

Toxicology- 1

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Toxicology Terms

Toxicology Terms

- The term “**toxicant**” refers to toxic substances that are produced by or are a byproduct of human-made activities.
- The term “**toxin**” refers to toxic substances that are produced naturally.
- A **toxic symptom** is any feeling or sign indicating the presence of a poison in the system.
- **Toxic effects** refers to the health effects that occur due to exposure to a toxic substance.
- **LD₅₀**: The amount (dose) of a chemical which produces death in 50% of a population of test animals to which it is administered by any of a variety of methods. Normally expressed as milligrams of substance per kilogram of animal body weight (mg/kg)

Toxicology Terms

Toxicity - The adverse effects that a chemical may produce.

Dose - The amount of a chemical that gains access to the body (mg/kg)

Adverse effects

- any change from an organism's normal state
- dependent upon the concentration of active compound at the target site for a sufficient time.

Hazard – is a chemical substance, physical agent, or biological agent that can harm the health of people

Exposure – Exposure means Contact with a hazard

- Exposure Frequency – how often
- Exposure Duration – how long
- Exposure Concentration – how much

$$\text{Risk} = \text{Hazard} \times \text{Exposure}$$



The Dose Makes the Poison!

- An apparently non-toxic chemical can be toxic at high doses. (Too much of a good thing can be bad!).



- Highly toxic chemicals can be life saving when given in appropriate doses. (Poisons are not harmful at a sufficiently low dose)

Exposure

Duration and frequency are important components of exposure and contribute to dose.

- Single exposure: Acute exposure - less than 24 hours
- Repeated exposures are classified as:
 - Subacute - repeated for up to 30 days
 - Subchronic - repeated for 30-90 days
 - Chronic -repeated for over 90 days



INTRODUCTION

Toxicology is the science of the adverse effects of chemicals, including drugs, on living organisms.

DESCRIPTIVE TOXICOLOGY

to obtain information that can be used to evaluate the risk that exposure to a chemical poses to humans and to the environment.

REGULATORY TOXICOLOGY

judges whether a drug or other chemical has a low enough risk to justify making it available for its intended purpose.

CONTD..

FORENSIC TOXICOLOGY

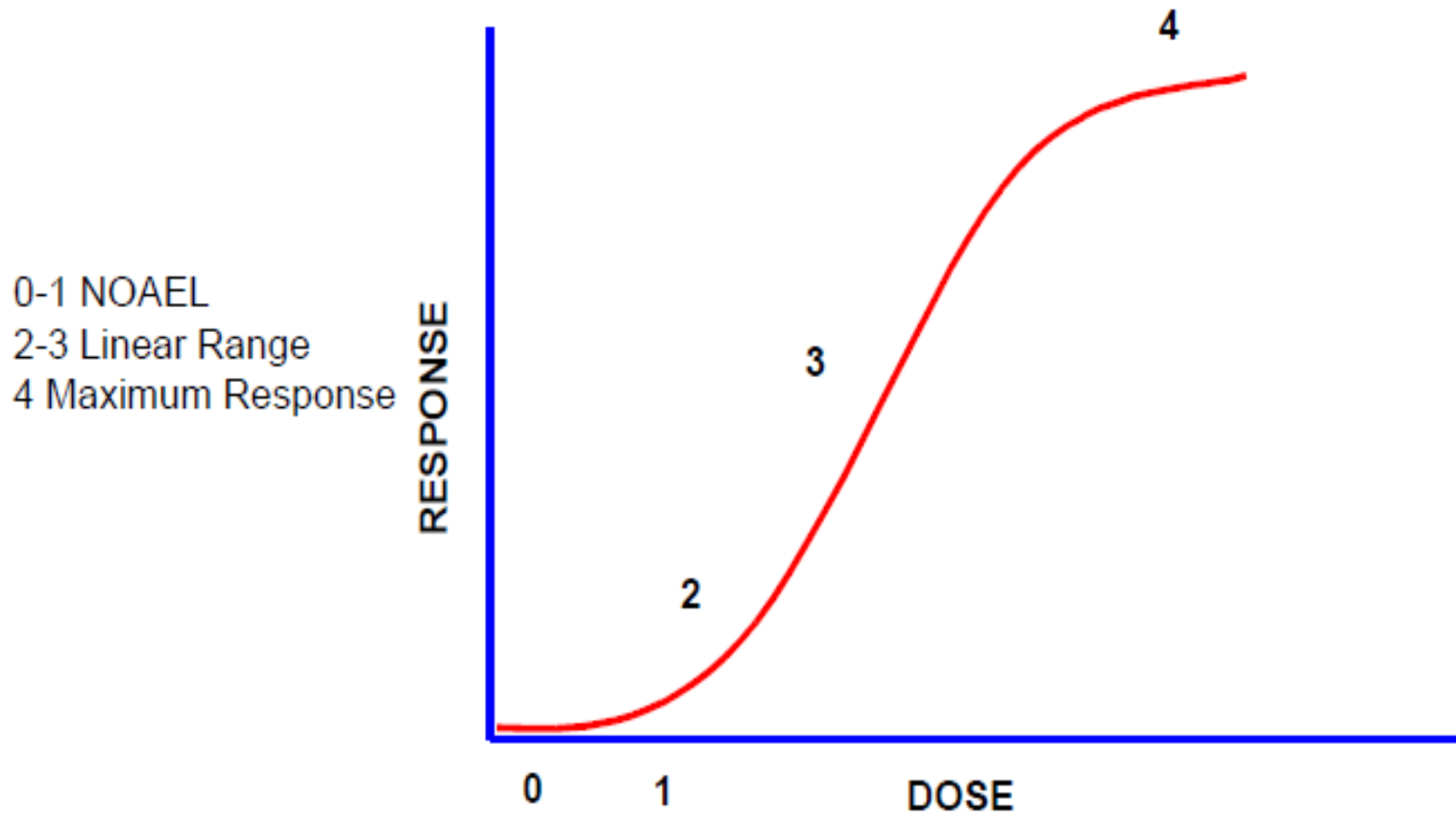
which combines analytical chemistry and fundamental toxicology, is concerned with the medicolegal aspects of chemicals

MECHANISTIC TOXICOLOGY

attempts to determine how chemicals exert deleterious effects on living organisms. Such studies are essential for the development of tests for the prediction of risks, for facilitating the search for safer chemicals, and for rational treatment of the manifestations of toxicity.

Dose - Response Curve

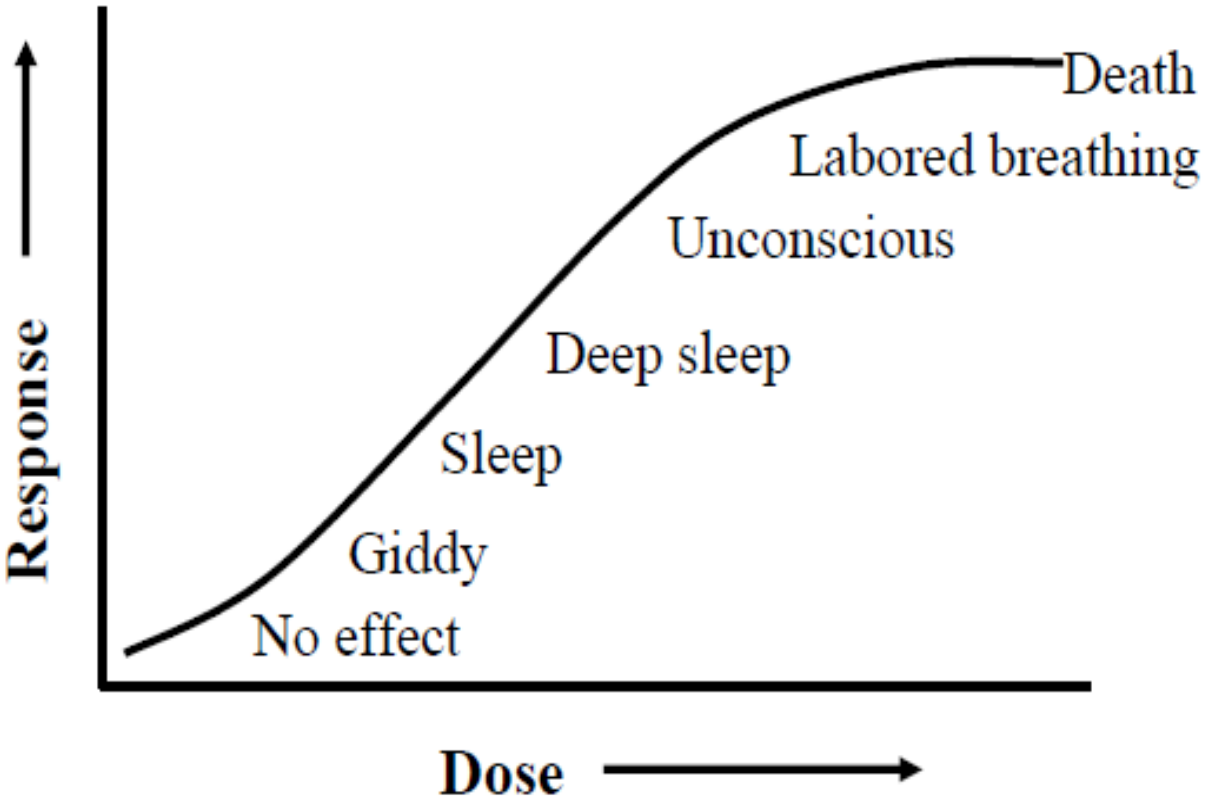
Dose-Response Relationship: As the dose of a toxicant increases, so does the response.



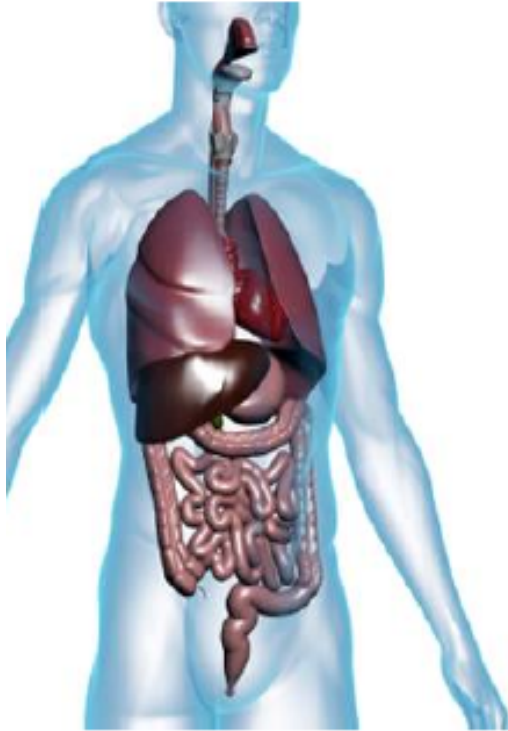
0-1 NOAEL
2-3 Linear Range
4 Maximum Response

NOAL No Observable Adverse Effect Level

Dose-response curve for alcohol



Route of Exposure



Ingestions account for 79% of exposures

- 7% dermal
- 6% ophthalmologic
- 5% inhalations
- 3% stings and bites
- 0.3% injection

Typical Effectiveness of Route of Exposure:

iv > inhale > ip > im > ingest > topical

Mechanisms of Toxic Effects

Adverse effects can occur at the level of the molecule, cell, organ, or organism

Molecular level: chemical can interact with: Proteins / Lipids / DNA

Cellular level: chemical can

- interfere with receptor-ligand binding
- interfere with membrane function
- interfere with cellular energy production
- bind to biomolecules
- Agitate homeostasis

Types of Interactions

Additive effects: $(1+1 = 2)$

Synergism: one contaminant enhances the effect of another $(1+1 = 3)$

Antagonism: one contaminant reduces the effect of another

Tolerance

state of decreased responsiveness to a toxic effect of a chemical, resulting from previous exposure

- dispositional tolerance; a decreased amount of drug reaching the site
- cellular; reduced responsiveness of a tissue

Types of toxic effect

A wide variety of effects:

- Allergic agents: itching, rashes, sneezing, watery eyes.
- Asphyxiants: cause displacement of oxygen and thus suffocation.
- Irritants: cause pulmonary edema (fluid in the lungs) when inhaled at high concentrations and rashes when spilled onto the skin.
- Necrotic agents – cause cell death.
- Carcinogens, mutagens and teratogens: Cancer, mutations, and deformed embryos result from chronic exposure to low levels
- Systemic poisons – can have an adverse effect on the whole body when taken internally.



MANAGEMENT OF POSIONING

Emesis: Vomiting can be induced mechanically by stroking the posterior pharynx. However, this technique is not as effective as the administration of *ipecac* or *apomorphine*.

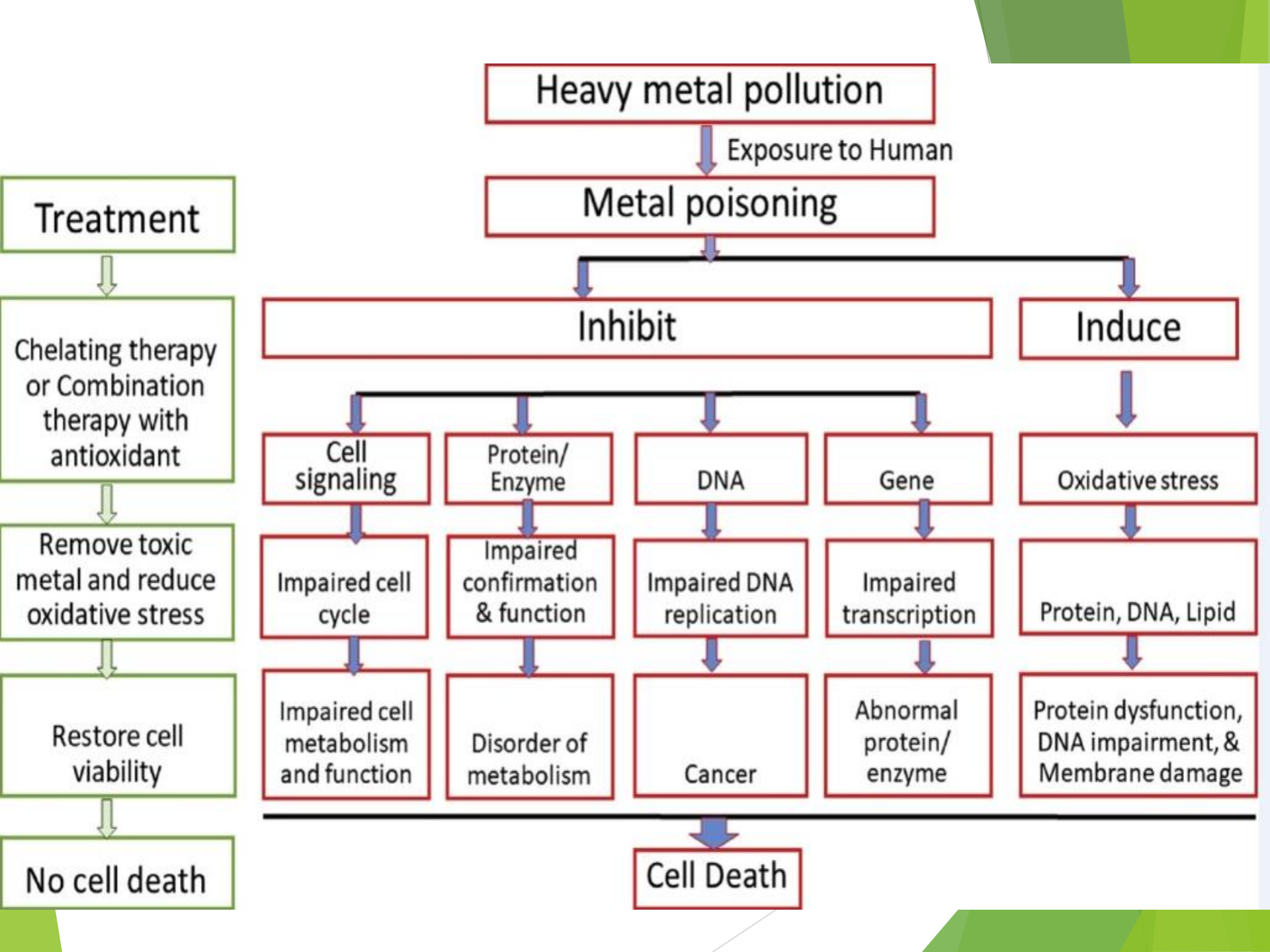
Gastric Lavage. Gastric lavage is accomplished by inserting a tube into the stomach and washing the stomach with water, normal saline, or one-half normal saline to remove the unabsorbed poison.

Chemical Adsorption. Activated charcoal avidly adsorbs drugs and chemicals on the surfaces of the charcoal particles, thereby preventing absorption and toxicity

Chemical Inactivation. Antidotes can change the chemical nature of a poison by rendering it less toxic or preventing its absorption. Formaldehyde poisoning can be treated with ammonia to form hexamethylenetetramine.

Purgation. The rationale for using an osmotic cathartic is to minimize absorption by hastening the passage of the toxicant through the gastrointestinal tract

Sorbitol is the most effective, but *sodium sulfate* and *magnesium sulfate* also are used



Antidote

❑ An antidote is a substance that can counteract a form of poisoning. The term antidote is a Greek word "**Antididonai**" meaning "**given against**".

❑ **In Cambridge dictionary,**

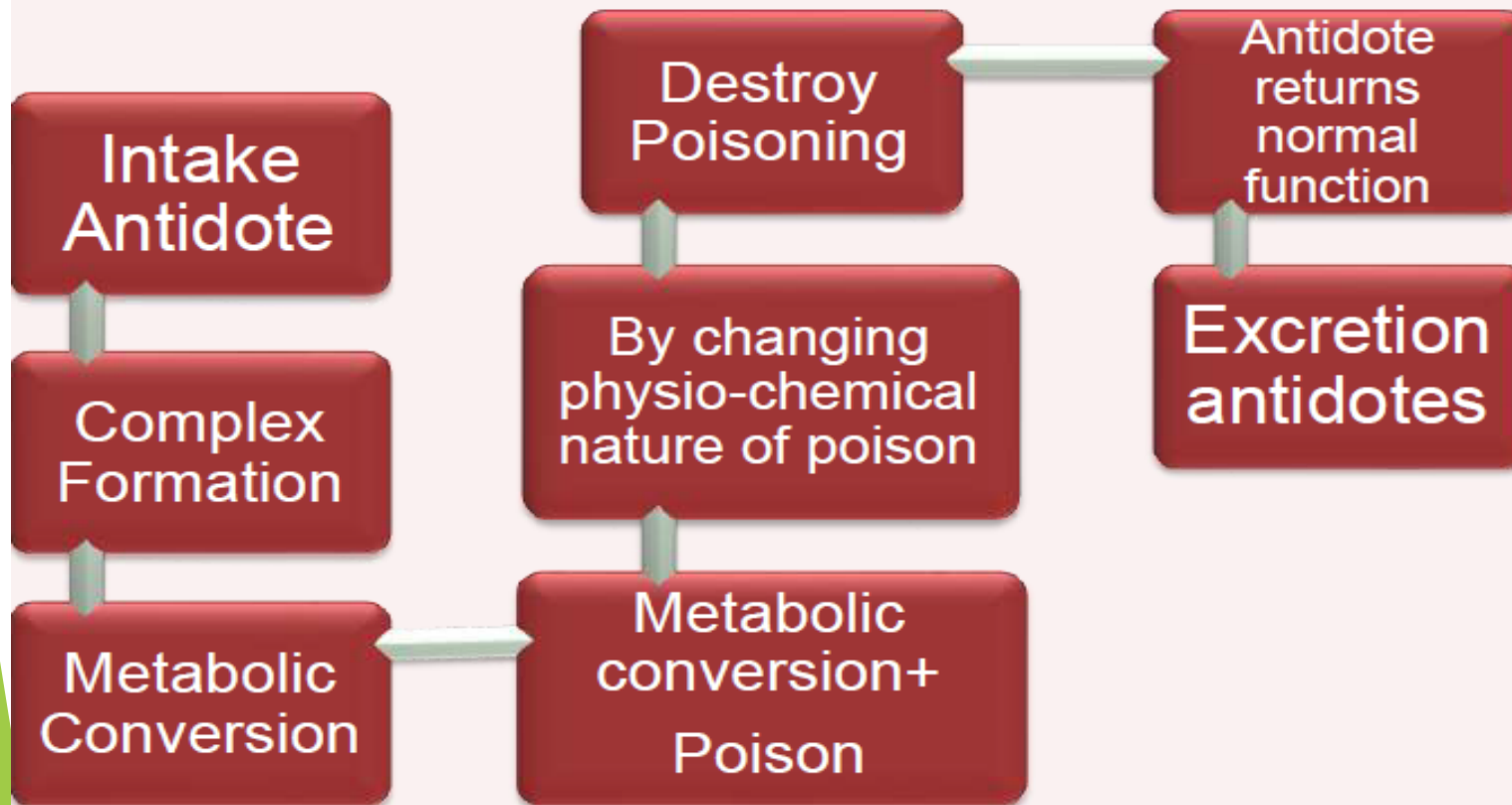
"Antidote is a chemical especially a drug that limits the effects of a poison".

OR

"A way of preventing or acting against something bad".



Flow chart of Mechanism



Antidotes in most common use in clinical toxicology

Poison	Antidote
Paracetamol	N-acetyl Cysteine
Iron	Desferroxamine
Heperin	Protamine Sulphate
Cyanide	Na-nitrate, Na-thaiosulphate
Theophylline, Caffaine	Esmolol
Atropine	Physotigmine
Copper, gold, lead, mercury, zinc, poisoning	Penicillamine
Arsenic poisonong	Dimercaprol
Insulin reaction	Glucose (Dextrose 50%)
Narcotics	naloxone (Narcan)

Thank
you 😊

