Calculation of Doses

By

Ass. Prof. Dr. Mohamed Akl

Dose Definitions

- **Dose of a drug is the quantitative amount administered or taken** by a patient for the intended medicinal effect

It may be expressed as:

- **Single dose:** the amount taken at one time
- **Total dose (Daily dose):** the amount taken during the time-course of therapy

→ A **daily dose** may be subdivided and taken in divided doses.

- **Dosage regimen:** the schedule of dosing (4 times per day for 10 days).

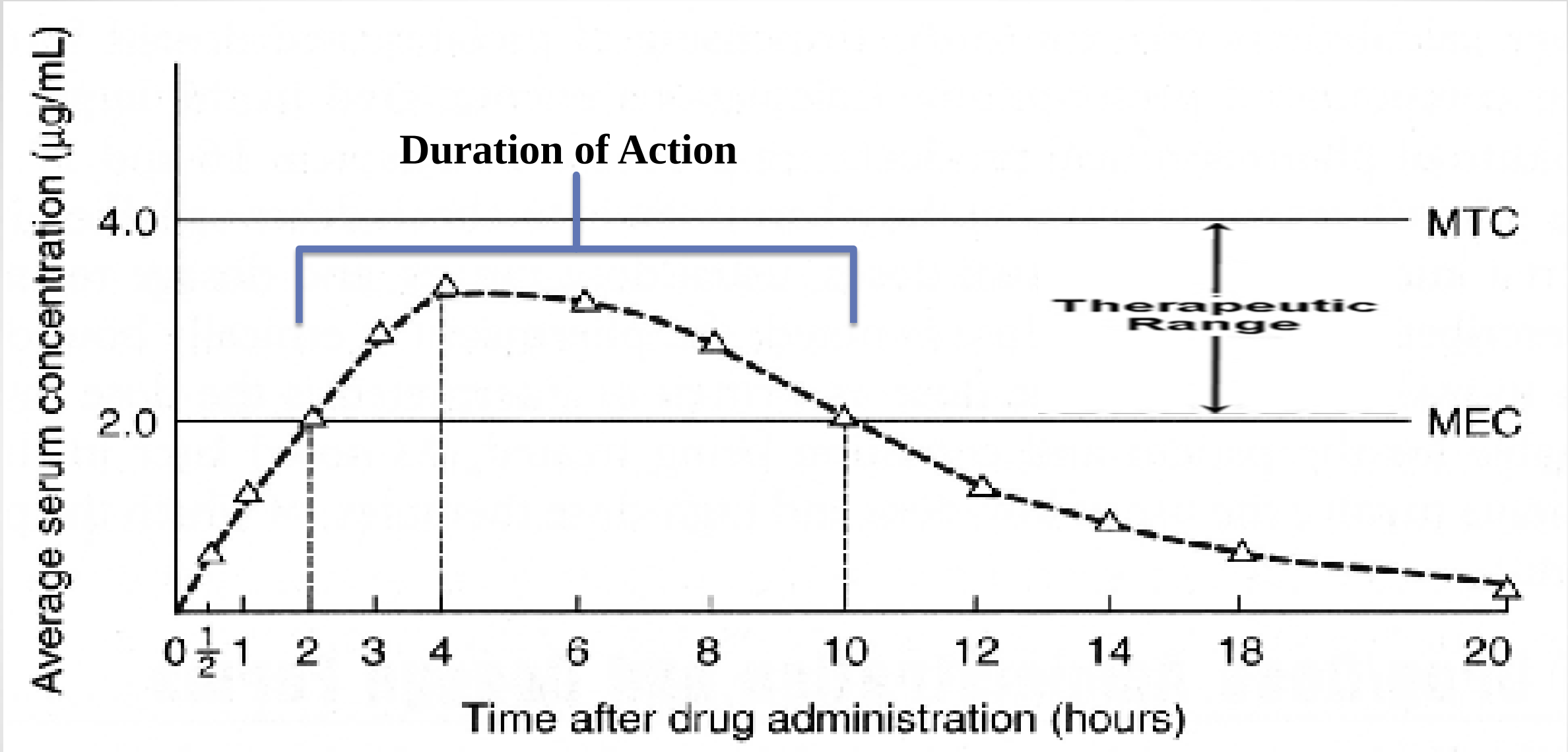
$$number\ of\ doses = {}^{total\ quantity}\Big/_{Size\ of\ dose}$$

Dose Definitions

- **Usual adult dose:** the amount that ordinarily produces the medicinal effect intended in the adult patient
- **Usual pediatric dose:** the amount that ordinarily produces the medicinal effect intended in the infant or child patient
- **Usual dosage range:** the quantitative range or amounts of the drug that may be prescribed within the guidelines of usual **medical practice**
- **Median effective dose** of a drug **is** the amount that produces the desired intensity or effect in 50% of the individuals tested.

Dose Definitions

MEC	• Minimum effective concentration: the minimum concentration that can be expected to produce the drug's desired effects in a patient. • Concentration < MEC does not produce pharmacological effect).
MTC	• Maximum tolerated concentration: The base level of blood serum concentration that produces dose-related toxic effects • Concentration > MTC are toxic.
Therapeutic window (range)	• Difference between MTC and MEC (Any concentration falling within this range produces a pharmacological effect).



- **Appropriate drug dosage** should result in blood serum drug concentrations that are **above the MEC** and **below the MTC** for the period of time that drug effects are desired.

Route of drug/dose administration and dosage forms

- Doses are administered by a variety of dosage forms and route of administration.

Route of Administration	Representative Dosage Forms
Oral	Tablets, capsules, lozenges, solutions, drops, syrups, and suspension
Sublingual	Tablets
Parenterals	Solutions and suspensions
Transdermal	Ointments, creams, powders, lotions, aerosol, and patches
Conjunctival	Solutions, suspensions, and ointments
Intranasal	Solutions, sprays, and ointments
Intrarespiratory	aerosol, and inhalant solutions
Rectal	Ointments, creams, suppositories, solutions and suspensions
Vaginal	Ointments, creams, suppositories, tablets, gels, solutions, and emulsion foams
Urethral	Solutions and suppositories

Dose Measurement

- In institutional setting, doses are measured and administered by professional and paraprofessional personnel.موظفين محترفين ومساعدي المهنيين
- A variety of measuring devices may be used, including
  - calibrated cups for oral liquids
  - syringes and intravenous sets for intravenous medication.
- In the home setting, the adult patient or a child's parent المريض البالغ أو والد الطفل generally measures and administers medication using **household measures**
  - Teaspoonful and tablespoonful for Liquid dosage
  - An oral dispenser is used for administering calibrated quantities of liquid medication to children

Dose Measurement

American Standard Teaspoon:

- According to the United States Pharmacopeia, “For household purposes, an American Standard Teaspoon has been established as containing 4.93 ± 0.24 mL
- In general, pharmaceutical manufacturers use the 5-mL teaspoon and the 15-mL tablespoon as a basis for the formulation of oral liquid preparations.

The Drop (gtt) as a Unit of Measure

- Occasionally, the drop is used as a measure for small volumes of liquid medications.
- A drop doesn't represent a definite quantity because drops of different liquids vary greatly → (few liquids have the same surface and flow characteristics as water).

the official medicine dropper:

- US Pharmacopeia, official medicinal dropper with a round opening delivery end and an external **diameter** of about **3 mm**.

– It held vertically, delivers approximately 20 drops water / ml (1 ml H_2O = 1000mg /50 mg).

– Each water drop has 45-55 mg in weight

The Drop (gtt) as a Unit of Measure

- The size of drops varies materially from one liquid to another
- The drop should not be used as a measure for a specific liquid medication until the volume that the drop represents has been determined for that liquid.

→ This determination is made by calibrating the dispensing dropper.

- The calibrated dropper is the only one that should be used for the measurement of medicine.
- Most manufacturers include a calibrated dropper with prepackaged medication for dosing.
- Dropper calibration involves counting liquid drops as they fall into a graduate to obtain a measurable volume. Drops / unit volume are then determined.

– If a pharmacist counted 40 drops of a medication in filling a graduate cylinder to the 2.5 mL mark, how many drops per milliliter did the dropper deliver?

40 drops → 2.5 ml

X → 1 ml → So, X = 40/2.5 = 16 drop/ml

Dose Measurement

Case 1

- A physician asks a pharmacist to calculate the dose of a cough syrup so that it may be safely administered dropwise to a child. The cough syrup contains the active ingredient dextromethorphan HBr, 30 mg/15 ml, in a 120- ml bottle. Based on the child's weight and literature references, the pharmacist determines the dose of dextromethorphan HBr to be 1.5 mg for the child. The medicine dropper to be dispensed with the medication is calibrated by the pharmacist and shown to deliver 20 drops of the cough syrup per 1 ml.
- Calculate the dose, in drops, for the child.

Answer

30 mg dextromethorphan HBr ⟶ 15 ml

1.5 mg dextromethorphan HBr ⟶ X ml So $X = {}^{15 \times 1.5}/_{30} = 0.75$ ml

- Number of drops of cough syrup in 0.75 ml dose

1 ml ⟶ 20 drops of cough syrup

0.75 ml ⟶ X drops of cough syrup So $X = {}^{20 \times 0.75}/_{1} = 15$ drop of syrup

General Dose Calculations: Number of doses

A pharmacist often needs to calculate:

- The size of a dose
- The number of doses
- The total quantity of medication to dispense

The following equation is useful:

$$\text{Number of doses} = \frac{Total\ Quantity}{Size\ of\ dose}$$

❑ If the dose of a drug is 200 mg, how many doses are contained in 10 g?

Answer

10 g = 10,000 mg , so Number of doses = 10,000 mg/ 200 mg = 50 doses

Or

1 dose ⟶ 200 mg

X dose ⟶ 10000 mg

So X = $\frac{10000 \times 1}{200}$ = 50 dose

General Dose Calculations: Number of doses

$$\text{Number of doses} = \frac{Total\ Quantity}{Size\ of\ dose}$$

- How many teaspoonful would be prescribed in each dose of an elixir if 180 mL contained 18 doses?

Answer

Size of dose = 180 mL/ 18 = 10 ml = 2 teaspoonful

- How many drops would be prescribed in each dose of a liquid medicine if 15 mL contained 60 doses? The dispensing dropper calibrates 32 drops/ mL?

Answer

15 mL = 15 x 32 drops = 480 drops

Size of doses = 480 (drops)/ 60 = 8 drops

General Dose Calculations: Total quantity of the product

$$Total\ quantity = number\ of\ doses \times size\ of\ dose$$

- How many milliliters of a liquid medicine would provide a patient with 2 tablespoonfuls twice a day for 8 days?

Answer

Number of doses = 16

Size of dose = 2 tablespoonfuls or 30 mL Total quantity = 16 x 30 mL

= 480 mL,

- How many milliliters of a mixture would provide a patient with a teaspoonful dose to be taken three times a day for 16 days?

Answer

Number tsp of doses = 16 x 3 = 48 tsp

Total quantity = 48 x 5 mL = 240 mL,

N.B. *Check other examples at page 111 and 112*.

General Dose Calculations: Total quantity of the product

- How many grams of a drug will be needed to prepare 72 dosage forms if each is to contain 30 mg? Answer (2.16 g)

- It takes approximately 4 g of ointment to cover an adult patient's leg. If a physician prescribes an ointment for a patient with total leg eczema to be applied twice a day for 1 week, which of the following product sizes should be dispensed: 15 g, 30 g, or 60 g? Answer (60 g)

Dosing Options

Low-Dose and High-Dose Therapies

- The administration of doses that are much smaller or much larger than the usual dose of a drug is referred to as *low- dose* or *high-dose* therapy, respectively.
- Example of *low-dose* therapy: Aspirin 81 mg instead of 325 mg → to **lower the risk of heart attack and clot-related stroke**
- Example of high-dose therapy: Cancer therapy in which there is an attempt, through increased dose intensity, to kill tumor cells..

❑ *If a patient is changed from a daily standard dose postmenopausal product containing 0.625 mg of conjugated estrogen (CE) to a low-dose formulation containing 0.35 mg CE, how many mg less of CE would the patient take per week?*

0.625 mg – 0.35 mg = 0.275 mg x 7 (days) = 1.925 mg

Dosing Options

- Pharmacists must be aware of the use of high-dose medications and take precautions to protect patients from unintentional high dosages and drug overdose.

To reduce the inflammation of an optic nerve, a patient is administered high-dose prednisone, 900 mg/day for 5 days by intravenous infusion. The usual daily dose of prednisone is 5 to 60 mg/day, depending on the condition being treated. Calculate the doses that the patient received, as a multiple of the highest usual daily dose. q ***900 mg/ 60 mg= 15, multiple of the highest usual dose, answer.***

Fixed-Dose Combination products

- A variety of products are available containing two or more therapeutic agents in fixed-dose combinations.
- Advantages: more convenient, enhance compliance, and less expensive.
- Disadvantage: Relative inflexibility in dosing.
- Whether the fixed-dose combination is a liquid (e.g., a syrup) or a solid (e.g., a tablet) dosage form, when a dose is taken, the component drugs are taken in a fixed-dose ratio.

❑ *Valsartan and hydrochlorothiazide tablets are available separately or in combination in strengths of 80 mg/12.5 mg, 160 mg/12.5mg, and 160 mg/25mg. If a patient was receiving the lowest-dose combination product and the physician wished to double the dose of hydrochlorothiazide, what is the option?*

Answer

– An additional prescription for 12.5 mg of hydrochlorothiazide
– or individual prescriptions for 80 mg of valsartan and 25 mg of hydrochlorothiazide may be written

Splitting Tablets

- A number of tablets are scored or grooved to allow breaking into approximately equal pieces (usually halves).
  - → allows dosage flexibility, particularly when a patient is started at a half dose and then is titrated up to a full dosage level.
  - → also enables a patient to take a product at a strength that is not otherwise available.
- Some patients use tablet-splitting devices to cut scored or un- scored tablets. Unfortunately, this often results in unequal portions of tablets and thus in uneven doses.
- *A patient attempted to split in half 20-mg un-scored tablets of a drug, resulting in "half-tablets" differing by 1.5 mg in drug content. Assuming a whole tablet was uniform in drug content, calculate the amount of drug in each "half tablet".*
  - If L = Larger half, and S = Smaller half, then L + S = 20 mg
    - L – S = 1.5 mg ⟶ 2 L= 21.5 mg ⇒ L = 10.75 mg
    - S = 20 mg – 10.75 mg = 9.25 mg, answer.

Special Dosing Regimens

- Certain drugs have unique dosing regimens such as chemotherapeutic agents and oral contraceptives.

- Oral contraceptive: regimen is based on a 28-day dosing cycle of 21 consecutive days of tablets containing a combination of estrogen and progestational drugs followed by 7 consecutive days of non-drug tablets material.
- One tablet is taken daily, preferably at approximately the same time.
- The tablets generally are color coded and packaged in special dispensers to facilitate compliance.
- *The ORTHO TRI-CYCLEN LO 28-day regimen consists of norgestimate (N), ethinyl estradiol (EE), and nonmedicated tablets as follow:*
  - *7 white tablets containing 0.18 mg (N) = 0.025 mg (EE)*
  - *7 light blue tablets containing 0.215 mg (N) = 0.025 mg (EE)*
  - *7 dark blue tablets containing 0.25 mg (N) = 0.025 mg (EE)*
  - *7 green tablets containing 0 mg (N) = 0 mg (EE)*

Special Dosing Regimens

- How many mg each of (N) and (EE) are taken during each 28-day cycle?

(N)= (0.18 + 0.215 + 0.25) x 7 = 4.515 mg (N))

(EE) = (0.025 + 0.025 + 0.025) x 7 = 0.525 mg (EE)


Thank
You!