

Module 01 Lecture 04

Safety of potable water

Demand for water

Some compelling statistics

- human water use has increased more than 35-fold over the past three centuries
- per capita water consumption in North and Central America is twice that of Europe, three times that of Asia and seven times that of Africa
- about one billion people in developing countries do not have access to potable water
- unsafe water, along with food, is implicated in 3 million deaths about 2.4 billion episodes of illness per year
- the world's population, now 5 billion, is expected to increase to 8 billion by 2025 and 10 billion by 2050. This means that demands for water and food will also increase.

Water safety a matter of public concern

Water quality

- ◆ **strictly regulated**
- ◆ **an important public health indicator**
- ◆ **standards are becoming more rigorous**

Hazards in water

Surface water

- ◆ acid rain
- ◆ storm water runoff
- ◆ pesticide runoff
- ◆ industrial waste

Hazards in water

Ground Water

- ◆ **disease-producing pathogens**
- ◆ **leachate from landfills and septic systems**
- ◆ **hazardous household products**
- ◆ **agricultural chemicals**
- ◆ **leaking underground storage tanks**

Waterborne pathogens

These organisms cause most waterborne infections

- ◆ **bacteria**
- ◆ **viruses**
- ◆ **parasites**

Waterborne pathogens

Bacteria

- *Shigella* spp
- Pathogenic *Escherichia coli*
- *Vibrio cholerae*
- *Campylobacter jejuni*
- *Salmonella typhi*

Viruses

- Adenoviruses
- Enteroviruses
- Hepatitis A & E
- Norwalk virus
- Rota virus
- Small round viruses

Parasites

- *Giardia intestinalis*
- *Cryptosporidium parvum*
- *Entamoeba histolytica*

Toxins associated with *Cyanobacteria*

- **hepatotoxins (induce death by circulatory shock and liver haemorrhage)**
- **neurotoxins**
- **lipopolysaccharides**

Other sources of contamination in drinking water

- **corrosion or deposits on pipes and storage tanks, caused by iron and sulfur bacteria**
- **colonisation by microorganisms of non-metallic pipe-fittings, joints, lining**
- **microbial growth in distribution systems, encouraged by the presence of organic carbon in the water**
- **infestation of water mains by animal life**

Characteristics of waterborne pathogens

- ◆ pathogens are *discrete* and not in solution
- ◆ pathogens are often *clumped*, or adhere to solids in water; thus, the likelihood of acquiring an *infective dose cannot be predicted* from their concentration in water
- ◆ the likelihood that the pathogen will cause an *infection depends on its invasiveness* and *virulence*, and the *immunity* of the individual
- ◆ pathogens *multiply* in their host

Categories of chemical contaminants in drinking water

- **toxic organic chemicals**
- **toxic inorganic chemicals**
- **radioactive elements.**

Toxic organic chemicals

- *Trihalomethanes (THMs)*
- *Pesticides*
 - herbicides
 - insecticides
 - fungicides
- *Volatile organic chemicals (VOCs)*

Toxic inorganic chemicals

- **arsenic**
- **barium**
- **cadmium**
- **chromium**
- **lead**
- **mercury**
- **nitrate**
- **silver**

Radiological aspects of drinking water quality

- **environmental radiation originates from natural and man-made sources**
- **radionuclides occur naturally in drinking water**
- **drinking water is not a significant source of exposure to radionuclides**

Ensuring water quality

Focus of water quality assurance programs

- ◆ **selection and protection of sources**
- ◆ **treatment process**
- ◆ **distribution networks**

Protecting water sources

- **isolation or protection of the watershed**
- **control of polluting activities in the area**
- **protection of springs, wells and ground water**
- **control or prevention of public access**

Water treatment

Treatment of urban water

- ◆ **pre-disinfection**
- ◆ **coagulation, flocculation, sedimentation**
- ◆ **filtration**
- ◆ **disinfection**

Controlling the distribution system

- **deterioration of underground reservoirs**
- **back siphonage of contaminated water, due to loss of pressure**
- **microbial growth, especially on lining materials and plastics**
- **corrosion of tanks, pipes, valves and pumps**

Assuring drinking water safety: general considerations

- **compliance with existing guidelines**
- **monitoring to ensure continued compliance**
- **having adequate contingency plans in place to be used in emergencies**

Summary

- **Only a small percentage of the earth's water is available for drinking**
- **Demand for safe water is increasing**
- **Microbial contamination (by bacteria, viruses, parasites, algae) is the most serious problem**
- **Tolerable Daily Intake levels (TDIs) have been established for chemical contaminants**
- **Water quality assurance efforts should focus on: selection/protection of sources, treatment, distribution**
- **Compliance with WHO guidelines on drinking water quality should assure a safe water supply**