Epidemiology toxicology ehra

Recap of everything we have learned so far

- Concept of Environmental Health
- Environmental Epidemiology
- Environmental Toxicology
- Going forward:
- Environmental Health Risk Assessment

Concept of Environmental Health

Which of the following is **NOT** an example of an Environmental Health problem?

- Social deprivation and stunting in children
- Water contamination and diarrhoea
- Soil contamination with nitrate and cancer

Correct Answer

> Social deprivation and stunting in children

- This is NOT ENVIRONMENTAL HEALTH
- This is an example of SOCIAL DETERMINANTS ofHEALTH
- It may seem:
    - Social deprivation is outside of humans
    - Social deprivation is within the control of human intervention
- Reason:
    - Social deprivation is not a TANGIBLE entity

Which of the following is/are NOT Environmental Health?

- a. Rheumatic Fever caused by Group A Streptococci
- b. Poor housing conditions that lead to Rheumatic Fever
- c. Poverty leading to skin infections leading to rheumatic heart disease

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Correct answer

- a. and (c) ARE NOT examples of Environmental Health
- b. is ENVIRONMENTAL HEALTH
- a. is INFECTIOUS DISEASE

- c. is SOCIAL DETERMINANT of health

Review of Epidemiology

- **Prevalence**
- **Incidence**
- **Study designs**

Prevalence

> In a Town T, there are 400 residents. 20 of them have an unknown fever (“FUO”). What is the prevalence of FUO in Town T (calculate in number of people per 1000)?

Answer to Prevalence

- The prevalence of FUO in Town T is:

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## [1] 50
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Concept of prevalence

- Number of people with the Disease (“D”)
- Total number of people (“N”)
- If the Base population is “B” (such as 100, 1000, etc)
- **Prevalence = (D / P) * B**

Worked out solution

- Here, “D” = 20
- “N” = 400
- “B” = 1000,
- Therefore, Prevalence = (20 / 400) X 1000 = = **50 per 1000**

Prevalence is a Proportion

- We measure prevalence as ONE time
- Prevalence is calculated based on cross-sectional surveys

Incidence

- Number of **NEW CASES of a HEALTH CONDITION**
- Population-Time (Person-Time)

What is incidence: consider the data

year	population	time_period	cases	at_risk	cumulative_cases
2001	1000	0	10	1000	10
2002	1000	1	20	990	30
2003	1000	1	30	970	60
2004	1000	1	20	940	80
2005	1000	1	10	920	90

Explanation

- We follow data between 2001 and 2005, 5 years of data
- There were 1000 people, no one died, no one moved away
- First year was 2001, hence follow up period is 0
- For subsequent years, we followed them for 1 year, hence 1
- Cases indicate number of existent (as in 2001) cases and
- Number of new cases (from 2002 onwards)

Prevalence and incidence

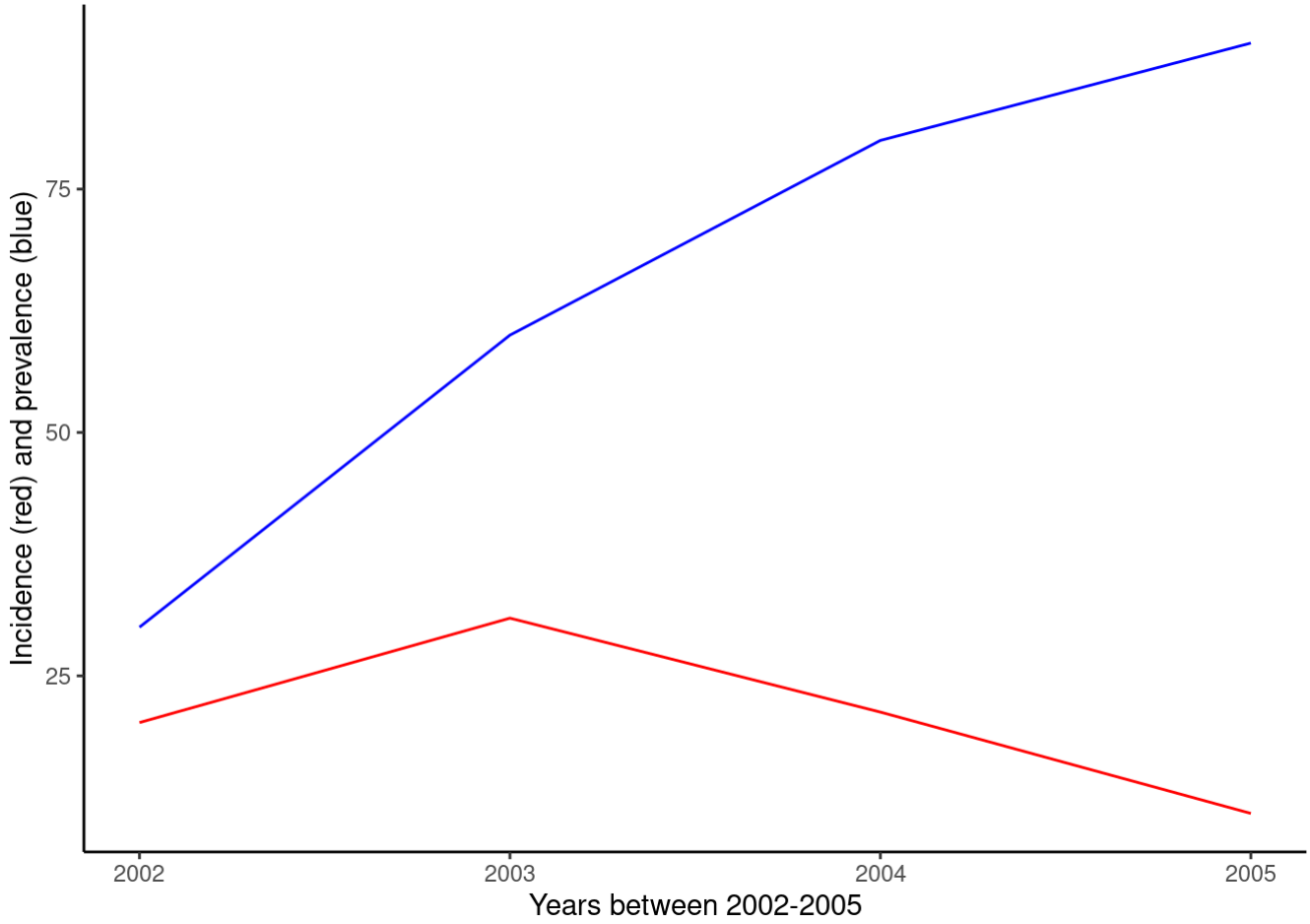
year	prevalence_1000	incidence_1000py
2002	30	20.20202
2003	60	30.92784
2004	80	21.27660
2005	90	10.86957

Explanation for the incidence and prevalence

- For the first year, the time period of follow up is 0
- Hence the incidence is NOT ESTIMABLE and shows as inf
- But for 2002 onwards, it is based on the
- Number of new cases / population X time period

- The prevalence in any year is based on CUMULATIVE CASES

Prevalence (Blue) vs Incidence (Red)



What does the graph show?

- For a chronic disease such as the one shown
- Incidence can increase and decrease over time
- Prevalence will continue to remain high unless
- People die from the disease or get cured
- This is because incidence relates to NEW CASES

- # Prevalence is about EXISTING CASES

Study designs

- Prevalence can be studied by **Cross-sectional surveys**
- Incidence can be studied by **Prospective Studies**
- In Environmental Health, many studies are **Ecological**
- This means, aggregated health events and environmental data are studied

Toxicology

- Study of toxins
- Dose is the poison or toxin
- Toxicokinetics
- Toxicodynamics

Toxicokinetics

- How toxins once enter the body
- Moves around
- Five steps
- Absorption, Distribution/Storage, Metabolism, Excretion

Which of the following is NOT an entry point for toxin

- Skin
- Oral cavity (mouth/eating/drinking)
- Respiratory system (breathing/inhalation)
- Thinking and Brain

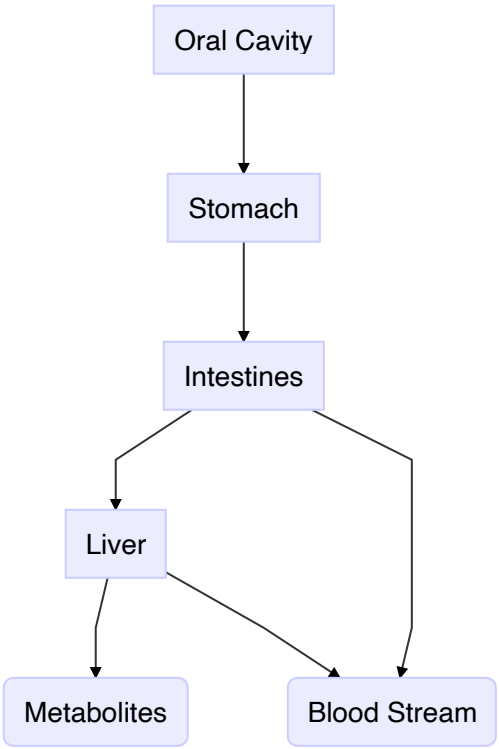
Answer to entry point

- Thinking and Brain
- There is NO PORTAL of entry

All toxins follow ADME

- A: Absorption
- D: Distribution and storage
- M: Metabolism
- E: Excretion

Which of the following is missing in this diagram



Answer to what is missing

- Excretion
- A is from Oral Cavity to Stomach to Intestines
- D is via Blood Stream
- M is from Liver to Metabolites
- E is not shown here

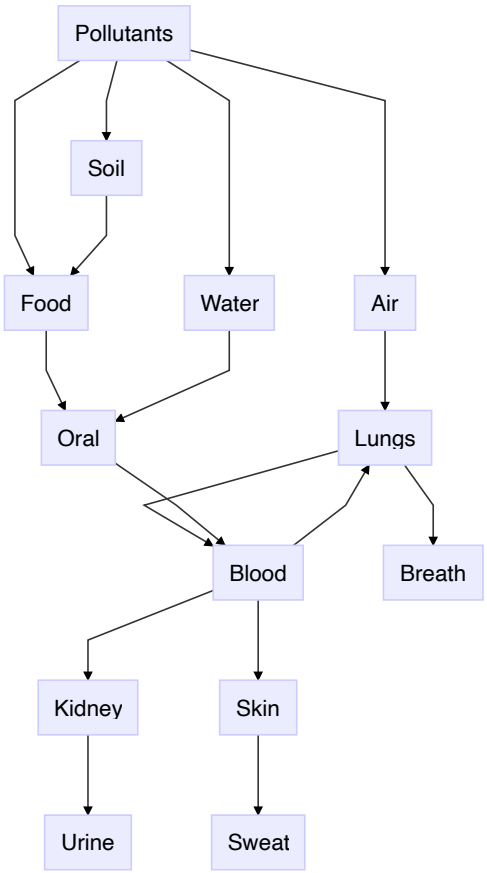
Toxicodynamics

- As the toxin circulates it can act on cells
- How toxins act on cells
- Toxins act being outside of cells
- Toxins act after entering the inside of cells

Every toxin has toxicokinetics and toxicodynamics

- Toxins in air
- Toxins in water
- Toxins in soil
- Toxins in food

Pathways and actions of Environmental Toxins



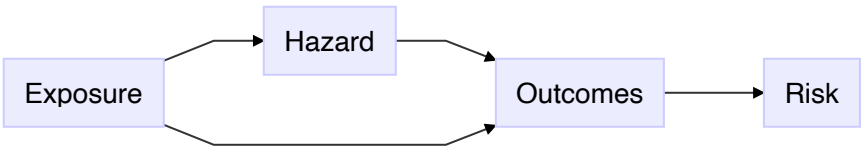
Toxins can be

- Physical (Pressure, wind, sunlight, other light, radiation)
- Chemical (Acids, bases, alkali, solvents, …)
- Biological (viruses, bacteria, fungi, plants, animals)

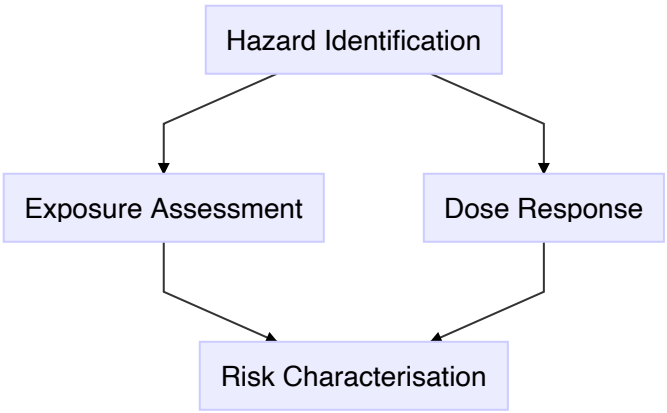
Basic concepts

- Epidemiology and Experiments is about identifying Hazards
- Toxicokinetics is about converting the Exposure to Dose
- Toxicodynamics is about converting Dose to Risk
- Assumption: Higher the dose, higher the risk

Relationship between Hazard and risk



Environmental Health Risk Assessment



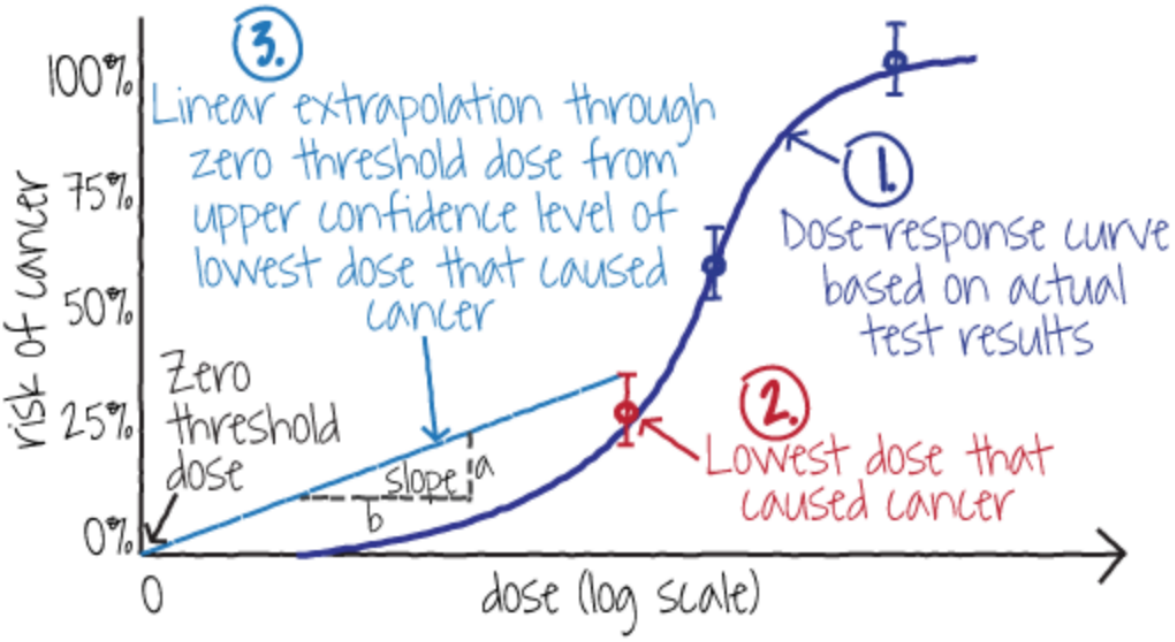
Hazard identification

- Animal experiments
- Epidemiological Studies
- Characterise dose-response effects

Dose Response effects

- Non-cancer causing toxins
- Cancer causing toxins

Shape of cancer causing toxins



Cancer slope factor

Shape of non-cancer causing toxins

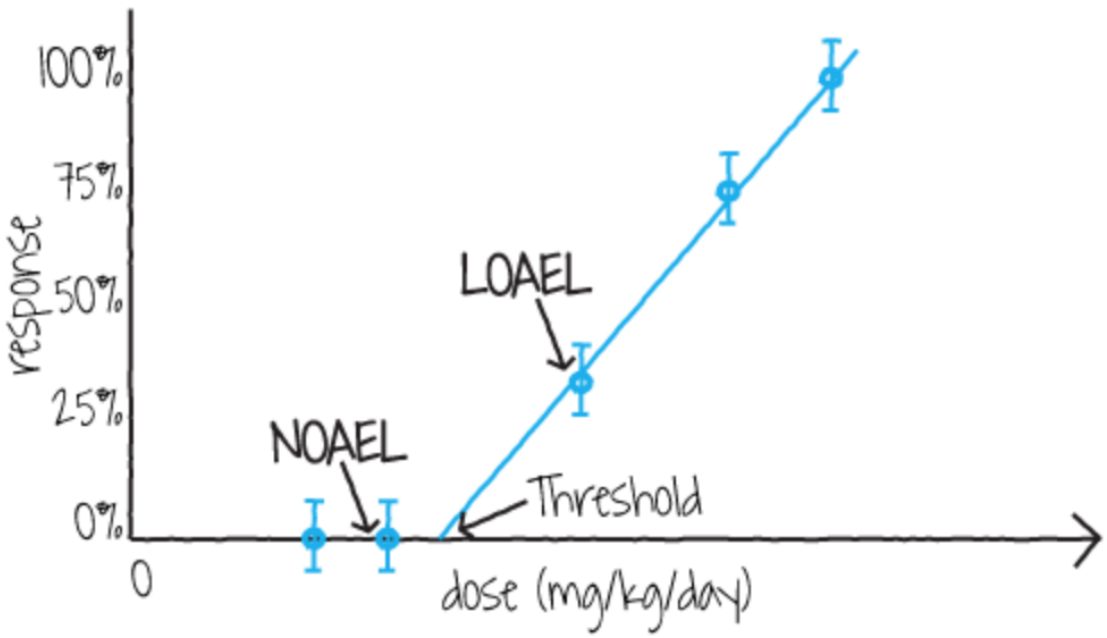


Figure 3. Dose-response curve for noncarcinogenic effects (Image Source: NLM)

Summary

- To study environmental health
- You need to know first what is NOT environmental health
- You must have a good grasp of basic environmental epidemiology
- You must understand the basics of toxicology
- Next up, nitty gritty of environmental health risk assessment