



THE LIFELINE GROUP

Incorporating Population-Specific Diets and Activity Profiles into Aggregate and Cumulative Exposure Assessments : A Review of Capabilities and Shortcomings

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3 Legs of Exposure Assessment



People: what are they doing that brings them into contact with the chemical(s)

Chemical: How much is in/on the medium or item(s) of interest

Chemical's characteristics (physical/chemical) and behaviour in the medium (evaporation, binding, transfer dynamics, degradation, etc.)

3 Legs of Exposure Assessment



People: what are they doing that brings them into contact with the chemical(s)

Amount of the chemical in/on the medium

Chemical's characteristics (physical/chemical) and behaviour (evaporation, binding, transfer dynamics, degradation, etc.)

Characterization of people's activities – NOT CHEMICAL SPECIFIC

Opportunity to maximize power of the exposure assessment when information about the chemical is limited...much is known about people and their activities...can be applied to many chemical exposure assm'ts

Characterizing people and opportunities for exposure

People are well characterized

What they do and how they do it...defines their opportunities for exposure

We can define daily activities and the environment / conditions in which those activities take place.

Diet is an activity...during which the environmental medium is consumed.

Characterizing people and opportunities for exposure

Activity and Diet

Highly influenced by:

- Age, Gender*
- Socio-economics*
- Ethnicity*
- Seasons and climate*
- Health status*

So...where do we get the data on a population's diet and activities?

Characterizing people and opportunities for exposure

People, their diets and activities are measured, monitored, discussed and documented continuously. More and more information is available --- but not necessarily in typical formats.

What do we know from formal surveys?

from formal records in other disciplines?

[marketing, finance, school/work records]

from informal sources – anecdotal, social?

Formal surveys -- the “best” data??

Large Scale “snapshot” surveys of diet or activity

- Can consider many foods or broad array of activities
- Can involve many people—statistical validity for the overall study results
- Scientists and regulators have experience with these and they are trusted

Formal surveys -- the “best” data??

Large Scale “snapshot” surveys of diet or activity


- Are expensive
- Parts of the information may age quickly – most of it ages within a decade---perhaps sooner
- May not be statistically robust for application to subpopulations within the survey population
- Some subpopulations don’t appear meaningfully in the survey
- May not be seasonally accurate and may reflect aberrant circumstances existing during survey (economic highs, weather problems, national traumas), fads

Formal surveys -- the “best” data??

Small Scale “snapshot” surveys of diet or activity

- May be accurate for the object(s) of the study [cell phone use, carbonated beverage consumptions]
- May be accurate for the population under study [TV / screen time for preschool children, chocolate consumption by men]
- May accurately reflect causes of variability [seasonal, regional, economic, fads, etc]
- May be repeatable—yielding trend information

Changing markets of food

- 
- Localization...and special subgroups, vegetarian, poor, ethnic specialties, special diet plans
 - Globalization...spread of ethnic/national food globally...new types of foods, new types of preparation into all neighborhoods
 - Fast food...no longer just hamburgers

Changing activities

- By season, economics, region...urban/rural
- Local and global trends
- Activity pattern changes related to digital communication devices and screen entertainment options !!!!!!!!
 - Work environment options
 - Children's activity selections
 - Adult's activity selections
 - Time spent in areas of home / work



Using Representative Data to Make Relevant Risk Assessments

- Who is described by the information?
- Is it contemporary?

Where is the relevant, contemporary information and/or how do we adapt the existing information?



Harvesting Atypical Data

There is an abundance of information about these elements of characterizing human exposure opportunities...but the data may be in atypical formats. Task at hand:

- Find the information, retain the source identity
- Consider the integrity of the information:
 - Pedigree (source and credibility),
 - RELEVANCE to the population of interest and conditions (such as seasonality, contemporary status),
 - Ability to represent existing variability and conditions driving the variability.

Bringing Relevant Information to the Assessment

How do people spend their time? Where? How often? In what environment? Seasonal? Age Related?

Activity (Community Specific) Information



Transform information to useable data format

Exposure /Risk Assessment Model

Characterizing Dietary Profiles (by age, gender, etc)

1. What foods are being undertaken (by age, gender, etc.)
2. On any given day, what is the probability that a given person (by age or gender or other descriptor) will eat that food?
 - Some probabilities may be independent
 - Some foods will be competitive
3. When the food is eaten by that given person (by age or gender or other descriptor) how much is eaten? (point value or distribution of values)

Special note: why the interest on food when non-food items are the topic?

Defining Top Level Probability of Consumption

Dietary Record Generator - File 1

File Help

Consumption Parameters:
Viewing Hierarchy:

Foods Season Age Range Move Up Move Down

- Salmon
 - Chinook Salmon
 - Cooked
 - Winter
 - Age 0 to 0
 - Age 1 to 2
 - Age 3 to 5
 - Age 6 to 12
 - Age 13 to 20
 - Age 20 to 60
 - Age 61 to **
 - Spring
 - Summer
 - Fall
 - Dry
 - Raw/Frozen
 - Moose

Season: Winter - Age Range: 0 to 0

Consumption Group:

Name	Is Food	Probability of Consumption	Consumption Amount
Salmon	<input type="checkbox"/>	0.31	Single Value: 110 ...

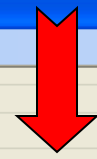
Species:

Name	Is Food	Probability of Consumption	Consumption Amount
Chinook Salmon	<input type="checkbox"/>	1	Single Value: 110 ...

Sub Species:

Name	Is Food	Probability of Consumption	Consumption Amount
Cooked	<input checked="" type="checkbox"/>	0.07	Distribution: Log Normal ...
Dry	<input checked="" type="checkbox"/>	0.9	Single Value: 74 ...
Raw/Frozen	<input checked="" type="checkbox"/>	0.03	Distribution: Log Normal ...

Overview
Food Setup
Age Range Setup
Consumption Setup
Generate Consumption
Reports



Defining 2nd, 3rd, and 4th Level Probabilities

Dietary Record Generator - File 1

File Help

Consumption Parameters:
Viewing Hierarchy:

Foods
Season
Age Range

Move Up
Move Down

- Salmon
 - Chinook Salmon
 - Cooked
 - Winter
 - Age 0 to 0
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 - Age 0 to 0
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 - Age 3 to 5
 - Age 6 to 12
 - Age 13 to 20
 - Age 20 to 60
 - Age 61 to **
 - Summer
 - Fall
 - Dry
 - Winter
 - Spring
 - Summer
 - Fall
 - Raw/Frozen
 - Winter
 - Spring
 - Summer
 - Fall

- Moose

Season: Winter - Age Range: 0 to 0

Consumption Group:

Name	Is Food	Probability of Consumption	Consumption Amount
Salmon	<input type="checkbox"/>	0.31	Single Value: 110 ...

Species:

Name	Is Food	Probability of Consumption	Consumption Amount
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Overview
Food Setup
Age Range Setup
Consumption Setup
Generate Consumption
Reports

Portion Size

Dietary Record Generator - File 1

File Help

Overview

Food Setup

Age Range Setup

Consumption Setup

Generate Consumption

Reports

Consumption Parameters:

Viewing Hierarchy:

Foods
Season
Age Range

Move Up
Move Down

Season: Winter - Age Range: 0 to 0

Consumption Group:

Name	Is Food	Probability of Consumption	Consumption Amount
Salmon	<input type="checkbox"/>	0.31	Single Value: 110 ...

Species:

Name	Is Food	Probability of Consumption	Consumption Amount
Chinook Salmon	<input type="checkbox"/>	1	Single Value: 110 ...

Edit SubSpecies Consumption Amount

Variable Data:

Single Value

Distribution

Distribution Type:

- Log Normal
- Normal
- Triangular
- Pareto
- Uniform
- User Supplied

Distribution Parameters:

Mean: 128

Standard Deviation: 91

Enable

Upper Bound (opt): 0.0

Inherited From Parent

OK
Cancel

Consumption Amount

Distribution: Log Normal ...

Single Value: 74 ...

Distribution: Log Normal ...

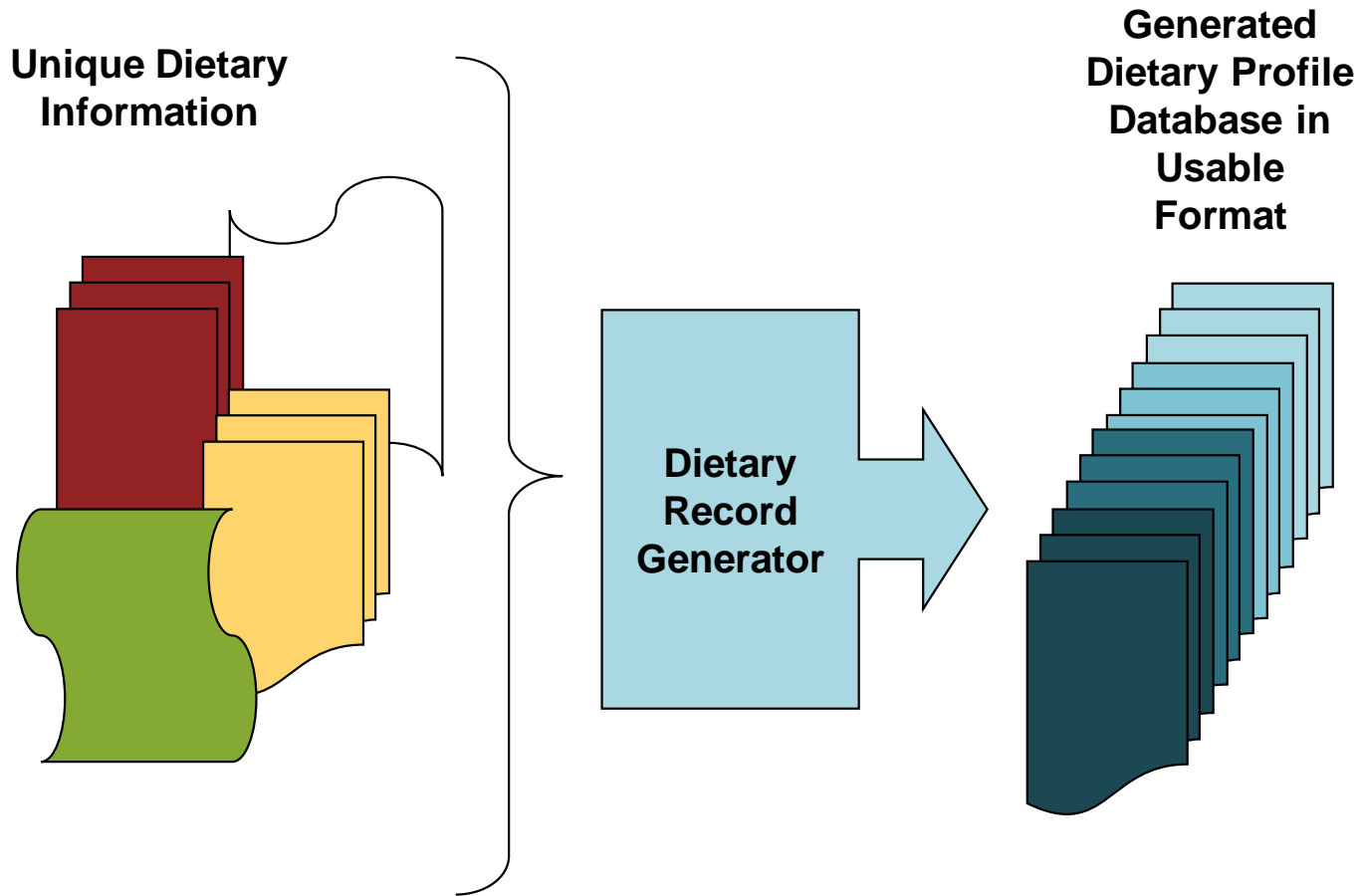
Dry

- Winter
- Spring
- Summer
- Fall

Raw/Frozen

- Winter
- Spring
- Summer
- Fall

Moose



Database can be “recycled” to add, amend, delete information about food list, probabilities or portion sizes...upgrades or customizing

Data Set: Sub Arctic Freshwater Pe

Annual Residues

Season Selected

Annual

Spring Summer

Fall Winter

Inputs

Outputs

Translate to Food Residues

Residues Factors

	Code	Crop Group	Code	Commodity	Code	FoodForm	Residue #1 (ppm)	Residue #2 (ppm)
17	8	Game mammals	38	bear		All		
18	8	Game mammals	39	beaver		All		
19	8	Game mammals	40	deer		All		
20	8	Game mammals	41	mink		All		
21	8	Game mammals	42	moose		All		
22	8	Game mammals	43	muskrat		All		
23	8	Game mammals	44	rabbit		All		
24	8	Game mammals	45	squirrel		All		
25	8	Game mammals	46	elk		All		
26	9	Bread		All		All		
27	10	Vegetables		All		All		
30	11	Sea mammals	65	beluga	25	flesh		
31	11	Sea mammals	65	beluga	26	liver		
32	11	Sea mammals	65	beluga	33	eyes		
33	11	Sea mammals	65	beluga	34	flipper		
34	11	Sea mammals	65	beluga	35	skin and fat (muktuk)		
35	11	Sea mammals	66	seal		All		
36	11	Sea mammals	67	oogruk		All		
37	11	Sea mammals	68	walrus		All		
38	11	Sea mammals	69	whale		All		
39	11	Sea mammals	70	devilfish (gray whale)		All		
40	12	Fowl		All		All		
41	13	Egg		All		All		
42	14	Soil		All		All		
43	15	Tea/tundra		All		All		
44	16	Water		All		All		

Characterizing Activity Profiles (by age, gender, etc)

1. What activities are being undertaken (by age, gender, etc.)
2. On any given day, what is the probability that a given person (by age or gender or other descriptor) will partake in that activity?
 - Some probabilities may be independent
 - Some activities will be competitive
3. When the activity is undertaken, what is its duration (also intensity) and what physical medium (or product) is involved? [carpet, air, toy, chair, pool water]

Select a season and age category for an activity to enter the activity probability.

Activity List Hierarchy

Activity Probability

Activity probability **is** entered in decimal format. How would you like to enter activity probability for this activity?

- Point value
- Distribution
- Supply my own values

Distribution Type: Distribution Parameters:

Log Normal Parameter 1:

Normal Parameter 2:

Triangular Enable

Pareto Parameter 3:

Uniform

User Supplied

- Enter reference for probability
- Copy probability value to other activities, seasons or age groups

Paste Location(s):

Foods:

Base 1st Level Consumption Gro

New 1st Level Consumption Gro

Seasons:

Spring

Summer

Fall

Winter

Age Ranges:

Age 0 to 0 (Infants)

Age 1 to 2

Age 3 to 5

Age 6 to 12

Age 13 to 19

Age 20 to 60

Age 61 and Older

- Load Activity File
- Enter Activities
- Define Age Ranges
- Define Hand to Mouth Events
- Enter Exertion Level
- Enter Activity Probability
- Enter Activity Duration
- Define Clothing Worn During Activity

- Ability Data
- Activity probability
- Exertion
- Activity probability
- Exertion
- Activity probability
- Exertion
- Activity probability
- Exertion
- Activity probability
- Exertion

Help

Next

Select season and age category for an activity to enter activity duration.
Activity List Hierarchy

Activity Name	Season/Age	Activity Duration (minutes)
<input type="checkbox"/> Activity 1		

Activity Duration

Activity duration should be entered in minutes. How would you like to enter activity duration for this activity?

- Point value
- Distribution
- Supply my own values

Distribution Type: Log Normal Normal Triangular

Distribution Parameters: Parameter 1: Parameter 2:

Enable

Reference: Activity Duration

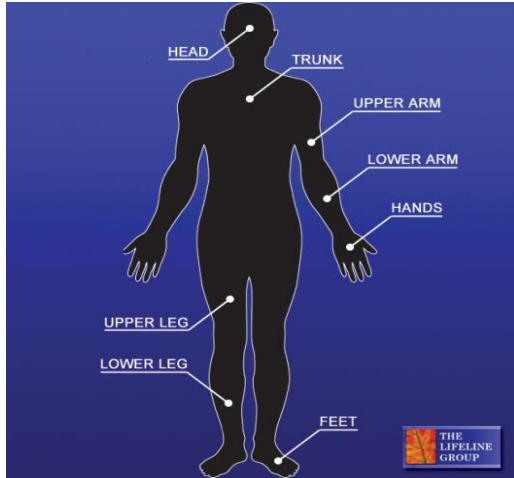
here data is not are inactive

- Age 13 to 19
- Age 20 to 60
- Age 61 and Older

- Load Activity File
- Enter Activities
- Define Age Ranges
- Define Hand to Mouth Events
- Enter Exertion Level
- Enter Activity Probability
- Enter Activity Duration
- Define Clothing Worn During Activity

Materials Body Contact Area

Select where the material contacts the body during this activity.



Enter the % of the body area that comes in contact with the material during the activity.

Activity Name	Material	Body Contact Area	% of body area in contact with the material

Body Contact
Reference
Reference
Reference

- Enter reference for materials body contact area
- Use this materials body contact area for other activities which use the same material.

Paste Location(s):

Foods:

Base 1st Level Consumption Gro

New 1st Level Consumption Gro

Seasons:

Spring

Summer

Fall

Winter

All

Age Ranges:

Age 0 to 0 (Infants)

Age 1 to 2

Age 3 to 5

Age 6 to 12

Age 13 to 19

Age 20 to 60

Age 61 and Older

Cancel Ok

Help

Next

Check for missing data

Expand

- Enter Activity Materials L
- Define Mater Body Conta Area
- Enter Materi Contact Ra
- Enter Materi Contact Duration

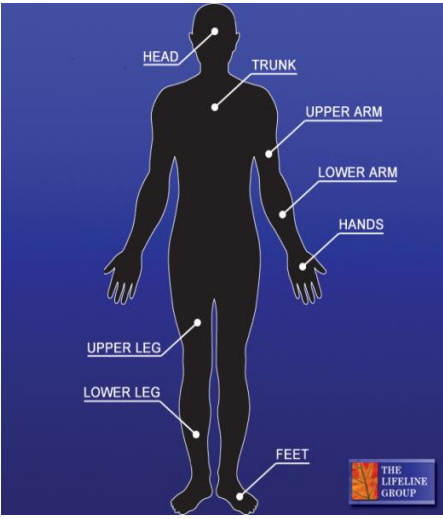
- Load Activity File
- Enter Activities
- Define Age Ranges
- Define Hand to Mouth Events
- Enter Exertion Level
- Enter Activity Probability
- Enter Activity Duration
- Define Clothing Worn During Activity

Clothing Worn During Activity

Select default values for clothing
 Supply my own clothing data

Select all clothing worn while participating in the activity.

- Hat
- Tee shirt
- Shorts
- Socks
- Shoes
- Short Pants
- Long Pants
- Long Sleeved Shirt
- Short Sleeved Shirt
- Vest
- Half Length Coat
- Full Length Coat
- Gloves



Select all body areas covered by clothing and click on "enter data" to enter clothing information. To view or edit previously entered data click on "view/edit."

- Enter reference for clothing worn during the activity
- Use these clothing values for other activities, seasons or age groups

Paste Location(s):

<p>Foods:</p> <input type="checkbox"/> Base 1st Level Consumption Gro <input type="checkbox"/> New 1st Level Consumption Gro	<p>Seasons:</p> <input type="checkbox"/> Spring <input type="checkbox"/> Summer <input type="checkbox"/> Fall <input type="checkbox"/> Winter
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Age Ranges:

 Age 0 to 0 (Infants)
 Age 1 to 2
 Age 3 to 5
 Age 6 to 12
 Age 13 to 19
 Age 20 to 60
 Age 61 and Older

- Age 1
- Age 2
- Age 3

Bringing Relevant Information to the Model

Activity Record Generator

How do people spend their time? Where? How often? In what environment?
Seasonal? Age Related?

Activity (Community Specific) Information



Activity Record Generator™ yields database in format ready for use in models

Used in exposure/risk assessment models

Importance of Probability Information

Single source models:

- Assume chemical is in the medium/object
- Assume medium/object is used by the person

Therefore:

Probability of exposure is always 100%

Does NOT permit competition or variation

OK for single source issues

Importance of Probability Information

Aggregate Exposure Assessment requires
inclusion of competitive use situations

CANNOT just add together single source assm'ts

Chemical is in the carpet AND in the chair cover. Where do you sit?

Chemical is in suntan lotion AND clothing softener...do you use suntan lotion under the clothes?

Etc, etc, etc, etc.

Importance of Data Distributions

Today's exposure assessment models can accept data as:

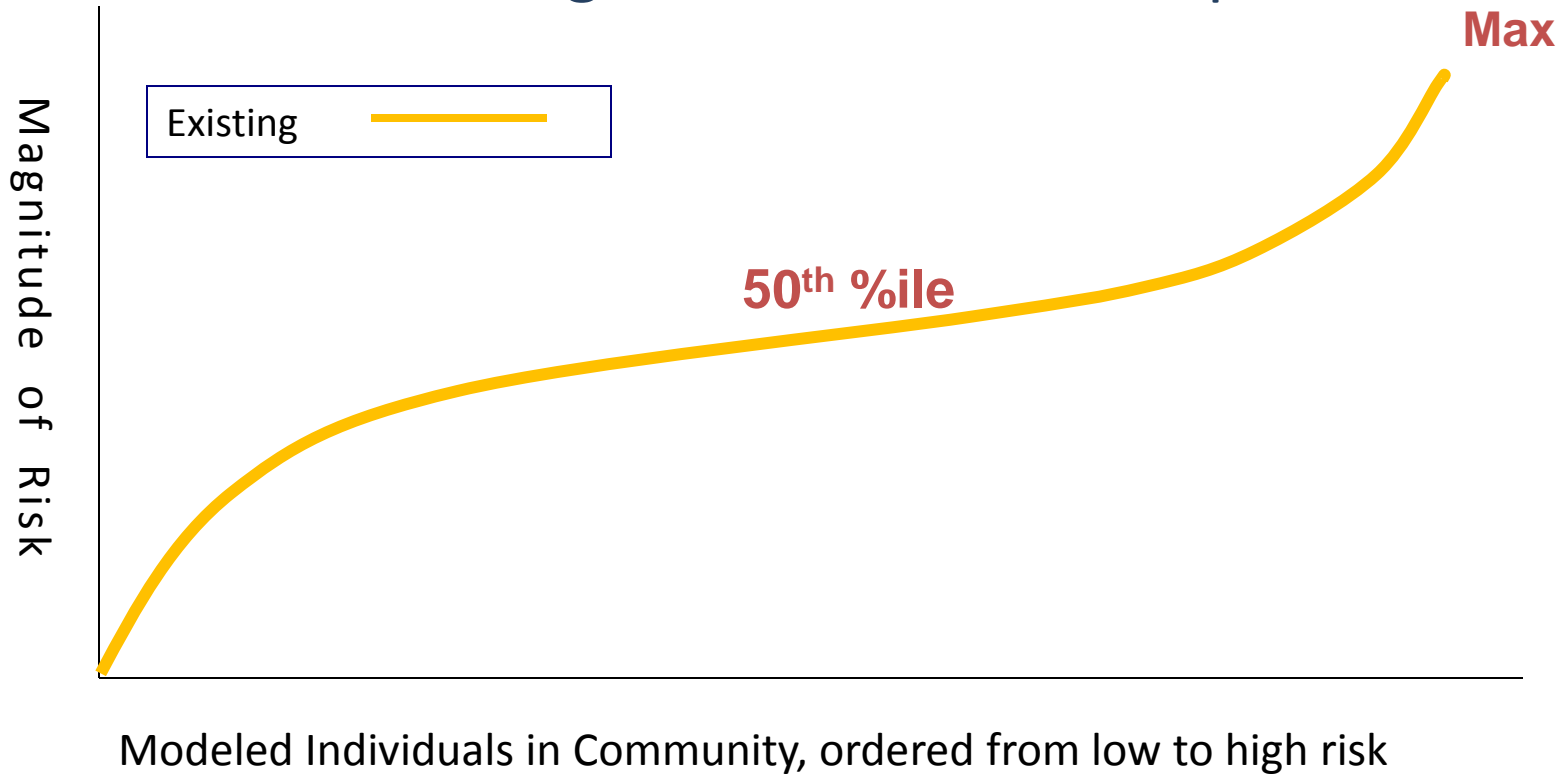
- Single point
- Distributions
- Parametric distributions

Using probabilistic methodology, exposure assessments can then be presented as a distribution of answers...the exposure as it is distributed across the population of interest.

This can be a powerful tool for considering the consequences of change...mediation options, risk mitigation strategies.

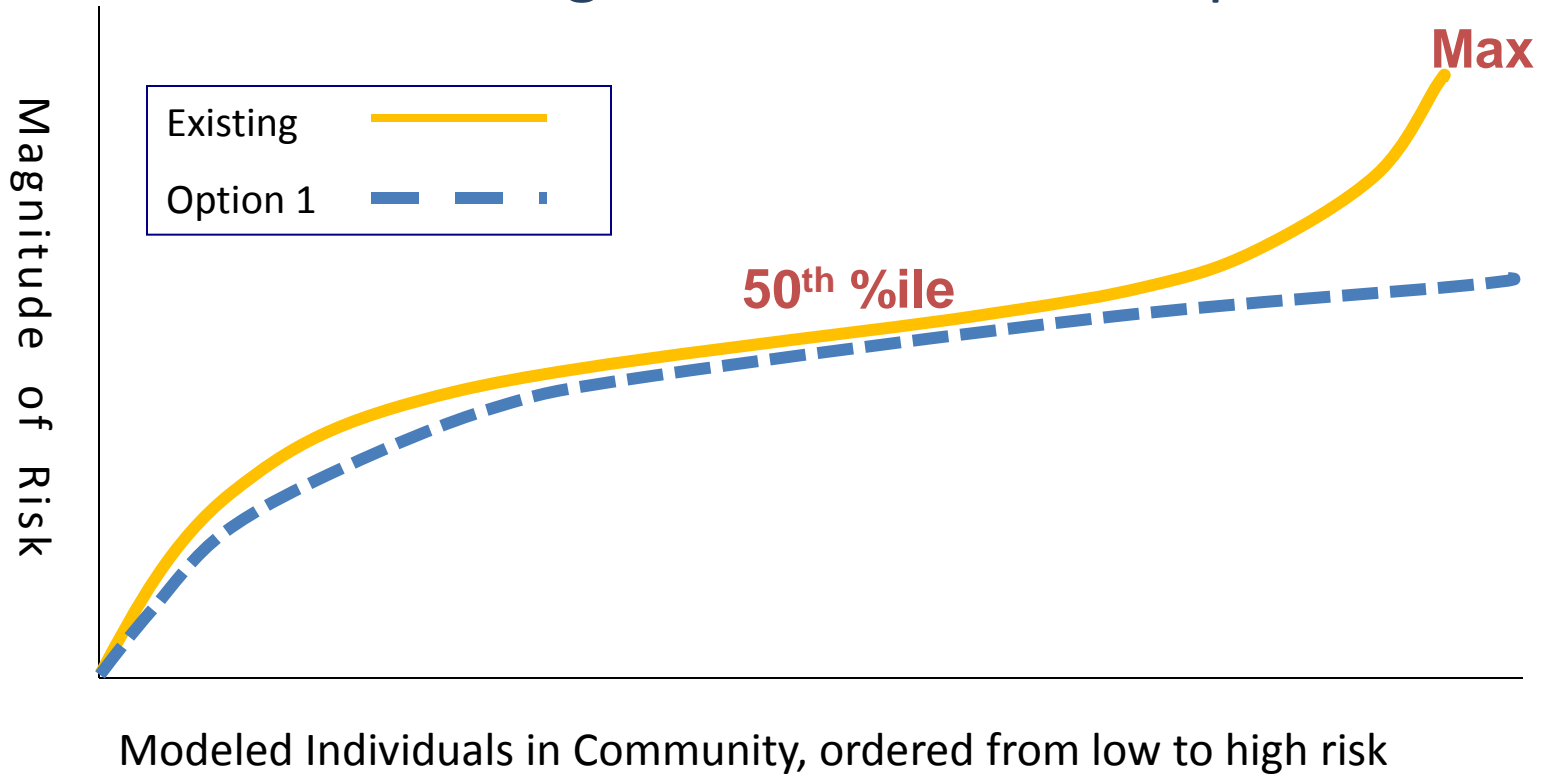
Distribution of Aggregated Exposure / Risk

Considering Risk Remediation Options



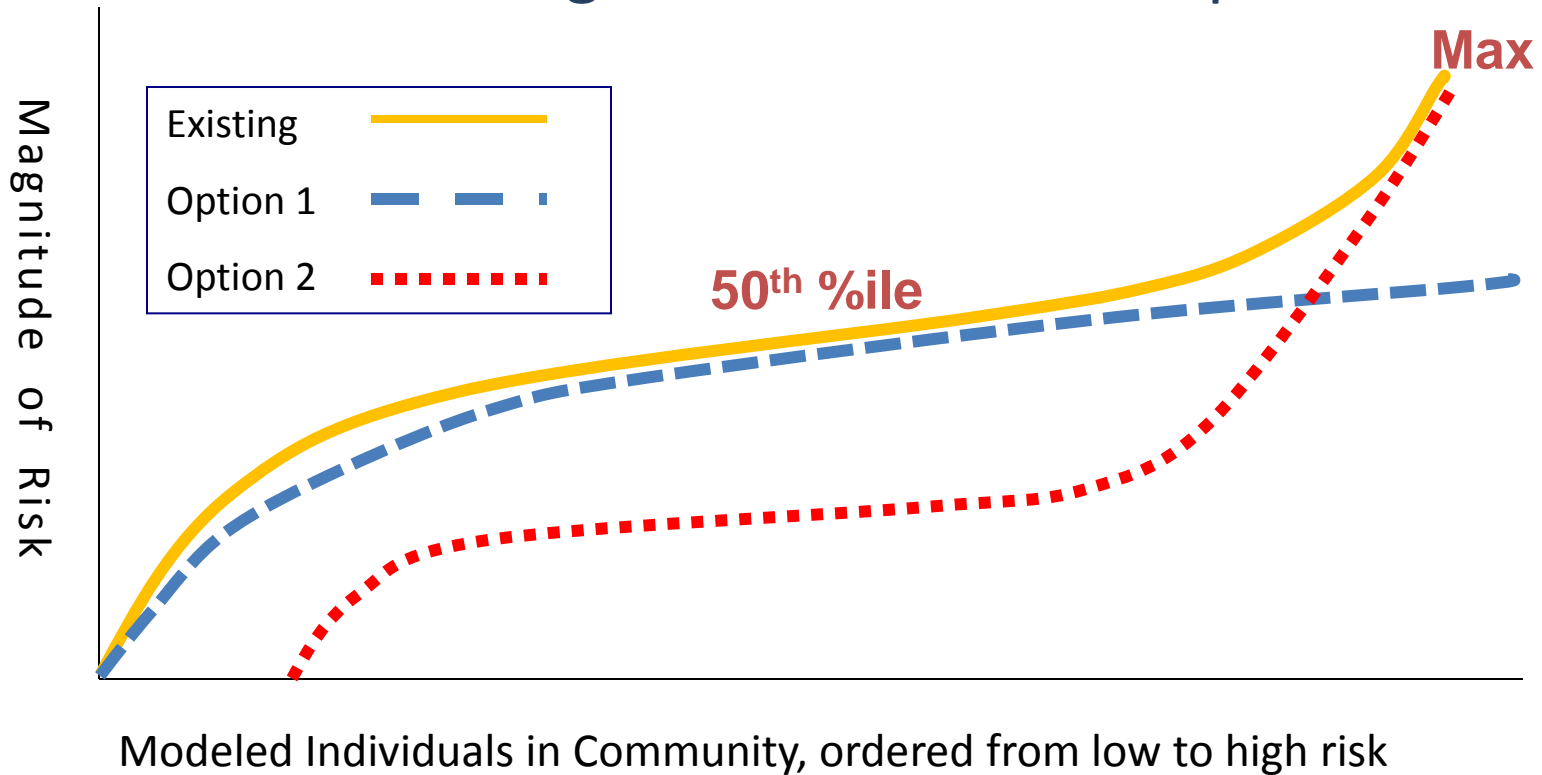
Distribution of Aggregated Exposure / Risk

Considering Risk Remediation Options



Distribution of Aggregated Exposure / Risk

Considering Risk Remediation Options



New Capabilities Introduce New Challenges

Quality of information and application to model structure may require “ratification” from “experts”.

WHO are the “experts” ???

- Broadening of definition of expert to include “those who know best” in terms of people’s practices within a community or population group.
- Criteria for accepting or rejecting data should be clear and transparent.
- Source of information must be retained with metric.
 - Population-specific info, genre, conditions of variability

New Capabilities Introduce New Challenges

New information sources exist that are unfamiliar to many “exposure scientists”

- Commercial marketing data
- Product ingredient information and chemical function within the products
- Social survey information – behaviour data on populations
- Community planning information – travel modes, exercise opportunities, demographics

New Capabilities Introduce New Challenges

A challenge to the scientist....

Scientific publications normally present “collapsed data” – mean, max, upper percentile, etc.

The full data set would be more useful..

Can we encourage presentation and access to all of the data...not just the digested version?

New Capabilities Introduce New Challenges

Thank you...

Models described here (and others) are freely
available

www.TheLifeLineGroup.org