# Health & Environment

HLSC 3850A - Dr. Kalischuk

# Chapter 1: Intro to Enviro Health

# Environmental Health

Enviro Health is part of Public Health (physical, chemical, bio, social & psych factors in enviro)

Environment = complex of physical, chemical, biotic and social factors that surround an organism

Health = physical, mental and social well-being

Sustainability = system that continue functioning without depleting or damaging

# Chapter 2: Ecology & Ecosystems Foundations for Health

# Ecology & Ecosystem

Ecology = focus on interactions in and to their environment

Ecosystem = organism, their enviro & interactions

Ecosystem literacy helps us understand the impact of our actions on the enviro

System thinking = approach to solving problems with macro level understanding

# Chapter 3: sustainability & health

# Sustainability

Current human activity, growth, energy and resource use is not sustainable

Sustainability requires complex systems including enviro, social, health and economic systems

Neo-sustainability = improving quality & operations within sustainable system limits

Impact on earth's systems = population * affluence (per capita consumption) * technology (production & consumption)

I = PAT

Today's global ecological footprint = 2.6 global hectares per person, sustainable is 1.8 gha per person

Stockholm Enviro Institute: limits to human growth

Currently past 350 ppm of $CO_2$ which furthers climate change, rate of biodiversity loss is 100-1000x's natural rate, past safe levels of Nitrogen and Phosphorus cycles {fertilizer production} past 120 million tons per year (safe limit: 35 million)

# Chapter 11: Environmental Justice

# Environmental Justice

**EJ** = impact of enviro hazards on vulnerable groups & promotes access to enviro, social and economic assets {air & water quality}

Cumulative Health Impacts:

- Health inequality between groups are significant and exist, linked to social & enviro factors
- Inequalities linked to increased risk of adverse health outcomes
- Biological & physiological factors can modify effects of enviro factors, = differences in frequency and severity of enviro mediated disease
- Social factors (indiv. & community) amplify effects of enviro hazards

Social Inequality & Enviro Quality:

- Social inequality is growing (it creates more pollution) and impacts Population Health
- Social inequality leads to more consumption, relates to more hours worked (higher inequality) impacts the enviro
- Social inequality in society has less pro-environmental policies

# Chapter 13 Air Pollution

# Air pollution

Air pollution = adverse health (asbestos to death)

Ambient air pollution

- Lead - builds up in tissues. WHO: .50 $mg/m^3$
- Sulfur dioxide - lungs + respiratory. WHO: 10m = 500 $\mu g/m^3$ & 1 yr. = 20 $\mu g/m^3$
- Carbon monoxide - oxygen disruptor. WHO: 15m = 100 $\mu g/m^3$ , 30m = 60 $\mu g/m^3$ & 1 hr =30 $\mu g/m^3$
- Particulate Matter - respiratory + CVD. WHO: $PM_{10}$ - annual 20 $\mu g/m^3$ // 24hr = 50 $\mu g/m^3$ . $PM_{2.5}$ - 10 $\mu g/m^3$ & 25 $\mu g/m^3$
- Nitrogen oxide - lowers lung function. WHO: 1 hr = 200 $\mu g/m^3$ and annual = 40 $\mu g/m^3$
- VOC - respiratory irritation, nausea & cancer

Primary pollutant = direct emission {car → carbon monoxide}
Secondary pollutant = physics + chemical conversion { ozone }

# Chapter 12
# Climate change & Human Health

# climate

Climate Δ ---> threatens health [ morbidity, death, mental health, air pollution, disease & less food production

Vulnerable regions

- Areas with climate sensitive disease
- Association with epidemic & weather extremes
- Risk by combined climate impacts (less food/water)
- Lack of health infrastructure & SES stresses

Food & malnutrition

- Climate Δ = less food production by 2% per decade
- Plant disease = (fungi, viruses, bacteria) = 16% global crop loss
- Ocean acidification

# climate

Weather extremes = higher temp., storms, sea levels, floods, droughts, wildfires **impact health**

Air pollution - aeroallergens = pollens

Infectious disease

Marine ecosystems - algae blooms (poisonous to us & fish)

Vector borne disease = mosquitoes & ticks

Mental health - PTSD, depression, anxiety

Mitigation = reduce GHG = lower energy demand

Adaptation = reduce PUBH climate change impact

# Chapter 17 Solid & Hazardous Waste

# waste

Waste def: material that has no value *subjective

Waste = solid/ hazardous/ specialized {medical}

Waste amount & type vary with SES

Waste management = incineration + landfill

Municipal waste = items from households (1.3 B tonnes per yr.)

Leachate = liquid organic waste decomposition

Sanitary landfills contain & Ctrl waste (compacted & covered in soil)

Deep well injection = vertical well that is filled with waste not suited for landfill

Special waste

- Medical
- Construction
- Asbestos
- Mining
- Agriculture
- Radioactive
- Sewage
- Electric

Radioactive waste

Low level = PPE & items

High level = spent nuclear fuel + waste materials

# Chapter 19 Food Systems
# Enviro & PUBH

# Food Systems

Input = fertilizer, pesticide, energy

Output = product

Soil, water, energy, climate

Agriculture

Input = pesticides, fertilizers, GMOs, glyphosate - human carcinogen

Animal production & waste management => health

Food consumption, food environment, food safety, food deserts

Pathogens in the supply chain

# Chapter 26: Enviro PUBH from theory to practice

# Prevention

Prevention <<>> PUBH (control hazards, Health promo via Enviro)

Prevention >> Enviro Health  {root causes that impact health}

Prevention: *primary, secondary & tertiary*

Enviro PUBH = assessment, policy dev + assurance => prevention

{food protection, water sanitation, OH&S, etc.}

# Concepts of Enviro Health Prevention

DPSEEA

Driving forces - pop. growth & tech development

Pressures - # of driving kms or # of coal plants

State - of the environment (pollutants in air)

Exposure - time & place of exposure to hazards

Efforts - amount of exposure (dose) + timing of exposure + factors in life stage

Actions - reduce/ control the hazards

# Model for Prevention (Leavell & Clark)

Primary = interventions prior to development of any signs of ill health, health promo (prevention) & protection (elim diseases)

Secondary = early detection of health problems

Tertiary = treatment/ prevent disability & death

Prevention hierarchy:
- Substitution (elim hazards with safer products)
- Engineering controls (reduce risk & exposures)
- Admin Control (change how work is done, reduce risk)
- PPE personal protective equipment

Pollution Prevention (increase efficiency: energy,water,resources)

# Principles of Prevention in Enviro PUBH

Precautionary principle = prevention of enviro degradation shouldn't be stopped by threats of damage, lack of scientific certainty

Intergenerational equity = the right to developmental & enviro needs for present + future generations (economic analysis)

# PUBH Core Functions [Institute of Med.]

Assessment {prevention} | Policy development | Assurance

Forecast impacts of new tech + population growth, assess trends in drivers of Enviro health and track trends in state of Enviro + human exposure levels

Prevention - control lead poisoning
Precautionary principle - banning the DDT pesticide
Intergenerational equity - methylmercury etc. last for generations
Health impact assessment - highway expansion vs. public transit

# Chapter 27:
# Risk Assessment in Enviro Health

# Risk and Risk Assessment

Risk = probability of an adverse effect occurring

Risk assessment = decision making in Enviro Health & Protection about a hazard or agent of concern. “Acceptable risk” = Policy decision

Risk of disease = (Enviro, genetics, behavior,lifestyle,SES,lifestage,psychosocial)

RISK ASSESSMENT to protect PUBH (widely used, tool for PUBH Policy)

1. Problem formulation (what adverse effects? Existing policies to reduce risk?)
2. Hazard ID
3. Dose response assessment (dose & probability of adverse health?)
4. Exposure assessment
5. Risk characterization (nature & magnitude of risk to health + uncertainties)

# Step 1 - Problem Formulation

Intro: design goals, scope & tech requirements. Define enviro health problem within policy context & decide on specific technical & analysis approach

Goal: ID the issues to be assessed, establish roles of decision makers & risk assessors using likely health outcomes, data req's & time frame

Methods & Tools:
conceptual models = ID's detailed enviro stressors/pathways/sources/populations & potential health effects
analysis plans = define analytical approach, ID how data on population sources will be located, which chemicals are of concern, how exposure will be assessed, exposure concentrations estimated/measured & what risk metrics will be used. Map out technical req's like Epi or Toxicological data

# Step 2 - Hazard Identification

Intro: examine the evidence for adverse effects from enviro contaminants (using observational & experimental studies)

Goal: determine adverse health effects related to exposure & evaluate quality/nature/strength of scientific evidence supporting causation

Methods & Tools: use toxicological/ epidemiological & other sources to assess the contaminant (products & metabolites), level of frequency & duration of dose/exposure, absorbed & metabolized, physical form, synergistic properties or not, targeted organs & mode of action

# Step 3 - Dose Response Assessment

Intro: relationship between dose of chemical and resulting effect. Paracelsus's "the dose makes the poison", low levels & effect need to be considered

Goal: use hazard ID to characterize the likelihood & severity of adverse health effects at different levels of exposure to a chemical, using mathematical models to estimate toxicity levels

Methods & Tools: use dose response model determination processes for carcinogenic & noncarcinogenic chemicals.

Terms:  (non carcinogens threshold)
NOAEL no observed adverse effect level
LOAEL  lowest observed adverse effect level
RfD reference dose/ RfC reference concentration

# Step 4 - Exposure Assessment

Intro: potential exposures in population are calculated/estimated, all factors need to be considered - acute/chronic at low levels

Goals: determine the concentration of chemical of interest (space & time) of exposed population, describe magnitude, duration, timing & route of exposure, chemical size & nature

Methods & Tools: seek to determine who (population), how (exposure routes), time period (duration), frequency (how often) & magnitude (how much) of chemical exposure in population. Exposure assessment requires Average Daily Dose (ADD) and Lifetime Average Daily Dose (LADD)

Exposure defaults: average adult drinks 2L of water per day and breathes 22 cubic metres per day of air

# Step 5 - Risk Characterization

Intro: provide a synthesis of risk level for particular health effect of chemical in population (specifically!). Address chemicals, pathways, health effects & populations

Goals: make judgments on risk to the population, a summary that restates the scope and assumptions of the analysis, show results & interpret them

Methods & Tools:

Cancer Slope Factor (CSF)
dose-response LADD
(carcinogens) Pop. Cancer Risk is calculated: CSF * LADD  results: <= 1 : 1,000,000
Population lifetime cancer risk is range if 1 in 10,000 to 1 in 100,000 is acceptable

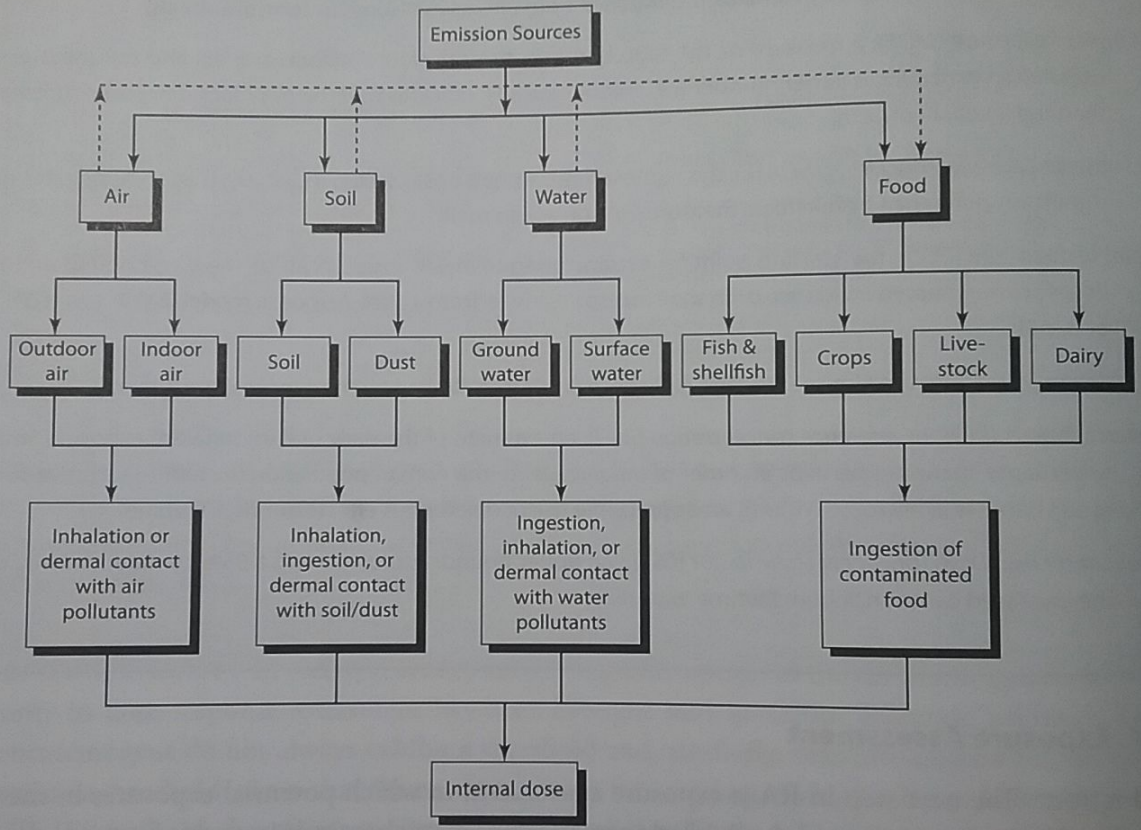
# Risk Management

Risk Management = process of identifying, evaluating, prioritizing and choosing policy options

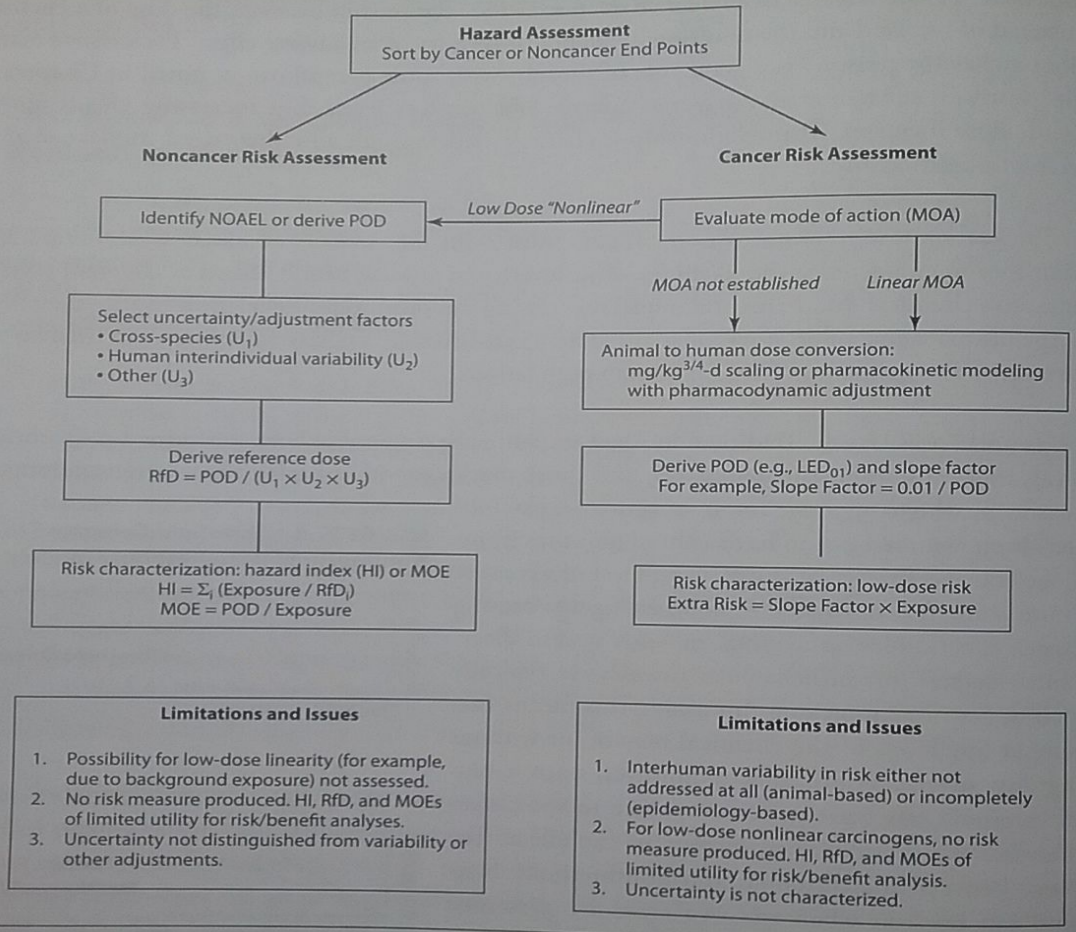
RM Evaluation:

- acceptable level of risk - based on scientific findings & reference dose
- Existing legislation to reduce risks
- Economic costs & benefits -health risks
- Admin. Considerations of policies to implement
- Stakeholder perceptions - those affected/potentially by the risk **must** be included

**FIGURE 27.6 Some Common Exposure Pathways**




*Source:* Based on Agency for Toxic Substances and Disease Registry, 2005.




*Source:* NRC, 2009, p. 130.

# Chapter 28:
# Communicating Enviro Health

# Communicating Enviro Health

Communication & Enviro Health include social marketing & risk communication

* use clear messages to be repeated

Prime Objectives of Enviro Risk Communication:

1. To inform + educate about the risks
2. To build/repair trust
3. Encourage people to take appropriate actions

Make information available

# Health behaviour recommendations

Health recommendations normally fail for 3 reasons:

1. Difficult for people to adopt new change
2. Requires time and money
3. Unclear of the social implications are of change

Get message through by making the behaviour FUN, EASY & POPULAR

Social norms (descriptive & injunctive) play role

# Risk Communication

Risk communication is done by Gov't, private and civil sector

Risk perception paradox: hazards that cause most harm have little amount of concern to people. Example: worry about toxic exposure by chemical (low risk) but not worry about seat belt use (high risk)

Mental noise = when stressed & upset people won't process/understand info and focus on the negatives

Communication during/after Enviro Disaster:

People concerns = anxiety/stress/anger/misery/depression/empathy/disappointment

So when communicating be clear, specific, prioritize info & actions, No Jargon, authoritative language and od regular updates