

Human Health Risk Assessment Overview

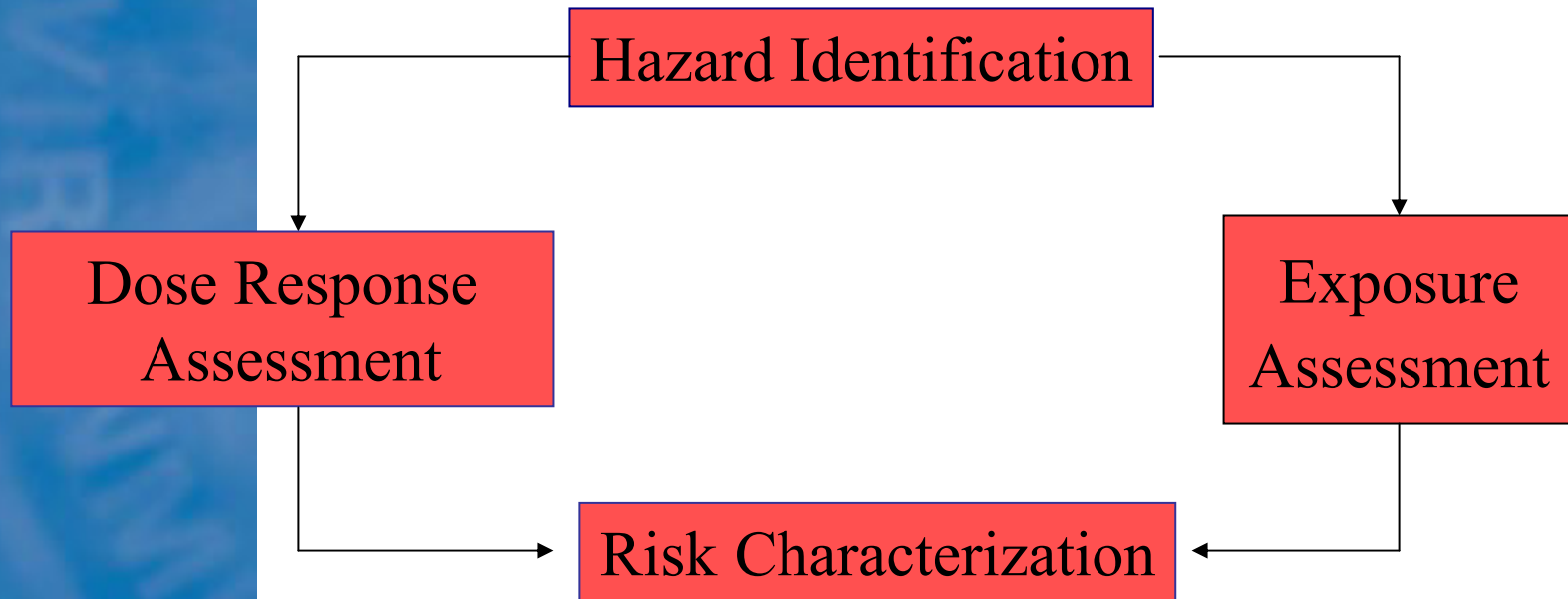
[For the APS/OPP Roundtable]

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[Slides Courtesy of Mike Metzger, USEPA]

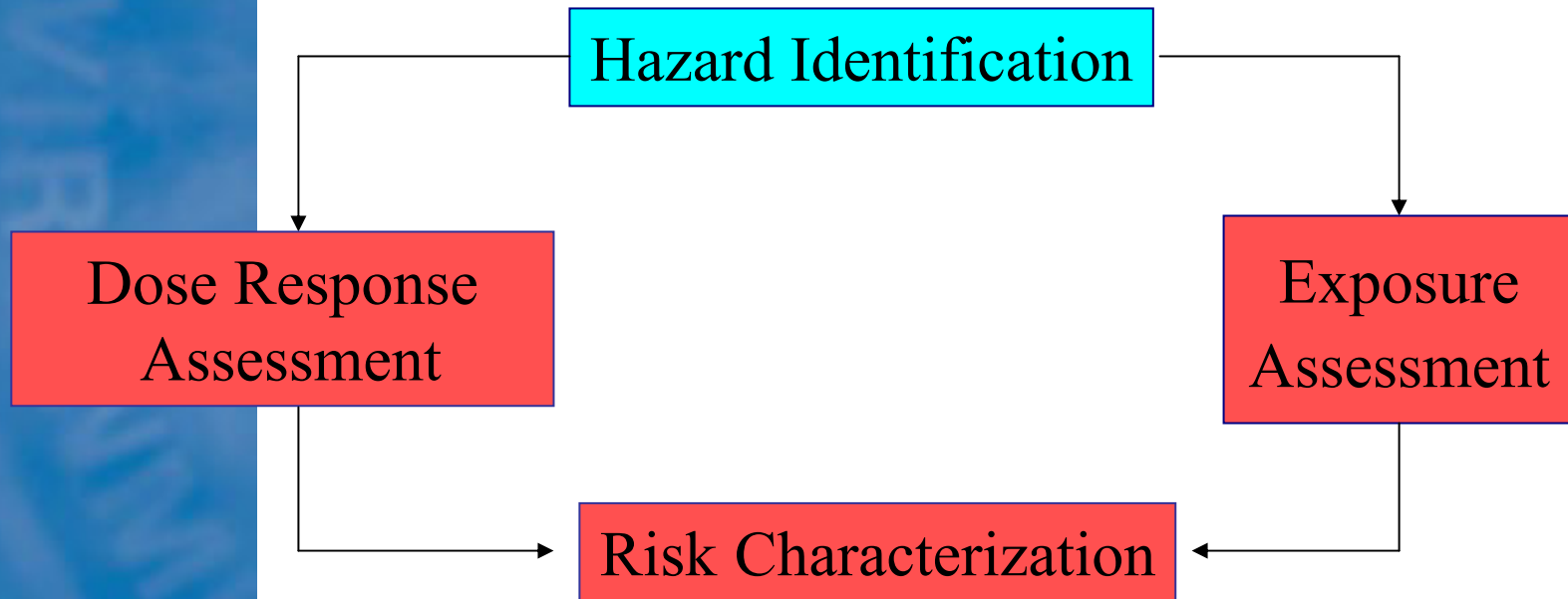
The Risk Assessment Paradigm: The "Red Book"



*From the National Research Council's *Risk Assessment in the Federal Government: Managing the Process*, 1983.

<http://books.nap.edu/books/030904894X/html/1.html>

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Hazard Characterization

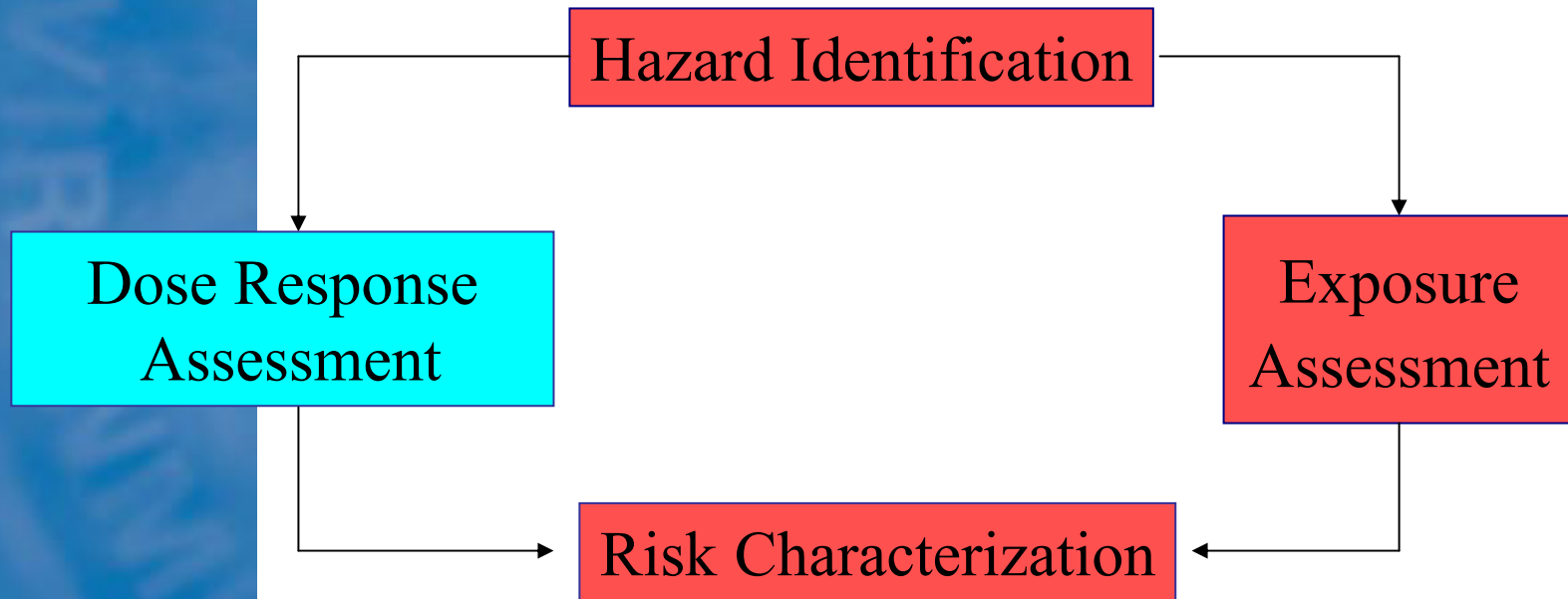
- Important toxicological effects observed in animal testing, including developmental / fetal, reproductive, endocrine, carcinogenic, and other effects
- Critical exposure periods and routes (short-term vs. longer term, dermal vs. inhalation)
- Studies which provide conflicting results, and why a particular study might be deemed to be the most appropriate to rely on
- Is the toxicity likely to be observed in humans?
- Confidence in the conclusions, other conclusions which could be drawn, data gaps, and highlights of major assumptions

Hazard Characterization

- The hazard characterization tells a story about the toxicity of a chemical, and how much confidence we have that the story is true
- When combined with exposure characterization it tells a risk assessment story
- Transparent, clear, consistent, and reasonable characterization is necessary for effective regulation of pesticides

A risk assessment is not a number!

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Dose-response Assessment and Endpoint Selection: Definitions

- **Endpoint:** Toxic Effect upon which the risk assessment is based
- **Lowest Observed Adverse Effect Level (LOAEL):** Lowest dose from a study at which adverse toxic effects were observed
- **No Observed Adverse Effects Level (NOAEL):** The dose below the LOAEL at which no adverse toxic effects are observed
- **Point of Departure (POD):** Any dose level used to quantify risk (generic)

Dose-response Assessment and Endpoint Selection: Dose

“All substances are poisons; there is none which is not a poison. The right dose differentiates a poison from a remedy.”

Paracelsus (1493-1541)

- **Tylenol – 2 cures a headache, 222 leads to death.**
- **Lower dose ⇒ less toxicity observed**
- **Higher dose ⇒ Higher toxicity**
- **No exposure ⇒ No (risk)**

Dose-response Assessment and Endpoint Selection: Exposure Scenarios

- **Dietary**
 - **Oral food and water (all ages)**
- **Residential**
 - **Incidental oral ingestion (children, adult swimmers)**
 - **Dermal exposure (all ages)**
 - **Inhalation exposure (adults, children indoors)**
- **Occupational**
 - **Dermal and inhalation exposure (adults)**

Major Risk Assessments

Assessment	Duration of Continuous Exposure
Acute	1-day
Short-term (ST)	1-30 days
Intermediate-term (IT)	1-6 months
Chronic	6 months - lifetime
Cancer	Chemical-specific

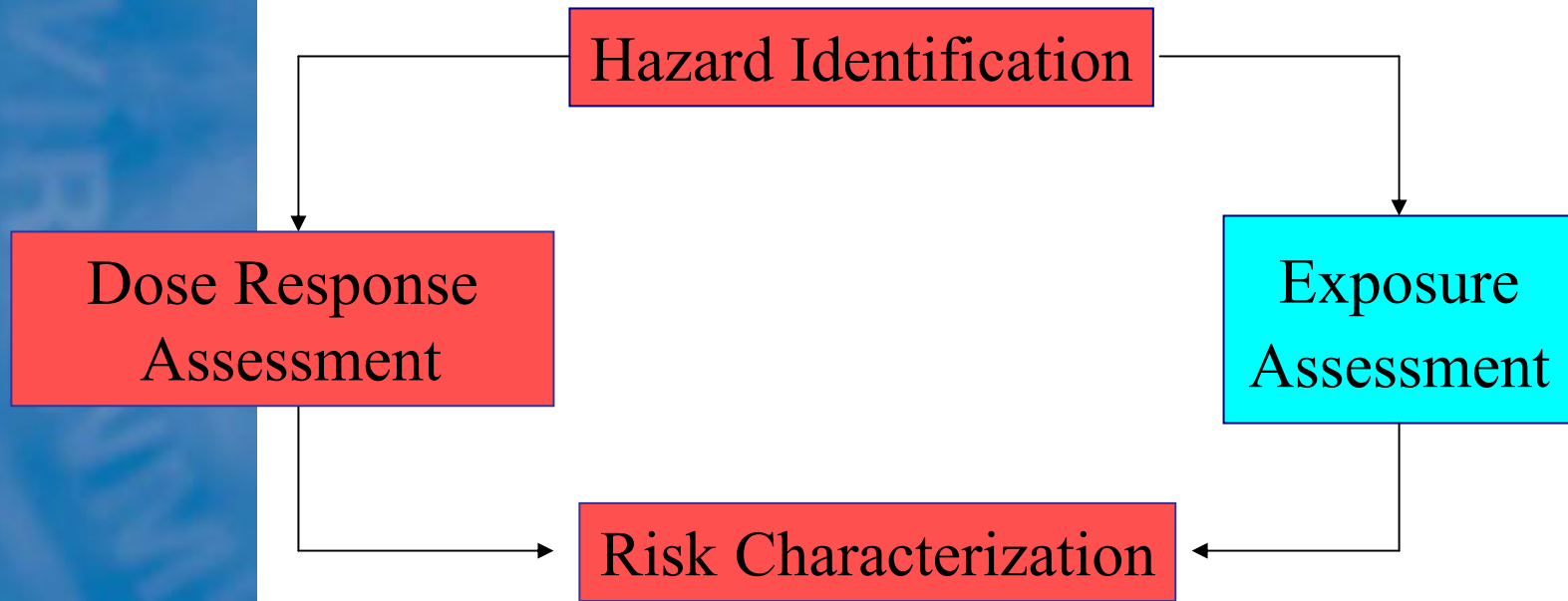
Uncertainty and Safety Factors

- **“One of several, generally 10-fold factors, used in operationally deriving the RfD and RfC from experimental data”**
(<http://www.epa.gov/iris/gloss8.htm>)
 - **Intraspecies – variability among humans**
 - **Interspecies – extrapolating animal data to humans**
 - **Extrapolating from less-than-lifetime to lifetime exposures**
 - **LOAEL to NOAEL**
 - **Incomplete data base**
 - **Increased concern for susceptibility of infants and children not addressed by other safety factors**

Unique FQPA Concerns

- A significant concern and uncertainty exists, but:
 - Toxicity data are not available to address the uncertainty, and
 - An appropriate study to generate such data has not been developed (i.e., we can't figure out how to do it)
- A significant concern exists for missing exposure data

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Dietary Exposure Assessment

- Two components
 - Food and drinking water residues
 - Food and drinking water consumption

Dietary Exposure: Food and DW Residues

- Residue estimates obtained from
 - Field trials (plants)
 - Livestock feeding studies
 - Monitoring data (various foods)
 - Processing factors (e.g. cooking or peeling)
 - Drinking water models

Dietary Exposure: Consumption

- Consumption data obtained from the USDA's Continuing Survey of Food Intake by Individuals (CSFII)(1994-96, 1998 supplemental data)
- Consumption data may be grouped by various factors including age, sex, region, ethnicity, others

Dietary Risk Characterization

What factors determine how closely the risk estimates approximate real population risks?

➔ Estimated risks can differ by orders of magnitude when different data or methods are used.

Occupational Exposure

Occupational - job-related exposures

- **Handler: Mix, load and apply pesticide (agricultural, professional residential, others)**
- **Postapplication worker: Reentry after application (e.g., pickers, thinners)**
- **Dermal and inhalation routes**

Residential Exposure

Residential: non-job-related exposures

- **Handler: Mix, load, and apply by homeowner**
- **Post-application: Reentry after application (e.g., playing on lawns, playing golf, rolling on rug – OR BYSTANDER?)**
- **Dermal, inhalation, and oral routes**

Occupational Handlers

Three Major Inputs:

- Application Rate: Label or usage information (lbs. A.I./A)
- Acres treated: Standard values from data and surveys
- Unit exposure: exposure per pound of active ingredient handled from the Pesticide Handlers Exposure Database (PHED)

Pesticide Handlers Exposure Database (PHED)

- Concept: Handler exposure is less dependent on chemical structure, more dependent on the physical processes of mixing and loading, the type of formulation, Personal Protective Equipment (PPE), packaging, application equipment, etc.
- PHED aggregates data for different chemicals into scenarios representative of each activity / formulation type / PPE / etc → unit exposures
 - **e.g., mix/load dry flowables, apply granules**

Residential Risk Assessments

- Standard Operating Procedures for Residential Exposure Assessment (“Residential SOPs”)
 - Residential lawns
 - Gardens (vegetable, ornamental)
 - Trees (fruit, nut, ornamental)
 - Swimming pools
 - Painting / wood preserv.
 - Fogging
 - Crack and crevice tx
 - Pet uses
 - Detergents/hand soap
 - Impregnated mat.
 - Termiticides
 - Indoor inhalation
 - Rodenticides
 - U-pick

Occupational and Residential Exposure

ORE Test Guidelines can be found at:

http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/875_Occupational_and_Residential_Exposure_Test_Guidelines/Series/

Aggregate Exposure / Risk Assessment

FQPA defines “safe” as:

“there is a reasonable certainty that no harm will result from aggregate exposure to the pesticide chemical residue, including all anticipated dietary exposure and all other exposure for which there is reliable information.”

Aggregate Exposure / Risk Assessment

Aggregate typically includes:

- Food
- Drinking water
- Other non-occupational exposures (e.g. residential, playing golf)

Oral, dermal, and inhalation routes

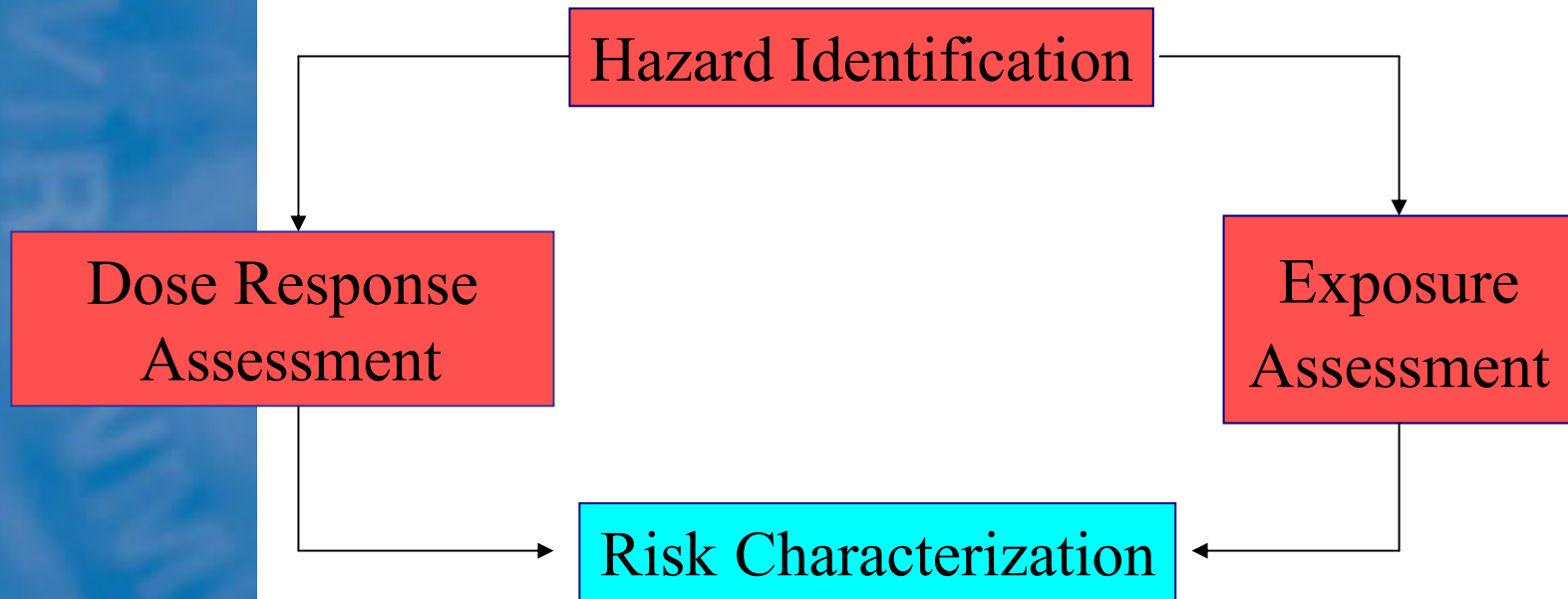
Cumulative Risk

- Combined aggregate risks from all chemicals which have a common mode of action

-or-

- Combined risks from food, drinking water, and residential exposure, for all pesticides which have common toxic effects produced in the same way

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Risk Characterization

- Describes major assumptions used in the risk assessment
- Is clear about uncertainties and confidence in the data that support the assessment
- Describes differences in risks for various populations (including environmental justice issues)
- Identifies risks “drivers” when there are risks of concern, and identifies ways to refine risk
- Tells a story, rather than just providing a set of numbers

Risk Characterization / Risk Management

- The purpose of risk assessment in OPP is **to inform risk management decisions**
- **Risk management** is the **decision-making process** involving considerations of political, social, economic and engineering factors with relevant risk assessments relating to a potential hazard so as to develop, analyze and compare regulatory options and to select the optimal regulatory response for safety from that hazard.