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Hazardous Substance Research Centers

The five regional Hazardous Substance Research Centers were established in 1989 and funded by the U.S. Environmental Protection Agency (U.S. EPA). The Centers' mission is to support and conduct innovative research and technology development in hazardous substance control, cleanup and management. The Centers have an interdisciplinary group of knowledgeable scientists and engineers who can offer technical advice, review sites, and help increase understanding of hazardous contamination.

For more information visit www.toscprom.org or call 1-800-490-3890.



The Great Lakes & Mid-Atlantic Center is a consortium of the University of Michigan, Michigan State University and Howard University

Human Health Risk Assessment

What is risk assessment?

Risk assessment is a method used to estimate a community's increased risk of health problems as a result of exposure to a toxic pollutant. Risk assessment methods can also be used to estimate increased risk of adverse ecological effects due to chemicals in the environment. This Information Brief addresses human health risk assessment. There are four steps to risk assessment: hazard identification, exposure assessment, toxicity assessment, and risk characterization.

The four steps of risk assessment

1. HAZARD IDENTIFICATION

The first step of risk assessment is hazard identification. This is the attempt to determine what potentially harmful chemicals are present in the environment. Scientists collect samples of soil, air, water, sediment, plants, fish and/or animals at and around a site. They analyze those samples in laboratories. This analysis reveals the chemicals present and their levels. Often a screening process is conducted to determine which chemicals are most likely to pose risks. These chemicals are studied further in the following steps.

2. EXPOSURE ASSESSMENT

The exposure assessment identifies conditions where people could come in contact with the chemicals identified in step 1 and how much exposure could occur.

Exposure to toxic pollutants occurs primarily in three ways: ingestion, inhalation, and absorption through the skin. Several ways that exposure occurs are listed below.

- Ingestion
 - Eating contaminated soil or food
 - Drinking contaminated water
- Inhalation
 - Breathing contaminated air
 - Breathing dust that is contaminated with a toxic substance
 - Showering with contaminated water
- Absorption
 - Skin contact with contaminants, whether in soil, water or air
 - Showering or bathing in contaminated water

For each of these pathways, scientists estimate quantities of a given chemical to which a person is exposed. They take into account how long, how often, and how many ways people could be exposed to site chemicals.

3. TOXICITY ASSESSMENT

The toxicity assessment examines the toxicity, or harmfulness, of each chemical found at the site by looking at studies of those chemicals. Scientists examine both the cancer and non-cancer health effects. For chemicals known to cause cancer, any exposure is assumed to increase the chance of developing cancer.

(continued on reverse)

The Four Steps of Risk Assessment

1. Hazard Identification
What chemical hazards are present at the site or in the air?
2. Exposure Assessment
How much of the chemical are people being exposed to and over what time period?
3. Toxicity Assessment
What do studies tell us about the chemicals in question?
4. Risk Characterization
What is the extra risk to human health caused by this amount of exposure to this chemical?

The likelihood of cancer resulting from exposure to a chemical is expressed as a probability—for example, a “one in a million

chance.” For non-cancer effects, a very low exposure may not cause harm to human health. Threshold values have been developed for those chemicals. Exposures below the threshold value are considered safe and levels above the threshold value are considered harmful.

4. RISK CHARACTERIZATION

During the risk characterization step, information from the hazard identification, exposure assessment, and toxicity assessment helps scientists to estimate the additional risk to human health that is caused by toxic pollutants. They add up potential risks from the individual chemicals and pathways and calculate a total site risk. They also consider the amount of uncertainty in the risk estimates. Risk assessment results are then factored into decisions on how best to clean up the site during the risk management phase.

How accurate are risk assessments?

Risk assessments cannot be completely accurate because they contain estimates and assumptions. Scientists often do not have enough information on how toxic substances react in the body or on actual exposures at the site to make completely accurate calculations. Risk assessment is not an exact science. Scientists use the best available data on what is occurring, or could occur, at the site, and apply their judgment to calculate the risks associated with chemicals at the site. Results are probabilities, not certainties.

From risk assessment to risk management

Following the completion of the risk assessment, steps are taken to reduce risk at the site. Risk managers plan strategies to limit or prevent exposures to contaminants. This may or may not call for the removal of contaminants or the cleaning of soil, air, or water. Sometimes workers can place a cap over the site or build underground walls to keep chemicals from reaching people. In other cases, removal may be needed as risk managers seek a solution that will make the site suitable for both current and expected future uses.

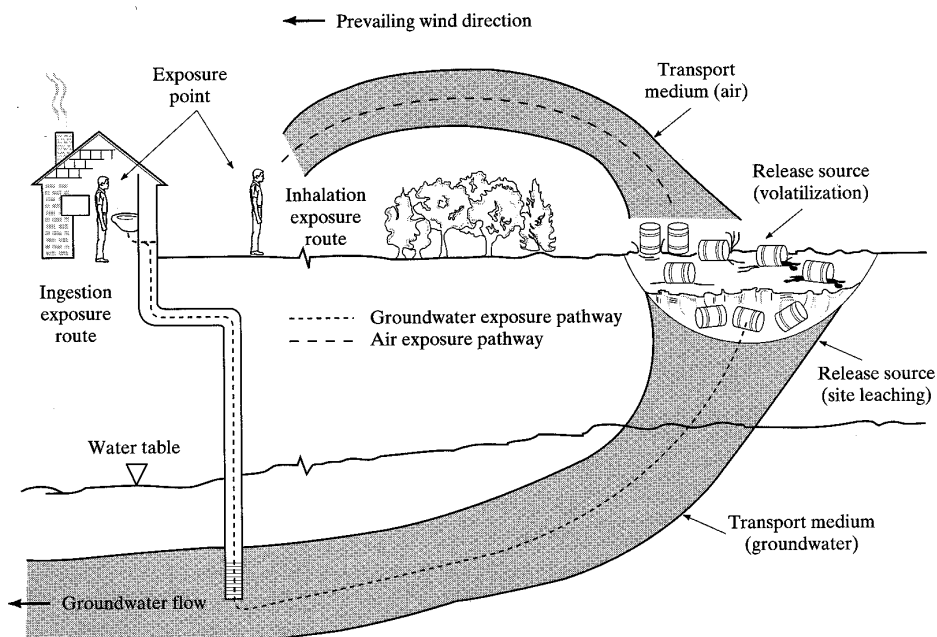


Fig. 1: Common ways for exposures to occur at a contaminated site

For more information:

- **U.S. EPA's Human Health Risk Assessment**
<http://www.epa.gov/Superfund/programs/risk/humhlth.htm>
- **Superfund Today—Focus on Risk Assessment**
<http://www.epa.gov/superfund/tools/today/risk1.htm>