CHAPTER OVERVIEW

Section 6: Risk Assessment

Learning Objectives

After completing this lesson, you will be able to:

- Identify the basic steps in the risk assessment process.
- Explain the framework for risk-based decision-making.
- Describe methods for identifying hazards.
- Explain methods for toxicity assessment, including dose-response and exposure.

In this section...

Topics include:

What We've Covered

This section made the following main points:

- A **hazard** is the capability of a substance to cause an adverse effect.
  A **risk** is the probability that the hazard will occur under specific conditions.
- **Risk assessment** is the process of determining hazard, exposure, and risk.
  Risk management is the process of weighing policy alternatives and deciding on the most appropriate regulatory action.
- There are **four basic steps to risk assessment**:
  1. **Hazard Identification**
     - Identify or develop information suggesting or confirming whether a chemical poses a potential hazard to humans.
     - (Quantitative) Structure Activity, or (Q)SAR methods, including computer models, help consider closely related chemicals as a group or category.
     - Read-across involves estimating what a chemical may be like, including the presence or absence of certain properties or activities, based on one or more other chemicals.
     - Adverse Outcome Pathways (AOPs) involve *in vitro* methods that evaluate changes in normal cellular signaling pathways.
     - Other emerging methods include (Quantitative) *in vitro* to *in vivo* extrapolation, or (Q)IVIVE, Integrated Testing Strategies, and Integrated Approaches to Testing and Assessment (IATA).
  2. **Dose-Response Assessment**
     - Carcinogenic (cancer) risk assessment involves two steps:
       1. Perform qualitative evaluation of all epidemiology studies, animal bioassay data, and biological activity.
       2. Quantitation of the risk for substances classified as definite or probably human carcinogens.
     - Non-carcinogenic risk assessment includes:
       - Acceptable Daily Intake (ADI), which divides the NOAEL by uncertainty/safety factors.
       - Reference Dose (RfD), which divides the NOAEL or LOAEL by uncertainty/safety factors.
       - Benchmark Dose Method (BMD), which extrapolates data to determine a point of departure (POD) that accounts for study quality.
       - Assessments for noncancer toxicity effects, acute or short-term exposures, and occupational exposures.

3. **Exposure Assessment**
   - People are exposed to mixtures of hundreds of chemicals in everyday life.
   - An **exposure pathway** describes the:
     - Route a substance takes from its source to its endpoint.
     - How people can be exposed to the substance.
   - The three steps of exposure assessment are to:
     1. Characterize the point of exposure setting and exposure scenario.
     2. Identify exposure pathways.
     3. Quantify the exposure.
   - Exposure models are commonly used because actual exposure measurements are often not available.
4. **Risk Characterization**
   - This final phase predicts the frequency and severity of effects in exposed populations.
   - Biological and statistical uncertainties are described.
   - For carcinogenic risks, the probability of a person developing cancer over a lifetime is estimated by multiplying the cancer slope factor for the substance by the chronic, 70-year average daily intake.
   - For noncarcinogenic effects, the exposure level is compared with an ADI, RfD, or MRL derived for similar exposure periods.
