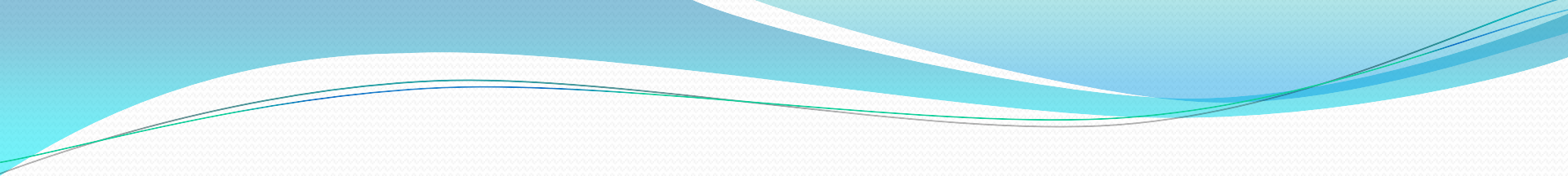




Occupational and Environmental Health Division
Department of Public Health
Ministry of Health and Sports

Outlines of presentation

- Occupational and Environmental Health Division
- Water Pollution
- Air Pollution
- Pesticide
- Heavy Metals
- Climate Change
- Occupational Hazards
- Healthcare Waste Management



Occupational and Environmental Health Division

- policy priority strategies
- Occupational Health Strategies
- Environmental Health Strategies

Location of OEHD

- Main office of OEHD is situated in Office No (47), Ministry of Health and Sports, Naypyidaw.
- Yangon sub-office is situated in No (250/A), Lower Kyeemyindaing Road, Alone Township, Yangon.
- Two main Laboratories –
  - (1) Occupational Hygiene Laboratory and
  - (2) Environmental Health and Toxicological Laboratory are attached to Yangon sub-office.

National Health Policy

Sustained occupational health services

The policy priority strategies are as follow:

- Strengthen occupational health services in national healthcare delivery system;
- Formulate, review, amend and advise on legislation relating to occupational health;
- Develop and implement a strategic framework for occupational health for all sectors; public, private and informal sectors;
- Ensure integration of occupational health services in the primary health care;
- Enhance the development of human resources required for occupational health services provision;
- Enhance public private partnership in provision of occupational health services
- Promote and provide health worker's awareness on health and safety.

Preventing and reducing environmental health problems and enhancing resilience of health care for climate change

The policy priority strategies include:

- Strengthen systems to establish green and **climate resilient health care facilities** in health service delivery;
- Improve **systems and capacities to mitigate** potential health impact due to **climate change** and public health risks from **development activities**, poor housing and unplanned settlements in community; and
- Enhanced national, regional and global **intersectoral collaboration** in prevention and reduction of environmental health problems.

Occupational Health Strategies

- Developing and maintaining **human resources** necessary for occupational health services (Occupational Physician, Occupational Nurses, Occupational Hygienists, Laboratory Technicians and so on) and providing training to them
- Developing national occupational health and safety **standards**
- Providing **comprehensive** occupational **health services** to the workforce of all sectors (public / private / informal)

Occupational Health Strategies

- Assessing the hazardous workplaces and industries
- Assessing the health status of workers working in hazardous workplaces
- Building the healthy workplace for workers
- Strengthening the interdepartmental collaboration in order to facilitate the promotion of occupational health services

Environmental Health Strategies

- Ensuring **sound chemical management** all over the country
- Enabling the people to be **aware of hazardous waste management** including health care waste management, all over the country
- Participating in or providing **environmental impact assessment, social impact assessment and health impact assessment** relating to development projects or economic activities in the country

Environmental Health Strategies

- Ensuring the development of **poison information center**
- **Upgrading the pre-existing laboratory** as an environmental and toxicological reference laboratory
- Ensuring safe drinking water supply by **regular monitoring of water quality** all over the country
- Monitoring of **ambient air quality**

Water pollution

- Definition
- Sources
- Water pollutants
- National Drinking Water Quality Standards (2019)
- Diseases associated with water
- Purification of water

Water pollution

- Any physical, biological or chemical alteration in water quality
- **Point source of water pollution**
  - Discharge from a defined point s/a a sewer pipe effluent
- **Non point source of water pollution**
  - Pollution from many sources
  - Fertilizer run off from an agricultural area

Water pollutants

1. Physical:

- Thermal (ground water)
- color, turbidity (surface water)

2. Chemical:

- Heavy metals (ground water and surface water)

3. Biological:

- Bacterial-Coliform organisms, streptococcus faecalis (recent pollution), clostridium perfringens (remote pollution), viral, protozoal, helminthes, Leptospiral, fungal

4. Radiological

- radioactivity (rain water, surface water and ground water)

National Drinking Water Quality Standards (2019)

No:	Priority Parameters
1	Total Coliforms
2	Faecal Coliforms
3	Taste
4	Odor
5	Color
6	Turbidity
7	Arsenic
8	Lead
9	Nitrate
10	Manganese
11	Chloride
12	Hardness
13	Iron
14	pH
15	Sulphate
16	Total Dissolved Solids [TDS]

General Requirements

Range of Standards – Parameters for drinking water quality

- Physical, Chemical, Microbiological
  - **Physical and Chemical** – heavy metals, trace organic compounds, total suspended solids, turbidity
  - **Microbiological Quality**
    - Microbiological Indicators of drinking water quality
      - Waterborne pathogens
      - Diseases caused by waterborne pathogens
    - Microbiological Requirements
      - Total coliforms
      - Faecal coliforms

pH

- The pH of the water is the measurement of the **acidity or alkalinity** of the water.
- Practically every phase of water supply and waste water treatment is pH dependant.
- Natural waters usually have pH values in the **range of 4 to 9** and most are slightly basic because of the presence of the bicarbonates and carbonates of the alkali and alkaline earth metals.

Microbiological requirements

Microbiological requirements

Parameters	Method of Testing	Units of Measurement	Treated pipe water	Water in distribution system	Un-piped water	Emergency water supply
			VALUES			
Total Coliforms	Multiple Tube Fermentation Technique(MTFT) APHA 9221A	MPN/ 100ml	0	0	3	10
Faecal Coliforms	Multiple Tube Fermentation Technique(MTFT) APHA 9221E	MPN/ 100ml	0	0	0	3

Coliform group of bacteria

- If coliform bacteria are present in the water supply, pathogens may also be present.
- The coliform bacteria live longer in water and are easier to detect by laboratory testing.
- This is the reason the coliform group has been chosen as the indicator organisms for waterborne pathogens.
- Results may reveal as either total coliform positive (TC positive) or fecal coliform positive (FC positive or E.coli positive).
- Fecal coliform positive indicates the presence of E.coli which means there is a greater chance of pathogens being present.

Diseases associated with water are categorized as follows

1) **Water-borne diseases**

- ❖ infections spread through contaminated drinking water

2) **Water-washed diseases**

- ❖ diseases due to lack of proper sanitation and hygiene

3) **Water-based diseases**

- ❖ infections transmitted from aquatic invertebrate organisms

4) **Water-related diseases**

- ❖ diseases transmitted by insects that depend on water for their propagation

Purification of water

- Natural purification

1. Evaporation and condensation (rain water)
2. Filtration through earth (ground water)
3. Dilution (rivers, streams)
4. Storage and sedimentation (lakes, ponds, reservoirs)
5. Ultraviolet rays and sunlight (surface and rain water)
6. Aeration - Oxidation (rain and surface water)

- Artificial purification

1. Purification of water on a small scale
2. Purification of water on a large scale

Purification of water on a small scale

1. Straining
2. Aeration
3. Storage and settlement
4. Filtration
5. Disinfection

Large scale water purification

Steps for community supply

- (1) Storage
- (2) Aeration
- (3) Coagulation and sedimentation
- (4) Filtration (Rapid or slow)
- (5) Chlorination (Disinfection)
- (6) Distribution

Pesticides

- Definition
- Classification
- Hazards related to Pesticides
- First-aid for pesticide poisoning
- Safe use of pesticides

Pesticides

- A chemical or mixture of chemicals intended for preventing, destroying, repelling or lessening the damage caused by pest, including insects, rodents, fungi and unwanted plants (weeds)
- In agricultural sector, used to kill pests that damage crops
- Public health aspect, used to kill vectors of diseases, such as mosquitoes, rats
- By their nature, pesticides are potentially toxic to other organisms, including humans and need to be used safely and disposed properly

- Pesticides are classified into the following groups
  - i. Insecticides – insects (E.g. *DDT*)
  - ii. Herbicides – weeds (E.g. *Borax, Nitro fen*)
  - iii. Rodenticides – rodents (*E.g. Warfarin, Zinc phosphide*)
  - iv. Fungicides – fungi (E.g. *Bordeaux mixture*)
  - v. Bactericides – bacteria (E.g. *Dichlorophen, Oxolinic acid*)

Hazards related to Pesticides

- Highly toxic in nature and if not handled carefully, can cause **serious health problems** like cancer, deformities and disease
- Impact through food commodities
- Can harm **non-target organisms** - soil microorganisms and insects, non-target plants, fish, birds and other wildlife
- **Accidents** in pesticides manufacturing units cause great loss of human life

1. Impacts on Environmental Health (Pollution)

2. Impacts on Human Health

- Either acute or chronic effect causing some of followings:
  - Damage to the nerves
  - Damage to lungs (asthma, bronchitis, farmer's lung)
  - Cancer
  - Birth defects
  - Allergic reactions
  - Fatal poisoning

Routes of entry

- Can enter into body during mixing, applying, or clean-up
- Three main routes of entry:

a) **Inhalation**

- Most common routes
- Breathed in as dust, fumes, vapors or gasses when spraying or working near
- Pesticides with a high inhalation hazard should be labelled with directions to use a respirator and prevent by using masks

Contact (Dermal Exposure)

- Pesticides on skin and absorb through skin pores used for sweating or through skin ulcer, abrasions or wounds
- When working at high temperature or hot environment, skin pores are widely opened and become a favorable condition for pesticides entry
- In some working situations, absorption through skin is most common route of exposure and can be exposed when mixing, loading or applying pesticides without wearing suitable PPE
- Prevent by wearing suitable personal protective clothes and avoid working at high temperature

c) Ingestion (Oral)

- Swallowing pesticide by mouth (intentional)
- Less common to be exposed but resulting in most severe poisonings
- Unintentionally ingest when eating foods and drinks on the field or dust swallowed with saliva or smoking cigarettes if not washing hands first
- Accidentally drink pesticide that has been put into an unlabeled bottle or cup or container (including cans)
- Children can swallow pesticides due to their hand to mouth behavior if pesticides are kept within their reach

First-aid for pesticide poisoning

- First-aid is an initial effort to assist the person of pesticide poisoning
- Pesticide poisoning require **immediate care**
- **Transfer the patient to hospital as quickly as possible** for specific treatment according to the types of poisoning
- **First aid should be administered before transferring** to hospital but should not be a substitute for professional care

General

- Act calmly
- The highest priority is **adequate breathing** and it must be maintained continuously
- If breathing has stopped or is labored, give **artificial respiration** and done cardio-pulmonary resuscitation (CPR)
- **Terminate exposure** by avoid further skin contact and/or inhalation of fumes or dust

Specific

i. Poison on skin

- Remove contaminated clothing quickly and completely, and collect separately for washing or discard
- Cleanse skin and hair thoroughly with soap and large amount of water, and avoid harsh rubbing or scrubbing

ii. Poison on eye

- Hold eyelid(s) open, wash eyes immediately with gentle stream of clean, running water
- Tilt head for water not run from one eye into the other
- Continue washing intermittently for 15 minutes or more
- DO NOT use chemicals or drugs in wash water

- 
- Keep all information about the case and first-aid administered, and pass it to medical professional together with the pesticide container and label
  - Even if full recovery from poisoning takes place after simple first aid measures, must take patient to hospital.
  - Symptoms and signs of poisoning by some pesticides can reappear suddenly in the first 24 hours

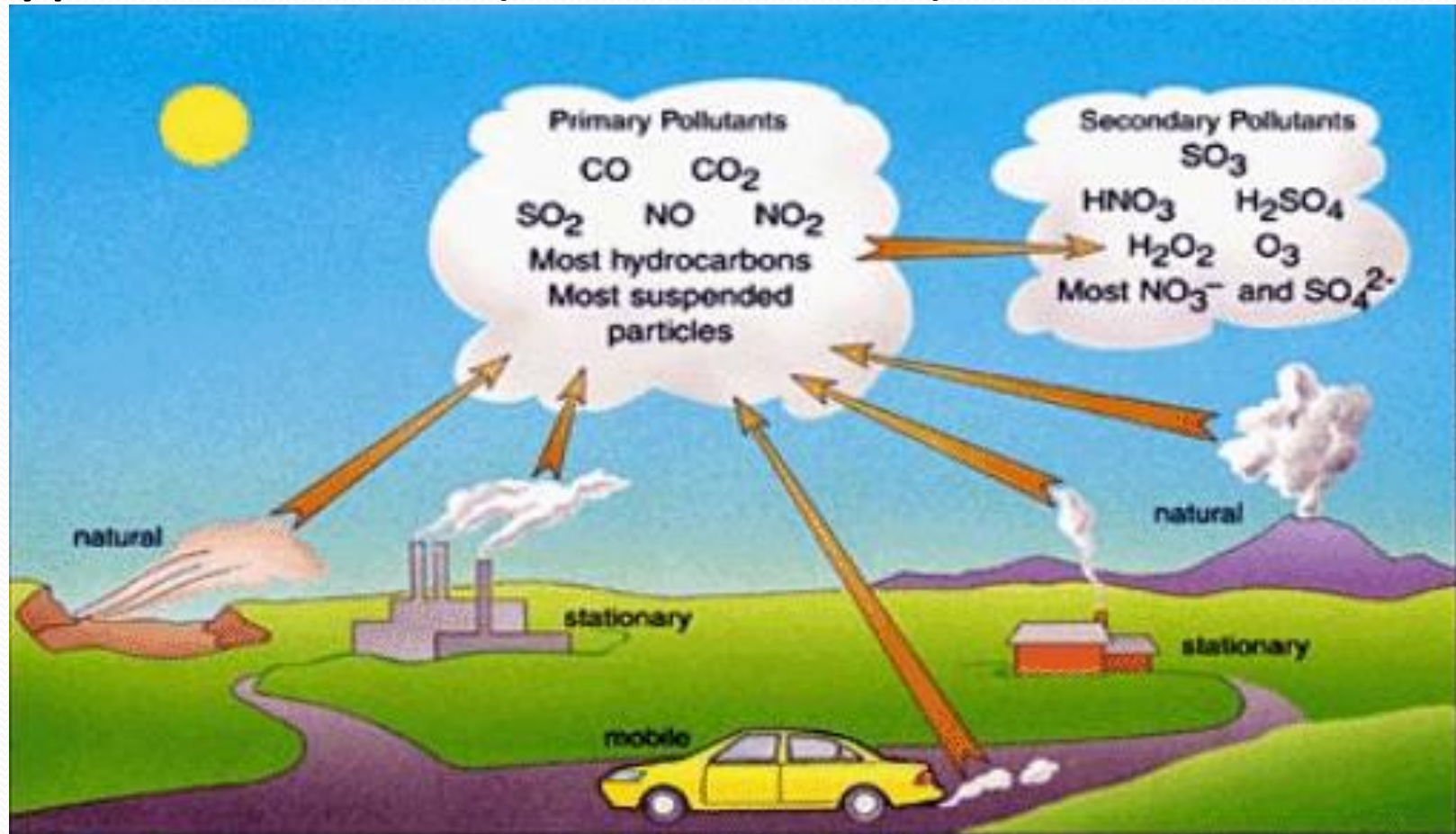
Safe use of Pesticides

- Most pesticides will cause adverse effects if intentionally or accidentally ingested or if they are in contact with the skin for a long time
- Pesticide particles may be inhaled with the air while they are being sprayed
- To contaminate the drinking-water, food or soil
- Special precautions must be taken during transport, storage and handling
- Spray equipment should be regularly cleaned and maintained to prevent leaks
- People who work with pesticides should receive proper training in their safe use

Air Pollution



Types & Sources(Air Pollutants)



Types and sources of air pollutants

Air pollution

- Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms or cause damage to the natural environment.

Clean Air

- consists of approximately
  - Nitrogen - 78%
  - Oxygen - 21 %
  - Carbon dioxide, Argon and trace amount of other gases - <1%

Sources

Can be classified into two major categories

(1) Anthropogenic sources (human activity)

- mostly related to burning different kinds of fuel

Stationary Sources

- smoke stacks of power plants, factories, waste incinerators, furnaces

Mobile Source

- motor vehicles,
- marine vessels,
- aircraft

(2) Natural Sources

- Dust
  - usually large areas of land with little or no vegetation
- Methane,
  - emitted by the digestion of food by animals, for example cattle
- Radon gas from radioactive decay within the Earth's crust.
  - Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. considered to be a health hazard.
  - Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement.
  - Second most frequent cause of lung cancer, after cigarette smoking
- Carbon monoxide from wildfires
- Volcanic activity, which produce sulfur, chlorine, and ash particulates

- **Largest sources of air pollution (in order of importance)**
- (1) Transportation (automobiles and trucks)
- (2) Electric Power Plants that burn coal or oil
- (3) Industry (steel mill, metal smelters, oil refineries, pulp and paper mills)
- (Less importance) – heating homes and building and burning refuse

Air Pollutants

- They may be natural or man-made
- Pollutants can be classified as primary or secondary
  - Primary pollutants are directly emitted from a process, such as
    - ash from a volcanic eruption
    - the carbon monoxide gas from a motor vehicle exhaust or
    - sulfur dioxide released from factories.
  - Secondary pollutants are not emitted directly, they form in the air when primary pollutants react (eg. ground level ozone)

Major Primary Pollutants

- (1) Sulphur oxides (SO_x)
- (2) Nitrogen oxides (NO_x)
- (3) Carbon monoxide (CO)
- (4) Carbon dioxide (CO₂)
- (5) Volatile organic compounds - VOCs (methane (CH₄) and non-methane (NMVOCs) and other hydrocarbon VOCs
- (6) Particulate matter

Secondary Air Pollutants

- Ground Level Ozone

Minor Air Pollutants

- A large number of minor hazardous air pollutants. (HAPs)
- A variety of persistent organic pollutants, (POPs) which can attach to particulate matter.

Indoor air pollution

Inefficient biomass and coal stoves

- Household combustion of polluting fuels releases large quantities of health-damaging pollutants, such as particulate matter (PM), carbon monoxide and volatile organic compounds.
- Household coal and biomass stoves emit high levels of carbon monoxide and nitrogen oxides.

Kerosene

- The use of kerosene as a household fuel in unvented wick cook stoves or kerosene lamps generates high levels of carbon monoxide, nitrogen dioxide, and sulfur dioxide.
- Kerosene PM2.5 emissions are primarily composed of black carbon making it a major concern for climate change.

Health Impacts of air pollution

Pneumonia

- Exposure to household air pollution almost doubles the risk for childhood pneumonia and is responsible for 45% of all pneumonia deaths in children less than 5 years old and contributes to 28% of all adult deaths to pneumonia.

Chronic obstructive pulmonary disease

- One in four or 25% of premature deaths from chronic obstructive pulmonary disease (COPD) in adults in low- and middle-income countries are due to exposure to household air pollution.
- Women exposed to high levels of indoor smoke are more than two times as likely to suffer from COPD as women who use cleaner fuels and technologies.
- Among men (who already have a heightened risk of COPD due to their higher rates of smoking), exposure to household air pollution nearly doubles that risk.

Health Impacts of air pollution

Stroke

- 12% of all premature deaths due to stroke can be attributed to the daily exposure to household air pollution arising from cooking with solid fuels and kerosene.

Ischemic heart disease

- Approximately 11% of all deaths due to ischaemic heart disease, accounting for over a million premature deaths annually, can be attributed to exposure to household air pollution.

Lung cancer

- Approximately 17% of premature lung cancer deaths in adults are attributable to exposure to carcinogens from household air pollution caused by cooking with kerosene or solid fuels like wood, charcoal or coal. The risk for women is higher, due to their role in food preparation.

Reducing Household Emission

Cleaner Technologies

- ❖ Dramatically increasing access to cleaner household energy fuels, such as **LPG, biogas, ethanol, and electricity** should be a key development priority,
- ❖ **Electric and electric induction stoves** are often the cleanest in terms of absolute indoor emissions –although the pollution emitted by power production is a consideration in countries **dependent on dirty fuels such as coal**.
- ❖ For **solar stoves or stoves using renewable fuels** such as ethanol and biogas, the climate change and SLCP benefits are even greater.

Prevention and Control

- **Substitution**

- conversion to cleaner fuels (such as bioethanol, biodiesel)
- Use of reformulated gasoline, no more than 1% Benzene
- Must be free of lead, manganese and other heavy metals

- **Engineering Measures**

- **particulate control** -Mechanical collectors (dust cyclones, multicyclones), Electrostatic precipitators
- **NO_x control** -Low NO_x burners, NO_x scrubbers, Catalytic converter (also for VOC control)
- **VOC abatement** -Adsorption systems, such as activated carbon, Thermal oxidizers, Catalytic converters, Biofilters
- **Acid Gas/SO₂ control** -Wet scrubbers, Dry scrubbers

Prevention and Control

- **Environmental & Biological monitoring**
- **Medical Measures**
- **Administrative measures**
  - Law and regulation - Environmental conservation law, EIA procedure, Public health law, Environmental quality emission guideline
  - land use planning - zoning and transport infrastructure planning.
- **Health education- burning, effect of air pollution,**
- **Personal Protection Equipment**

Reducing Household Emission

Discontinuing use of Dirty Fuels

- The WHO *Guidelines for Indoor Air Quality: Household Fuel Combustion* recommends that unprocessed coal and kerosene be discontinued altogether due to their extremely high emissions of VOCs and (in the case of coal) heavy metals as well as particulates, including black carbon.

Advanced Combustion Low-Emission Biomass Cook stoves

- Switching from open fires or rudimentary stoves to “improved” biomass stoves can reduce black carbon and PM2.5 emissions, reducing harmful CO emissions.

Solar Electrification

- when solar power replaces diesel generators in households or health facilities, not only is health improved, but black carbon emissions are reduced

Improved Housing Design

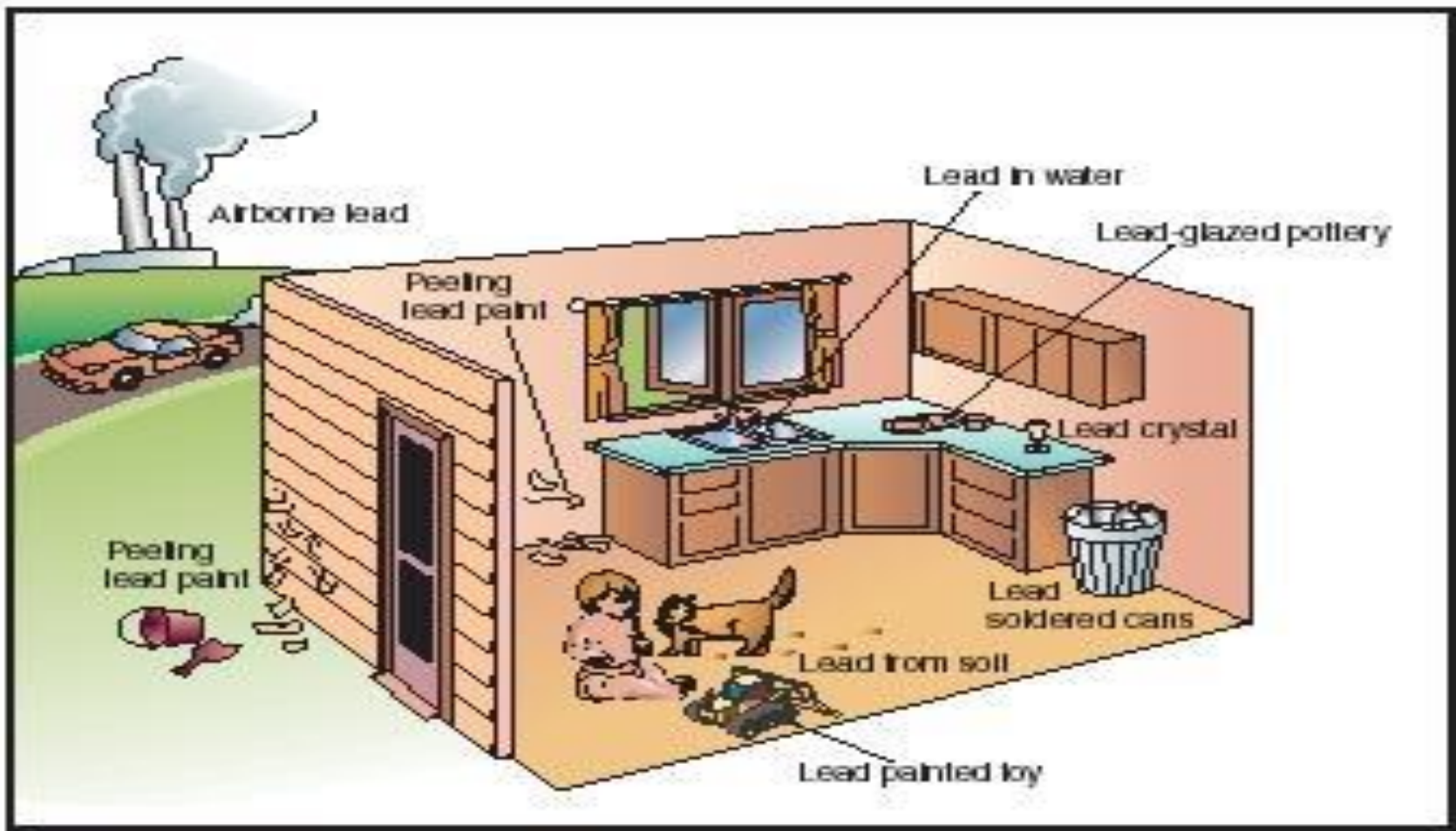
- Building design measures can significantly improve stove ventilation as well as decrease the amount of heat and power that must be used to meet other essential household energy requirements.

Lead Poisoning

- Soft, blue, gray metal
- Exist naturally in soil and rock
- Organic and inorganic form
- Organic lead can be more toxic because body more readily absorb it
  - Primary routes of absorption are ingestion and inhalation
  - About 40 % of inhaled lead oxide fume is absorbed through the respiratory tract
  - Absorption of ingestion is depended on age and physiological status
  - In adult 5-10% of orally ingested lead is absorbed by GI tract
  - Children absorb up to 70% of oral dose

Uses and exposure

- Lead are used in storage batteries, plastic and rubber materials in pipes and cable sheathing, use for brilliance and hardness of ceramic, electrical solder, pottery glaze, cosmetics, leaded petrol, artist's pigment, paints, glass material
- Lead exposure occurs in battery manufacturing workers, gas station attendants, mining workers, pottery worker, demolition workers, foundry workers, lead miners, workers in lead smelting and refining factories, plastic industrial workers, painters, stained glass makers, welders, workers in rubber industries, agricultural workers, children chewing lead painted items of injection of lead contaminated soil and materials



Acute poisoning

- Abdominal pain- moderate to severe, usually diffuse but may be colicky, nausea, vomiting, constipation, headache, fatigue
- Severe case- lead encephalopathy more common in children, characterized by seizures, delirium, confusion and coma, oliguria, jaundice, acute renal failure

Chronic effect (children)

- **Slow insidious onset**
- **CNS** – behavior problems, low IQ, hearing loss, learning disability
- **GI symptoms** -pain, nausea, diarrhoea or constipation
- **Haematology**- anaemia
- **Renal**- renal damage
- **Bone and muscle** – decrease bone and muscle growth

Clinical features

Chronic effect (Adult)

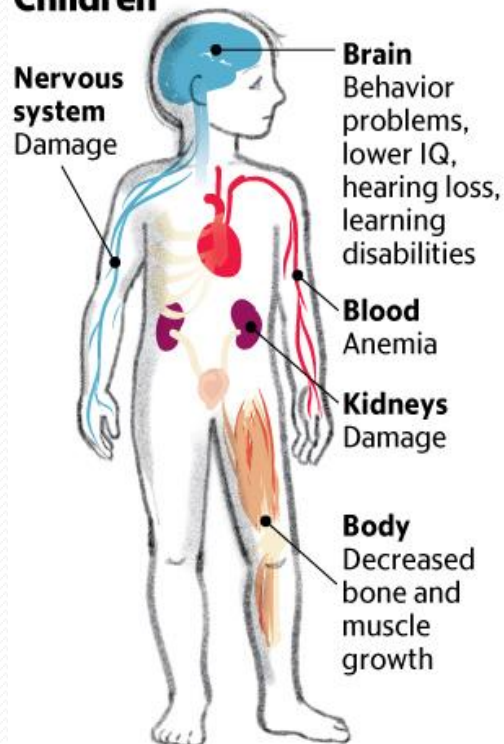
- Slow insidious onset
- **General**- malaise, fatigue, weight loss
- **CNS** - Headache, insomnia, impaired concentration, memory loss, irritability, depression, delirium, coma
- **Mouth** – unusual taste, slurred speech, blue line along the gum
- **GI symptoms** -pain, nausea, diarrhoea or constipation
- **Cardiovascular**- hypertension,
- **Extremities**- pain, tingling, arthralgia, myalgias, distal motor neuropathy (wrist drop),
- **Haematology**- anaemia
- **Reproductive**- sperm dysfunction, impaired fertility, spontaneous abortion, menstrual disturbance
- **Renal**- chronic renal failure
- **Neuromuscular** – pain, tremor, delay reaction time, weakness loss of coordination, convulsion,

Clinical features

Lead exposure

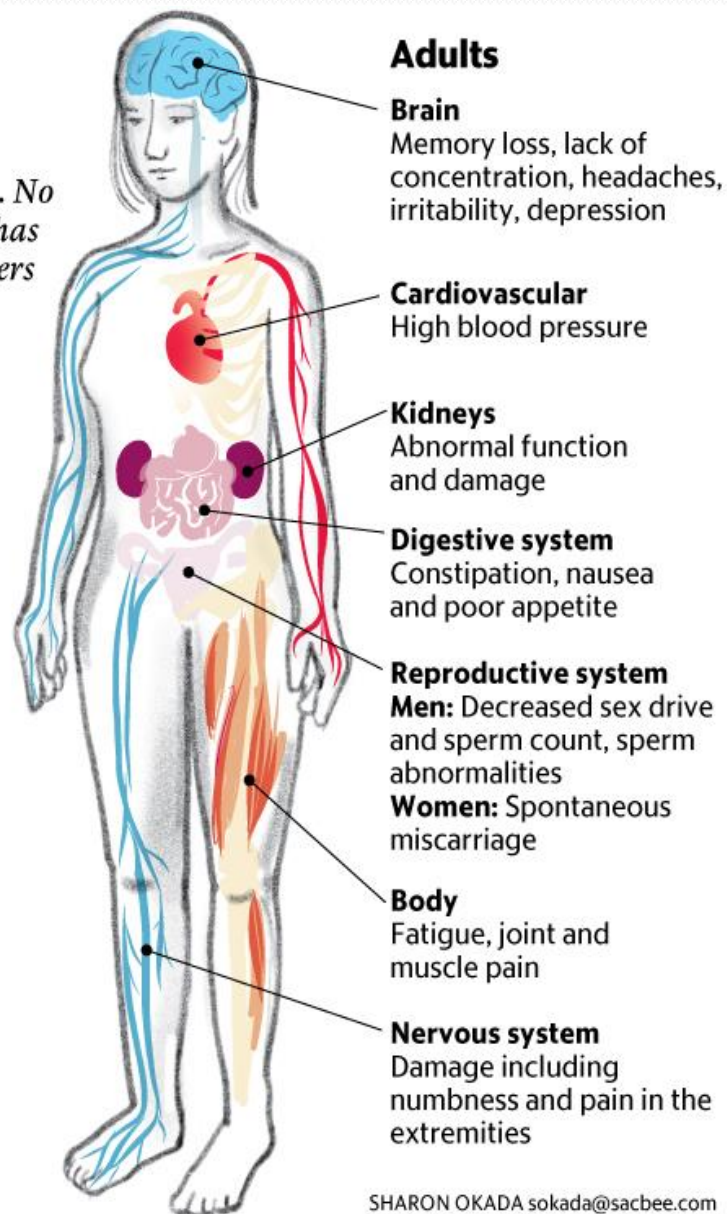
Although often without obvious symptoms, lead exposure can affect nearly every part of the human body. No safe level of lead in the bloodstream has been determined by the federal Centers for Disease Control and Prevention.

Children



Sources: Centers for Disease Control and Prevention; National Institutes of Health

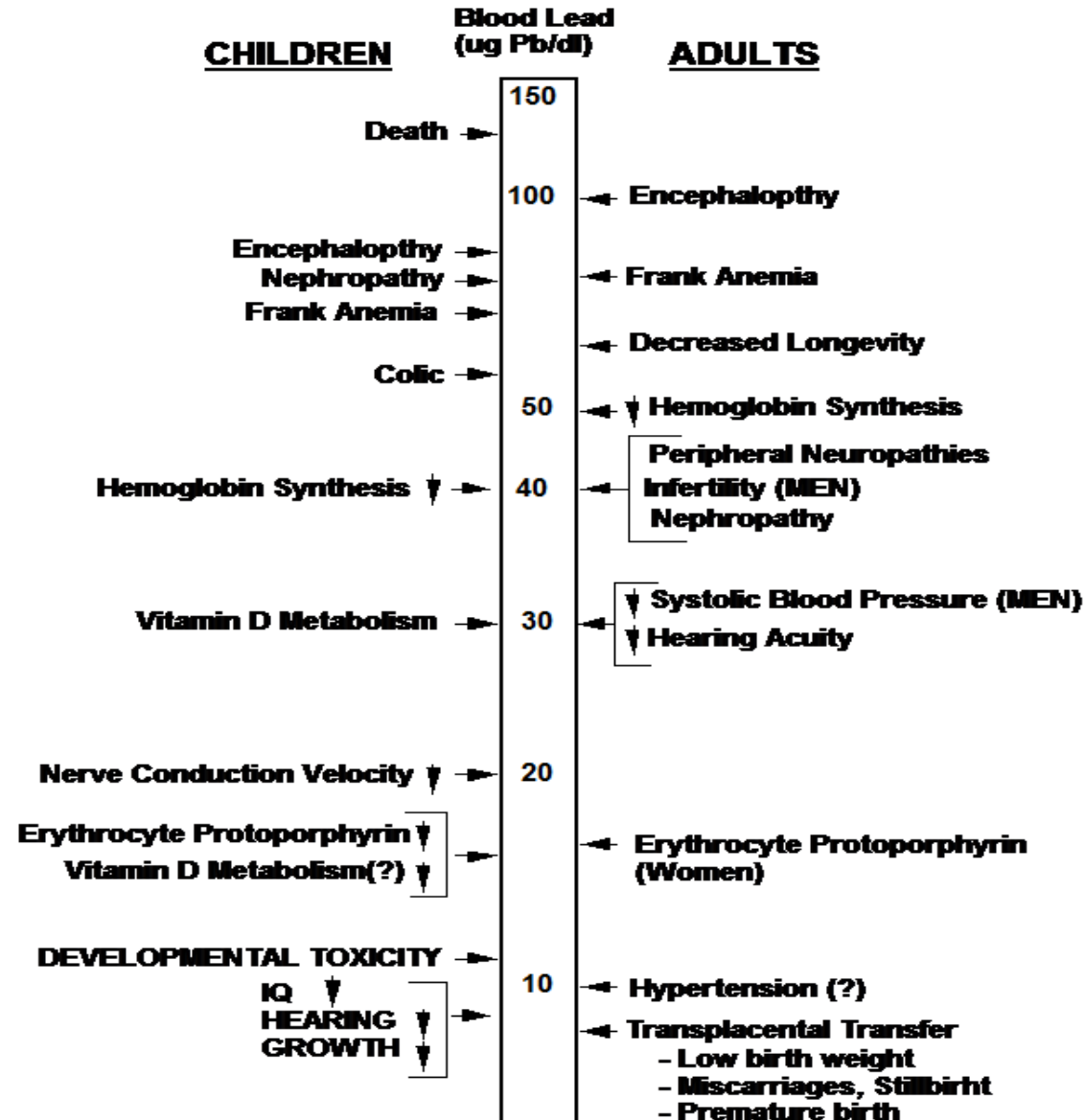
Adults



SHARON OKADA sokada@sacbee.com

EFFECTS OF LEAD -- CHILDREN vs ADULTS

(LOAEL)



Diagnosis of Lead Poisoning

- Detailed medical and occupational history
- Particular attention directed to lead exposure history (occupational and non-occupational);
- Facilities at work
- Personal and workplace hygiene;
- History of gastrointestinal, hematologic, renal, reproductive and neurologic disorders.

Physical examination

- Particular attention directed to neurologic and hematologic abnormalities; pulmonary status should be evaluated in workers required to wear respiratory protective devices
- Blood pressure measurement

Laboratory Test and Finding

- **Blood for CP-** Anaemia, normochromic (usually)
  - Basophilic stripping, reticulocytosis
  - Increase erythrocyte protoporphyrin or zinc protoporphyrin
- **Blood lead level-** indication for recent exposure (days or weeks)
- **X-ray** –dense metaphyseal lines (lead line)- chronic exposure
- **Proximal Renal injury-** Fanconi syndrome with aminoaciduria, glycosuria, phosphaturia
- **BUN and creatinine** -Impaired renal function- Elevation of BUN and serum creatinine
- **Urine Test-** Increase urinary delta amino leuvulenic acid and urinary corpropophyrin, Hyperuricemia
- **Liver function test** -Liver involvement- mild elevation of serum aminotransferases

X ray demonstrating the characteristic finding of lead poisoning in humans—dense metaphyseal lines (lead line)



Prevention of Lead Poisoning

- Substitution of less hazardous material
- Isolation
- Engineering controls via containment structure
- Ventilation via local exhaust system
- Personal protective equipment (eg. Respirator utilization)
- Work practices
- Housekeeping activities to remove lead dust accumulation
- Personal hygiene practices
- Periodic inspection/maintenance of control equipment

MERCURY

Essentials of diagnosis

Inorganic mercury (mercuric chloride, acetate sulphide)

- a/c respiratory distress
- tremor
- shyness, emotional liability
- proteinuria, renal failure

Organic mercury (alkyl mercury) – methyl, ethyl

- mental disturbance
- ataxia, spasticity
- visual and auditory disturbances

Elemental mercury vapor (Hg⁰)

- The forms most likely encountered by the general public are:
- Elemental mercury vapor (Hg⁰) from metallic mercury or liquid mercury
- the elemental or pure form of mercury, not combined with other elements
- the primary form of mercury released into the air by natural processes, such as volcanic activity

Methyl mercury

- Microorganisms in the environment can convert inorganic mercury to the organic form methyl mercury
- Accumulate in certain freshwater and saltwater fish, and marine mammals
- the form of mercury most likely to cause adverse health effects in the general population

Ethyl mercury

- an organic form of mercury
- found in some **medical preservatives**
- used in some parts of the world as an **antifungal agent** in grains

Inorganic mercury (mercuric salts)

- an oxidized mercury
- combines with other chemical elements to create salt forms
- Mercuric oxide (HgO)
  - Almost insoluble in water.
  - Used as a **topical antiseptic**
- Mercuric sulphide (HgS)
  - Insoluble in water. Used as **a red pigment** in ancient times.
  - Most mercury in natural environment exists as this form

Use

- Elemental Hg is used in rectifiers, thermometers, barometers, Manometers, Sphygmomanometers batteries, radio valves, & others electrical devices
- Historically use of alkyl Hg compounds (methyl & ethyl Hg) as grain fumigants - serious human poisoning
- Mercury is used in gold extraction
- Mercury dental amalgams
- Mercury based paint & pigments
- Manufacturing of artificial silk

Occupational and environmental exposure

- Workers involved in the extraction & refinery of mercury are at high risk for exposure to mercury vapour
- Maintenance work on furnaces & flues
- Health care worker – damage or broken of equipment or work place contamination
- Dentists & dental technicians
- Workers during production and application of organic mercury fungicides
- Workers in paints & plastic factory

- Two serious epidemics of organic mercury poisoning occurred owing to environmental contamination of food sources
- Release of mercury wastes from a chemical plant into Minamata Bay in Japan led to accumulation of methyl mercury in seafood
- Minamata disease resulted in **neurological impairment and birth defects** in thousands of the affected area residents
- Distribution of grain contaminated with organic mercury fungicides similarly poisoned over 50000 persons in Iraq

Absorption, metabolism & excretion

- Elemental mercury is efficiently absorbed after inhalation but not ingestion, dermal absorption minimal
- Organic (alkyl) and inorganic mercury compounds are absorbed readily through all routes, including skin contact
- Both organic & elemental mercury compounds readily cross the placenta & are secreted in blood milk
- Hg compounds are eliminated slowly in the urine, faeces, saliva & sweat
- Inorganic mercury – half life – 60 days
- Organic (alkyl) Hg compound – 70 days
- Can be measured in hair & nails

Clinical findings

Acute exposure

- **Inorganic mercury** – inhalation of high concentration of Hg vapour or salts - cough, dyspnoea, inflammation of oral mucosa, GI complaints (Vomiting, Diarrhoea, gingival pain, ulcer in buccal mucosa)
- Chemical pneumonitis
- Renal injury presents as initial diuresis followed by oliguric renal failure
- After recovery from acute illness---neurological symptoms similar to chronic poisoning

Chronic exposure

- Primarily effect nervous system
- Earliest symptoms – numbness & tingling of extremities & lips, loss of motor coordination follows with gait ataxia, tremor, loss of fine m/m, constriction of visual fields, hearing loss , muscular rigidity & spasticity with exaggerated deep tendon reflexes (difficulty in opening his hand a/f he has been grasping an object)
- Neuropsychiatric manifestations include
  - changes in personality, shyness, anxiety, memory loss, emotional liability
- Sensory peripheral neuropathy
- Hallucination and dementia - - serious late manifestation

- GI effect
  - gingivitis, increased salivation, tongue coated , gums—swollen, bluish line in tooth or gums, dental erosion
  - Slate grey pigmentation of oral mucosa
- Blood- mild anaemia, lymphocytosis, eosinophilia
- Slit- lamp exam – reddish brown pigmentation of the lens
- Skin- Excessive sweating, eczematous skin lesion

Mercury Poisoning

Exposure : High toxicity: **mercurialism**



Acrodynia ('Pink Disease')

- Pain
- Pink discolouration



Minamata Disease

- Ataxia
- Impairment of speech & hearing



Laboratory findings

- After acute inhalation – hypoxemia & diffuse infiltrates on CXR
- renal injury – proteinuria
- Hg in blood & urine- - confirm diagnosis
- Normal in blood <0.01 mg/l
- Urine--- <10 µg/g of creatine in urine
- Hair & nail—document exposure

Prevention

- Awareness of hazard of mercury vapour exposure
- proper handling of materials & alteration to work place hygiene
- Proper ventilation & respiratory protection is required in all operation
- Special attention in maintenance worker
- Care in handling & disposal of mercury compounds
- Control of industrial emission – prevent water ways & sea food
- Medical surveillance of mercury – exposed worker should include careful history and neurologic exam & periodic urinalysis

Arsenic

General

- Arsenic is an element and a naturally occurring mineral found widely in the environment
- Arsenic occur numerous in volcanic area
- Important Industrial sources of exposure-smelting operation, pesticide use, emission form coal-fired power plant.
- More common form of industrial use- trivalent arsenic and pentavalent arsenic
- Arsenic gas is highly toxic

Arsenic mineral ores



Use

- Arsenic is used for hardening lead in battery girds, cable sheaths
- Used as **pigments and refining agents** in glass
- Copper chromate arsenate (CCA) is widely used **wood preservative**
- Used as **herbicides**
- 1% arsenic trioxide, was used historically to treat skin conditions such as **psoriasis and eczema**
- When skin cancer resulted from the use of Fowler's solution, there was a marked decrease in medicinal use of arsenic
- Found in folk remedies & health foods,
- Used in microelectronics **industry**, semiconductor manufacturing
- **Arsenic in Drugs** (chemotherapy for acute promyelocytic leukemia and other cancers) found in some traditional remedies from a number of Asian countries

Food

- Seafood (clams, scallops, crabs, lobsters]
- Seaweed (Recent literature suggests hijiki seaweed has very high levels of inorganic arsenic)
- mainly arsenobetaine and arsenocholine, also referred to as “fish arsenic”
- generally considered to be nontoxic
- excreted in urine within 48 hours of ingestion

Sea food (organic arsenic)



Arsenic levels in common foods

Arsenic intake occurs through food and drinking water with recent concerns focused on high levels in rice. Elevated levels of arsenic can cause lung, bladder and skin cancers, cardiovascular disease and hypertension and could cause neurological deficits and diabetes.

RICE, RICE PRODUCTS



3.5-6.7 μg
per cup

COOKED SPINACH

1.1 μg
per cup



GRAPE JUICE

2.3 μg
per cup



MEAT*

Beef

0.1 μg per half pound



Chicken

0.2 μg per half pound



Shrimp

0.4 μg per half pound



*FISH

Fish has high amounts of organic arsenic that are not as risky to human health as inorganic arsenic.



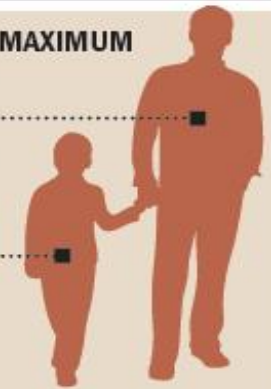
RECOMMENDED MAXIMUM ARSENIC INTAKE

220-lb. person

30 μg

50-lb. child

14 μg



Health threat = **50+ μg**

Arsenic in water

WELL, SPRING, NATURAL WATER

- Concentration can reach 100-200 ppb (parts per billion) = 200-400 μg per 2 liters of water.

PUBLIC WATER

- Typical concentration: 2-4 ppb = 4-8 μg per 2 liters of water.

NOTE: 10 ppb is the maximum concentration allowed, or 20 μg per 2 liters of water.



Occupational & environmental exposure

- Exposure to arsenic occurs in the **smelting** of lead, copper, gold and other non-ferrous metals
- Readily, volatilized arsenic trioxide is concentrated in flue dust can be condensed in a cooling chamber.
- **Furnace & flue** maintenance operations carry a high risk of exposure
- Significant arsenic exposure – **pesticide manufactures** and applicators
- Forest & farm worker
- In **microelectronic & glass industries** – **workers** may be exposed to arsenic from source materials, finished products, maintenance operation
- Exposure from intake of food & drinking water

Routes of Exposure for Arsenic

The primary routes of arsenic entry

- ingestion
- inhalation
- Dermal exposure can occur
- half-life of inorganic arsenic in humans is about 10 hours
- Approximately 70% of arsenic is excreted, mainly in urine
- Most of a single, low-level dose is excreted in urine within a few days after ingestion

Distribution

- Most tissues rapidly clear arsenic except for skin, hair, and nails
- Two to four weeks after exposure ceases, most of the arsenic remaining in the body is found in keratin-rich tissues such as hair, nails, skin and to a lesser extent (bones and teeth)
- Fish arsenic - rapidly excreted unchanged in the urine
- biologic half-life of ingested fish arsenic in humans is estimated to be less than 20 hours with total urinary clearance in approximately 48 hours
- Because arsenic is rapidly cleared from the blood
- blood levels may be normal even when urine levels remain markedly elevated

Clinical findings

Acute poisoning

- Symptoms of a/c poisoning may develop minutes to hour after ingestion and consist of nausea, vomiting, abdominal pain, & copious blood- tinged diarrhea, cold, clammy skin, m/s cramps and facial oedema, liver enlargement, oliguria, seizure, coma ,circulatory collapse and death
- 120 mg of arsenic trioxide – may be fatal
- Persons who recover may develop delayed peripheral neuropathy- symmetric distal sensory loss, lower extremities- more effective
- Motor involvement may extend to total paralysis
- Triad of abdominal pain, Jaundice, oliguria- strong suggest arsenic exposure

Chronic Exposure

- **Gastrointestinal Effects**

- Anorexia
- A hemorrhagic gastroenteritis may develop with bloody diarrhea as a presenting effect

- **Renal**

- limited strength of association between chronic arsenic exposure and renal cancer
- Can cause acute tubular necrosis

- **CVS**

- fatty degeneration of the heart
- hypertension, and cardiovascular disease
- peripheral vascular disease
- Cardiomyopathy
- Vasospastic (Raynaud's) disease

Neurological Effects

- may cause encephalopathy at acute high doses ($> 2\text{mg As/Kg/day}$)
- peripheral neuritis (muscular weakness, pain and paresthesias in extremities)
- can cause peripheral neuropathy

Respiratory Effects

- erosive lesions of the respiratory mucosa
- nasal septum perforation
- Lung cancer

Can cross placenta—fetotoxicity , decrease birth weight, congenital malformation

Dermal Effects

- Brown pigmentation
- Hyperkeratoses in palm and sole are characteristic of chronic arsenic exposure
- Benign arsenical keratoses may progress to malignancy
- Mee's lines (horizontal lines)- in nails
- The common appearance of the dark brown patches with scattered pale spots described as "raindrops on a dusty road"
- Patchy hyperpigmentation - occurs particularly on the axillae, eyelids, groin ,neck, nipples,
- In severe cases - the pigmentation extends broadly over chest, back, abdomen
- Pigment changes have been observed in populations chronically consuming drinking water containing 400 ppb or more arsenic
- basal cell carcinoma and squamous cell carcinoma

Arsenical hyperkeratosis

- occurs most frequently on the palms and soles



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Hematologic Effects

- common in chronic arsenic toxicity
- reversible bone marrow depression with pancytopenia may occur
- Anemia and leukopenia
- often accompanied by thrombocytopenia
- mild eosinophilia.,
- Anemia may be normocytic or macrocytic and basophilic stippling
- Chronic arsenic ingestion may cause cancers of bladder, kidney, liver, lung, prostate, skin

Prevention

- Engineering control – sources of exposure
- Reduce exposure in smelting & pesticide manufacturing operation
- PPE should be worn when performing maintenance work or during application of arsenic compound
- Medical surveillance—skin & respiratory complication , liver, haematological, renal & nervous system function
- Biologic monitoring of arsenic in urine

Climate Change

- Climate Change is a **change in the statistical properties** of the climate system when considered over periods of **decades or longer, regardless of cause**
- A change of climate which is attributed directly or indirectly human activity that alters composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods

Major causes of Climate Change

- Natural Causes

- Wetlands release methane, greenhouse gas
- Earth naturally has a cycle of climate change that occurs every 40,000 years
- the sun's solar energy output is changing and naturally increases Earth's average temperature by about 1°C every century

■ Human Causes

- Increasing green house gas emissions from burning fossil fuels-oil, coal, gas
- Pollution, smog from factories
- Large forests have been cut down (deforestation creates about 6 billion tons of CO₂ per year)
- Increasing world population-more people requires more food, energy, transportation, etc. Farms animals release methane from their wastes.
- More people also means more CO₂ production from respiration and less trees to make room for human population

Greenhouse Gases

- Any gaseous compound in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat in the atmosphere
- By increasing the heat in the atmosphere, greenhouse gases are responsible for the greenhouse effect, which ultimately leads to global warming
- Three factors affect the degree to which any greenhouse gas will influence global warming
  - Abundance in the atmosphere
  - How long it stays in the atmosphere
  - Global warming potential

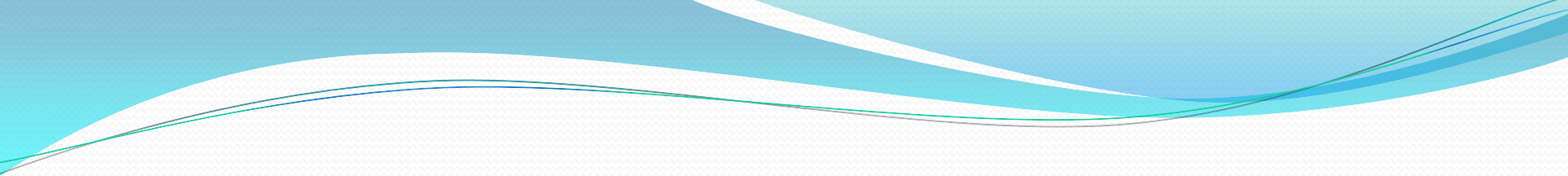
- Most significant greenhouse gases

- Water vapor (H_2O)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Chlorofluorocarbon (CFCs)
- Fluorinated gases (Hydrofluorocarbons, Perfluorocarbons, Sulphurhexachloride)

GHGs	Main Sources
Co2	Burning Fossil Fuels; deforestation
CH4	Livestock; natural gas leaks; landfills; coal mining
NO2	Agriculture; fertilizers; burning fossil fuels
HFCs	Liquid coolants
PFCs	Al production; semi-conductor manufacture
SF6	Dielectric fluid in transformers
O3	Natural and man made (smog, severe air pollution)
H2O	Abundant in atmosphere, evaporation from water body

Greenhouse Effect

- Greenhouse effect is a natural process which warms our planet to support life
- The Earth's atmosphere traps the energy from the sun just like a green house
- Solar radiation reaches the Earth's atmosphere, some of this is reflected back into space
- The rest of the sun's energy is absorbed by the land & the oceans and heating the Earth
- Some heat radiates from the earth towards the space
- This heat trap keeps the Earth warm

- 
- Without this heat trapping system, the Earth surface would be 15°C colder than it is now
  - Some of this heat is trapped by greenhouse gases in the atmosphere, keeping the earth to sustain life
  - Human activities such as burning fossil fuels, agriculture and land clearing are increasing the amount of greenhouse gases released into the atmosphere
  - This is trapping extra heat , causing the Earth temperature to rise

Climate Change Impacts

Health Impacts



Heat-related deaths
Infectious diseases
Air quality-respiratory illnesses



Temperature



Precipitation



Sea Level Rise



Wildlife
Loss of diversity
Species range shifts

Agriculture

Crop yields
Irrigation demand
Pest management

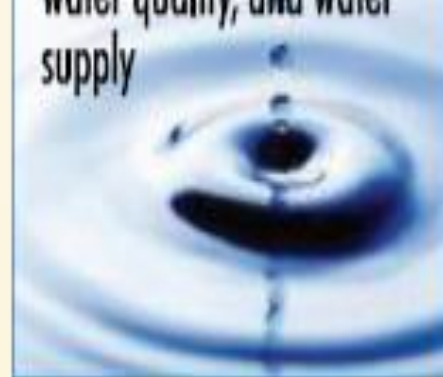


Forest Impacts

Health, composition
and productivity

Water Resources

Changes in precipitation,
water quality, and water
supply



Coastal Areas

Erosion and inundation
of coastal lands
Cost of protecting
vulnerable lands



Health Impacts

- Climate sensitive health outcomes
  - Injuries, disability, drowning
  - Heat stress
  - Water & food borne diseases, Vector borne diseases, Infectious diseases
  - Malnutrition
  - Social dislocation, Psychological stress, Migration
- Natural disasters
- Water quality and quantity
- Food security
- Air Pollution

Vulnerable population groups

- Chronic medical conditions
- Poor & vulnerable communities
- Being confined to bed
- Some types of occupation, outdoor workers
- Very young children
- Elderly suffer the greatest effects of heat-waves (impact on mortality greater in women)

What can we do make a difference?

- 2 basic ways to deal with health problems of climate change
  - Mitigation - Reduce the causes of climate change and its consequences on human beings
  - Adaptation - Improve the capacity to cope with the health risks by being better prepared

1) Mitigation

- Any action taken to permanently eliminated or reduced the long-term risks to human life, property and function from the hazards of climate change.
- Without good and early mitigation, the difficulties and costs of adaptation will grow rapidly (*World Health Organization*)
- Reduction of GHG

Example of Mitigation Measures

- Reduce ozone precursors (reduction of vehicle miles travelled)
- Controlling black carbon
- Use of renewable (wind, solar, wave) and nuclear sources of power generation
- Turn off computers, TV and other appliances when not in use
- Alternative transportation options (walking, cycling)
- Urban tree cover and urban vegetation
- Preservation of forests and wetlands
- Implement three Rs principle - Reduce, Reuse and Recycle

2) Adaptation

- Actions undertaken to **reduce the adverse consequences** of climate change as well as to harness any beneficial opportunities
- Aim to **reduce the impact** of climate stresses on human and natural systems

OCCUPATIONAL HAZARDS

OCCUPATIONAL HAZARDS

- **HAZARD**

- any source of **potential damage, harm or adverse health effects** on something or someone under certain conditions at work.

- **RISK**

- the **chance or probability** that a person will be harmed or experience an adverse health effect if exposed to a hazard.



Hierarchy of control of occupational Hazards

- 1) Elimination
- 2) Substitution
- 3) Engineering control
- 4) Administrative control
- 5) personal protective measure

Health hazards associated with agricultural works

- Agriculture means all forms of activities connected with growing, harvesting and primary processing of all types of crop with the breeding, raising and caring of animals and with tending gardens and nurseries. (ILO/WHO)
- Physical agents: Agriculture - outdoor work - exposed to extreme heat & cold, rain & dust, bright sunlight, thunder-strike, injuries from sharp objects, fall from height
- Chemical agents: exposure with pesticides, fertilizers and dust (Specific: sugar cane - Bagassosis, Mouldy hay farmer's lung)

- Biological agents: hazards of rabies, anthrax, tetanus, malaria, leptospirosis, scrub typhus, bee sting, snake bite
- Psychological agents: stress due to unpredictable weather, unfavorable climate, irregular working hours, temporary employment, investment, new methods of cultivation, psychosocial: hostility, aggressiveness, anxiety, depression, alcoholism/ psychosomatic: headache, fatigue, back-ache, PU, H/T

Prevention of occupational hazards in agricultural works

- Comprehensive public health program including agricultural health program
- Active immunization: Tetanus Toxoid, Russel Viper toxoid
- Early Diagnosis & Effective Treatment of agricultural hazards
- Health Education
- Environmental measures: avoid working at sunny times, monsoon season, thunder strike
- Substitution:
- Isolation of animals
- Enclosure of dust and pesticides
- Wearing protective devices: hat, loose fitting clothes, sunscreen, top boots
- Supportive measures: ORS

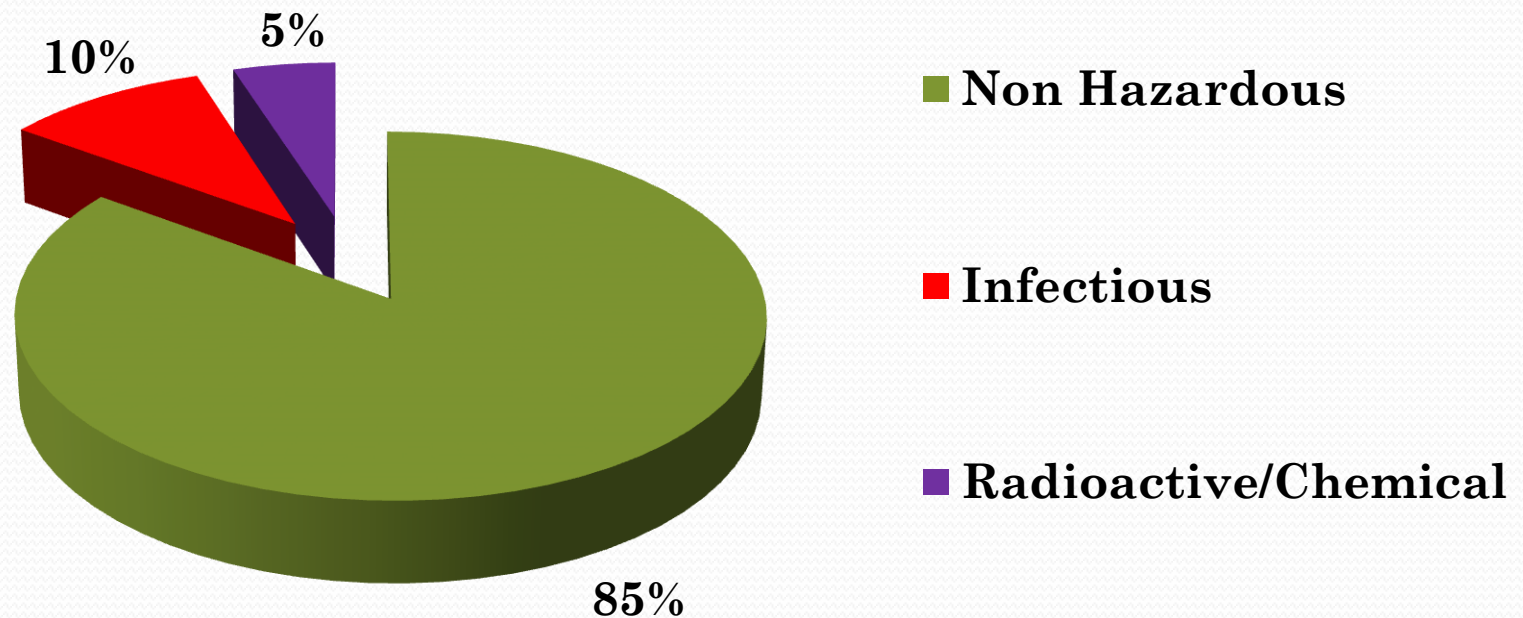
Healthcare Waste Management

Healthcare waste

- It includes all the waste generated within
  - healthcare facilities
  - research centers
  - laboratories related to medical procedures (WHO, 2014)
- In addition, it includes the same types of waste originating from minor and scattered sources, including waste produced in the course of healthcare undertaken in the home (e.g. home dialysis, self-administration of insulin, recuperative care)

Introduction to Healthcare waste

HCW includes all the waste from healthcare research facilities, and laboratories



Categories of Healthcare Waste

Waste Category	Description and Examples	
Hazardous healthcare waste	Sharp waste	Used or unused sharps
	Infectious waste	Waste suspected to contain pathogens and that poses a risk of disease transmission
	Pathological waste	Human tissues, organs or fluids, body parts, fetuses, unused blood products
	Pharmaceutical waste Cytotoxic waste	Pharmaceuticals that are expired Cytotoxic waste - waste containing cytostatic drugs used in cancer therapy; genotoxic chemicals
	Chemical waste	Waste containing chemical substances - laboratory reagents, high content of heavy metals - broken thermometers and blood-pressure gauges
	Radioactive waste	Waste containing radioactive substances used in radiotherapy
Non-hazardous healthcare waste	Waste that does not pose any particular, biological, chemical, radioactive or physical hazard	Waste that does not pose any particular biological, chemical, radioactive or physical hazard

Health Hazards associated with Healthcare Waste

- **Hazards from infectious waste and sharps**
  - **Pathogens** may enter the human body through a puncture, abrasion or cut in the skin, through mucous membranes by inhalation or by ingestion.
  - There is particular concern about infection with HIV, Hepatitis B and C.

Health Hazards associated with Healthcare Waste

- **Hazards from chemical and pharmaceutical waste**
  - Many of the chemicals and pharmaceuticals used in healthcare are hazardous.
  - They are commonly present in small quantities in health-care waste
  - Chemical wastes may cause **intoxication**, either by **acute or chronic exposure**.
  - Common chemical waste types are mercury and disinfectants

Health Hazards associated with Healthcare Waste

- **Hazards from genotoxic waste**
  - Exposure may also occur during the preparation of or treatment with particular drug or chemical.
  - The main pathway of exposure is inhalation of dust or aerosol, absorption through the skin, ingestion of food accidentally contaminated with cytotoxic drugs.

Health Hazards associated with Healthcare Waste

- **Hazards from radioactive waste**
  - It can range from headache, dizziness, vomiting to much more serious problems.
  - It may also **affect genetic** materials.
  - Healthcare workers, and **waste-handling and cleaning personnel exposed to radioactivity** are most at risk.

Health Hazards associated with Healthcare Waste

- **Hazards from healthcare waste treatment methods**
  - **Gases from waste incinerators** may have an impact on people living and working close to a treatment site.
  - The health risk is most serious where an incinerator is improperly operated or poorly maintained.
  - If poorly controlled, emissions from waste incinerators may cause health concern from particulates.
  - Ash from the incineration of hazardous health-care waste may continue to pose a risk.
  - **Burnt-out needles and glass** may have been disinfected but can still cause physical injury.
  - **Burial** of healthcare waste in landfill sites may pose hazards to workers and public.

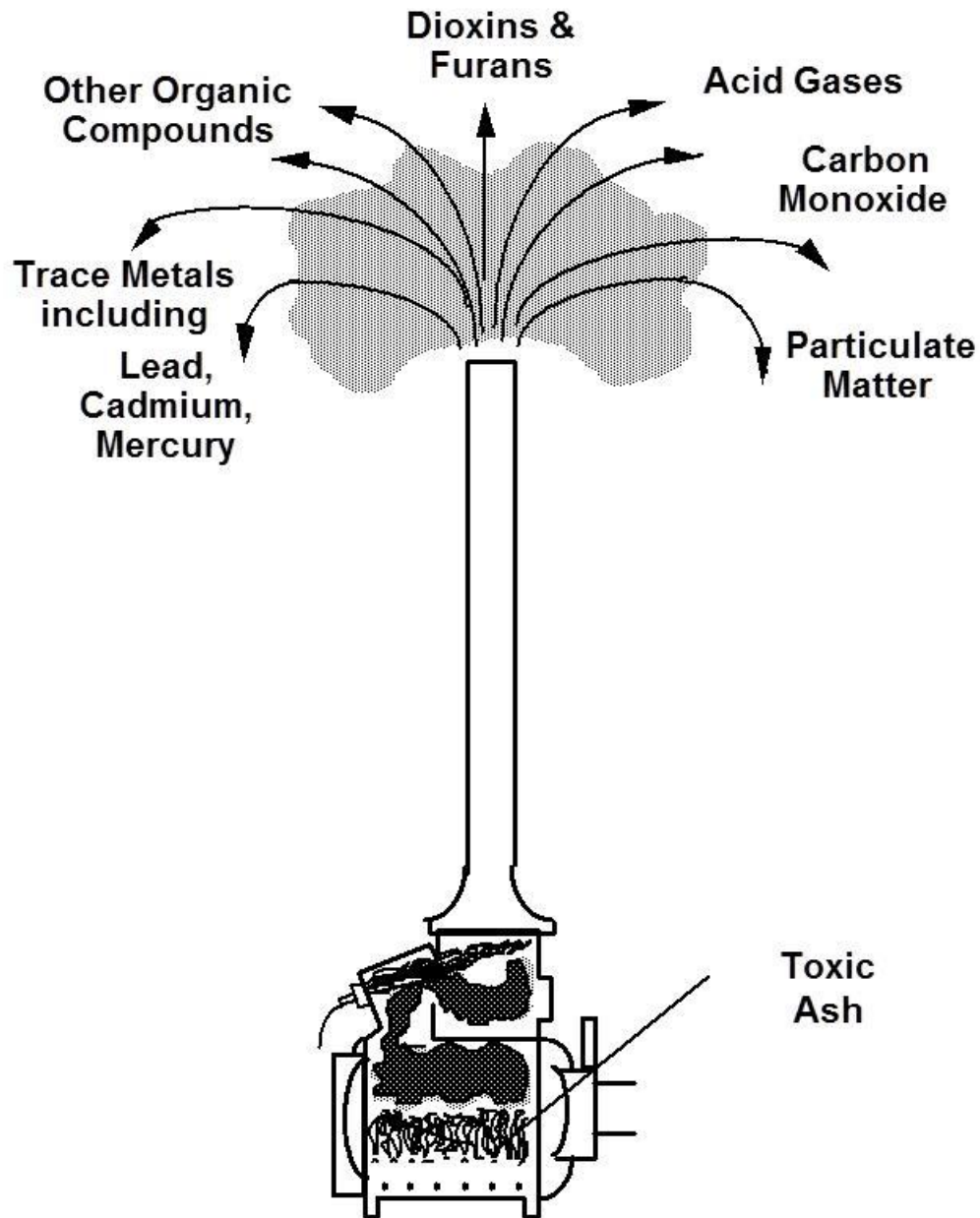
Health Effects of Dioxin and Dioxin-like Compounds

- Dioxins are a group of chemically-related compounds that are persistent organic pollutants (POPs).
- They are released as a by-product of waste incineration and they can travel long distances from the emission source leading to persistence in the environment.
- They are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer.
- **Short-term exposure**
  - Skin lesions and patchy darkening of the skin
  - Altered liver function
  - Persons exposed to dioxin-contaminated agents had transiently elevated liver enzyme levels

Health Effects of Dioxin and Dioxin-like Compounds

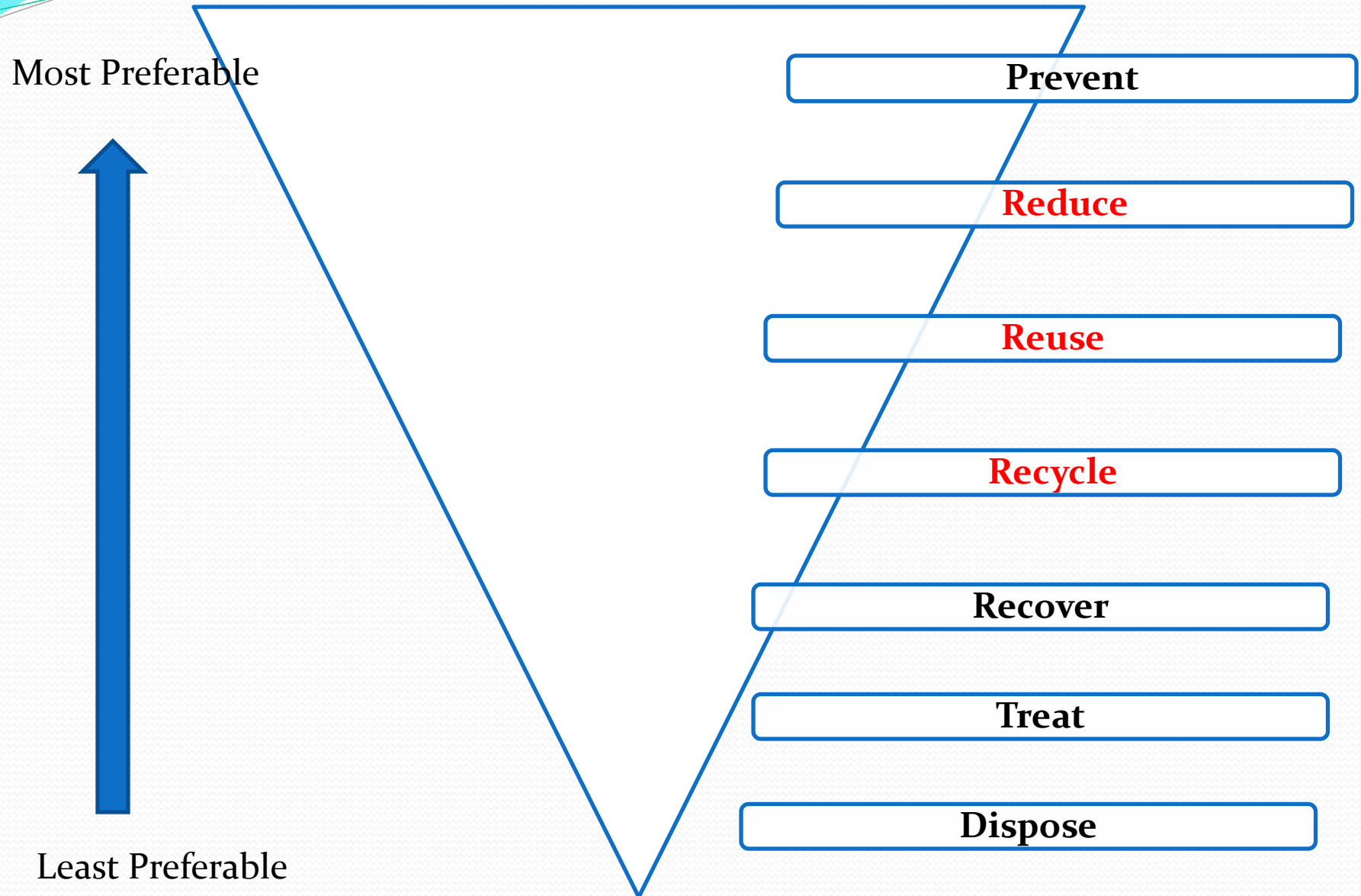
- **Long-term exposure**

- A range of toxicity, including immunotoxicity, developmental and neuro-developmental effects, and effects on thyroid and steroid hormones and reproductive function.
- Animal studies and some studies in people have shown that maternal exposure to dioxins can damage the function of their babies' thyroid gland.
- Developmental effects are the most sensitive health endpoint so that developing foetus, neonate and particularly breastfed infants become the population most at risk.



Air Emissions From a Medical Waste Incinerator

The waste-management hierarchy



Health Care Waste Management Process

1. Segregation

2. Storage

- Initial
- Final

3. Transport

- On Site
- Off Site

4. Disinfection or Treatment

5. Final Disposal

Segregation of HCW (Color Coding)

- **Infectious waste** - **Yellow color**
- **Sharps waste** - **Red color**
- **General waste** - **Black color**
- **Chemical and Pharmaceutical waste** - **Brown color**
- WHO
  - Infectious (Yellow),
  - Sharps (Yellow with biohazard symbol)
  - Chemical and Pharmaceutical (Brown)
  - General (Black)
- Hospital Management Manual Myanmar (2011 and revised in 2015)
  - Infectious (Yellow)
  - Highly infectious (Red)
  - General (Black)
- City Development Committee
  - Infectious (Yellow)
  - Sharps (Red)



Biohazard symbol



Radiation symbol



Storage of Healthcare Waste

- Storage room or place for health care waste
- Person in charge of health care waste storage room or place
- Store different health care waste streams separately
- Storage time of health care waste - not exceed 48 hours
- Bury or dispose anatomical waste daily
- Clean and disinfect storage room or place and equipment at least once a week
- Locate specific areas for the initial storage of wastes, in the wards and departments, near the source of waste
- Locate central storage area away from food preparation, public access and exit route



- **Castle Street Hospital**

Source : HCWM Regional Workshop, Nepal (2016)

Infectious Waste Storage



- Castle Street Hospital
- Source : HCWM Regional Workshop, Nepal (2016)

Transport of Healthcare Waste

- Basket, Trolley, Cart
- Remove bags and containers from initial storage area regularly.
- Minimize manual handling of waste bags
- Handle all waste bags by the neck.
- Plan internal transport routes from initial storage to central store to minimize the passage of waste through patient care areas and other clean areas
- Use dedicated wheeled containers, trolleys or carts to transport the waste containers to central storage area
- Reserve these vehicles only for the transportation of clinical waste
- Clean and disinfect wheeled containers, trolleys or carts regularly and immediately after spillage or accidental discharge

Transport of Healthcare Waste

- On site Transport
  - Hazardous and general waste should be transported separately using three different transport systems
    - Trolleys for general waste with the label “General waste”
    - Trolleys for highly infectious, infectious (pathological) and sharps waste with the label “Infectious waste”
    - Trolleys for other hazardous healthcare waste (chemical, pharmaceutical and radiological waste)





Sample design of waste bin stand and transportation trolley

Source : HCWM Regional Workshop, Nepal (2016)

2020-07-10

Transport of Healthcare Waste

- Off site Transport
  - It should be collaborated with respective City/ Township Development Committee
  - There will be
    - Staff requirements including training
    - Vehicle requirements
    - Labeling of the transport vehicle
    - Cleaning of container and vehicle
    - Transport documentation

Treatment of Healthcare Waste

- Storage room or place for health care waste
- Autoclave- autoclavable infectious waste before disposal



Designated waste autoclave

TREATMENT OF HEALTHCARE WASTE

Chemicals:

non-autoclavable

infectious waste

chemically by using

bleaching powder, lime

solution, calcium oxide or

others (Aseptol/ Detol).

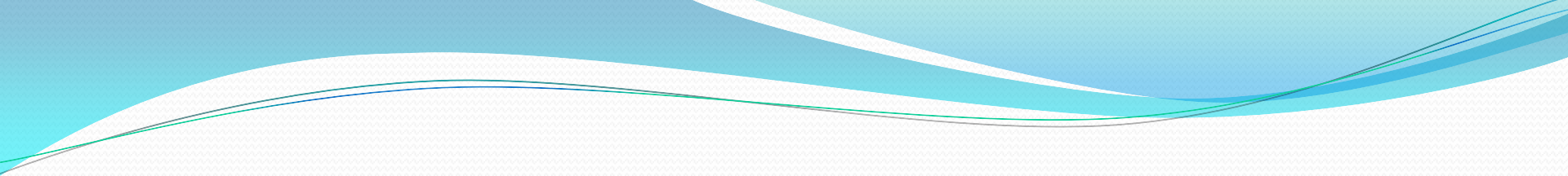


Chemical disinfection

(bleaching powder – 2% Chlorine Solution)

Final Disposal of Healthcare Waste

- **Incinerator** - non-treated infectious waste, placenta and small anatomical waste (by combustion or pyrolysis and gasification)
- **Sharp pit**
- **Placenta pit** - placenta and small anatomical waste to placenta pit where there is no effective incinerator
- Materials for **encapsulation and inertization** - pharmaceutical waste
- **Burial** large anatomical waste in appropriate site.



Thank You