Environmental Hazards & Human Health

Chapter 18

Toxicology, Risk, & Health

Web of Life - we are part of the earth

Does it magnify in the trophic pyramid?

Biomagnification

- Fat-soluble compounds
- DDT
- PCB’s
Does it accumulate in our body?  
**Bioaccumulation**
- Increased concentration in specific tissues or organs
- Red tide – Florida Manatee’s & other marine organisms
- Dioxin- persistent toxic chemical used to make paper (chlorination) and PVC plastic
- Asbestos- mineral fiber used for insulation and fire-retardant
- Mercury

---

**Life expectancy at birth (2003)**

- 80-85
- 75-80
- 70-75
- 65-70
- 60-65
- 55-60
- under 55
- NA

---

**Leading causes of mortality in developing and developed countries 1998**

**Developed countries**
- Total number of mortalities = 6 million
- 45% Cancers
- 25% Communicable diseases
- 6% Injuries

**Developing countries**
- Total number of mortalities = 45.9 million
- 35% Cancers
- 14% Communicable diseases
- 11% Injuries

Fig 16-2
Hazards in the Environment

Cultural Hazards
- Unsafe working conditions
- Poor diet
- Drugs, drinking, driving
- Poverty

Biological Hazards
- Plagues: *Yersinia pestis*: Black Death
- Cholera: in copepods increases during El Nino
- Malaria: *Anopheles* Mosquito
- Tuberculosis: *Mycobacterium tuberculosis*
- Overuse of Antibiotics
The Growing Threat of Tuberculosis

- Lack of TB screening and control programs in developing countries where 95% of the new cases occur.
- Most strains of the TB bacterium have developed genetic resistance to most of the effective antibiotics.
- Weakened AIDS patients develop TB.

Epidemiological Transition

Will the Bird Flu (H5N1) Be the Next Epidemic?

The World’s Top Five Deadliest Diseases
Chemical Hazards- Industrialization

- Mutagens
- Carcinogens- cigarette smoke!
- Neurotoxins- DDT, PCB’s, organophosphates, formaldehyde, dioxin
- Hormone Disruptors- dioxin, CB’s, lead
- Depends upon the persistence of the compound
- Oil-or fat-soluble toxins can penetrate cell membrane

Dose-Response Curve- at what point does the substance become a poison

How do we Estimate Toxicity?

Toxicity ratings are based on the average lethal dose

ED-effective dose
TD-toxic dose to
LD-lethal dose

Note: overlap of curves due differences in body size
2004 EPA Top 5 toxic substances

1. Arsenic
2. Lead
3. Mercury
4. Vinyl chloride (used to make PVC plastic)
5. Polychlorinated biphenyls (PCB’s)

Mercury
The Hatters Disease

200 years ago, the furs used to make beaver felt hats was dipped into mercury nitrate solution as a preservative and to soften the animal hairs. Unfortunately the workers in the felt hat trade absorbed mercury through their skins; the resulting mercury poisoning caused shaking and slurred speech.

Mercury

- Mercury is a neurotoxin, meaning it affects the nervous system, it effects the cognitive development of children.
- It causes fatal heart attacks in adults.
- Mercury vapors from gold mining are causing brain damage in the children of Nambija.
- Mercury from the burning of fossil fuels escapes into the environment and changes into methylmercury, it is ingested by fish. Mercury-contaminated fish are the most likely source of mercury poisoning.
The current EPA reduction of mercury released by the burning of coal has been criticized by the Harvard Center for Risk Analysis, the rule calls for a reduction from the current 48 tons a year to 15 tons a year by 2018.

Mercury is Bioaccumulated in the body. Pregnant woman should not eat sushi or tuna.

Safe Harbor Seafood
A company that tests fish for mercury and only certifies fish with low levels of mercury.
Risk Assessment

Risk - a measure of the likelihood that you will suffer harm from a hazard

Begun by the EPA in the mid 1970's for cancer risk

What is the probability of harm to human health, society, or the environment?

Risk Management

Is a regulatory action necessary?

- Part of the EPA policy for the last 20 years
- Cost-benefit analysis
- Risk-benefit analysis
- Public Preferences - risk perceptions
Comparative risk analysis of ecological and health problems

### Scientists (in rank order in each category)
- High-Risk Health Problems
  - Human health cancers
  - Respiratory problems
  - Kidney, liver damage
  - Nervous system damage
  - Birth defects
- High-Risk Ecological Problems
  - Acid deposition
  - Nuisance species
  - Air pollution
  - Pollution
  - Disease and habitat alteration
- Low-Risk Ecological Problems
  - Air pollution
  - Pollution
  - Disease and habitat alteration

### Citizens (in rank order)
- High-Risk Problems
  - Nuclear power-plant accidents
  - Industrial accidents
  - Wastewater pollution
  - Oil spills
  - Toxic substances in food
- Medium-Risk Problems
  - Species extinction and loss of biodiversity
  - Habitat alteration and destruction
  - Oil spills
  - Leaking underground tanks
- Low-Risk Problems
  - Air pollution from vehicles
  - Pestidice residues in foods
  - Water pollution from sewage plants

---

**Risk Assessment**
- Hazard identification: What is the hazard?
- Probability of risk: How likely is the event?
- Consequences of risk: What is the likely damage?

---

**Risk Management**
- Comparative risk analysis: How does it compare with other risks?
- Risk reduction: How much should it be reduced?
- Risk reduction strategy: How will the risk be reduced?
- Financial commitment: How much money should be spent?
Neurotoxins

- Create behavioral changes
- Learning disabilities
- Attention deficit disorder
- death

Endocrine disruptors

- DDT - pesticide
- PCB’s -
- Atrazine - herbicide
- Bisphenol A – hard plastics
- Phthalates- cosmetics

Where an activity raises threats of harm to human health, or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically.

In this context, the proponent of an activity, rather than the public, should bear the burden of proof.
Indoor Air Pollution

Biofuels with improper ventilation

Asthma