DIPLOMA IN LAW ENFORCEMENT

DLE 2163: SECURITY RISK MANAGEMENT

Chapter 14

Case Studies

LEARNING OUTCOMES

Upon completion of the syllabus topics, students should be able to:

1. Identify the importance of risk management.
2. Demonstrate comprehension of various aspects of risk management.
3. Apply risk management techniques to risk management issues.
4. Demonstrate risk management skills in work.

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Topic 14

Case Studies

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Risk Assessment: Learning Outcomes

1. Definitions: Risk Analysis, Risk Assessment (Evaluation) and their components
2. A detailed look at **HAZARD EVALUATION**
3. Risk Perception, Risk Communication, Risk Management
4. An example of risk assessment: Mesothelioma among Quebec asbestos mining area women.
5. Risk and the precautionary principle

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Buzzword Alert!

- There are a number of technical terms in this lecture
- Yes, you have to know them!
- These terms have precise meaning, even though you will often see them MIS-used.
- Since risk assessment is (or aims to be) a scientific activity we must agree on terminology

Risk Analysis

- This is the overall term for all of Risk Science
- It has four elements:
- - Risk Assessment (Risk Evaluation)
- - Risk Communication
- - Risk Perception
- - Risk Management (Risk Characterization (EPA))

Definition of Risk Assessment

- Risk Assessment, or risk evaluation, is a scientific/ mathematical discipline which is
- a substantive, changing and controversial field.

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Definition of Risk Assessment

- at the margin of our understanding of the health effects of chemicals and other substances.
- best defined as the determination of pathology caused by human production and activity, with the understanding that "pathology" is a change in some aspect of human anatomical structure or function.

Risk Assessment: Two Roads

- **Qualitative**
- - virtually the same thing as "hazard evaluation" step of "Quantitative" Risk Assessment
- - is the material harmful to humans under *any* circumstances
- - Codified by agencies, especially for cancer

- **Quantitative**
- A formal process with four steps
- Ends with a mathematical estimation of *actual risk*, usually quantified as deaths per 1,000,000 per year or less.

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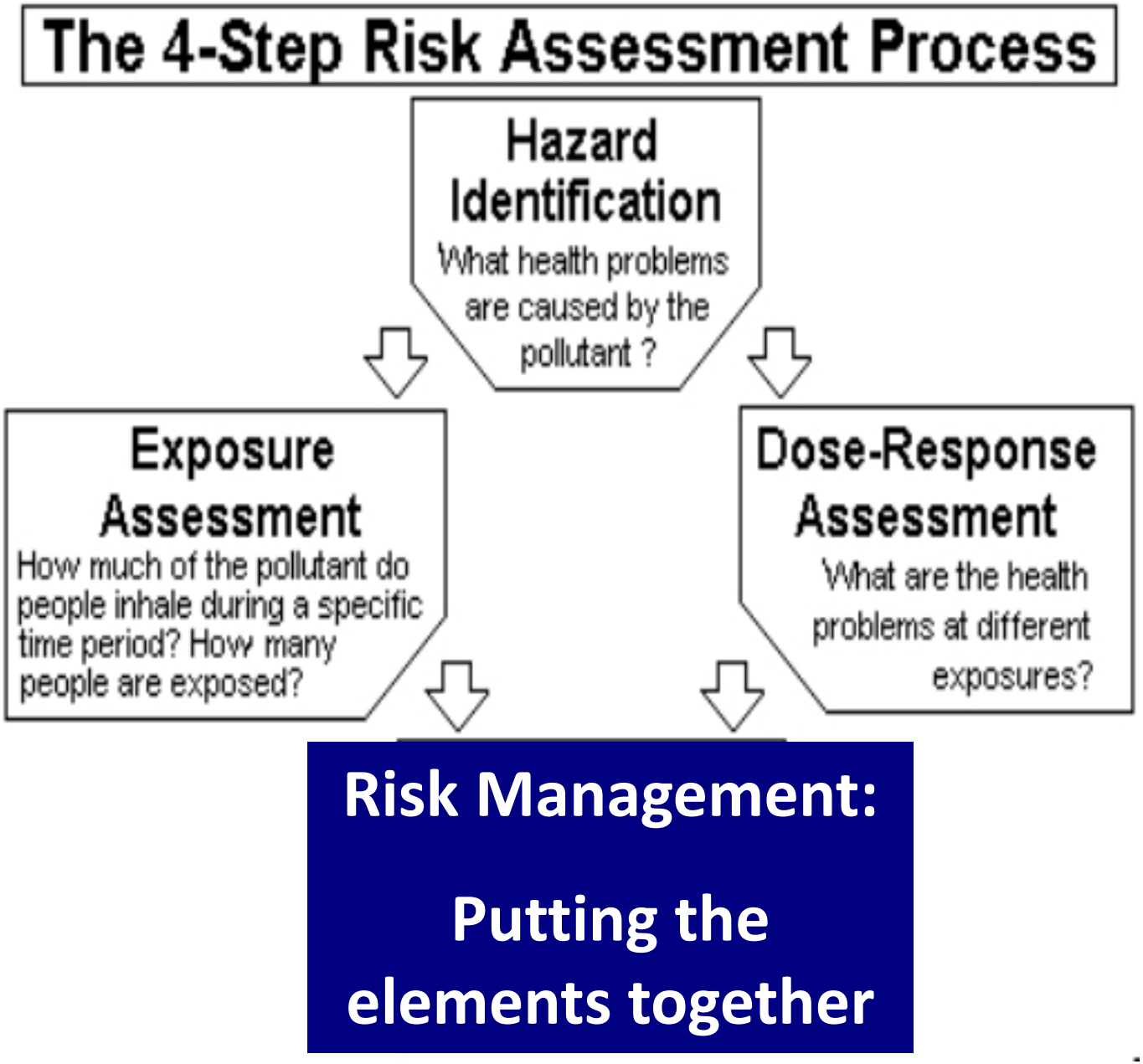

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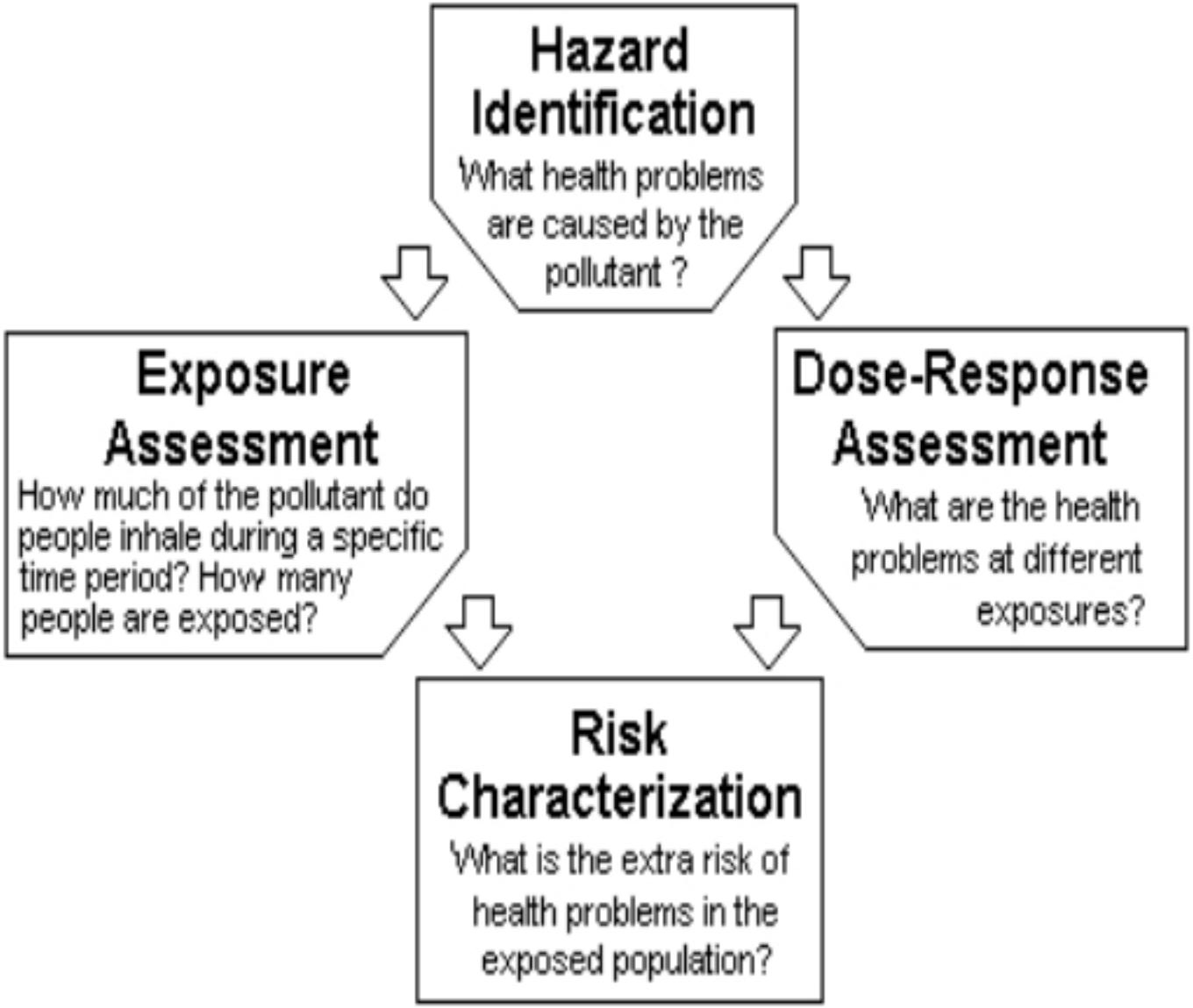
The 4-Step Risk Assessment Process



“Hazard Evaluation” is the equivalent of Qualitative Risk Assessment.

(in many instances the three further steps are not taken)

Examples: EPA, IARC Cancer Monographs

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Types of Study Available for Hazard Evaluation

- BEST: Human Evidence (Epidemiology)
- Next best: Whole animal studies (toxicology; animals exposed to known dose and allowed to live to times of sacrifice or natural death)

Types of Study Available for Hazard Evaluation

- Other:
  - In-vitro studies (studies on cells in culture)
  - Structure-function relationship study and similar
  - Identification of active compounds in metabolism

Study for Hazard Evaluation: Human

- Case reports (example: angiosarcoma of liver)
- Case series (example: mesothelioma in S. Africa)
- Descriptive epidemiology (much like geographic study; ecological fallacy is a problem)

Study for Hazard Evaluation: Human

- **Analytical epidemiology:**
- **best: cohort studies: following exposed humans through time**
- **second best: case-referent studies: comparing "cases" of given disease to MATCHED referents and noting differences in exposure.**

Study for Hazard Evaluation: Animal

- Studies of cells (in vitro studies: example $O2^-$)
- Acute toxicity studies (how much does it take to kill half of all the animals?)
- Chronic toxicity studies:
  - Best method but very expensive and time-consuming
  - Proper design (doses, sacrifice times, animal selection) a must.

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Study for Hazard Evaluation: Animal: Problems

- Ethical Concerns (see: papers by Peter Singer and Henry Spira):
- e.g. Rack L, Spira H. **Animal rights and modern toxicology** *Toxicol Ind Health* 1989 Jan;5(1):133-43.
- **Conversely: non-realistic models may be useless;**
  - **e.g. animal intra-tracheal injection versus inhalation**
  - **e.g. use of rats (who do not have the same respiratory tract structure as humans: HOGS are best!!!)**

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Study for Hazard Evaluation: Human: Problems

- Ethical Concerns
- Expense
- LATENCY
- Practical considerations: for example the use of questionnaires or interviews in a case-referent study and:
  - -- sample size, response rate
  - -- selection bias and other bias

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Hazard Evaluation: Synthesis: IARC Group 1

- **GROUP 1: AGENT CARCINOGENIC TO HUMANS**
- Assignment to this category is based on a finding of "sufficient" evidence of carcinogenicity *in humans*. This implies a causal relationship between exposure to a chemical and cancer in epidemiological studies in which "...chance, bias and confounding could be ruled out with reasonable confidence"[13].

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Hazard Evaluation: Synthesis: IARC 2A

- **GROUP 2A: AGENT *PROBABLY* CARCINOGENIC TO HUMANS**

- "limited" or inadequate evidence in epidemiological studies for carcinogenicity:
- the agent falls into this category if there is "**sufficient**" evidence from experimental animal work. Causal relationship has been shown in **two or more species of animals** *OR* in **two or more *independent studies* in one species.**

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Hazard Evaluation: Synthesis: IARC 2B

- **GROUP 2B: AGENT *POSSIBLY* CARCINOGENIC TO HUMANS**

- sufficient evidence for carcinogenicity **neither** in humans nor in experimental animals.
- a "credible" causal HUMAN relationship is suggested but bias, chance and confounding cannot be ruled out **AND** sufficient animal evidence **OR**
- "inadequate" evidence in humans but "sufficient" animal evidence.

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Hazard Evaluation: Synthesis: IARC 3:

- **GROUP 3: AGENT NOT CLASSIFIABLE FOR HUMAN CARCINOGENICITY**

- category for agents which cannot otherwise be classified.
- Really a “garbage” category scientifically, but corresponds to some extent to the *Precautionary Principle*
- *GMOs could possibly fit this category*

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Hazard Evaluation: Synthesis: IARC 4

- **GROUP 4: AGENT "PROBABLY" NOT CARCINOGENIC TO HUMANS**

- animal studies in at least two species showing that the substance is “not carcinogenic”.
- *If there is a large body of negative animal evidence:*
- the agent will fall into this category even if there is some, but "inadequate", epidemiological evidence

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Exposure Assessment 1

- **How much of a pollutant do people inhale/ ingest ?**
- **In what period of time?**
- **How many people will be exposed?**
- **To what? Or which (e.g. PCB)?**
- **From what source(s)?**
- **With what interaction(s) (e.g. smoking)**

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Exposure Assessment 2

- **Example: Total suspended particulates**
- **Sample stacks; sample environment; sample PEOPLE**
- **Characterize the particles (carbon? Asbestos?)**

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Exposure Assessment 3

- **Model the exposure (using for example wind speed)**
- **Determine the source(s)**
- **Find out anything “special” about the population**

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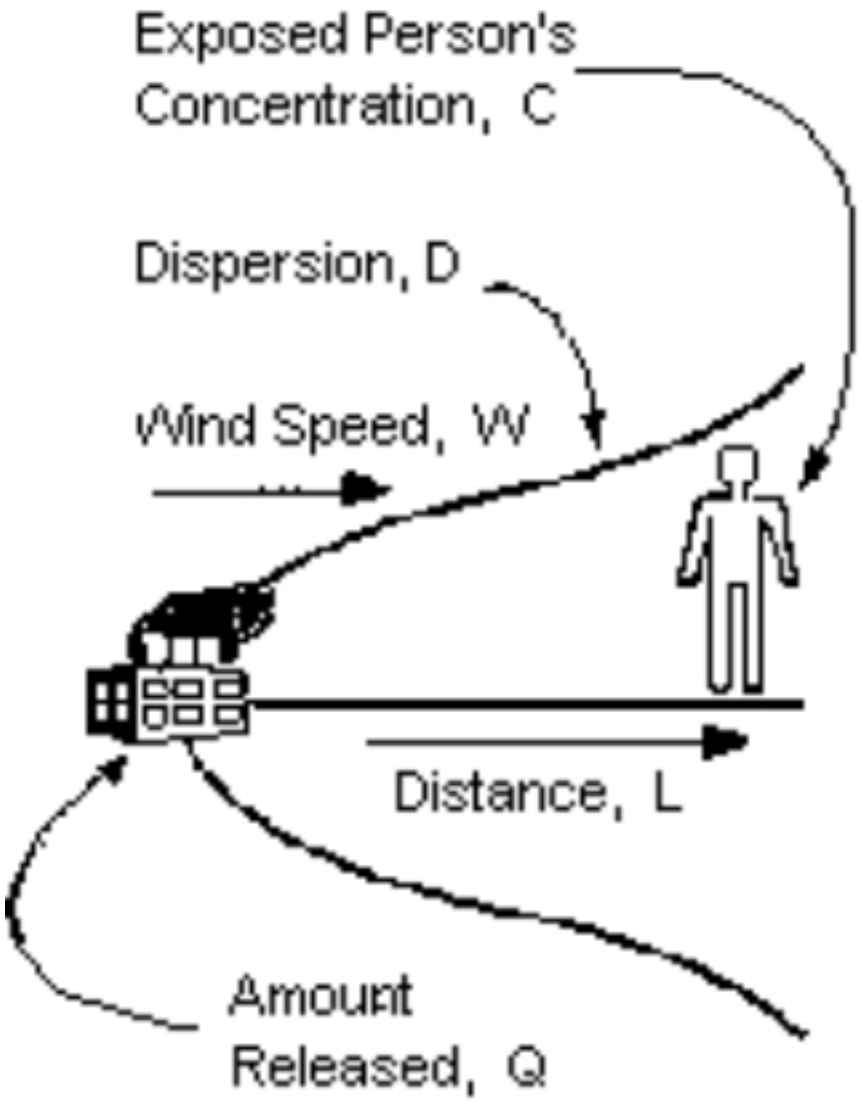
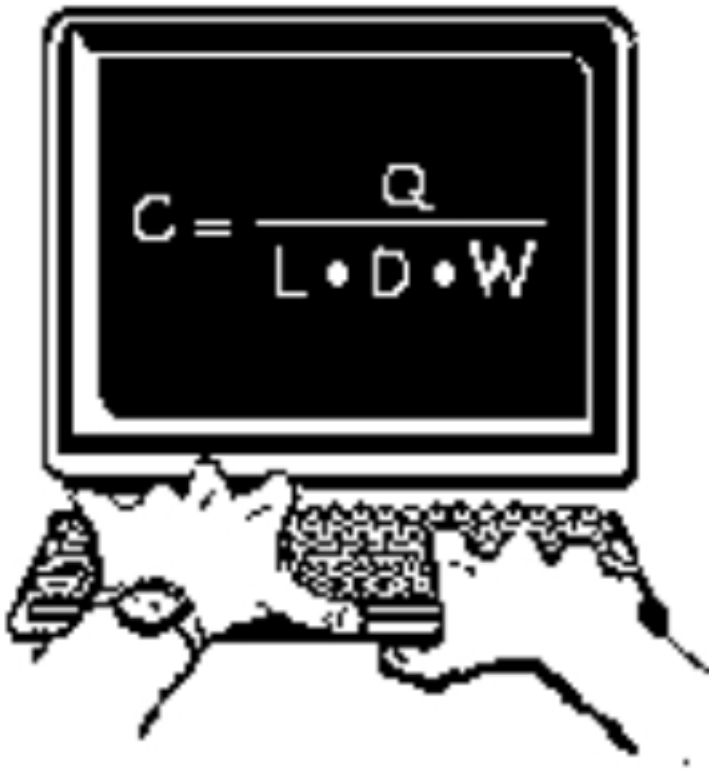
Exposure Assessment





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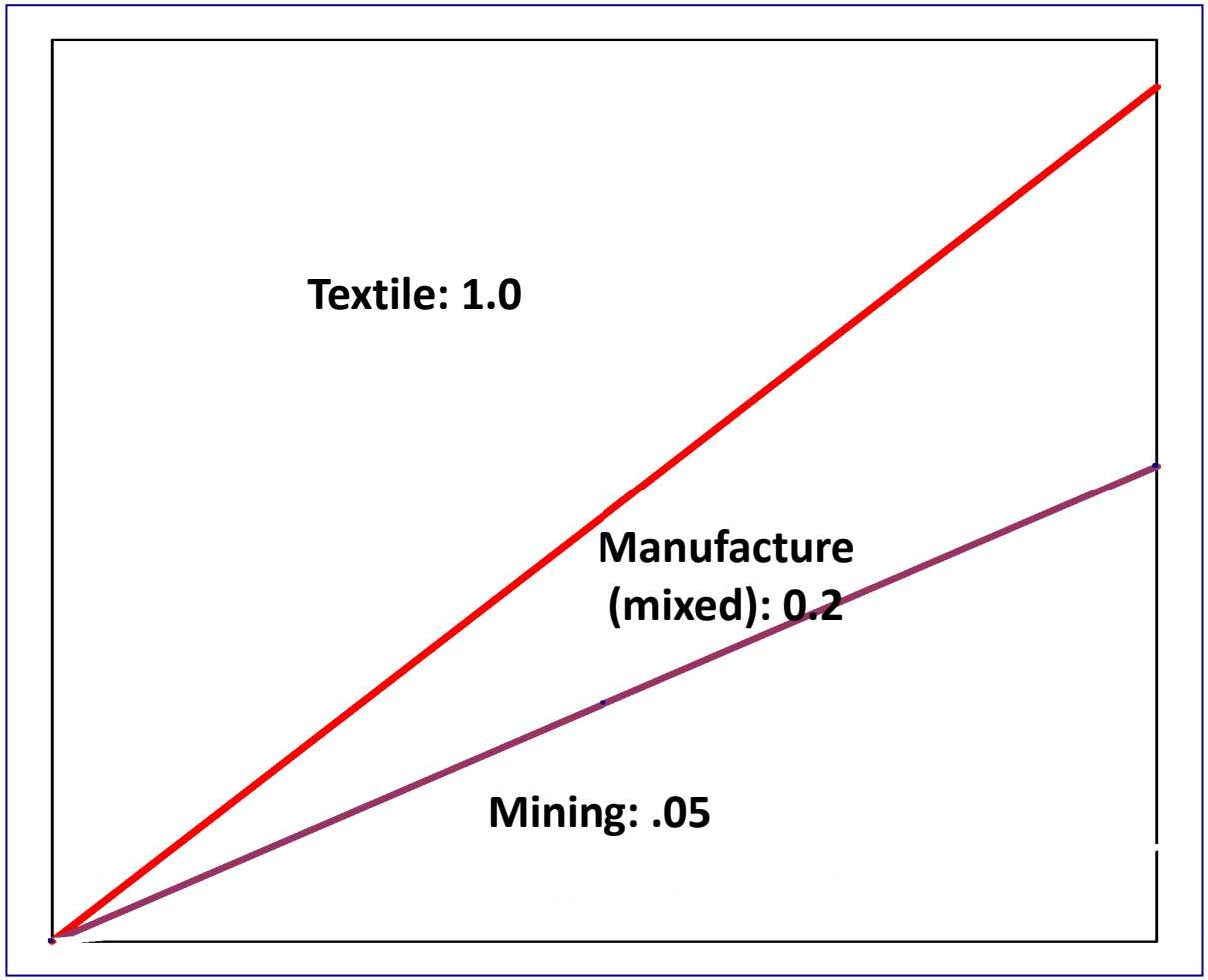
Dose-response relationships

- **"how much is dangerous" ?**
- **Animal data and (preferably) human occupational data used: example: BEIR IV**
- **The problem of thresholds**
- **Extrapolation: most common convention is the use of some multiple of the upper bound of the 95% confidence interval**

SLOPE (b) of the lung cancer/ exposure curve:
SMR = 100 + [b *times* (cumulative exposure)]

Slope (extent per unit exposure) of risk



Degree of exposure ----→

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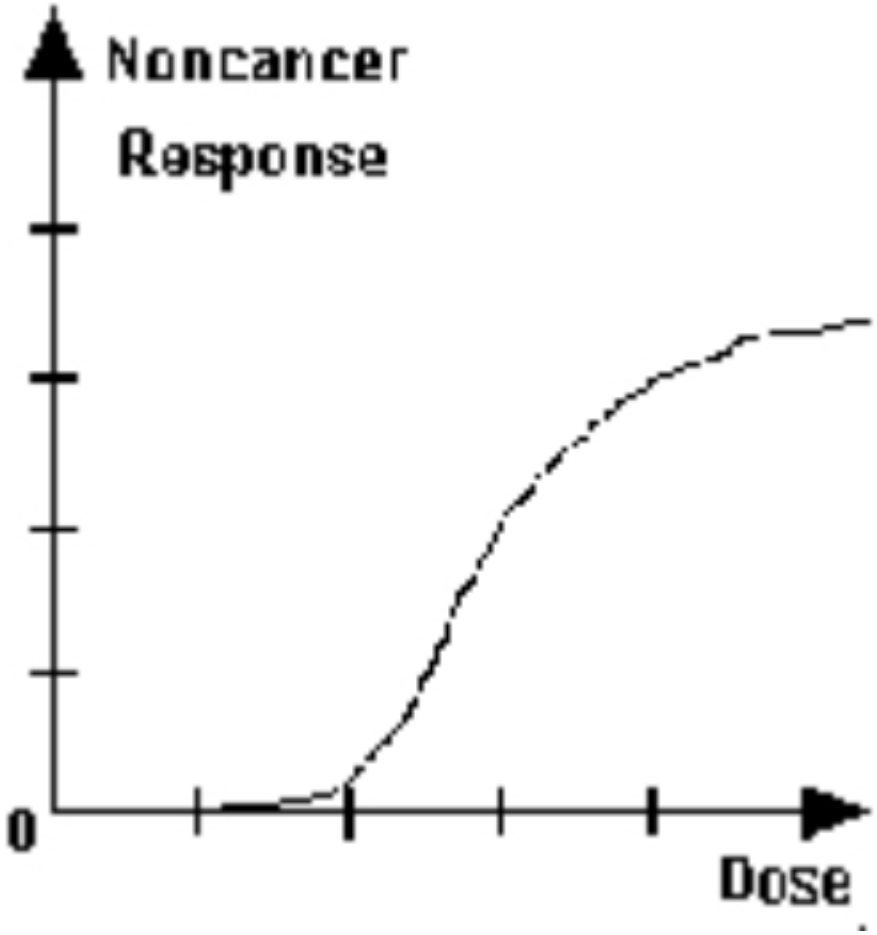
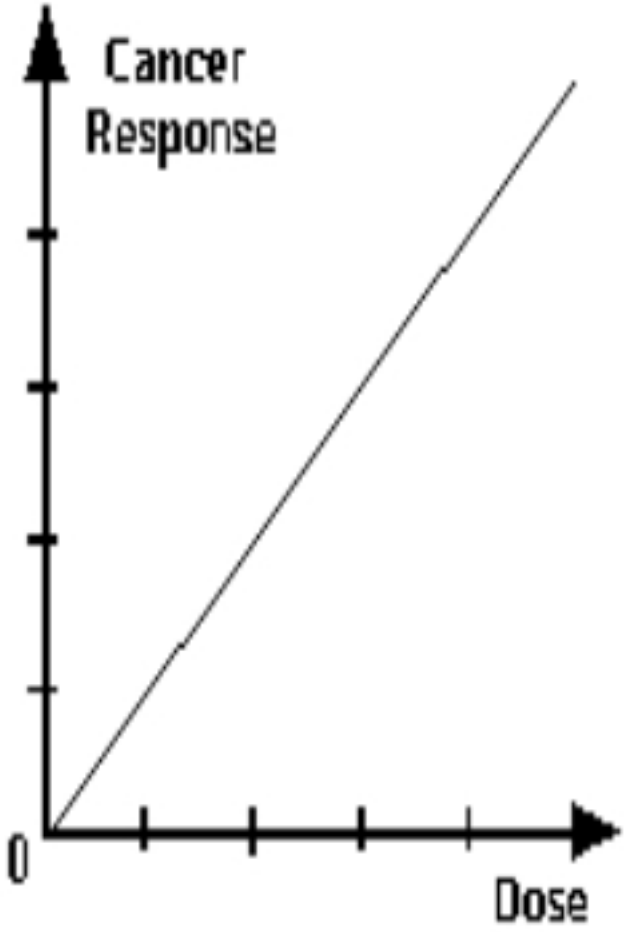
Different principles for cancer and non-cancer





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The threshold issue

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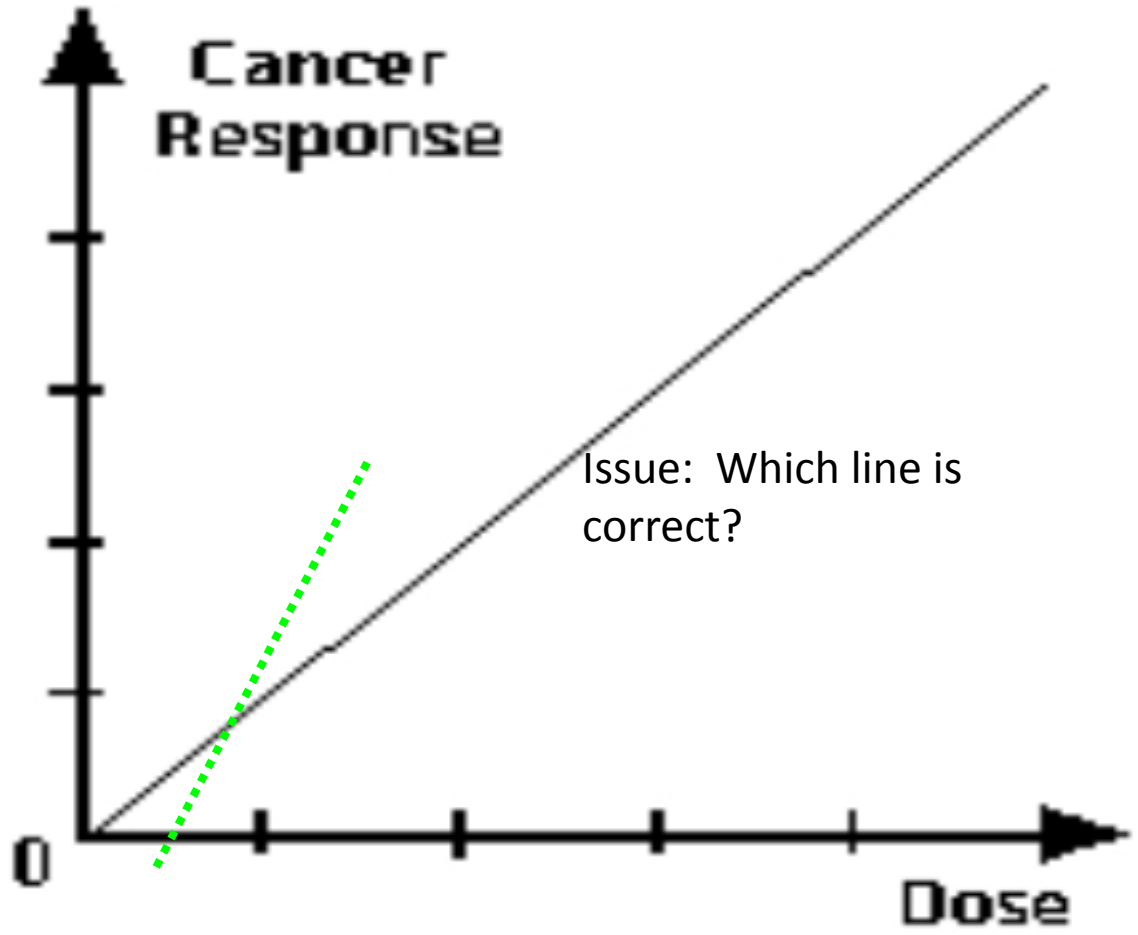

Exposure ---→

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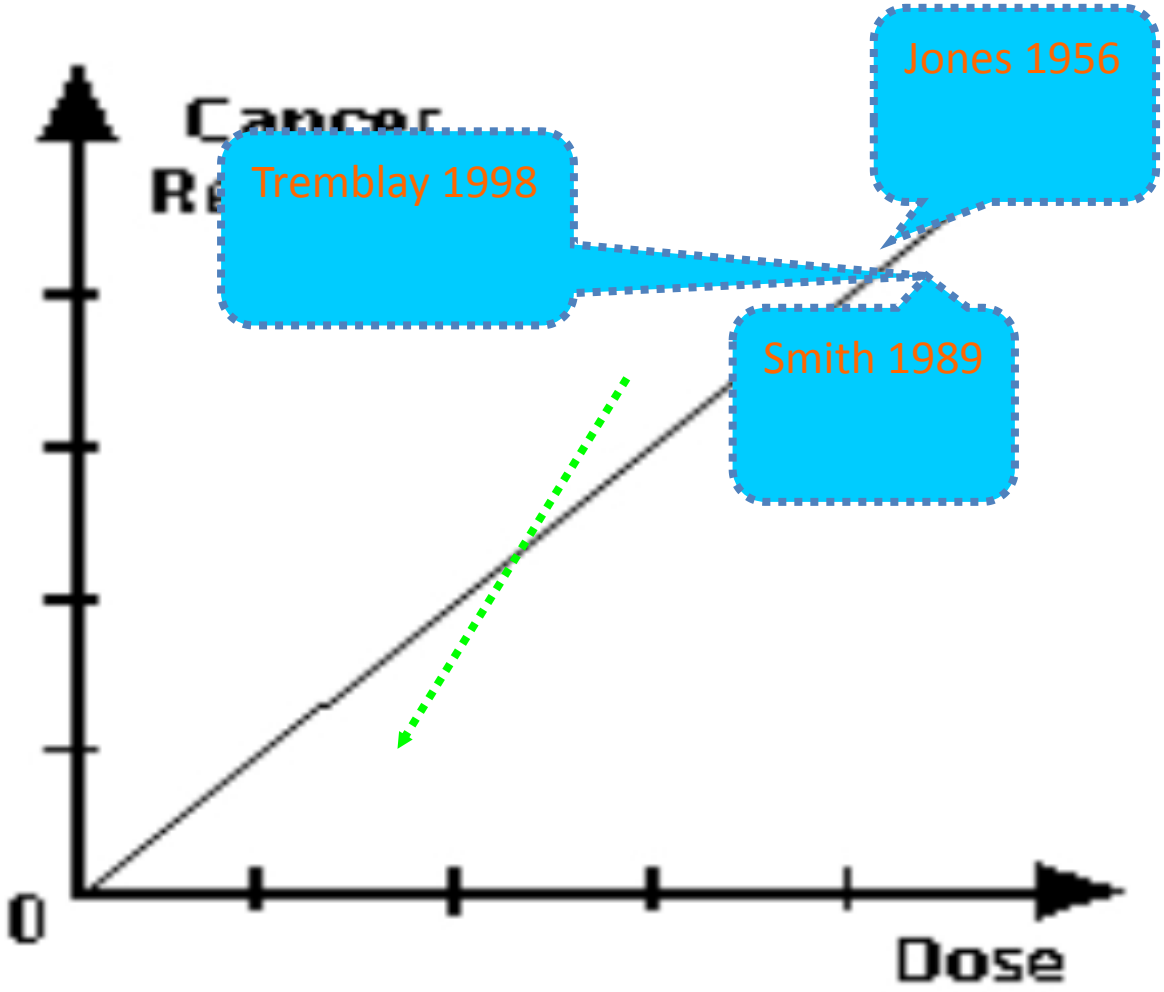
The threshold problem: points are at high dose



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Risk Characterization/ Management 1

- What Is the **Extra** Risk to Health?
- Maximum Individual Lifetime Cancer Risks:

Maximum Lifetime Exposure **X** Dose-Response Relationship **=** Maximum Individual Lifetime Risk

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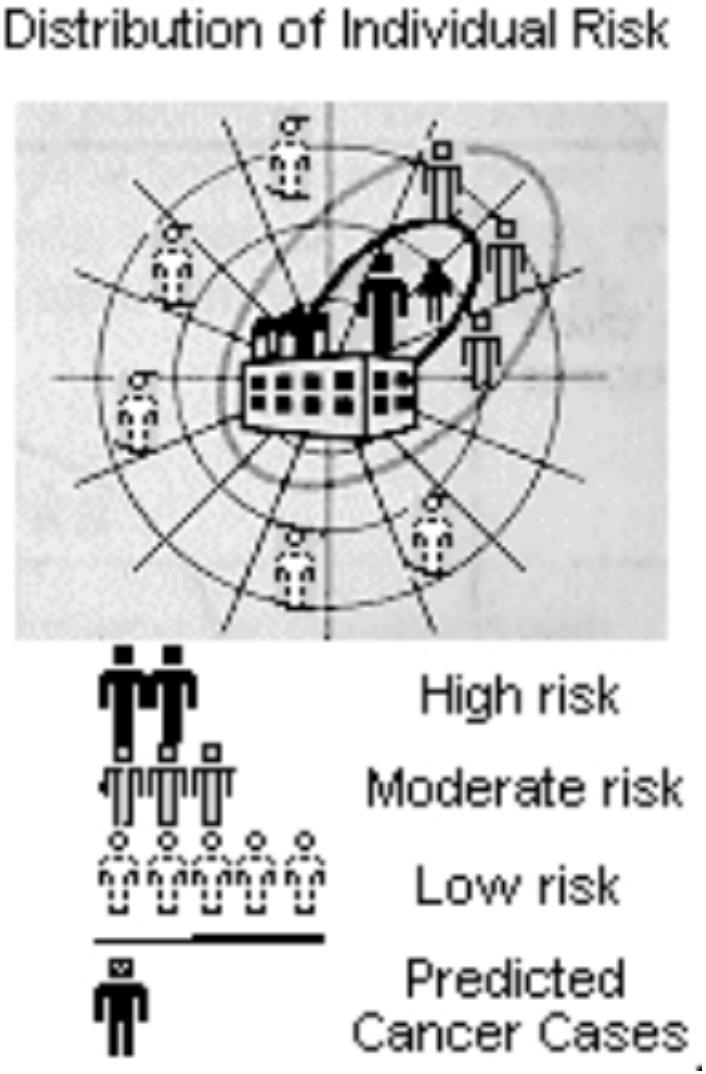
Risk Characterization/ Management 2

- What Is the **Distribution** of **Individual** Risks?

Population Cancer Risks can be calculated from the Distributed Individual Risks



This is where we "do the math"

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Risk Perception; Risk Communication

- The balance between “risk” and “outrage”
- High risk/ low outrage: radon and lung cancer?
- Low risk/ high outrage: asbestos in schools?
- The media as an "amplifier"
- Voluntary vs. Involuntary Risk (smoking vs. hazardous waste siting)
- Known vs. Unknown Risk (lead pipes; lead in gas)

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Risk assessment based on the linear exposure-effect model