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GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

GLOBAL HEALTHCARE WASTE PROJECT

MODULE 2: Health and Environmental Impacts of Healthcare Waste



Module Overview

- Describe hazards of healthcare waste
- Describe who is at risk of exposure
- Describe the chain of infection, routes of exposures, how to intervene
- List common pathogens associated with healthcare waste
- Describe potential public health and environmental impacts of healthcare waste

Learning Objectives

- Characterize main types of hazards associated with healthcare wastes and their health effects
- Identify who is at risk of exposure
- Identify key routes of exposure
- Describe the public and environmental impacts of mismanagement of healthcare wastes in your country

Types of Hazards of Healthcare Waste

- Hazardous nature of healthcare waste may be due to one or more of the following characteristics:
 - It contains **infectious** agents
 - It contains **genotoxic or cytotoxic** agents
 - It contains **toxic or hazardous chemicals or pharmaceuticals**
 - It is **radioactive**
 - It contains **needles and other sharps**

What is Risk?

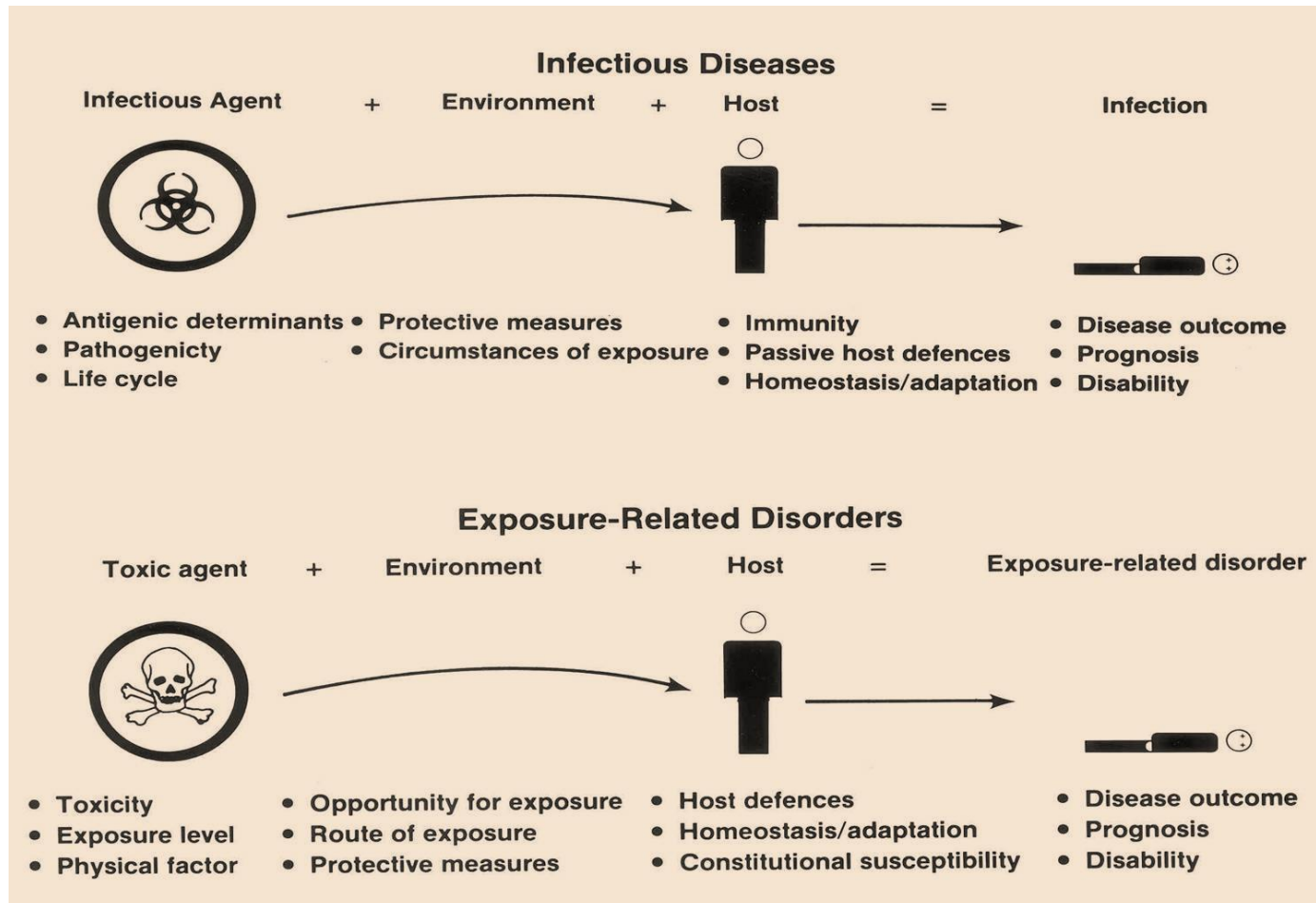
- It is probability that the hazard of a substance will cause harm and the severity of that harm
- Individuals, cleaning staff, public health and the environment are exposed to the risks from healthcare wastes



Persons at Risk

- Medical doctors
- Nurses
- Healthcare auxiliaries
- Hospital maintenance personnel
- Patients
- Visitors
- Healthcare support services (laundry, waste handlers, cleaners, and porters)
- Workers transporting the waste to a treatment and disposal facility
- Workers in waste management facilities, such as landfills or incinerators
- Scavengers
- Communities exposed to landfills, dump yards, improper disposal

Effects of Exposure to Healthcare Waste

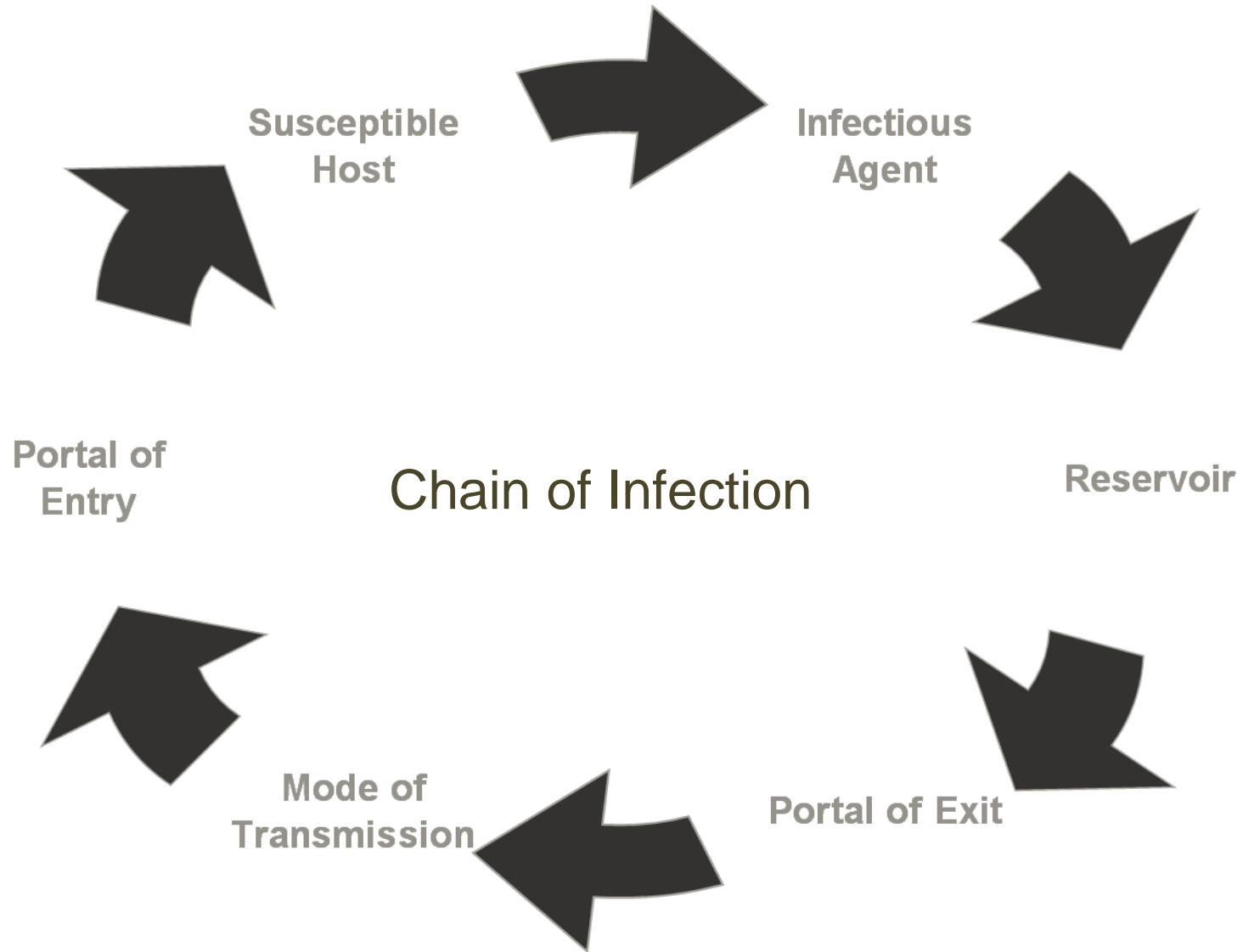


Infectious Waste Including Sharps

- Infectious waste should always be assumed to contain pathogenic microorganisms
- Routes of exposure include:
 - Through puncture, abrasion, or cut in the skin
 - Through the mucous membrane
 - By inhalation
 - By ingestion



Chain of Infection

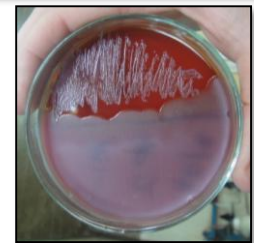


Common Pathogens and Routes of Transmission

Type of infection	Examples of causative organisms	Transmission vehicles
Gastroenteric infections	Enterobacteria, e.g. Salmonella, Shigella spp.; Vibrio cholerae; Clostridium difficile; helminths	Feces and/or vomit
Respiratory infections	Mycobacterium tuberculosis; measles virus; Streptococcus pneumoniae, Severe Acute Respiratory Syndrome (SARS)	Inhaled secretions; saliva
Ocular infection	Herpesvirus	Eye secretions
Genital infections	Neisseria gonorrhoeae; herpesvirus	Genital secretions
Skin infections	Streptococcus spp.	Pus
Anthrax	Bacillus anthracis	Skin secretions
Meningitis	Neisseria meningitidis	Cerebrospinal fluid
Acquired immunodeficiency syndrome (AIDS)	Human immunodeficiency virus (HIV)	Blood, sexual secretions, body fluids
Haemorrhagic fevers	Junin, Lassa, Ebola, and Marburg viruses	All bloody products and secretions
Septicaemia	Staphylococcus spp.	Blood
Bacteraemia	Coagulase-negative Staphylococcus spp.; (including Methicillian-resistant S. aureus); Enterobacter, Enterococcus, Klebsiella, and Streptococcus spp.	Nasal secretion, skin contact
Candidaemia	Candida albicans	Blood
Viral hepatitis A	Hepatitis A virus	Faeces
Viral hepatitis B and C	Hepatitis B and C viruses	Blood and body fluids
Avian influenza	H5N1 virus	Saliva, other secretions

Examples of Hazards of Infectious Waste including Sharps

- Acute potential hazards:
 - Hypodermic needles contaminated with patient blood
 - Exposure to splashes of blood or body fluids
 - Concentrated pathogenic cultures
- Sharps pose a double risk
 - Injury and disease transmission if the sharps are contaminated



Risks of Infections from Sharps

- Sharps injuries cause an estimated 66,000 HBV, 16,000 HCV and 200–5000 HIV infections among healthcare workers each year (Prüss-Üstün, Rapiti & Hutin, 2003).
- 40-65% of new HBV and HCV are due to percutaneous occupational exposure (Prüss-Üstün, Rapiti & Hutin, 2003).
- Burden of disease (Dziekan G, Chisolm D, Johns B, Rovira J, & Hutin Y 2003).
 - Worldwide, the reuse of injection equipment in the year 2000 accounted for 32%, 40%, and 5% of new HBV, HCV and HIV.
 - For each year between 2000-2030, these infections are estimated to cost society over 270,000 lives

Risks of Infections from Sharps

- Highest rates of occupational injury reported among cleaning personnel and waste handlers
 - Annual rate in USA is 180 per 1000 workers (WHO, 1999)
 - There are documented cases of staphylococcal bacteremia and endocarditis among housekeeping staff after a needle injury
- Healthcare workers at increased risk infection of Hepatitis B after needle-stick injury
 - Chances of infection are 6 - 30% after single needle-stick exposure

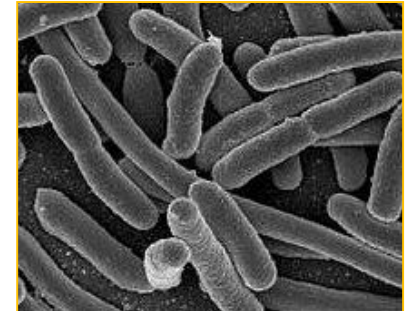
Risks of Infections from Sharps

- Post Exposure Prophylaxis (PEP) with HB Ig & HB vaccine is 90% effective. However, Pre-Exposure Prophylaxis with HB Vaccine is essential (WHO, 1999)
- There are no vaccines against HIV. PEP with a two drug combination has to be administered within 6 - 12 hours for 80% effectiveness (Wilburn et al., 2004)

Rates of Injury at Regional or National Level

Examples of Other Hazards Related to Healthcare Waste

- Antibiotic and chemical resistant bacteria may develop as a result of improper disposal of healthcare waste to the environment
 - *E.Coli*, *MDR-TB*, *MRSA*
- Poorly implemented waste disposal methods may pose risks to waste workers
 - Burns, smoke inhalation and exposure to air toxicants from incinerators
 - Exposure to pathogenic aerosols, burns or injuries from poorly designed or improperly operated shredders, autoclaves and waste compactors



Chemical Wastes

- Usually present in small quantities
- Acute or chronic exposure
- Absorption through skin, or mucous membranes, or inhalation or ingestion
- Burns are a common injury



Hazardous Properties

- Chemical waste is hazardous if it has one or more of the following properties:
 - Toxic
 - Corrosive
 - Flammable
 - Reactive
 - Oxidizing
 - Explosive

Hazardous Properties

- **Toxic**

- Based on a substance's lethal dose from **acute exposure** or its adverse health or ecological impact from **chronic exposure**
- Exposure through skin contact, ingestion, or inhalation of fumes, vapors, dusts, contaminated air
- Effects includes cancer and toxicity to specific organs, tissues or cells



- **Corrosive**

- Based on $\text{pH} < 2$ or $\text{pH} > 12$
- Causes burns on skin or eyes
- Can break down to poisonous gases



Hazardous Properties

- **Flammable**

- Capable of causing fire or combustion based on flashpoint of a substance
- Includes many volatile solvents and lubricants



- **Reactive**

- Reacts to form toxic gases with air, water, or other substances and may burn spontaneously

- **Oxidizing**

- Reacts to generate oxygen and cause or contribute to the combustion of other material (e.g., perchloric acid, nitric acid, concentrated hydrogen peroxide)

- **Explosive**

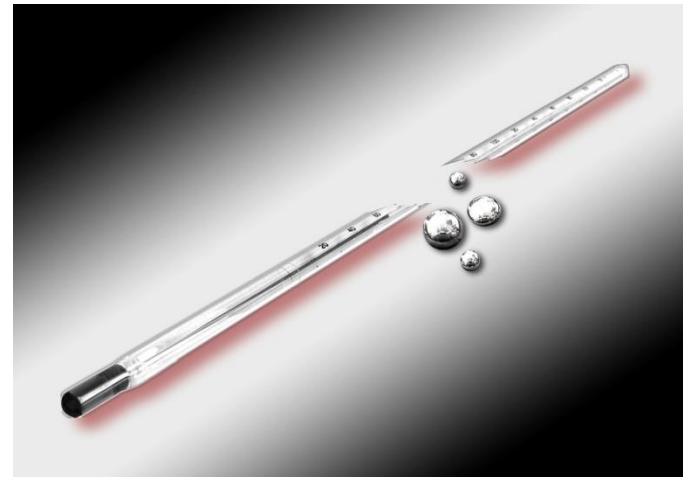
- Includes compressed gases



Some Examples of Hazardous Chemical Wastes

- **Mercury**

- Found in thermometers, blood pressure devices, lab chemicals, cleaners and other products used in healthcare
- A potent neurotoxin that can affect the brain, spinal cord, kidneys and the development of children



Some Examples of Hazardous Chemical Wastes

- **Toxic laboratory chemicals**
 - Glutaraldehyde is a severe skin irritant (dermatitis)
 - Formaldehyde is an irritant and possible carcinogen
 - Others toxic chemicals include: xylene, toluene, methanol, ethylene oxide, quarternary ammonium compounds, chloroform, phenols, barium compounds, herbicides, pesticides
- **Corrosive acids and bases**
 - Hydrochloric acid, concentrated acetic acid, sodium hydroxide, ammonium hydroxide

Some Examples of Hazardous Chemical Wastes

- **Flammable chemicals**
 - Ethyl alcohol, isopropyl alcohol, ether, toluene
- **Reactive chemicals**
 - Lithium metal, concentrated hydrogen peroxide, dry picric acid, ethylene oxide
- **Disinfectants that are corrosive and reactive**
 - Chlorine bleach may result in burns and respiratory effects, and may react with strong acids to release chlorine gas



Hazards from Pharmaceutical Wastes

Expired, unused, and contaminated drugs; vaccines and sera

- Risk that the active ingredients act on an unintended target
- Toxic risk if they contaminate food or drinking water
- Fire and corrosion risks from some solvents and compounding agents used by pharmacies
- Risk of increasing microbial drug resistance through improper disposal in the environment



Chemotherapeutic Wastes

- Include:
 - Cytotoxic drugs used in cancer treatment and their metabolites
 - Antineoplastic drugs and alkylating agents
 - IV sets containing chemotherapy drugs
 - Gloves and gauze contaminated with chemotherapy drugs

Examples of Chemotherapy Agents

Alkylating agents

Vesicant drugs:

aclarubicin, chlormethine, cisplatin, mitomycin

carmustine, cyclophosphamide, dacarbazine, ifosfamide, melphalan, streptozocin, thiotepa

Intercalating agents

Vesicant drugs:

amsacrine, dactinomycin, daunorubicin, doxorubicin, epirubicin, piarubicin, zorubicin

mitoxantrone

Vinca alkaloids and derivatives

Vesicant drugs:

vinblastine, vincristine, vindesine, viorelbine

Epipodophyllotoxins

Irritant drugs:

teniposide

Hazards of Chemotherapy Wastes

- Exposure may occur during
 - Handling and disposal
 - Preparation of or treatment with drugs or chemicals
 - Administering chemotherapy
- Main pathways of exposure
 - Inhalation of contaminated dusts or aerosol
 - Absorption through skin
 - Ingestion of contaminated food
 - Ingestion as a result of bad practices (pipetting with mouth)

Hazards of Chemotherapy Wastes

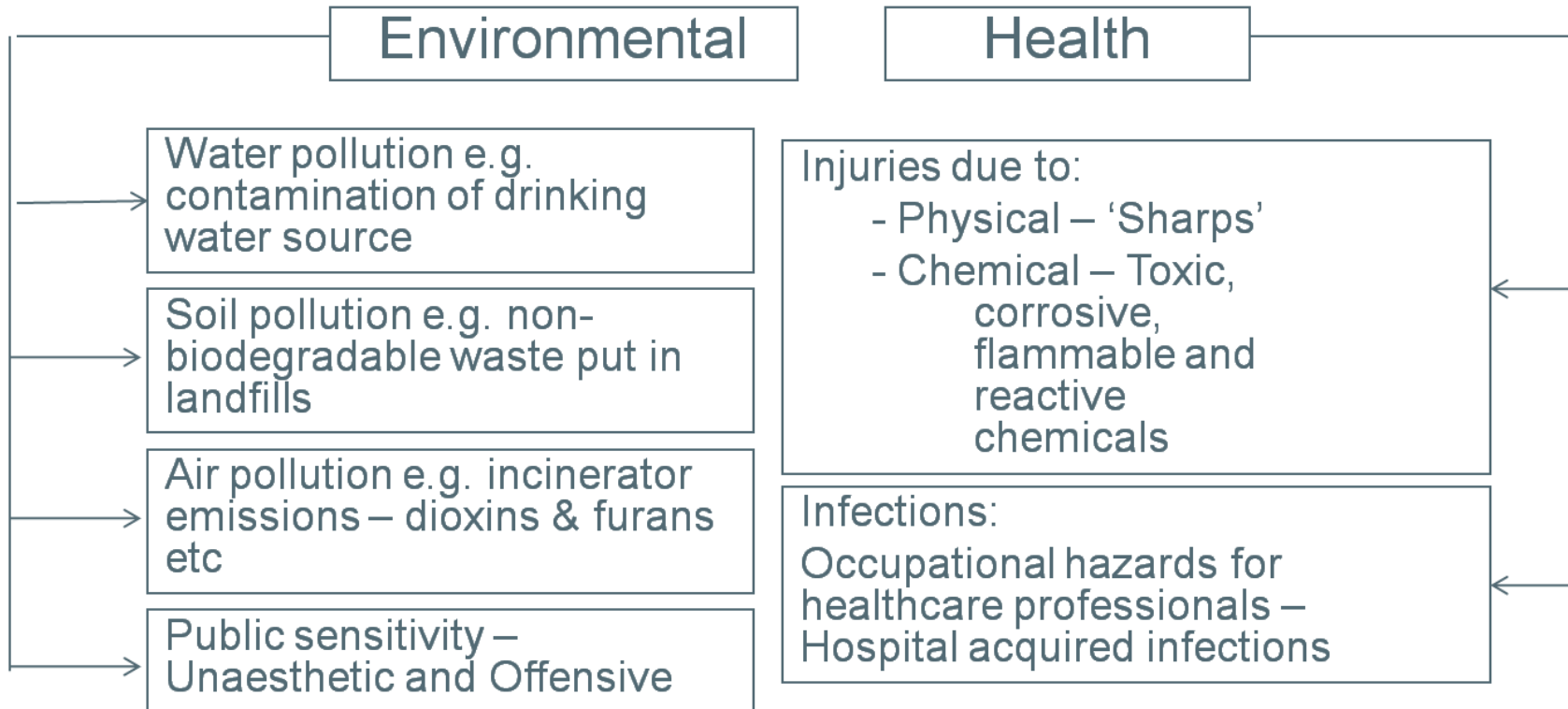
- Severity of hazards depend on substance toxicity and duration of exposure
- Generally highly mutagenic, teratogenic and/or carcinogenic
- Extremely irritant with harmful local effects on skin and eyes
- May cause dizziness, nausea, headache or dermatitis

Hazards from Radioactive Wastes

- Diagnostic equipment
 - Glassware contaminated with radioactive diagnostic material
 - Radiotherapy drugs
- Hazard depends on the type and duration of exposure
- Symptoms and effects range from
 - Headache, dizziness, vomiting to more serious health problems
 - Genotoxic effect
 - Severe burns and tissue injury



Effects of Improper Healthcare Waste Disposal



Some Data on Public Health & Environmental Impacts of Healthcare Waste

- WHO assessment of 22 developing countries in 2002 showed that 18% to 64% of healthcare facilities do not use proper waste disposal methods.
- Reuse of contaminated injection equipment accounted for 32%, 40%, and 5% of new HBV, HCV and HIV cases worldwide in 2000 (Dziekan G, Chisolm D, Johns B, Rovira J, & Hutin Y 2003).
- Outbreak of hepatitis B in India due to reuse of injection equipment claimed 94 lives (Gandhi, 2011)
- Six children were diagnosed with smallpox after playing with ampoules of expired smallpox vaccine at a garbage dump in Vladivostok in 2000 (Russia).



Some Data on Public Health & Environmental Impacts of Healthcare Waste

- Hazards occur from scavenging at waste disposal sites and the manual sorting of hazardous waste from healthcare establishments.
 - practices are common in many developing countries.
 - waste handlers are at immediate risk of needle-stick injuries and exposure to toxic or infectious materials.
 - leachate may cause groundwater contamination
- Trade in second hand medical devices , especially syringes, which are re-packed and sold illegally in India
- Uncontrolled discharge of sewage from field hospitals treating cholera patients implicated in cholera epidemics in some Latin American countries



Public Health & Environmental Impact



This picture of a rag picker with a syringe for re-use in Nairobi was published in a West Coast US newspaper in about 2004.

Public Health & Environmental Impact



A man picks through a dumpsite among strewn blood-contaminated waste and hypodermic needles that were improperly discarded.
Photo from World AIDS Day 2011; photo By Bilawal Arbab

Some Data on Public Health & Environmental Impacts of Healthcare Waste

- Exposure to improper disposal of waste from radiotherapy treatment.
 - Serious accidents have been documented in Brazil where four people died and 28 had serious radiation burns (IAEA, 1988)
 - Other cases in Mexico (1962) and Morocco (1983), Algeria in (1978)



Other Public Health & Environmental Impacts

- Incinerators may present a hazard to people and the environment
 - Flue gases, ash, synthesis of dioxins and furans
 - Dioxins and furans are potential human carcinogens and have been associated with a range of adverse health effects
- Healthcare facilities become sources of mercury release into the environment
- Public sensitivity
 - Fear of hazards, visual impact of anatomical wastes, exposure to incinerator smoke, discarded needles



Discussion

- What are some of the major routes of exposure to healthcare wastes? Who do you think is at risk of exposure to hazards from healthcare waste at your facility? What are some of the hazards that are often present? Do certain hazards present greater risk than others?
- How does your facility deal with the major categories of healthcare wastes (sharps, chemical, etc.)? Do you know of any interventions that can reduce exposure to healthcare wastes?
- Think about the chain of infection. Can you give an example of this process within the healthcare setting?
- What are some public health and environmental impacts of mismanaged healthcare wastes, both within and beyond the facility? How might people outside of the immediate medical setting be exposed to healthcare waste hazards?