Introduction to Attributes Discussion

Presentation for the NDWAC CCL CP Work Group

Plenary Meeting

March 27-28, 2003

Purposes of This Discussion

- What is the purpose for using attributes?

- What are the NRC-recommended attributes and how does NRC define these attributes?

- Review attribute scoring of the example dataset

- Examine attributes issues to be addressed

- Decide who will take on attributes issues

Purposes for Using Attributes

- Allows different types of contaminants (chemical and microbial) to be compared in a consistent manner

- Allows different types and degrees of information associated with one attribute

- Defines model

- Focuses on occurrence and health effects data

What are the NRC-Recommended Attributes?

- **Occurrence**
  - Prevalence
  - Magnitude
  - Persistence/Mobility

- **Health Effects**
  - Potency
  - Severity

Occurrence Attributes

PREVALENCE

- NRC definition: "How commonly does or would a contaminant occur in drinking water?"

MAGNITUDE

- NRC definition: "The concentration or expected concentration (e.g., based on chemical production) of a contaminant relative to a level that causes a perceived health effect."

PERSISTENCE/MOBILITY

- NRC definition: "The persistence/mobility attribute of a contaminant is intended to describe the likelihood that the contaminant would be found in the aquatic environment based solely on physical properties of the contaminant."

Health Effects Attributes

POTENCY

- NRC definition: Indicating power or strength: the amount of a contaminant required to cause an adverse health effect. Potency of a pathogen may refer to the number of organisms required to cause disease, while potency of a chemical refers to the dose required to cause disease.

SEVERITY

- NRC definition: Degree to which a potential contaminant can cause an adverse health effect. Severity can be scored based on the anticipated clinical significance of the most sensitive health end point in affected individuals.

Steps to Develop Attributes

- Determine whether NRC attributes are the most relevant

- Determine if sufficient data are available to develop the value of an attribute

- Define meaning/terminology
  - prevalence (differs for chemicals and microbes)

- Determine practical scoring systems for selected attributes

- Conduct scoring

Principles to Consider for Attributes

- Attribute conceptually characterizes a contaminant from different data types
  - hierarchy of data types
- Attribute scoring must be practical
  - reproducible
  - define needs for expert judgement
- Same attributes for chemical and microbial candidates
- Handout on Principles

Status of Method Activity Group

- **Example Dataset**
  - developed data for 46 data rich chemicals and 6 microbes on draft/final CCL1
  - developed straw scoring approach for chemicals
  - scored 46 chemicals
  - compared raw data to scored in model performance
    - artificial neural network (ANN)
    - classification and regression tree analysis (CART)
    - multiple adaptive regression splines (MARS)
    - linear logistic regression model

Severity

- NRC definition: Degree to which a potential contaminant can cause an adverse health effect.

- Severity can be scored based on the anticipated clinical significance of the most sensitive health endpoint in affected individuals.

- Issues
  - How to account for sensitive sub-populations
  - Choosing among endpoints and exposure for scoring

EPA Activities

- ## Severity Scoring Exercise

  - Scores strictly based upon the critical health effect and its proper placement within the draft severity scale

  - No supplemental health effects data were used.

  - Data used:
    - The critical effect which was basis for RfD and the cancer weight of evidence [as reported in IRIS]
    - Exceptions: sulfate, diazinon (DW Guidance, DW Health Advisory)

EPA Activities

- **Severity Scoring Exercise cont.**
    - Problems identified during scoring exercise:
        - Focus on specific chemical tended to bias the score.
        - Limited critical effects data on IRIS necessitated assumptions for severity of effect.
        - Difficulty deciding how to score differences in organ or body weights.
    - Lessons learned:
        - Need to revise draft scale categories and expand descriptions.
        - During scoring, chemical identify should be excluded.
        - Need detailed descriptions of critical health effects.
        - Difficult to be objective.
        - An approach must be developed for chemicals that lack a critical effect.

How Severity of Chemicals has been scored in the Example Dataset

- Severity was scored for the critical effect associated with the potency value, which, for chemicals, is a critical effect for a study used to derive either an RfD or a 10^{-4} cancer risk by oral exposure (from the IRIS database).

- For the example dataset, the DRAFT Severity Scale developed by health scientists in EPA's Office of Science and Technology, Health Effects Criteria Division (HECD) was utilized. Contaminants may also be scored for severity using NRC-suggested severity scale.

Health Effects Attributes for Microbes (NRC)

Attribute	Possible Data Elements
Severity	Manifestation of disease Duration Outcome
Potency	Infective dose
Magnitude	Probability of infectious dose reaching a susceptible host

Severity Scales for Chemicals and Microbes

Chemical Effects (NRC)

- No effect
- Change in organ weight
- Biochemical changes
- Pathology (slight)
- Disease (minimal)
- Disease (significant)
- Treatable disease
- Organ function loss (1)
- Organ function loss (>1)
- Likely mortal
- Death

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Microbial Effects (EPA)

- No effect
- Sub-clinical infection/colonization
- Symptomatic infection
- Infection resulting in work loss
- Infection resulting hospitalization
- Infection resulting chronic disease or sequellae
- Infection that results in death

Susceptible Populations to Address in Severity Scoring for Microbes

- Persons older than 5 years with normal immune function
- Elderly with decline in immune function
- Severely immunocompromised individuals
- Infants and children
- Neonates and pregnant females
- Persons with chronic diseases

Issues involving Attributes

- Need creative ways to account for lack of data
- How to reconcile the difference in the number of contaminants types (i.e., 100,000 chemicals vs. $\geq$1,000 microbes)
- Data relation between Universe - PCCL - CCL
- How should attribute scoring account for
    - Data Availability
    - Data Quality
    - Data Gaps
    - Data Decisions
    - Relationships between the attributes
        - Lack of independence (e.g., magnitude)
        - duplicates other attributes

Who should take on the next steps?

Which activity group?

- **Data Group**
  - ❑ Data issues involving attributes

- **Methods Group**
  - ❑ Scoring approaches for attributes

- **Plenary Group**
  - ❑ Data relation between Universe - PCCL - CCL