#### TU10 Environnement (2024-2025)

# Concepts in Environmental Health





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#### Environmental Health - Definition

ENVIRONMENTAL HEALTH comprises "those aspects of human health, including quality of life, that are **determined** by physical, chemical, biological, social, psychosocial and aesthetic factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling and preventing those factors in the **environment** that can potentially affect adversely the health of present and future generations". WHO, 1994



is to PREVENT or control disease, harm and disability related to interactions between populations and their environment



**Psycosocial factors** 











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Helsinki Declaration on Environment and Health, Helsinki, 20-22 June 1994

#### Factors influencing Heath

#### Main characteristics of the 4 main families of determinant

#### ENVIRONNEMENTAL FACTORS

Linked to the state of the environment in which people live: quality of the air, water, soil, etc.

Linked to the living environment: housing, land use, transport, public facilities and services, etc.

Linked to the social environment: family, friends, employment, poverty, social support, etc.

Not individually modifiable, but levers for action to promote health through appropriate public policies

#### HUMAN BIOLOGICAL FACTORS

Individual, genetic and biological: age, sex, heredity, etc.

Not modifiable

# HOLISTIC VIEW OF HEALTH

#### FACTORS RELATED TO THE HEALTH CARE SYSTEM

Accessibility and quality of both preventive and curative care: primary health care, specialised services, etc.

Influenced by health policies and the socio-cultural environment

Santé Canada, 1974

#### BEHAVIOURAL FACTORS

#### Individual decisions:

addictions, food, work, culture, education, physical activities, etc.

Changeable lifestyle habits that are the result of individual decisions, but frequently influenced by the sociocultural environment

> (EHESP/DGS Guide, A. Roué-Le Gall, J. Le Gall, J.-L. Potelon et Y. Cuzin, «Concepts and tools for health-friendly urban planning,» 2014)

# Factors influencing Heath

The determinants of health - other representation

Organization according to 4 levels of influence around the factors of human biology



The model of Whitehead et Dahlgren, 1991



#### Factors influencing Heath - The Environment

HOW IMPORTANT IS THE IMPACT OF THE

# Diseases with the highest environmental contribution worldwide, 2012



+ Years lived with disability (YLD)

#### 400 years before Christ : HIPPOCRATES

"To deepen medicine, one must first consider the seasons, know the quality of the waters, the winds, study the various states of the soil and the kind of life of the inhabitants" (Hippocrates, "Treatise on Airs, Waters and Places")



#### XVIII century : The "invention" of OCCUPATIONAL HEALTH

"Let us listen to Hippocrates: we must ask him (the patient) what he feels, what the cause is, for how many days, but to these questions, let me add: and what profession does he have? (*Ramazzini, doctor from Padova, Italy*)

#### Mid-XIX century : Birth of MODERN MEDICINE

Medicine practiced close to the patient's bed (questioning/observation)

medicine based

empirical

on observation



The facts of everyday life can always be explained by science in the form of experience and observation (Theories of Auguste Comte)

POSITIVISM (current of thought)

Takes into account the social context and health conditions of a population

#### Environmental Health - Historical origin

#### Late XIX century : infectious diseases

MAJOR INFECTIOUS DISEASES (cholera, tuberculosis, typhus...)





3rd plague pandemic

HYGIENISM (current of thought)





#### Reduction of infectious diseases through action on the environment FIRST: sewage, water supply, housing, social rights, education...





Pasteur – anti-rabies vaccine (18785)

# Environmental Health - Historical origin



#### XXI century :

#### PUBLIC HEALTH LAW of 2002 (Kouchner Law, France) : HEALTH DEMOCRACY

The citizen must now have a real place in the system (e.g. right to information)

and be "better informed of his rights, duties and the consequences of his actions or lack of actions".

Law based on the **RISK MANAGEMENT** paradigm

- 1st approach: the cause and effect relationship had to be established before acting
  - Insufficiently protective concept!
- 2nd approach: Health risk assessment, HRA (USA, 1983)



Asbestos: 50 years to ban!



Environmental Health - Historical origin

- 2nd approach: Health risk assessment, HRA (USA, 1983)



#### POLLUTION

direct or indirect change in any component of the environment which is harmful to the living organisms and in particular undesirable for man



#### POSITIVE ASSOCIATION

between diseases and environmental exposure to pollutants...

... but, it is more difficult to establish a cause and effect relationship!

# Difficult to estimate the number of sick people due to the environment!

#### • Diseases:

- Often non-specific and multi-factorial

(1 risk factor/n diseases ; n risk factors/1 disease ; n factors/n diseases)

- Can occur in the long term (long standby time; e.g. cancers)

#### • Exposure conditions:

- At various doses, especially low doses
- Multiple (multi-environments, multi-routes, multi-dangerous agents)
- Chronic
- Risks:
  - Low individual risks (difficult to identify when high risks coexist: e.g. air pollution and smoking)
  - But strong collective impacts!

# <u>Multi-agents of exposure (hazard)</u>

#### BIOLOGICAL

Fungi Viruses, Parasites, Bacteria Prions







#### PHYSICAL

Extreme temperatures Noise Ionizing radiation Radio frequency energy UV radiations

Vibrations

hhhhhhh





#### CHEMICAL

Inorganics Organic compounds Gas (nano)particles, fibers









#### MULTI CLASSIFICATION of environmental chemical hazards

# • Pollutant

- Any substance present in the environment <u>in such concentration</u> which adversely affects the environment by damaging the growth rate of a species and by interfering with the food chains, and affects the health, comfort and property.
- Contaminant
  - Any substance found in a place where it is not normally found.

# • Residue

 Any pharmacologically active substance (drug, metabolite, excipient, degradation product) which remains in food obtained from animals which have received veterinary drug treatment.

#### MULTI CLASSIFICATION of environmental chemical hazards

- Depending on their existence in nature
  - Quantitative pollutants  $(CO_2)$
  - Qualitative pollutants (insecticides)
    - Primary pollutants (COx, SOx, NOx, VOCs, PM, metals, hydrocarbons)
    - Secondary pollutants (NOx + VOCs + UV  $\rightarrow 0_3$ )

- According to their natural disposal
  - Non-degradable pollutants
    - Waste (glass, plastic, aluminium cans...)
    - Toxicants (heavy metals)
  - Bio-degradable pollutants
    - Slowly degradable or persitent pollutants (<sup>137</sup>I, <sup>239</sup>Pu...POPs)
    - Rapidly degradable or non-persistent pollutants



MULTI CLASSIFICATION of environmental chemical hazards

Persistent Organic Pollutants - POPs

Mobile: transported over long distances (distant from anthropogenic sources) Persistent: high half life (Air > 2 days, Eau > 2 months, Soil > 6 months, sediment > 6 months) **Bioaccumulative:** accumulates in living organisms Toxic: for humans or the environment



#### **Unintentional POPs:**

- open burning, waste incineration, biomass burning (forest fires, domestic fires)
- some industrial processes (production of chemicals, metals, textiles, etc.)

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**INHALATION** particles, gas, microorganisms...

#### INGESTION

dust, food, water contaminants (chemicals, microorganisms)



Cosmetics, water, clothing (chemicals, microorganisms)

Transplacental (lipophilic compounds)

temperature, noise...

**Physical stress** 

Radiation,

MULTI-ROUTES of

exposure



Which is a function of the time spent in various environments ...

#### MULTI- ENVIRONMENTS of exposure



TRANSPORT





LEISURE ACTIVITY



# HOUSING

...and practices

Diet, smoking/cannabis, cosmetics, alcoholism, illicit drugs, medication...



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**TIME SPACE - BUDGET** Average daily time associated with various activities and their locations (home, workplace, indoor, outdoor...)



WORKPLACE







<u>Transfers of pollutants</u> <u>in the food chain</u> <u>(trophic chain)</u>



#### BIOACCUMULATION

- Increase in concentration of a pollutant from the environment to the first organism in a food chain

#### BIOMAGNIFICATION

- Increase in concentration of a pollutant from one link in a food chain to another. In order for biomagnification to occur, the pollutant must be: long-lived, mobile, soluble in fats, biologically active



MeHg: Bioconcentration and bioaccumulation in fatty fish

Trophic pyramid



#### <u>Transfers of pollutants in the</u> <u>food chain (trophic chain)</u>





ppm : parts per million

#### <u>Multi-exposure of INDIVIDUALS and ECOSYSTEMS to</u> <u>environmental pollution</u>



Biosphere The part of Earth ECOLOGICAL WOODLAND ECOSYSTEM that contains all ecosystems LEVELS: from Biosphere individuals to Ecosystem Community and its nonlivina surroundings ecosystems Hawk, snake, bison, prairie dog, grass, stream, rocks, air Populations that Community live together in a Biological COMMUNITY defined area group or assemblage of Α lawk, snake, bison, prairie dog, grass Population Group of populations of different species organisms of one type that live in that share a common biotope the same area **Bison herd** Organism Individual living thing Bison **Biological POPULATION** Tissues, organs, Groups of A group of individuals of the same and organ systems Cells species occupying the same site Nervous system Brain Nervous tissue Smallest functional simultaneously Cells unit of life Nerve cell Groups of atoms; smallest unit of Molecules most chemical 30 compounds Water DNA

# <u>INTERDEPENDENCY</u> <u>humans/animals/environment</u>

" Environment of today, health of tomorrow "







The One Health concept is a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment. The synergism achieved will advance health care for the 21st century and beyond by accelerating biomedical research discoveries, enhancing public health efficacy, expeditiously expanding the scientific knowledge base, and improving medical education and clinical care. When properly implemented, it will help protect and save untold millions of lives in our present and future generations.



#### « ONE HEALTH »

The good health of environments (natural or "anthropised") is a condition for the conservation of the biodiversity of animal and plant species, which in turn enables the good health of the inhabitants to be maintained

> Never again isolate human from his environment!



How predict RISKS of chemicals such as pharmaceutical residues for the health of ecosystems, including humans?

#### ECOLOGICAL RISK ASSESMENT



Intrinsic hazard ?

Target population ?

Exposure conditions (dose, frequency, duration) ?



#### HUMAN RISK ASSESMENT









#### THE ANTHROPOCENE "The era of Man, now the main geological force on the Earth "



# Acting for health equality

Protecting our environment, is to protect our health and that of our children ...

# Thank you for your attention!



... and to protect the biodiversity of ecosystems

# ANNEX - Air pollution



IUGR: intra uterine growth retardationLBW: low birth weight

Farmer et al., 2014

#### ANNEX - Food contaminants



Food: main vector of human exposure to environmental contaminants

#### ANNEX - Food contaminants



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# ANNEX - Soil pollutants



#### The main soil pollutants:

Heavy metals Dioxin Hydrocarbons PCBs...