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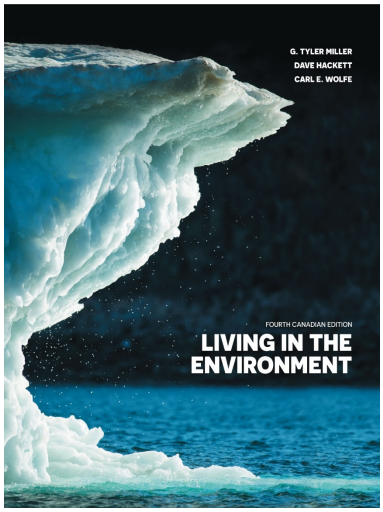


prepared by

Ian Dawe

Chapter 19

Risk, Toxicology, and Human Health

Key Concepts

What types of hazards and risks do we face?

- Toxicity
- Chemical hazards
- Biological hazards and diseases

How do we assess, manage, and reduce risks?

Case Study: The Big Killer

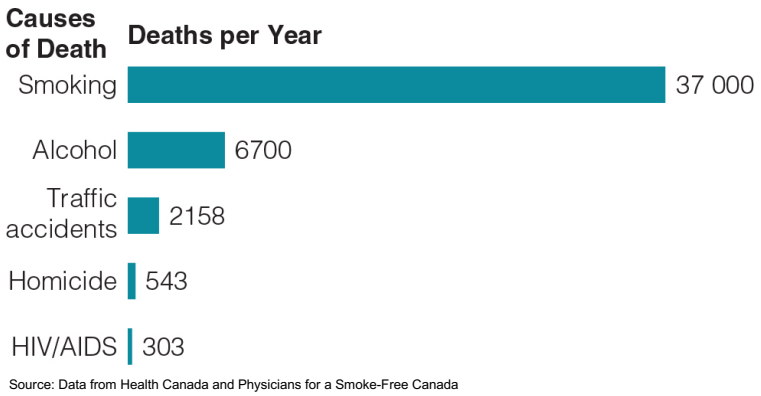
Tobacco is responsible for one in every five deaths in Canada.

100 deaths per day

Costs $17.7 billion a year in health care, disability, fires related to smoking

Taxation, banning advertising and sale, anti-smoking campaigns

Case Study: The Big Killer



Source: Data from Health Canada and Physicians for a Smoke-Free Canada

What Is Risk?

The **probability** of suffering harm from a hazard such as

- Cultural hazards
- Chemical hazards
- Physical hazards
- Biological hazards

How Risky Are These Hazards?

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Toxicology: Assessing Chemical Hazards

Toxicity: Measure of the amount of harm caused by a compound

- **Dose**: Quantity ingested, inhaled, absorbed
- **Frequency** of exposure
- **Personal traits**: Age, organ function, genes

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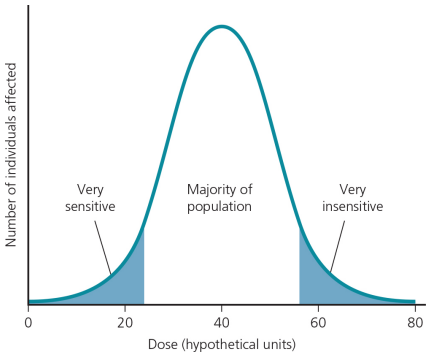
Toxicology and Genetics

Genes can make a subset of the population more vulnerable.

Can also make certain individuals less vulnerable

Gives rise to anecdotal evidence with little scientific meaning



Factors Affecting the Toxicity of a Substance

Solubility

Persistence

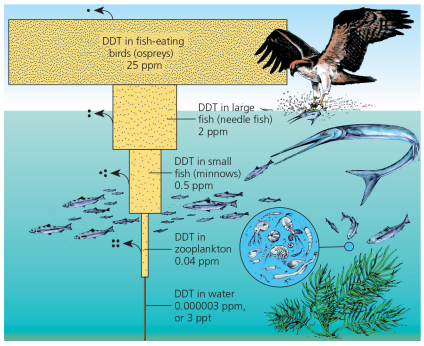
Bioaccumulation

Biomagnification

Chemical interactions

- Antagonistic *vs.* synergistic

Bioaccumulation and Biomagnification of DDT



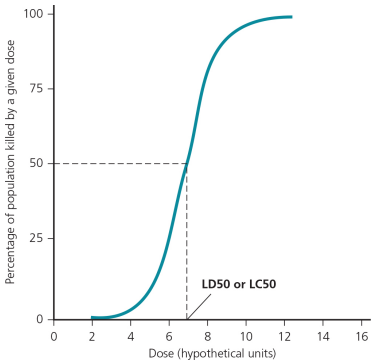
How Do We Estimate Toxicity?

Testing in lab animals

Lethal dosage (LD_{50}) *or* **lethal concentration** (LC_{50}) to kill 50% of the population

Acute *vs*. **chronic** effects

Does this always extrapolate to humans?



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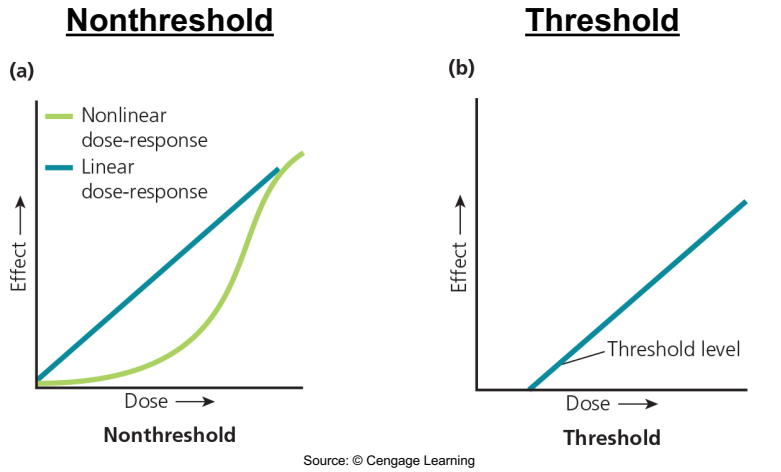
Dose-Response Curves



Source: © Cengage Learning

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What Are Toxic and Hazardous Chemicals?

Toxins

- Mutagens → *Possible DNA mutations*
- Teratogens → *Harm or birth defects in utero*
- Carcinogens → *Promote malignant tumour growth*
- Neurotoxins → *Harm to the nervous system, including behaviour, paralysis, death*

Hazards

- Flammable
- Explosive
- Irritant or allergen
- Interfere w/ O_2 uptake

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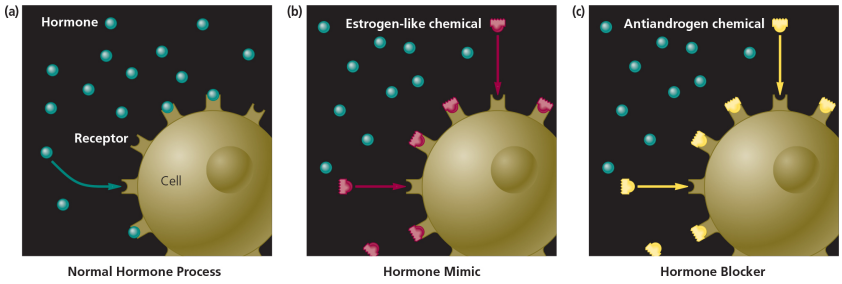
Are Hormonally Active Agents a Human Health Threat?

Possible effects on sexual development and reproduction

Feminizing/masculinizing chemicals affect sex distribution in animals



Normal Hormone Process | Hormone Mimic | Hormone Blocker

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Biological Hazards

Nontransmissible

44% of annual deaths

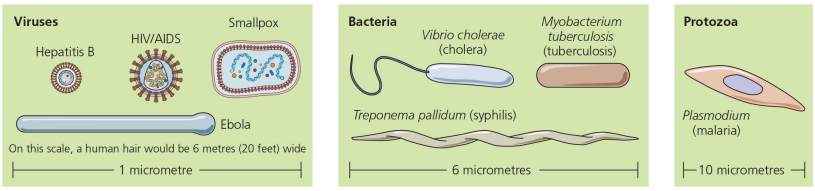
- Cardiovascular disorders
- Cancers
- Diabetes
- Asthma
- Emphysema
- Malnutrition

Transmissible

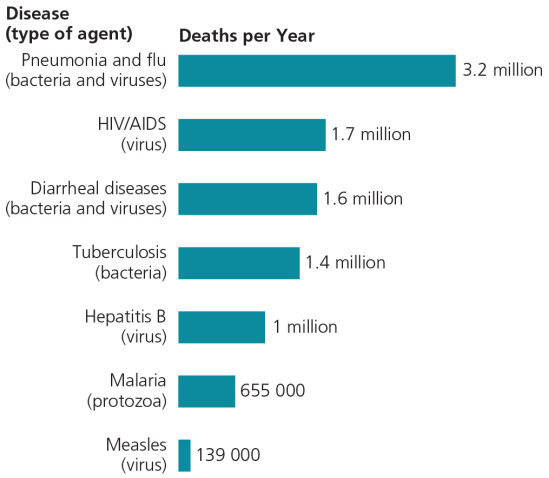
- Pathogens
  - Bacteria
  - Viruses
  - Protozoa
  - Parasites

28% of annual deaths worldwide

Biological Hazards



Deadliest Infectious Diseases



Source: Data from World Health Organization, 2012

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Are We Losing Ground in Our Struggle Against Infectious Bacteria?

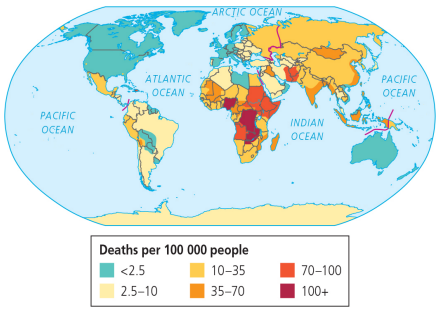
Genetic resistance due to high reproductive rate

Transfer resistance to previously nonresistant bacteria

Global travel

Overuse of pesticides

Overuse of antibiotics



Source: World Health Organization

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How Serious Is the Threat From Viral Diseases?

Most worldwide impact

- Influenza
- HIV
- Hepatitis B

~ 1.9 million deaths annually

Most media attention

- West Nile virus
- SARS
- Avian influenza
- H1N1 influenza

Ranging from 0 to 500 000 deaths during an outbreak

How Serious Is the Global Threat From HIV and AIDS?

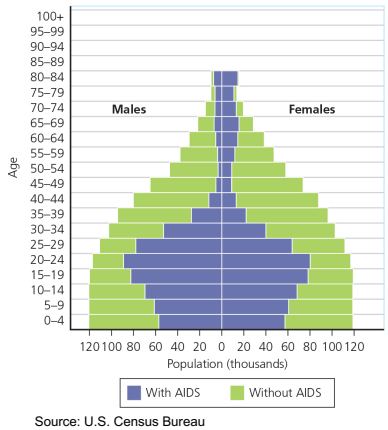
2013: 78 million people infected worldwide

- 96% in developing nations

7-10 year incubation

- High risk of transmission

Life expectancy dropped by 15 yrs in sub-Saharan Africa



Source: U.S. Census Bureau

Malaria

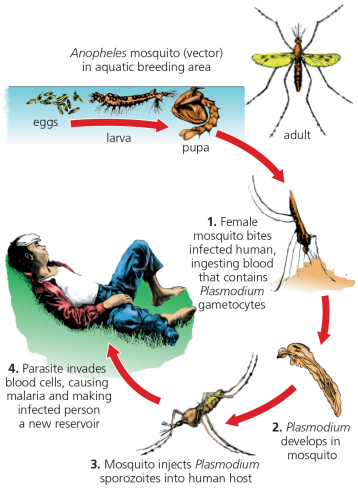
Challenges

- 1 in 5 people at risk
- Kills 655 000 people per year
- Resistance to insecticides
- Resistance to antimalarial drugs

Prevention

- Remove stagnant water
- Insecticide-treated nets
- Cultivating mosquito predators
- Zinc + vitamin A supplements
- Usage of DDT in endemic countries

Malaria Life Cycle



Infectious Diseases: Solutions

FIGURE 19-17 **SOLUTIONS**

Infectious Diseases

Ways to prevent or reduce the incidence of infectious diseases, especially in developing countries. Which two of these solutions do you believe are the most important?

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- Increase research on tropical diseases and vaccines.
- Reduce poverty.
- Decrease malnutrition.
- Improve drinking water quality.
- Reduce unnecessary use of antibiotics.
- Educate people to take all of an antibiotic prescription.
- Reduce antibiotic use to promote livestock growth.
- Institute careful hand washing by all medical personnel.
- Immunize children against major viral diseases.
- Provide oral rehydration for diarrhea victims.
- Conduct global campaign to reduce HIV/AIDS.

Checking Our Progress at Combatting HIV/AIDS, Malaria, and Other Diseases

HIV/AIDS

New HIV infections declined 21% since 1997

AIDS-related deaths declined 19% since 2004

13x increase in people receiving treatment for HIV/AIDS

– But only 50% of those who need it

Malaria

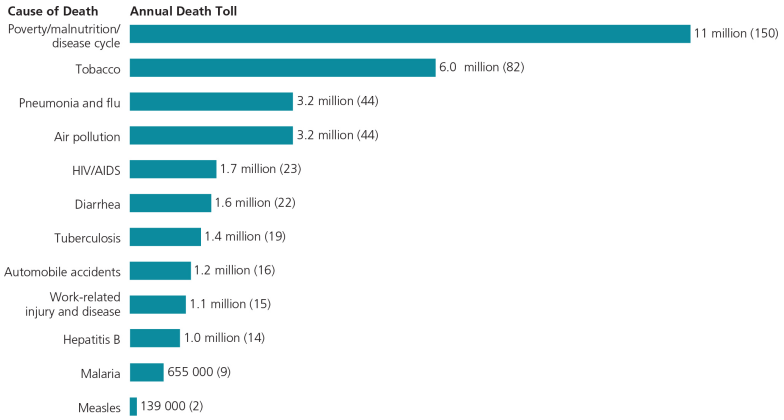
Reduced deaths from 1 million in 2008 to 655,000 in 2012

Tuberculosis

Reduced deaths by more than 1/3 since 1990

Worldwide Annual Causes of Premature Death

The greatest health risk of all is **poverty**.



Source: World Health Organization and U.S. Centers for Disease Control and Prevention

Risk Analysis

Risk assessment

– How reliable are our models?

– What are the uncertainties?

Comparative risk analysis

Risk management

– How much risk is acceptable? To whom?

Risk communication

How Can You Become Better at Risk Analysis?

Carefully evaluate media presentations.

Compare risks.

– How risky is this compared with other risks?

Concentrate on the most serious risks over which you have some control.

Conclusion

Environmental hazards include toxins and diseases.

Infectious diseases less deadly than 100 years ago (thanks to vaccination) but still deadly.

Environmental risks need to be managed.

Risks are sometimes difficult to assess.