicals must be identified by their DTXSID (DTXSID is a unique identifier provided by DSSTox, and available through the CompTox Chemistry Dashboard: https://comptox.epa.gov/dashboard). Chemicals listed must be present in the 'chemical_properties_HEM_withfabs.csv' and the 'composition_for_S2D.csv' input files for a dose to be calculated. Multiple chemicals may be listed in a single control file, each on their own line, and each preceded by 'chem.' If no 'chem' is listed, doses will be calculated for all chemicals present in the product category(ies) included in the control file.
- puc
  List of product categories of interest to include in the model run. Product categories must be identified by their associated unique ID code, available in Appendix D, and in the input file "NEW_PUC_product_codes.csv". Product category must have at least one associated formulation present in the 'composition_for_S2D.csv' input file for a dose to be calculated. If product category is identified as not being included in the current HEM version in the 'FullENT.csv' input file for the Product Use Scheduler, no dose will be calculated from use of the product category. Multiple product category IDs may be listed in a single control file, each on their own line, and each preceded by 'puc.' If no 'puc' is listed, doses will be calculated across all product categories which contain the chemical(s) included in the control file.
- Default input files
  The fug.file, chem.file, chem.frac.file, puc.type.file, compart.file, puc.met.file, skin.area.file, removal.file, and vent.file variables all identify the required input files for running the Source-to-dose module. Users may modify the input files if files are maintained in the same format. Users should ensure that the file names listed in the control file exactly match the file names present in the . . ./Dose/input/ folder.
- diary.prefix
  This value should match the prefix of the household behavior and product use diaries output from the Product Use Scheduler.
- run.name
  The run.name can be specified to any unique name the user desires to use. Note that the Source to Dose module will automatically generate a folder with the name 'run.name' within the . . ./Dose/output/ folder, to store module output. If a run name is used twice under the same file path, previously saved files will be written over.
- first.house
  The numeric identifier of the first household in the set of households you wish to run. Typically this will be 1 if user is evaluating a full set of 1 – n households. However, this parameter allows the user to start on a different household if, for example, a run is interrupted. Must be an integer value ≥1.
- last.house
  The numeric identifier of the last household in the set of households you wish to run. Must be an integer value ≥ 1.
- init.seed
  Seed to initiate the random number generator. If a run includes the same chemical and product category list, with the same seed, results will be exactly replicated.
- show.progress

A yes/no indicator to view additional progress related messages on the R console, as the program is running. Allows the user to track progress of the run (e.g. which household the code is currently on).

- parallel
  A yes/no indicator for the user to specify if they would like to take advantage of parallel computing power.
- comp.method
  Variable can take on a value of 0 or 1. Value of 0 indicates the module will only assign to the users of the product category of interest formulations which contain the chemical(s) of interest. Value of 1 indicates the module will randomly draw from all formulations for a product category when assigning formulations to a particular product user; formulations assigned may or may not include the chemical(s) of interest.

5.5 Output

When the run is complete, user will be able to access the saved output files in the . . ./Dose/output/S2D/run.name/ folder. The Source-to-dose module saves a daily dose file for each household in the . . ./Dose/output/S2D/run.name/Daily/ folder. Files are named in the following format: 'S2D_daily_n.csv', where 'n' is the household number. When all doses returned for a household are zero, a file is not saved for the household. A data dictionary detailing all variables output in the daily dose files is provided in Appendix E.

Appendices

Appendix A: FIPS and Region Codes for RPGen control file

FIPS code	Region code	State name
01	3	Alabama
02	4	Alaska
04	4	Arizona
05	3	Arkansas
06	4	California
08	4	Colorado
09	1	Connecticut
10	3	Delaware
11	3	District of Columbia
12	3	Florida
13	3	Georgia
15	4	Hawaii
16	4	Idaho
17	2	Illinois
18	2	Indiana
19	2	Iowa
20	2	Kansas
21	3	Kentucky
22	3	Louisiana
23	1	Maine
24	3	Maryland
25	1	Massachusetts
26	2	Michigan
27	2	Minnesota
28	3	Mississippi
29	2	Missouri
30	4	Montana
31	2	Nebraska
32	4	Nevada
33	1	New Hampshire
34	1	New Jersey
35	4	New Mexico
36	1	New York

37	3	North Carolina
38	2	North Dakota
39	2	Ohio
40	3	Oklahoma
41	4	Oregon
42	1	Pennsylvania
44	1	Rhode Island
45	3	South Carolina
46	2	South Dakota
47	3	Tennessee
48	3	Texas
49	4	Utah
50	1	Vermont
51	3	Virginia
53	4	Washington
54	3	West Virginia
55	2	Wisconsin
56	4	Wyoming

Appendix B: Data dictionary for RPGen output variables

Variable Name	Description
Population Variables from PUMS''	
gender	gender of selected person (primary individual); Male or Female
reth	ethnic group (httkpop categories)
compid	7-digit code; first two digits = state FIPS, last 5 digits = 2010 PUMA
recno	PUMS record number
race	W=White, B=Black, N=Native American, A=Asian, P=Pacific Islander, O=Other, M=Multiple
ethnicity	M=Mexican hispanic, O=other hispanic, N=not hispanic
age_years	age in full years, rounded down (range= 0 to 96)
pwgtp	statistical sampling weight
pool	combination of database matching variables family type, house type, income, census region, and urban/rural (range 1-288)
income	annual household income
ages	40-character string, each pair is age of one household member (range 00-96)
genders	20-character string, each is M or F
state	2-digit FIPS code for one of the 50 states or DC (range 01=Alabama to 56=Wyoming)
Housing Variables from RECS''	
afuel	fuel used for air conditioning ; 1-electricity, 2=gas or propane, 3=other, -6=NA
baths	number of full bathrooms; 0-10 (capped at ten), -6=NA
bedrms	number of bedrooms; 0-10 (capped at ten), -6=NA
built	year house was built; each year for 1990+, rounded down to 5x for 1970-1989, rounded down to 10x for 1920-1969, earlier=1919
cars	number of cars; 0-5 (capped at 5), -6=NA
cellar	type of basement; 1=full basement, 2=partial basement, 3=crawl space, 4=slab, 5=other, -6=NA
hequip	main heating equipment; 1=forced air furnace, 2=steam radiators, 3=heat pump, 4=electric baseboard, 5-14=others
lot	square footage of lot; range is 200 - 999,997 square feet (almost 22 acres)
pwt	statistical weight within AHS; used for random selection
rooms	number of rooms; 1-21 (capped at 21)
sewdis	type of sewage disposal; 1=septic tank, 2=chemical toilet, 3=outhouse, 4=other, 5=none, -6=municipal system
unitsf	square footage of house (excl. garage, unfinished areas); 99-99998 (minimum allowed=99, capped at 99,998)

Variable Name	Description
water	source of water (for washing and bathing); 1=water system, 2=well, 3=spring, 4=cistern, 5=stream or lake, 6=bottled, 7=other
waterd	source of drinking water; 1=water system, 2=well, 3=spring, 4=cistern, 5=stream or lake, 6=bottled, 7=other
control	record number from full 2013 AHS database
Housing Variables from AHS"	
doeid	record number from 2009 RECS database
nweight	sampling weight
hdd30yr	average annual heating degree days; range 0 - 13346
cdd30yr	average annual cooling degree days; range 0 - 5357
kownrent	own or rent house; 1=owned, 2=rented, 3 = stay without rent
condcoop	part of condo or coop; 1=condominium, 2=cooperative, -2=NA
naptflrs	number of floors in apartment; range 1-4, -2 = not an apartment
stories	number of stories in single-family home; 10=one, 20=two, 31=three, 32=4+, 40=split-level, 50=other, -2=not a single family home
stoven	number of oven-cooktop combinations; range 0-10
stovenfuel	fuel used for stove; 1=gas, 2=propane, 5=electric, 21=other
stove	number of cooktops (not combined with ovens); range 1-10
stovefuel	fuel used for cooktop; 1=gas, 2=propane, 5=electric, 21=other
oven	number of ovens (not combined with cooktops); range 0-10
ovenfuel	fuel used for oven; 1=gas, 2=propane, 5=electric, 21=other
ovenuse	frequency of oven use; 0=not used, 1=3+ per day, 2=twice per day, 3=once per day, 4 = few times per week, 5=1/week, 6=less
outgrill	outdoor grill used; 0=no, 1=yes
dishwash	dishwasher used in home; 0=no, 1=yes
cwasher	clothes washer used in home; 0=no, 1=yes
washload	frequency clothes washer used; 1=1/week or less, 2=2-4 per week, 3=5-9 per week, 4=10-15 per week, 5= 16+ per week
dryer	clothes dryer used in home; 0=no, 1=yes
dryruse	frequency clothes dryer used; 1=every time clothes washed, 2=sometimes when clothes washed, 3=rarely, -2=NA
tvcolor	number of televisions used in home; range 0-15
computer	computer used at home; 0=no, 1=yes
numpc	number of computers; range 0-15
pcprint	number of printers used at home; range 0-9, -2=NA
moisture	humidifier used at home; 0=no, 1=yes

Variable Name	Description
prkgplc1	have an attached garage; 0=no, 1=yes
prkgplc2	have a detached garage or carport; 0=no, 1=yes
cooltype	type of air conditioning system; 1=central, 2=window/wall, 3=both, -2=none
tempniteac	temperature setting at night (in warm weather); range 45-96, -2=no AC
numberac	number of window/wall AC units; range 1-15, -2=NA
numcfan	number of ceiling fans used; range 0-15
notmoist	dehumidifier used at home; 0=no, 1=yes
highceil	high ceilings in home; 0=no, 1=yes
windows	number of windows in heated areas of home; 0=none, 10=1-2, 20=3-5, 30=6-9, 41=10-15, 42=16-19, 50=20-29, 60=30+
adqinsul	level of insulation; 1=well insulated, 2=adequate, 3=poor, 4=none
drafty	home drafty in winter; 1=always, 2=mostly, 3=sometimes, 4=never
swim	swimming pool or hot tub; 0=none, 1=hot tub only, 2=pool only, 3=both
Physiological Variables from HTTKPop	
mean_logh	mean of log(height) for this age-gender group
mean_logbw	mean of log(body weight) for this age-gender group
weight	body weight in kilograms; calculated from mean_logbw and logbw_resid
height	height in centimeters; calculated from mean_logh and logh_resid
blood_mass	mass of blood (kg)
brain_mass	mass of brain (kg)
gonads_mass	mass of gonads (kg)
heart_mass	mass of heart (kg)
kidneys_mass	mass of kidneys (kg)
large_intestine_mass	mass of large intestines (kg)
liver_mass	mass of liver (kg)
lung_mass	mass of lungs (kg)
muscle_mass	mass of muscular tissue (kg)
pancreas_mass	mass of pancreas (kg)
skeleton_mass	bone mass (kg)
skin_mass	mass of skin tissue (kg)
small_intestine_mass	mass of small intestines (kg)

Variable Name	Description
spleen_mass	mass of spleen (kg)
stomach_mass	mass of stomach (kg)
adipose_flow	blood flow in adipose tissue ()
brain_flow	blood flow in brain ()
CO	Cardiac output, L/h
gonads_flow	blood flow in gonads ()
heart_flow	blood flow to heart muscle (not into heart)
kidneys_flow	blood flow to kidneys ()
large_intestine_flow	blood flow to large intestines ()
liver_flow	blood flow in liver ()
lung_flow	blood flow to lung tissue ()
muscle_flow	blood flow to muscles ()
pancreas_flow	blood flow to pancreas ()
skeleton_flow	blood flow to bone tissue ()
skin_flow	blood to to skin tissue ()
small_intestine_flow	blood flow to small intestines ()
spleen_flow	blood flow to spleen ()
stomach_flow	blood flow to stomach ()
other_mass	mass of other tissues (kg)
adipose_mass	mass of adipose tissue (kg)
org_flow_check	relevant to httkpop r package
weight_adj	adjusted body weight (sum of organ masses) (kg)
BSA_adj	adjusted body surface area (cm^2)
million.cells.per.gliver	Hepatocellularity, million cells/g liver
hematocrit	Percent volume of red blood cells in the blood
serum_creat	Serum creatinine, mg/dL
gfr_est	Estimated glomerular filtration rate, mL/min/$1.73m^2$ BSA
bmi_adj	adjusted body mass index
bmi	body mass index
BSA	body surface area (cm^2)

Variable Name	Description
Variables added by Module to Interface Input Datasets	
row	row number for this record on this data set
age_months	age in full months (range 0-1163)
num	row number for this record on this data set
logbw_resid	residual in regression of log(body weight); random sample generated using HEM random seed
logh_resid	residual in regression of log(height); random sample generated using HEM random seed

Appendix C: Data dictionary for Product Use Scheduler output variables

Variable Name	Units	Variable Description
household_index	--	Unique household ID, equal to the index number in the RPGen output (pophouse.csv), used as a household identifier
person_index	--	Number assigned to each person in each household; corresponds to the order in which the person's age is listed in the RPGen output (pophouse.csv)
Diary.category	--	Type of diary from the activity diary pool that has been assigned to an individual
person.gender	--	Gender of the person specified: Male (M) or Female (F)
person.age	Years	Age of the person specified in years
Day.of.the.year	--	Integer indicating day of the year, from 1 (January 1) to 364 (assuming 52 weeks of 7 days each)
Start.Time.hr.using.military.time	Military time	Start time of an activity (military time)
End.Time.hr.using.military.time	Military time	End time of an activity (military time)
Duration.hr	Hours	Duration of an activity
Duration.min	Minutes	Duration of an activity
Activity.Code	--	Activity performed during that time period: -2: idle time with an activity assignment -1: idle time with no activity assignment 1: morning commute 2: evening commute 3: breakfast 4: dinner 5: lunch 6: sleep 7: work
Personal.or.Communal	--	Specifies if a PUC satisfies personal or communal needs
Clusters	--	Specifies the cluster a PUC belongs to, if the PUC belongs to a cluster. Clusters are groups of PUCs that are often used in-tandem when performing a task.
Indoor.outdoor	--	Indicator if products are typically used indoors or outdoors
Primary.person	--	Binary variable to identify the primary person (1) in each household (the primary person is designated in the pophouse.csv file)
PUCID.producttype	--	Product type ID
PUCID.PT.description	--	Product type description
sheds.id.refined	--	Refined product type ID
use.act	Minutes	Activity time
use.ht	Minutes	Handling time
use.mass	Grams	Mass of product used

Appendix D: Product use category ID codes, along with description, for use in the Source-to-dose control file

PUC ID	General category	Product type	Refined type	Description
AC.0500.010.050.F	Arts and crafts/Office supplies	arts and crafts adhesive	spray	spray adhesives for primarily craft purposes, including spray mounts and stencil placement sprays
AC.0500.010.099.F	Arts and crafts/Office supplies	arts and crafts adhesive	NOC	glue sticks, glitter glues, fabric glues, craft glue, and other adhesives used for primarily craft purposes
AC.0500.020.099.F	Arts and crafts/Office supplies	arts and crafts cleaner	NOC	solvent-based products for cleaning paint, adhesives, etc. from hands or surfaces
AC.0500.030.050.F	Arts and crafts/Office supplies	arts and crafts finish	spray	spray shellacs or polyurethane coatings for primarily craft purposes
AC.0500.030.099.F	Arts and crafts/Office supplies	arts and crafts finish	NOC	shellacs or polyurethane coatings for primarily craft purposes
AC.0500.040.099.F	Arts and crafts/Office supplies	arts and crafts paint	NOC	paints and colorants for primarily craft purposes (including acrylic and enamel paints)
AC.0100.010.050.F	Arts and crafts/Office supplies	body paint	spray	body paints, markers, glitters, play cosmetics, and Halloween cosmetics (spray or aerosol formulation specified)
AC.0100.010.099.F	Arts and crafts/Office supplies	body paint	NOC	body paints, markers, glitters, play cosmetics, and Halloween cosmetics
AC.0200.010.099.F	Arts and crafts/Office supplies	bubble solution	NOC	liquid bubble solutions, including solutions for bubble machines
AC.0500.050.099.F	Arts and crafts/Office supplies	craft kit	NOC	multi-component crafting kits where individual products are not designated
AC.0200.020.099.F	Arts and crafts/Office supplies	crayons	NOC	wax crayons for coloring or illustration
AC.0300.010.099.F	Arts and crafts/Office supplies	fabric dye	NOC	products for dying fabrics
AC.0300.020.050.F	Arts and crafts/Office supplies	fabric paints and sealers	spray	paints or sealers for treating fabrics (spray or aerosol formulation specified)
AC.0300.020.099.F	Arts and crafts/Office supplies	fabric paints and sealers	NOC	paints or sealers for treating fabrics
AC.0200.030.099.F	Arts and crafts/Office supplies	finger paint	NOC	non-edible finger paints
AC.0500.060.050.F	Arts and crafts/Office supplies	flocking	spray	flocking and artificial snow (spray or aerosol formulation specified)
AC.0400.010.099.F	Arts and crafts/Office supplies	fogger	NOC	liquid solutions for fogger machines
AC.0800.010.099.F	Arts and crafts/Office supplies	glaze	NOC	liquid products for glazing craft pottery
AC.0600.010.099.F	Arts and crafts/Office supplies	gun cleaner	NOC	liquid solutions for cleaning interior or exterior of firearms
AC.0700.020.099.F	Arts and crafts/Office supplies	pens and markers	NOC	writing utensils containing liquid or gel ink
AC.0200.040.099.F	Arts and crafts/Office supplies	play dough	NOC	children's play modeling clays
VE.0500.010.099.F	Vehicle	antifreeze	NOC	antifreeze and/or coolant solutions for motorized vehicles
VE.0300.010.050.F	Vehicle	auto air freshener	spray	air fresheners for car interiors (spray or aerosol formulation specified)
VE.0300.010.099.F	Vehicle	auto air freshener	NOC	air fresheners for car interiors, including products for vents

VE.0500.020.050.F	Vehicle	auto fluids and additives	spray	power steering fluids, transmission fluids, brake fluids, fuel injector cleaners, gas treatments, or leak stoppers (spray or aerosol formulation specified)
VE.0500.020.099.F	Vehicle	auto fluids and additives	NOC	power steering fluids, transmission fluids, brake fluids, fuel injector cleaners, gas treatments, or leak stoppers
VE.0500.030.050.F	Vehicle	auto lubricant	spray	engine lubricants and belt dressings, not including motor oils (spray or aerosol formulation specified)
VE.0500.030.099.F	Vehicle	auto lubricant	NOC	engine lubricants and belt dressings, not including motor oils
VE.0100.010.050.F	Vehicle	auto paint	spray	paints and primers for auto body or engine (spray or aerosol formulation specified)
VE.0100.010.099.F	Vehicle	auto paint	NOC	paints and primers for auto body or engine
VE.0500.040.099.F	Vehicle	auto refrigerant	NOC	refrigerants and Freon products for auto applications
VE.0200.020.099.F	Vehicle	boat cleaner - general	NOC	cleaners, washes, and polishes for exterior marine applications
VE.0200.040.099.F	Vehicle	boat engine fluids	NOC	engine fluids for marine applications
VE.0400.010.099.F	Vehicle	body cleaner	NOC	cleaners, shampoos, and washes for auto body exterior (not including wax products)
VE.0100.020.050.F	Vehicle	body repair	spray	products for repairing auto body exteriors, including bondo-type products and scratch fillers (spray or aerosol formulation specified)
VE.0100.020.099.F	Vehicle	body repair	NOC	products for repairing auto body exteriors, including bondo-type products and scratch fillers
VE.0400.020.050.F	Vehicle	body wax	spray	auto body waxes and coatings, including combo wash/wax products (spray or aerosol formulation specified)
VE.0400.020.099.F	Vehicle	body wax	NOC	auto body waxes and coatings, including combo wash/wax products
VE.0400.040.050.F	Vehicle	degreaser	spray	auto, engine and brake degreasers (spray or aerosol formulation specified)
VE.0400.040.099.F	Vehicle	degreaser	NOC	auto, engine and brake degreasers
VE.0100.030.050.F	Vehicle	detailing	spray	products for cleaning, polishing, or protecting car interior surfaces, upholstery, leather, carpeting, tires, or rims (spray or aerosol formulation specified
VE.0100.030.099.F	Vehicle	detailing	NOC	products for cleaning, polishing, or protecting car interior surfaces, upholstery, leather, carpeting, tires, or rims
VE.0500.050.099.F	Vehicle	motor oil	NOC	petroleum-based or synthetic engine lubricants
VE.0100.040.050.F	Vehicle	windows/windshield	spray	products for washing or protecting windshields or windows (spray or aerosol formulation specified)
VE.0100.040.099.F	Vehicle	windows/windshield	NOC	products for washing or protecting windshields or windows
HM.0100.010.050.F	Home maintenance	adhesive remover	spray	solvent products for removing adhesives from surfaces (spray or aerosol formulation specified)
HM.0100.010.099.F	Home maintenance	adhesive remover	NOC	solvent products for removing adhesives from surfaces
HM.0400.010.099.F	Home maintenance	caulk/sealant	NOC	caulks and sealers for household use, including silicone products
HM.0500.010.099.F	Home maintenance	concrete	NOC	products for patching or cleaning concrete surfaces

HM.0600.010.050.F	Home maintenance	corrosion protection	spray	products for protecting metal surfaces from corrosion or removing corrosion (spray or aerosol formulation specified)
HM.0600.010.099.F	Home maintenance	corrosion protection	NOC	products for protecting metal surfaces from corrosion or removing corrosion
HM.0700.010.099.F	Home maintenance	degreaser	NOC	products for degreasing indoor surfaces
HM.0800.010.050.F	Home maintenance	finish	spray	products for permanently coating and protecting wood surfaces, including polyurethane products (spray or aerosol formulation specified)
HM.0800.010.099.F	Home maintenance	finish	NOC	products for permanently coating and protecting wood surfaces, including polyurethane products
HM.2100.010.099.F	Home maintenance	grout sealer	NOC	products for coating and protecting tile or grout
HM.1200.010.099.F	Home maintenance	lock deicer	NOC	products for deicing car or residential locks
HM.1300.010.050.F	Home maintenance	lubricant	spray	household maintenance lubricants (spray or aerosol formulation specified)
HM.1300.010.099.F	Home maintenance	lubricant	NOC	household maintenance lubricants
HM.2100.020.099.F	Home maintenance	mortar or grout	NOC	products for attaching and grouting interior tiles
HM.0100.020.050.F	Home maintenance	multipurpose adhesive	spray	general purpose repair adhesives including all-purpose glues, super glue, and epoxies; not including wood glues (spray or aerosol formulation specified)
HM.0100.020.099.F	Home maintenance	multipurpose adhesive	NOC	general purpose repair adhesives including all-purpose glues, super glue, and epoxies; not including wood glues
HM.1400.010.040.F	Home maintenance	paint	exterior	home improvement paints characterized as exterior use
HM.1400.010.041.F	Home maintenance	paint	interior	home improvement paints characterized as interior use
HM.1400.010.050.F	Home maintenance	paint	spray	home improvement paints not characterized as to interior or exterior use (spray or aerosol formulation specified)
HM.1400.010.099.F	Home maintenance	paint	NOC	home improvement paints not characterized as to interior or exterior use
HM.1400.020.050.F	Home maintenance	paint cleaner	spray	paint removing products for clean-up (spray or aerosol formulation specified)
HM.1400.020.099.F	Home maintenance	paint cleaner	NOC	paint removing products for clean-up
HM.1400.030.099.F	Home maintenance	paint texture	NOC	textured paints including ceiling texture
HM.1400.040.099.F	Home maintenance	paint thinner	NOC	paint or lacquer thinners
HM.1500.010.099.F	Home maintenance	patch and repair	NOC	drywall, ceiling, and joint compounds, spackles, or fillers
HM.1600.010.099.F	Home maintenance	plumbing	NOC	miscellaneous plumbing repair products (putties, tapes, cements)
HM.1400.050.040.F	Home maintenance	primer	exterior	home improvement primers characterized as exterior use
HM.1400.050.041.F	Home maintenance	primer	interior	home improvement primers characterized as interior use
HM.1400.050.050.F	Home maintenance	primer	spray	home improvement primers not characterized as to interior or exterior use (spray or aerosol formulation specified)
HM.1400.050.099.F	Home maintenance	primer	NOC	home improvement primers not characterized as to interior or exterior use
HM.1500.020.099.F	Home maintenance	putty or filler	NOC	putty-type crack, hole, and wood fillers

HM.1700.010.099.F	Home maintenance	refrigerant	NOC	air conditioner or other refrigerants
HM.1800.010.099.F	Home maintenance	roof	NOC	products for roof maintenance or repair, including cleaners, sealers, or coatings
HM.1900.010.099.F	Home maintenance	septic system	NOC	septic system treatment products
HM.1000.010.099.F	Home maintenance	spray foam	NOC	spray insulation and weather stripping products
HM.1400.060.040.F	Home maintenance	stain	exterior	wood stains characterized as exterior use, including deck stains
HM.1400.060.099.F	Home maintenance	stain	NOC	wood stains not characterized as interior or exterior use
HM.1400.070.050.F	Home maintenance	stripper	spray	paint and finish strippers (spray or aerosol formulation specified)
HM.1400.070.099.F	Home maintenance	stripper	NOC	paint and finish strippers
HM.2000.040.040.F	Home maintenance	surface sealer	exterior	products for coating and protecting household surfaces characterized as exterior use
HM.2000.040.050.F	Home maintenance	surface sealer	spray	products for coating and protecting household surfaces not characterized as interior or exterior use (spray or aerosol formulation specified)
HM.2000.040.099.F	Home maintenance	surface sealer	NOC	products for coating and protecting household surfaces not characterized as interior or exterior use
HM.2400.010.099.F	Home maintenance	welding	NOC	miscellaneous welding products including gases, fluxes, and adhesives
HM.0100.030.099.F	Home maintenance	wood adhesive	NOC	adhesives specifically characterized as wood glues
EL.0300.050.099.F	Electronics/small appliances	printer ink	NOC	ink for inkjet printers
EL.0300.060.099.F	Electronics/small appliances	printer toner	NOC	laser printer toners
AC.0700.030.099.F	Arts and crafts/Office supplies	white out	NOC	correction fluids for ink or type
CP.0100.010.051.F	Cleaning products and household care	air freshener	gel	home air fresheners (gel formulation specified)
CP.0100.010.052.F	Cleaning products and household care	air freshener	liquid	home air fresheners (liquid formulation specified)
CP.0100.010.054.F	Cleaning products and household care	air freshener	oil or diffuse	home air fresheners (oil formulations or diffusers)
CP.0100.010.050.F	Cleaning products and household care	air freshener	spray	home air fresheners (spray or aerosol formulation specified)
CP.0100.010.099.F	Cleaning products and household care	air freshener	NOC	home air fresheners
CP.0400.020.099.F	Cleaning products and household care	automatic dishwashing additive	NOC	rinse aids, spot removers, and dishwasher cleaners
CP.0400.030.051.F	Cleaning products and household care	automatic dishwashing detergent	gel	detergents for automatic dishwashers (gel formulation specified)
CP.0400.030.053.F	Cleaning products and household care	automatic dishwashing detergent	powder	detergents for automatic dishwashers (powder formulation specified)
CP.0400.030.099.F	Cleaning products and household care	automatic dishwashing detergent	NOC	detergents for automatic dishwashers

CP.0200.010.050.F	Cleaning products and household care	bathroom cleaner	spray	bathtub, tile, and toilet surface cleaners (spray or aerosol formulation specified)
CP.0200.010.099.F	Cleaning products and household care	bathroom cleaner	NOC	bathtub, tile, and toilet surface cleaners
CP.0700.010.099.F	Cleaning products and household care	bleach	NOC	bleaches (including color-safe bleaches)
CP.0300.010.050.F	Cleaning products and household care	carpet cleaner	spray	carpet cleaning products and machine solutions (spray or aerosol formulation specified)
CP.0300.010.099.F	Cleaning products and household care	carpet cleaner	NOC	carpet cleaning products and machine solutions
CP.0300.020.099.F	Cleaning products and household care	carpet deodorizer	NOC	carpet deodorizers
CP.0400.040.099.F	Cleaning products and household care	dish soap	NOC	hand dish washing liquids and detergents
CP.0700.020.050.F	Cleaning products and household care	disinfectant	spray	disinfecting liquids (spray or aerosol formulation specified)
CP.0700.020.099.F	Cleaning products and household care	disinfectant	NOC	disinfecting liquids (including wipes)
CP.0500.010.099.F	Cleaning products and household care	drain	NOC	drain openers or digesters
CP.1200.010.099.F	Cleaning products and household care	dry cleaner	NOC	dry cleaning fluids or kits for home use
CP.1200.020.099.F	Cleaning products and household care	dryer sheets	NOC	dryer fabric softener sheets
EL.0400.010.050.F	Electronics/small appliances	electronics cleaner	spray	miscellaneous products for cleaning home electronic equipment (including surface cleaners or cleaners for interior parts) (spray or aerosol formulation spec
EL.0400.010.099.F	Electronics/small appliances	electronics cleaner	NOC	miscellaneous products for cleaning home electronic equipment (including surface cleaners or cleaners for interior parts)
CP.1200.030.099.F	Cleaning products and household care	fabric deodorizer	NOC	spray fabric deodorizers
CP.1200.040.099.F	Cleaning products and household care	fabric protectant	NOC	fabric protectants and wrinkle releasers
CP.1200.050.099.F	Cleaning products and household care	fabric softener	NOC	fabric softeners (excluding dryer sheets)
CP.0600.010.099.F	Cleaning products and household care	fireplace	NOC	miscellaneous fireplace and fire pit products
CP.0300.030.099.F	Cleaning products and household care	floor cleaner	NOC	hard floor cleaners (including pre-moistened wipes and pads)
CP.0300.040.099.F	Cleaning products and household care	floor polish	NOC	hard floor shining and waxing products

CP.0700.030.050.F	Cleaning products and household care	glass cleaner	spray	glass and window cleaners (spray or aerosol formulation specified)
CP.0700.030.099.F	Cleaning products and household care	glass cleaner	NOC	glass and window cleaners
CP.0800.010.099.F	Cleaning products and household care	hand cleaner	NOC	products marketed as hand cleaners (solvent-based)
CP.0900.010.050.F	Cleaning products and household care	heavy duty cleaner	spray	heavy duty or concentrated multipurpose cleaners (spray or aerosol formulation specified)
CP.0900.010.099.F	Cleaning products and household care	heavy duty cleaner	NOC	heavy duty or concentrated multipurpose cleaners
CP.1000.010.050.F	Cleaning products and household care	houseplant care	spray	houseplant and cut flower foods, fertilizers, or pesticides (spray or aerosol formulation specified)
CP.1000.010.099.F	Cleaning products and household care	houseplant care	NOC	houseplant and cut flower foods, fertilizers, or pesticides
CP.1100.010.099.F	Cleaning products and household care	lamp oil/lighter fluid	NOC	lighters, lighter fluids, and other indoor fuels
CP.1200.060.052.F	Cleaning products and household care	laundry detergent	liquid	laundry detergents and soaps (liquid formulation specified)
CP.1200.060.053.F	Cleaning products and household care	laundry detergent	powder	laundry detergents and soaps (powder formulation specified)
CP.1200.060.099.F	Cleaning products and household care	laundry detergent	NOC	laundry detergents and soaps
CP.1200.070.099.F	Cleaning products and household care	laundry fragrance	NOC	scent products to be added to wash
CP.1200.080.050.F	Cleaning products and household care	laundry stain remover	spray	stain removers or laundry pre-treatment products (spray or aerosol formulation specified)
CP.1200.080.099.F	Cleaning products and household care	laundry stain remover	NOC	stain removers or laundry pre-treatment products
CP.1200.090.050.F	Cleaning products and household care	laundry starch	spray	fabric starches (spray or aerosol formulation specified)
CP.1200.090.099.F	Cleaning products and household care	laundry starch	NOC	fabric starches
CP.1300.010.099.F	Cleaning products and household care	lime remover	NOC	products for removing lime or scale from surfaces
CP.1400.010.099.F	Cleaning products and household care	metal polish	NOC	cleaning products for metal surfaces
CP.1500.010.050.F	Cleaning products and household care	oven cleaner	spray	oven and grill cleaners (spray or aerosol formulation specified)
CP.1500.010.099.F	Cleaning products and household care	oven cleaner	NOC	oven and grill cleaners

CP.1600.010.099.F	Cleaning products and household care	shoe polish or protectant	NOC	shoe polishes, cleaners, and protectants
CP.0700.040.050.F	Cleaning products and household care	surface cleaner	spray	hard surface and kitchen surface cleaners (spray or aerosol formulation specified)
CP.0700.040.099.F	Cleaning products and household care	surface cleaner	NOC	hard surface and kitchen surface cleaners
CP.1700.010.099.F	Cleaning products and household care	upholstery cleaner	NOC	upholstery fabric cleaners
CP.1800.010.050.F	Cleaning products and household care	wood polish	spray	wood or furniture dusting or polishing products (spray or aerosol formulation specified)
CP.1800.010.099.F	Cleaning products and household care	wood polish	NOC	wood or furniture dusting or polishing products
LY.0100.010.040.F	Landscape/Yard	cleaner	exterior	exterior surface (e.g. deck, house, driveway) cleaners
LY.0600.010.099.F	Landscape/Yard	garden care	NOC	miscellaneous garden care products not otherwise characterized (e.g. rooting powders)
LY.0600.020.099.F	Landscape/Yard	garden fertilizer	NOC	fertilizers for vegetable or flower gardens, including in combination with pest/weed controllers
LY.0200.010.099.F	Landscape/Yard	grill/camping fuel	NOC	grill, lantern and camping stove fuels, including briquets
LY.0300.010.050.F	Landscape/Yard	herbicide	spray	herbicides, weed killers, and brush killers (spray or aerosol formulation specified)
LY.0300.010.099.F	Landscape/Yard	herbicide	NOC	herbicides, weed killers, and brush killers
LY.0400.010.099.F	Landscape/Yard	lawn fertilizer	NOC	fertilizers for lawns, including in combination with pest/weed controllers
LY.0500.010.099.F	Landscape/Yard	lawnmower fluids	NOC	oils and other fluids for lawnmowers or other small yard care equipment
LY.0600.030.099.F	Landscape/Yard	mulch	NOC	mulches, including those with weed controllers
LY.0700.010.030.F	Landscape/Yard	pool chemicals	algaecide	algaecide products for pools, hot tubs, and spas
LY.0700.010.031.F	Landscape/Yard	pool chemicals	chlorinating	chlorinating products for pools, hot tubs, and spas
LY.0700.010.032.F	Landscape/Yard	pool chemicals	pH control	pH control products for pools, hot tubs, and spas
LY.0700.010.033.F	Landscape/Yard	pool chemicals	shock	shock products for pools, hot tubs, and spas
LY.0700.010.099.F	Landscape/Yard	pool chemicals	NOC	products not otherwise characterized for pools, hot tubs, and spas
LY.0600.040.099.F	Landscape/Yard	potting soil	NOC	potting soil and vermiculite
LY.0800.010.099.F	Landscape/Yard	surface deicer	NOC	products for deicing surfaces
LY.0600.050.099.F	Landscape/Yard	trees	NOC	miscellaneous tree care products including sealers
PC.0100.010.050.F	Personal care	acne spot treatment	spray	creams and wipes for spot-treating acne (spray or aerosol formulation specified
PC.0100.010.099.F	Personal care	acne spot treatment	NOC	creams and wipes for spot-treating acne

PC.2700.040.099.F	Personal care	aftershave	NOC	lotions, balms, liquids, and gels for post-shave applications (usually fragranced)
PC.0800.010.001.F	Personal care	baby lotion	child	baby cream or lotion (excluding diaper creams)
PC.0800.020.001.F	Personal care	baby oil	child	skin oils specifically marketed for babies
PC.0800.030.001.F	Personal care	baby powder	child	powders specifically marketed for babies
PC.0800.040.001.F	Personal care	baby shampoo	child	shampoos specifically marketed for babies
PC.0800.050.001.F	Personal care	baby wash	child	body washes and cleaners specifically marketed for babies
PC.0800.060.001.F	Personal care	baby wipes	child	diaper and other baby wipes
PC.0500.010.099.F	Personal care	bar soap	NOC	bar and other solid soaps
PC.2800.010.099.F	Personal care	bath oil	NOC	bath oils or oil-filled beads
PC.0800.070.001.F	Personal care	bath paints/crayons	child	bath paints or bath crayons
PC.2800.020.099.F	Personal care	bath salts	NOC	bath salts, soaks, and fizzes
PC.0200.010.099.F	Personal care	bite relief	NOC	soothing treatments for insect bites
PC.2300.010.099.F	Personal care	blush/bronzer	NOC	cheek blushes, bronzers, and rouges
PC.0300.010.099.F	Personal care	body adhesive	NOC	NA
PC.0400.010.099.F	Personal care	body care set	NOC	multicomponent body care or bath set for which individual products are not designated
PC.0600.010.050.F	Personal care	body oil	spray	body oils (not including baby or bath oils, spray or aerosol formulation specified)
PC.0600.010.099.F	Personal care	body oil	NOC	body oils (not including baby or bath oils)
PC.0700.010.099.F	Personal care	body powder	NOC	talcum and dusting powders for the body
PC.0500.020.099.F	Personal care	body scrub	NOC	body cleaners containing abrasives or exfoliants
PC.0500.030.099.F	Personal care	body wash	NOC	body cleaners, washes, shower gels
PC.0500.040.099.F	Personal care	body wipes	NOC	body wipes and towelettes (excluding diaper or baby wipes)
PC.2800.030.099.F	Personal care	bubble bath	NOC	bubble baths
PC.2700.050.099.F	Personal care	clipper lubricant/cleaner	NOC	cleaning and lubricating products for hair clippers
PC.1100.020.050.F	Personal care	contact care	spray	contact lens cleaners and solutions (spray or aerosol formulation specified)
PC.1100.020.099.F	Personal care	contact care	NOC	contact lens cleaners and solutions
PC.2300.020.099.F	Personal care	cosmetic tool cleaner	NOC	NA
PC.0900.030.099.F	Personal care	denture adhesive	NOC	denture adhesives
PC.0900.040.099.F	Personal care	denture cleaner	NOC	denture cleansers
PC.1000.010.051.F	Personal care	deodorant	gel	deodorants and antiperspirants (gel formulation specified)
PC.1000.010.056.F	Personal care	deodorant	solid	deodorants and antiperspirants (solid formulation specified)

PC.1000.010.050.F	Personal care	deodorant	spray	deodorants and antiperspirants (spray or aerosol formulation specified)
PC.1000.010.099.F	Personal care	deodorant	NOC	deodorants and antiperspirants not otherwise characterized
PC.2700.060.050.F	Personal care	depilatory	spray	chemical products for removal of body or facial hair (spray or aerosol formulation specified)
PC.2700.060.099.F	Personal care	depilatory	NOC	chemical products for removal of body or facial hair
PC.0800.080.001.F	Personal care	diaper cream	child	diaper creams and ointments
PC.2000.070.050.F	Personal care	dry shampoo	spray	dry shampoos for removing hair oils (spray or aerosol formulation specified)
PC.2000.070.099.F	Personal care	dry shampoo	NOC	dry shampoos for removing hair oils
PC.2000.080.099.F	Personal care	ethnic hair care	NOC	products for ethnic hair care, including wrap set lotions and pressing lotions (excluding relaxers)
PC.1100.030.099.F	Personal care	eye cream	NOC	creams and moisturizers for specific treatment of eye area
PC.1100.040.099.F	Personal care	eye drops	NOC	products for lubricating eyes or treating redness
PC.1100.050.050.F	Personal care	eye lid spray	spray	NA
PC.2300.030.052.F	Personal care	eye liner	liquid	eye liners or brow coloring products (liquid or gel formulation specified)
PC.2300.030.099.F	Personal care	eye liner	NOC	eye liners or brow coloring products
PC.2300.040.099.F	Personal care	eye makeup	NOC	miscellaneous cosmetic eye products including lash adhesives and tints
PC.1100.060.099.F	Personal care	eye products	NOC	NA
PC.2300.050.099.F	Personal care	eye shadow	NOC	products for coloring eye lids
PC.1200.010.099.F	Personal care	face cleansing wipes	NOC	textile wipes or pads treated with cleansing solution
PC.1200.020.050.F	Personal care	face cream/moisturizer	spray	moisturizers, lotions, and creams for primarily treating the face (excluding eye-specific products) (spray or aerosol formulation specified)
PC.1200.020.099.F	Personal care	face cream/moisturizer	NOC	moisturizers, lotions, and creams for primarily treating the face (excluding eye-specific products)
PC.1200.030.099.F	Personal care	face mask	NOC	leave-on masks or peels for treatment of the face
PC.2300.060.099.F	Personal care	face powder	NOC	pressed or loose powders for face
PC.0100.020.099.F	Personal care	face scrub	NOC	facial cleansing products containing exfoliating particles, for acne treatment
PC.1200.040.099.F	Personal care	face scrub	NOC	facial cleansing products containing exfoliating particles (excluding products for acne)
PC.0100.030.099.F	Personal care	face wash	NOC	facial cleansing products (excluding scrubs), for acne treatment
PC.1200.050.050.F	Personal care	face wash	spray	facial cleansing products (excluding scrubs) (spray or aerosol formulation specified)
PC.1200.050.099.F	Personal care	face wash	NOC	facial cleansing products (excluding scrubs and products for acne)
PC.1500.010.050.F	Personal care	foot care	spray	miscellaneous products for application to feet, including scrubs, lotions, and deodorants (spray or aerosol formulation specified)

PC.1500.010.099.F	Personal care	foot care	NOC	miscellaneous products for application to feet, including scrubs, lotions, and deodorants
PC.2300.070.099.F	Personal care	foundation/concealer	NOC	liquid or cream foundation make-ups and concealers
PC.1600.010.050.F	Personal care	fragrance	spray	fragrances, colognes, and perfumes (spray or aerosol formulation specified)
PC.1600.010.099.F	Personal care	fragrance	NOC	fragrances, colognes, and perfumes
PC.1800.010.099.F	Personal care	glitter	NOC	powder products containing reflective particles for face or body
PC.1900.010.099.F	Personal care	hair bleach	NOC	products for lightening or removing color from hair on the head
PC.1900.030.099.F	Personal care	hair color - permanent	NOC	hair colors and dyes characterized as permanent
PC.1900.040.099.F	Personal care	hair color - professional	NOC	hair colors and dyes characterized as for professional use
PC.1900.050.099.F	Personal care	hair color - temporary	NOC	hair colors and dyes characterized as temporary
PC.1900.050.050.F	Personal care	hair color - temporary	spray	hair colors and dyes characterized as temporary (spray or aerosol formulation specified)
PC.1900.020.099.F	Personal care	hair color	NOC	hair coloring products not otherwise categorized
PC.1900.060.099.F	Personal care	hair color activator	NOC	chemical activators for hair coloring products
PC.1900.070.099.F	Personal care	hair color developer	NOC	chemical developers for hair coloring products
PC.1900.080.099.F	Personal care	hair color toner	NOC	chemical toners for hair coloring products
PC.2000.100.099.F	Personal care	hair conditioner - leave-in	NOC	leave-in everyday hair conditioners and detanglers
PC.2000.100.050.F	Personal care	hair conditioner - leave-in	spray	leave-in everyday hair conditioners (spray or aerosol formulation specified)
PC.2000.090.050.F	Personal care	hair conditioner	spray	rinse-out everyday hair conditioners (excluding combo shampoo/conditioner products) (spray or aerosol formulation specified)
PC.2000.090.099.F	Personal care	hair conditioner	NOC	rinse-out everyday hair conditioners (excluding combo shampoo/conditioner products)
PC.2000.120.099.F	Personal care	hair conditioning treatment - professional	NOC	hair conditioning and moisturizing treatments for occasional use characterized as for professional use
PC.2000.110.050.F	Personal care	hair conditioning treatment	spray	hair conditioning and moisturizing treatments for occasional use (spray or aerosol formulation specified)
PC.2000.110.099.F	Personal care	hair conditioning treatment	NOC	hair conditioning and moisturizing treatments for occasional use
PC.2000.130.099.F	Personal care	hair relaxer	NOC	chemical hair relaxers
PC.2000.140.099.F	Personal care	hair spray	NOC	spray fixatives for hair
PC.2000.160.051.F	Personal care	hair styling - gel	gel	hair styling products for hold, shine, or texture (gel formulation indicated)
PC.2000.160.057.F	Personal care	hair styling - gel	gel|spray	hair styling products for hold, shine, or texture (gel and spray formulation indicated)
PC.2000.170.058.F	Personal care	hair styling - mousse	mousse	foaming hair styling products

PC.2000.170.059.F	Personal care	hair styling - mousse	mousse|spray	NA
PC.2000.150.053.F	Personal care	hair styling	powder	NA
PC.2000.150.050.F	Personal care	hair styling	spray	hair styling products for hold, shine, or texture (spray or aerosol formulation specified)
PC.2000.150.099.F	Personal care	hair styling	NOC	hair styling products for hold, shine, or texture
PC.0500.050.050.F	Personal care	hand sanitizer	spray	antibacterial products for hands (spray or aerosol formulation specified)
PC.0500.050.099.F	Personal care	hand sanitizer	NOC	antibacterial products for hands
PC.0500.060.099.F	Personal care	hand soap	NOC	liquid hand soaps
PC.0500.070.099.F	Personal care	hand wipes	NOC	wipes and solution primarily for hands
PC.1700.010.051.F	Personal care	hand/body lotion	gel	lotions and creams primarily for hands and body (gel formulations indicated)
PC.1700.010.057.F	Personal care	hand/body lotion	gel|spray	lotions and creams primarily for hands and body (gel and spray or aerosol formulation specified)
PC.1700.010.050.F	Personal care	hand/body lotion	spray	lotions and creams primarily for hands and body (spray or aerosol formulation specified)
PC.1700.010.099.F	Personal care	hand/body lotion	NOC	lotions and creams primarily for hands and body
PC.2000.180.099.F	Personal care	lice shampoo	NOC	shampoos for the treatment of head lice
PC.2200.010.099.F	Personal care	liniment	NOC	liniments and ointments for treatment of muscle or joint pain
PC.2300.080.099.F	Personal care	lip balm	NOC	lip products primarily for protection
PC.2300.090.099.F	Personal care	lip color	NOC	colored lip products, excluding glosses
PC.2300.100.099.F	Personal care	lip gloss	NOC	glossy lip products
PC.2300.110.099.F	Personal care	lip liner	NOC	pencils for lining lips
PC.2300.120.099.F	Personal care	makeup primer	NOC	products for priming face for make-up
PC.2300.130.099.F	Personal care	makeup remover	NOC	products for removing face make-ups
PC.2300.140.099.F	Personal care	makeup set	NOC	multicomponent make-up set for which individual products are not designated
PC.2300.150.099.F	Personal care	mascara	NOC	eyelash mascaras
PC.0900.050.050.F	Personal care	mouthwash	spray	antiseptic and dental mouthwashes and rinses (spray or aerosol formulation specified)
PC.0900.050.099.F	Personal care	mouthwash	NOC	antiseptic and dental mouthwashes and rinses
PC.2400.010.099.F	Personal care	nail adhesive	NOC	adhesives for repairing fingernails or attaching artificial nails
PC.2400.020.099.F	Personal care	nail polish	NOC	clear or colored nail enamels, polishes, basecoats, topcoats, and other acrylic coatings
PC.2400.030.099.F	Personal care	nail polish remover	NOC	products for removing nail polish or artificial nails
PC.2400.040.050.F	Personal care	other nail products	spray	miscellaneous products for nail or cuticle treatment not otherwise characterized (spray or aerosol formulation specified)

PC.2400.040.099.F	Personal care	other nail products	NOC	miscellaneous products for nail or cuticle treatment not otherwise characterized
PC.2000.190.050.F	Personal care	scalp treatment	spray	products for treating the scalp, including products dandruff or hair loss (spray or aerosol formulation specified)
PC.2000.190.099.F	Personal care	scalp treatment	NOC	products for treating the scalp, including products dandruff or hair loss
PC.2500.010.050.F	Personal care	self-tanner	spray	chemical products for tanning, staining, or coloring the skin (spray or aerosol formulation specified)
PC.2500.010.099.F	Personal care	self-tanner	NOC	chemical products for tanning, staining, or coloring the skin
PC.2600.010.099.F	Personal care	sexual wellness	NOC	sexual wellness products, including personal lubricants
PC.2000.200.099.F	Personal care	shampoo - dandruff	NOC	shampoos, including dual shampoo/conditioner products for treatment of dandruff
PC.2000.210.099.F	Personal care	shampoo	NOC	shampoos, including dual shampoo/conditioner products
PC.2700.070.051.F	Personal care	shaving cream	gel	shaving creams, foams, balms and soaps (gel formulation specified)
PC.2700.070.099.F	Personal care	shaving cream	NOC	shaving creams, foams, balms and soaps
PC.2900.010.050.F	Personal care	sunscreen	spray	sunscreens and blocks (spray or aerosol formulations specified)
PC.2900.010.001.F	Personal care	sunscreen	child	sunscreens and blocks marketed to children or babies
PC.2900.010.011.F	Personal care	sunscreen	child | spray	sunscreens and blocks marketed to children or babies (spray or aerosol formulations specified
PC.2900.010.099.F	Personal care	sunscreen	NOC	sunscreens and blocks
PC.0900.060.099.F	Personal care	teeth whitener	NOC	teeth whitening products (excluding toothpastes)
PC.2300.160.099.F	Personal care	toner	NOC	face and skin toners and astringents
PC.0900.070.051.F	Personal care	toothpaste	gel	toothpastes and dentifrices (gel formulation specified)
PC.0900.070.099.F	Personal care	toothpaste	NOC	toothpastes and dentifrices
PC.2700.080.099.F	Personal care	waxing	NOC	wax products for removing hair from face or body
PE.0100.010.050.F	Pesticides	animal repellent	spray	chemical animal repellents (spray or aerosol formulation specified)
PE.0100.010.099.F	Pesticides	animal repellent	NOC	chemical animal repellents
PE.0200.010.050.F	Pesticides	fungicide	spray	fungicides for garden or home use (spray or aerosol formulation specified)
PE.0200.010.099.F	Pesticides	fungicide	NOC	fungicides for garden or home use
PE.0300.020.099.F	Pesticides	insect repellent - exterior	NOC	miscellaneous products for repelling insects, exterior use indicated
PE.0300.020.050.F	Pesticides	insect repellent - exterior	spray	miscellaneous products for repelling insects, exterior use indicated (spray or aerosol formulation specified)
PE.0300.030.099.F	Pesticides	insect repellent - skin	NOC	products for repelling insects from skin
PE.0300.030.050.F	Pesticides	insect repellent - skin	spray	products for repelling insects from skin (spray or aerosol formulation specified)

PE.0300.010.050.F	Pesticides	insect repellent	spray	miscellaneous products for repelling insects (excluding products to be applied to skin) (spray or aerosol formulation specified)
PE.0300.010.099.F	Pesticides	insect repellent	NOC	miscellaneous products for repelling insects (excluding products to be applied to skin)
PE.0400.020.099.F	Pesticides	insecticide - exterior	NOC	insecticides, exterior use indicated - including lawn and gardens
PE.0400.020.050.F	Pesticides	insecticide - exterior	spray	insecticides, exterior use indicated (spray or aerosol formulation specified)
PE.0400.030.099.F	Pesticides	insecticide - interior	NOC	insecticides, interior use indicated
PE.0400.030.050.F	Pesticides	insecticide - interior	spray	insecticides, interior use indicated (spray or aerosol formulation specified)
PE.0400.010.050.F	Pesticides	insecticide	spray	insecticides not otherwise characterized (spray or aerosol formulation specified)
PE.0400.010.099.F	Pesticides	insecticide	NOC	insecticides not otherwise characterized
PE.0500.010.099.F	Pesticides	rodenticide	NOC	rodenticides for interior or exterior use
PT.0400.010.099.F	Pet care	aquarium	NOC	miscellaneous aquarium treatment products
PT.0200.010.099.F	Pet care	cat litter	NOC	cat litters
PT.0100.060.050.F	Pet care	other pet treatments	spray	miscellaneous pet treatments (excluding pesticides) (spray or aerosol formulation specified)
PT.0100.060.099.F	Pet care	other pet treatments	NOC	miscellaneous pet treatments (excluding pesticides)
PT.0100.070.099.F	Pet care	pesticide - pet	NOC	pesticides for application to pets
PT.0100.070.050.F	Pet care	pesticide - pet	spray	pesticides for application to pets (spray or aerosol formulation specified)
PT.0100.080.099.F	Pet care	pet shampoo	NOC	pet shampoos (including those contain pesticides)
PT.0100.090.050.F	Pet care	pet stain cleaner	spray	carpet and upholstery cleaners for pet stains (spray or aerosol formulation specified)
PT.0100.090.099.F	Pet care	pet stain cleaner	NOC	carpet and upholstery cleaners for pet stains

Appendix E: Data dictionary for daily dose output variables from Source-to-dose module

Variable name	Description of Output Variable
household	Household number from ABM output
daynum	The number of the day in a year
DTXSID	DSSTox Chemical ID
dir.derm.exp	Total mass (mg) of chemical deposited on skin from direct product use over the day
dir.derm.max	Maximum loading (mass) of chemical (mg/cm^2) present on either hands or body at any time during the day (direct use)
dir.derm.abs	Mass of chemical (mg) absorbed through skin (direct use)
dir.inhal.exp	Average air concentration of chemical (mg/m^3) for primary person associated with direct use of products
dir.inhal.max	Maximum air concentration of chemical (mg/m^3) associated with direct use of products
dir.inhal.mass	Mass of chemical (mg) inhaled over the course of the day (direct use)
dir.inhal.abs	Total mass of chemical (mg) absorbed through the lungs over the course of the day (direct use)
dir.ingest.exp	Total mass of chemical (mg) absorbed ingested from hand-to-mouth transfer as well as transferred to the gut compartment during initial use phase of products (direct)
dir.ingest.abs	Mass (mg) of chemical absorbed through the gut (direct use)
Release	Mass (mg) of chemical released by product use (by primary person only)
ind.derm.exp	Total mass (mg) of chemical deposited on skin from indirect exposure (i.e., contact with contaminated surfaces)
ind.derm.max	Maximum loading (mass) of chemical (mg/cm^2) present on either hands or body at any time during the day (from indirect exposure)
ind.derm.abs	Mass of chemical (mg) absorbed through skin (indirect exposure)
ind.inhal.exp	Average hourly air concentration of chemical (mg/m^3) for primary person (indirect exposure)
ind.inhal.max	Maximum hourly air concentration (mg/m^3) (indirect exposure)
ind.inhal.mass	Mass of chemical (mg) inhaled over the course of the day (indirect exposure)
ind.inhal.abs	Total mass of chemical (mg) absorbed through the lungs over the course of the day (indirect exposure)
ind.ingest.exp	Mass of chemical (mg) ingested from hand-to-mouth transfer (indirect)
ind.ingest.abs	Mass of chemical (mg) absorbed through the gut (indirect)

Variable name	Description of Output Variable
out.sur	Mass of chemical (mg) released to outdoor surfaces (outdoor product use)
out.air	Mass of chemical (mg) released to outdoor air (outdoor use and house losses)
drain	Mass of chemical (mg) going into the drain system (includes chemical in the hair and nail compartments)
waste	Mass of chemical (mg) disposed in trash