

Risk Assessment Basics

- Risk Assessment is a 4-step process:
 1. Hazard Identification
 2. Toxicity Assessment
 3. Exposure Assessment
 4. Risk Computation

1. Hazard Identification

- Requires extensive knowledge of site:
 - Chemicals present – select Contaminants of Concern (COC) that represent most of the risk (high toxicity, high concentrations or quantity)
 - Concentration of COCs in air, soil/sediment/dust, water, biota (plants, animals, fish)
 - Spatial understanding of extent of contamination

2. Toxicity Assessment

- Use existing data developed by federal agencies
- Integrated Risk Information System (IRIS):
<http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList>
- Data by chemical:
 - Non carcinogens: Reference Doses (RfD),
mg chem/(kg body weight – day)) or mg/kg-d
 - Carcinogens: Slope Factors (SF) aka Potency Factors (PF), risk/dose, or risk/mg/kg-d

3. Exposure Assessment

- Where it gets complicated
- Depends on human activities => requires extensive knowledge of behaviors
- Much “standard” data exist, but little data for tribal/subsistence lifestyles
- By exposure route:
 - Inhalation (of contaminated air)
 - Dermal contact (with gases, water, biota, soils/dusts/sediments)
 - Ingestion (of soil/dusts/sediments, biota, water)

3. Exposure Assessment (cont)

- Must compute CDI: chronic daily intake, units of mg chemical / (kg body weight – day)
- This is an “absorbed” dose – what’s actually metabolized into the body
- Inhalation: assumes 100% absorption
 - $CDI = \text{conc of chem} * \text{contact rate} * \text{contact duration} / (\text{body weight} * \text{averaging time})$
 - $CDI = \text{conc} * CR * CD / (BW * AT)$
(mg chem/m³ air) * (m³ air / d) * (d/yr) * (yrs) / (kg body weight * avg days)
- Averaging time AT:
 - AT = CD for non-carcinogens
 - AT = 70 years for carcinogens

3. Exposure Assessment (cont)

- Ingestion: must consider absorption

- $CDI = \text{conc of chem} * ABS * CR * CD / (BW * AT)$

- (mg chem/m³ air) * (mg chem abs/mg chem) * (L water/d) * (d/yr) * (yrs) / (kg body weight * avg days)

- Ingestion of water, food or soil/dust/sediment changes the CR and CD => *this is where you need specific data on behaviors*

3. Exposure Assessment (cont)

- Dermal contact: must consider absorption AND surface area in contact
 - $CDI = \text{conc of chem} * ABS * CR * CD / (BW * AT)$
(mg chem/m³ air)(mg chem abs/mg chem))(cm² skin/event) (events/day) (days/year)(yrs)/
(kg body weight * avg days)
- **Contact rate** & **contact duration** includes:
 - Surface area of skin in contact with media / event (SA)
 - Events of contact / day (exposure rate, ER)
 - Days of contact / year (exposure duration, ED)
- Contact with vapors, water, biota, soil/dust/sed *requires specific knowledge of behaviors*

*It is the Exposure Assessment
where you have to adjust for
tribal/subsistence lifestyles!*

4. Risk Computation

- For non-carcinogens:
 - Risk = Hazard Index (HI)
 - $HI = CDI / RfD$
 - $HI > 1$ indicates excessive risk
 - $HI < 1$ indicates acceptable risk
- For carcinogens:
 - Risk = $SF * CDI$
 - Risk $< 1e-4$ to $1e-6$ (1 in 10,000 to 1 in a million chance of getting cancer) is acceptable
 - e.g., risk = $1e-9$ is acceptable but $1e-2$ is unacceptable
- Add all HI for non-carcinogens to get total non-carcinogenic risk
- Add all risks for carcinogens to get total carcinogenic risk