# Hazards and Risks

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# Hazard and Risk

**Hazard is the potential of a substance to cause damage**

-e.g; Toxicity is the hazard of a substance which can cause poisoning

**Risk is a measure of the probability that harm will occur under defined conditions of exposure to the hazard**

*(If there can be **no exposure** to a hazard, no matter how dangerous (hazardous) it may be, there is no risk of harm)*


HAZARD
Anything that can cause harm (eg. a chemical, electricity, ladders, etc)
RISK
How great the chance that someone will be harmed by the hazard

# Hazard and Risk

The relation of risk to hazard is expressed as;

$$R = f(H \times E) = f(H \times D \times t)$$

Risk = R

Function = f

Hazard = H

Exposure = E

Dose = D

Time = t

# Hazard and Risk

Thus, chemicals which pose only a small hazard but to which there is frequent or excessive exposure may pose as much risk as chemicals which have a high degree of hazard but to which only limited exposure occurs

# Study Designs Used in Environmental and Occupational Health

- **Descriptive studies** provide information for setting priorities, identifying hazards, and formulating hypotheses for new occupational risks.

- **Etiologic studies** can be used to show exposure-effect relationships

# Study Designs Used in Environmental and Occupational Health

**Ecologic study design** دراسة بيئية

- Studies which correlate environmental factors' exposure to mortality and morbidity rates
- Based on large populations in order to calculate (r)

# Study Designs Used in Environmental and Occupational Health

## Cross-sectional study design

## Case-Control study design

# Toxicologic Concepts Related to Environmental and Occupational Health

- Dose-response
- Threshold
- Latency
- Synergism

# Dose - Response

The dose–response relationship is the measurement of the relationship between the dose of a substance administered and its overall effect (the response)

(The response on the human being could be physiological or pathological or both)

The relationship is studied using the dose-response **curve**

# Dose - Response

A dose response curve records the percentage of a population showing a given quantal (all or nothing) response such as death when each individual member of the population is subjected to the same dose of toxicant (reflecting a given exposure).

(mainly used for expressing the association of exposure to a **chemical** or **toxic substance** upon an organism

# READINGS on the Dose-Response Curve

## Lethal Dose LD

e.g; $LD_{50}$ is the median dose associated with the death of **50%** of the population

## Effective Dose ED

Effective dose is a dose quantity in the International Commission on Radiological Protection system of radiological protection.

The sievert (symbol: Sv) is a derived unit of ionizing radiation dose in the International System of Units (SI) and is a measure of the health effect of low levels of ionizing radiation on the human body.

# Regulation of agents that can cause cancer

In the absence of data in humans to the contrary, chemicals which can induce cancer in experimental animals are regulated as if they could induce cancer in humans

There is a generally held assumption that **there is no threshold for safe exposure to substances which may cause cancer** by mutation of the genetic information in DNA.

This may not be the case but it ensures that regulatory levels are set very far below those which might carry a significant risk.

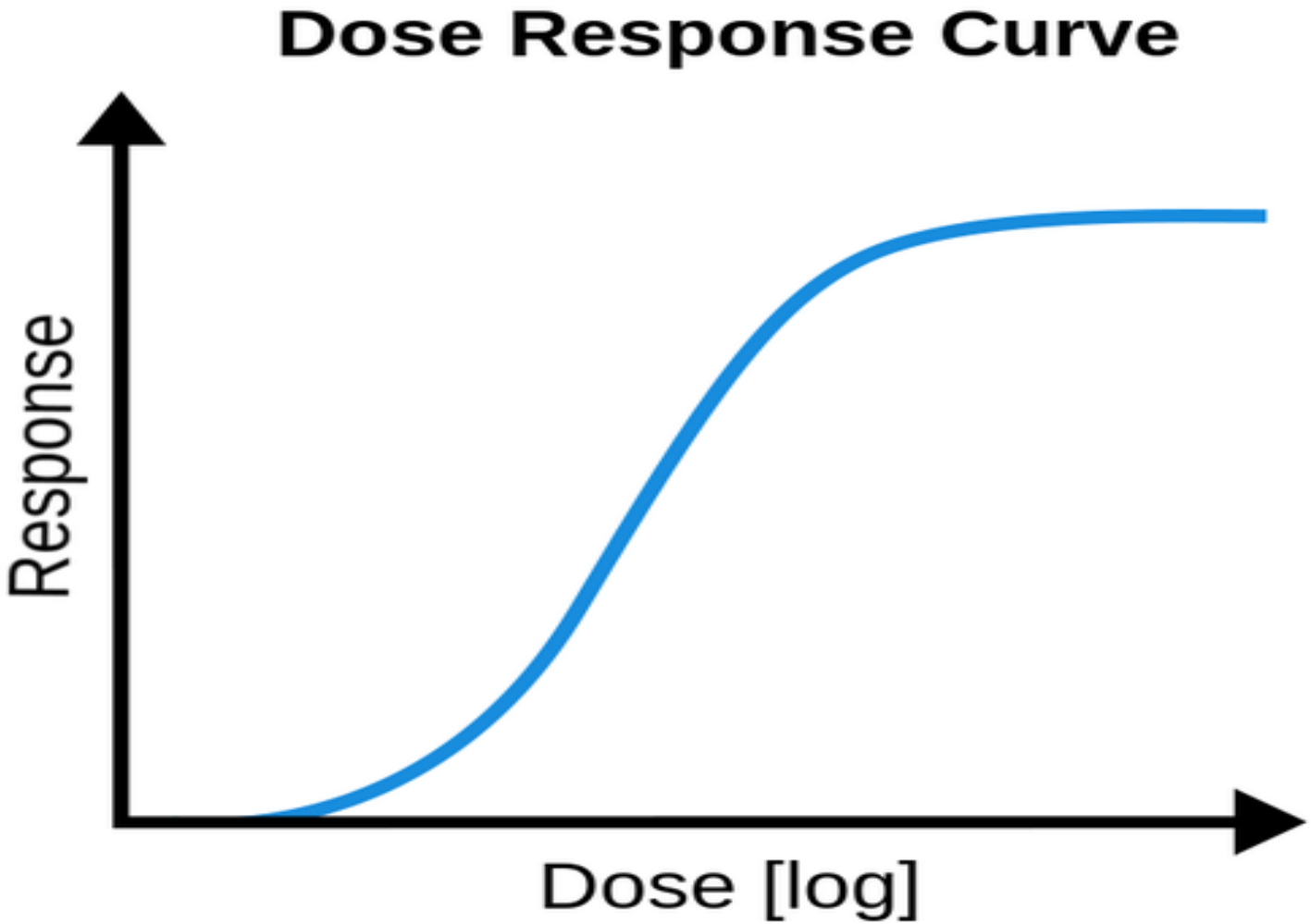
# Regulation of agents that can cause cancer

Regulatory permitted levels of agents that can cause cancer (for which no safety threshold of exposure can be established) are based on calculations of lifetime risk

It is generally considered that exposure levels corresponding to a calculated **increased lifetime risk of 1 in a million are acceptable** since an increased incidence of cancer at this level would be undetectable with current epidemiological methods; calculations are based on the worst possible case and the true increase is likely to be much less

## **Toxic Dose** $TD_{50}$

The calculated dose of a chemical introduced by a route other than inhalation, that would cause a specific toxic effect in 50% of a defined experimental animal population


Dose Response Curve
Response
Dose [log]

# Safe Exposure Levels

Important regulatory “safe” exposure levels are those for food or water Tolerable Daily Intake (TDI)

The Tolerable Daily Intake is an estimate of the daily intake of a chemical contaminant which can occur over a lifetime without appreciable health risk.

The concept of a “TDI” generally applies to unavoidable and undesirable contaminants of food or water which have no useful purpose.

The term “tolerable” is intended to signify permissibility rather than acceptability

# Safe Exposure Levels

In the United States, the “Reference Dose (RfD)” has a very similar definition to that of the Tolerable Daily Intake

Exposures above the TDI or RfD are not necessarily dangerous because a large margin of safety is allowed in their calculation but every effort should be made to keep below these values

# Threshold عتبة

The **lowest dose** at which a particular response may occur

Yet there is no evidence that subthreshold level do not produce health effect

# Latency كامن

The **time period** between **initial** exposure and **a measurable response**

Latency can range from seconds (acute toxic agents) to years (mesothelioma)

The long latency of health events in environmental research makes the detection of hazards difficult (confounding)

# Synergism التآزر

A situation in which the **combined effect** of several exposures is **greater than the sum** of the individual effects

**Example**: Study conducted among asbestos insulation workers demonstrated a synergistic relationship between asbestos and smoking in causing lung cancer