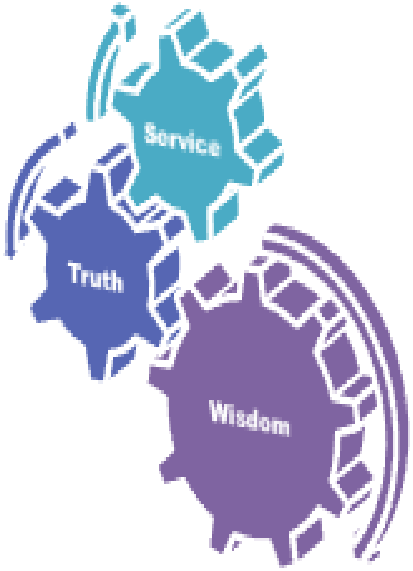
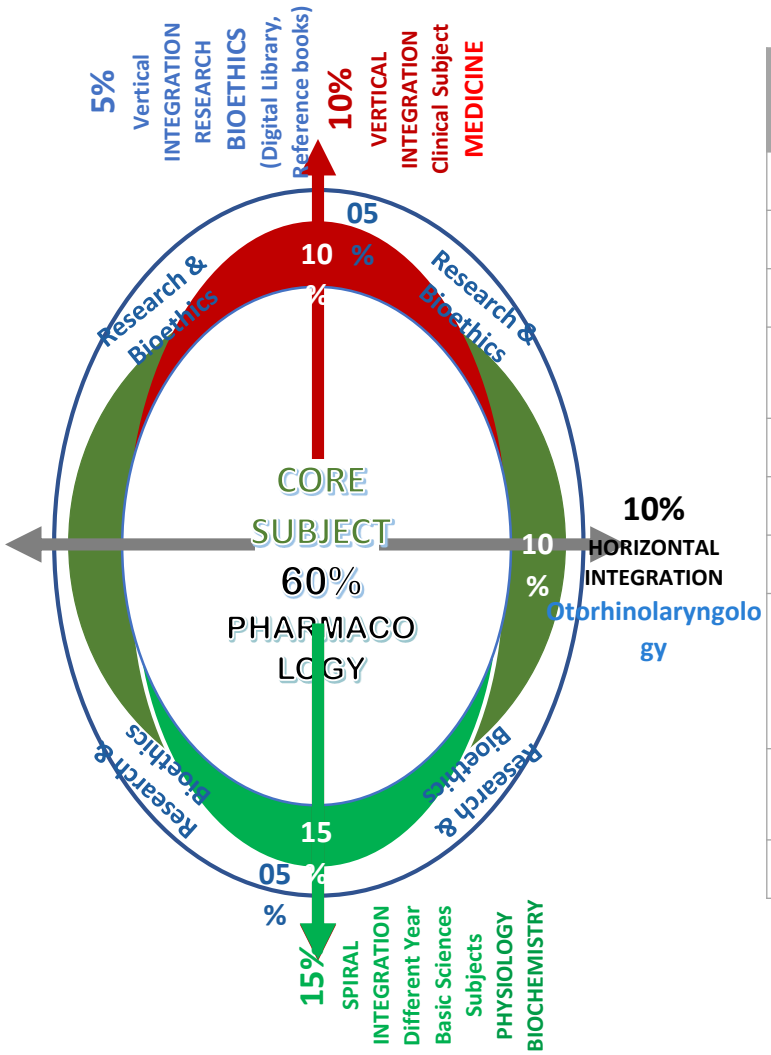

بسم الله الرحمن الرحيم
وَأَمَّا مَا يَنفَعُ ٱلنَّاسَ فَيَمْكُثُ فِى ٱلْأَرْضِ
but as for that which benefits the people, it remains on the earth.
Quran 13:17 (Surah ar-Ra'd)

MOTTO AND VISION



- To impart evidence based research oriented medical education
- To provide best possible patient care
- To inculcate the values of mutual respect and ethical practice of medicine

Prof. Umar's Clinically Oriented Integration Model
For Basic Sciences Interactive Lectures



3rd Year Pharmacology Practical	
Core Subject – 100%	
Pharmacology	
Horizontal Integration – 0%	
Same Year Subjects	• otorhinolaryngology (10%)
Vertical Integration – 0%	
Clinical Subjects	• Medicine (3%)
Spiral Integration – 0%	
Different Year Basic Sciences Subjects	• Physiology (10%) • Biochemistry (5%)
Vertical Integration – 0%	
Research & Bioethics,Digital library	

FOUNDATION I MODULE

PRACTICAL

Pharmacological Calculations

Solutions and types of solutions

- **Solution:**

liquid preparations containing solid substance(s) dissolved in a fluid medium are called solutions. Preparations of a solution maybe facilitated by shaking , vortexing or by sonication.

- **Solute:**

A solid substance dissolved in a liquid is called solute. The solutes maybe drugs or reagents. The solute dissolved in some biological fluid like blood , serum , urine , etc are also referred to as analytes.

- **Solvent:**

A liquid in which solute is dissolved is called solvent. In pharmaceutical terms it maybe called a vehicle. Mostly water is used as a solvent. Some of the substances maybe insoluble in water but soluble in organic solvents e.g. , ethyl alcohol , methyl alcohol , acetone , etc.

Stock solution and its dilution

- Stock solution is a concentrated solution prepared in laboratory and subsequently used in different dilutions. It is a common practice to prepare stock solutions in large amount for laboratory procedures.

Advantages:

- more convenient
- Less time consuming.

Disadvantages:

- Short shelf life
- Chances of interaction with other compounds.

Cont:---

- The desired dilution can be prepared by the following equation:

$$C1\ V1 = C2\ V2$$

- C1 = concentration of stock solution
- C2 = concentration of required solution
- V1 = volume of stock solution
- V2 = volume of required solution

Example:

- An ampoule of a drug contain 4 mg/ml. what volume of this stock solution is required to prepare 1liter solution containing 2microg/ml?as1mg=1000micro g

Data available:

C1= concentration of drug in amp = 4mg/ml=4000 micro g

V1= volume of stock solution = Y

C2 = concentration of required solution = 2microg/ml

V2 = volume of required solution = 1litre

Calculation:

C1V1 = C2V2

4000 x Y = 2 x 1000

Y = 2 x 1000 /4000

= ½= 0.5 ml

Answer:

Maeasure 0.5ml of stock solution and make the volume up to 1 liter.

Exercise 1:

Prepare 500 ml 40% ethyl alcohol solution from 90% stock solution.

Exercise 2:

How much of 40% (v/v) methanol solution can be prepared from 5 liter of 90% (v/v) stock solution?

Exercise 3:

A teaspoonful (5ml) of cough suppressants has the following composition. Calculate the amount of each ingredient in 120ml syrup.

Dextromethorphan hydrobromide	7.5mg
Phenylpropanolamine hydrochloride	9.0mg
Flavored syrup	5.0ml

Exercise 4:

How many grams of erythromycin ethyl succinate would be required for 50ml paediatric suspension? The composition of the suspension is 100 mg in each dropperful (2.5ml).

Exercise 5:

A 70kg patient is advised ceftriaxone 150mg/kg/day. How many milliliters of the infusion should be given daily from a dosage form of 1g in each 10ml?

Percentage solution

- One part of any substance mixed in 100 parts of another substance makes 1 % concentration. Percent has no unit. It is a type of ratio expressed as %. It maybe weight by volume (w/v) , weight by weight (w/w) or volume by volume (v/v).

Example:

Calculate the amount of NaCl required to prepare 1.5L of .015% solution?

Data:

Total quantity of solution = 1.5L = 1500ml

Percentage required = 0.015%

Cont---

Calculation:

o.o15% of sodium chloride solution means 0.015g of NaCl dissolved in 100ml.

If 100ml of solution contains NaCl = 0.015g

1ml of solution will contain NaCl = 0.015/100g

1500ml of solution will contain NaCl = 0.015/100 x 1500

= 0.225g or 225mg

Answer:

Weigh 225mg of NaCl and dissolve in distilled water to make up to 1.5L solution.

Clinical problem

A 45 year old man having 50 kg bodyweight reported in emergency room with severe breathlessness and wheeze. He was diagnosed as a case of bronchial asthma. Pulmonologist advised him infusion aminophylline at a rate of 6mg/kg bodyweight stat (within 30 min) and 3 mg/kg in next 24 hours. Calculate the volume of aminophylline solution required to prepare the infusion for stat and later administration if the ampoule contains 2.5% (w/v) of the drug.

Data:

Weight of pt = 50kg

First dose required = 300mg (0.3G)

Second dose required = 150mg (0.15G)

Dosage form = 2.5% w/v

Volume required for the first dose = 100/2.5x0.3=12ml

Volume of second dose required = 100/2.5x0.15=6ml

Cont--

Preparation of infusion for first dose:

Measure 12 ml of injection aminophylline and make the volume upto 100ml with normal saline.

100ml of normal saline contains = Aminophylline 300mg

If 1ml = 60µdrops

100ml =6000µdrops/30min

=200µdrops/min

Preparation of infusion for second dose:

Measure 6ml of injection Aminophylline and make the volume upto 1000ml in normal saline.

If 1 ml =60µdrops

1000ml =60000µdrops

60000µdrops given in 24hrs =42drops/min

(24x60=1440 =60000/1440=41.6≈42)

Exercise 1:-

Calculate the amount of pilocarpine required to inject in a 1.25kg rabbit when the dose of drug is 10mg/kg body weight and dosage form is 1% W/V.

Exercise 2:

A 4yr old baby is suffering from acute diarrhea. He has been administered 1Liter of ORS solution having following composition. Calculate the amount of various ingredients in the solution received by the boy.

Glucose = 2%

NaCl = 0.35%

$NaHCO_3$ = 0.25%

KCl = 0.15%

Exercise 3:-

If you inject 10ml of 5% MgSO4 to a female suffering from eclampsia(toxemia of pregnancy). What will be the total amount of drug injected?

Exercise 4:-

Calculate the amount of NaCl required to prepare 500ml of frogs Ringer's saline solution. The composition of solution is 0.65%.

Exercise5:-

A lady of 65kg is having an acute attack of ventricular fibrillation after cardiac resuscitation. How much volume. How much volume of lignocaine you will administer to this patient if the dose is 1.4mg/kg bodyweight and dosage form contains 2% lignocaine?

FRACTIONAL SOLUTIONS

These are solutions in which the relative quantities of solute and solvent are expressed as ratio e.g 1:100, 1:1000 etc. it means 1gm of drug is dissolved in 100 or 1000 ml of distilled water respectively

Example Calculate the concentration of acetylcholine (Ach) in 50-ml organ bath if we dissolve 1.5 ml of 1:6250 stock solution.

Data

Strength of acetylcholine = 1:6250

Volume of organ bath = 50ml

Volume of stock solution used = 1.5ml

Calculation: 1:6250 means 1g of acetylcholine dissolved in 6250ml of distilled water.

If 6250ml of solution contains ach = 1g = 1000mg

1 ml of solution will contain = 1000/6250mg

1.5 ml of solution will contain ach= 1000/6250 multiplied by

1.5

= 0.24mg

= 240 ug

If 50ml organ bath have ach = 0.24mg

1ml will contain = 0.24/50mg

=0.0048mg

= 4.8ug/ml

- **Answer of Example**
- The organ bath contains a total volume of Ach = 240ug i.e 4.8ug/ml

- **Exercise-1**
- Calculate the volume of 2% atropine to prepare 50ml of 1:750 solution.
- **Exercise-2**
- A patient in gynecology unit has developed an acute attack of anaphylaxis after interferon injection. How much of injection epinephrine you will give if the dose is 0.5mg and dosage form 1:1000.
- **Exercise-3**
- A wet dressing is prepared by mixing 30ml of benzalkonium chloride 1:750 with 170ml of distilled water. What will be the fractional strength of this solution.

- **Exercise-4**
- Express the following into fractional solution.
- 0.9%
- 05.0%
- 0.65%
- 20.0%
- 9.30%

- **Exercise-5**
- A local anesthetic is dispensed as lidocaine 2% (w/v) and epinephrine 1:50000 (w/v). Express the perentage strength as fraction and ratio as percentage.

Molecular or Molar Solutions:

- In case of fractional or percentage solutions one cannot determine the exact amount of active drug present in a solution, e.g one % atropine sulphate solution and one % of atropine hydrochloride solution will not contain the same amount of atropine base, because of the difference In the molecular weights of two salts. The molar system has been devised to overcome this problem.
- A mole is defined as the molecular weight of a drug expressed in grams. One mole of a solution means one gram molecular weight of a drug dissolved in one liter. It has been established that gram molecular weight of any substance contains 6.022×10^{23} particles.

- For example; 180g of glucose molecules, 23g of sodium ion, 35.5g of chloride ions, 17g of hydroxyl ions, all are equal to 1 mole or 6.022 x10^{23} molecules or particles. It is called Avogadro's Number.

- **Mole is indicated by M.**
- 1Millimole (mM) = 1/1000M
- Or 1 Millimole is = 0.001M (i.e formula weight in milligrams)
- 1Micromole (uM) = 0.001mM (i.e 1 formula weight in microgram)

- **Example**
- Calculate the amount of $CaC1_2$ required to make 150ml of 8.5 mMol solution (Molecular weight of $CaC1_2$ = 111)
- **Data**
- Gram molecular weight of $CaC1_2$ = 111g
- Volume of Solution = 150ml
- Strength required = 8.5mMol

Cont---

- **Calculation**
- If 1M of solution require $CaC1_2$ = 111g
- 1mM of solution require $Cac1_2$ = 111mg
- 8.5mM of solution require $CaC1_2$ = 111 x 8.5mg
- = 943.5mg
- 1000ml of 8.5 mM solution contains $CaC1_2$ =943.5mg
- 1 ml of solution contains $CaC1_2$ = 943.5/1000mg
- 150ml of solution contains = 943.5/1000x150mg
- = 141.525mg
- **Answer of Example**
- 141.525mg

- **Exercise-1**
- Calculate the mMol concentration of ORS
- **BP FORMULA**
- Glucose = 20g
- NaCl =3.5
- $NaHCO_3$ =2.5g
- KCl = 1.5g
- (MW glucose 180,Na 23, K 39, HCO_3 61,Cl 35.5)
- **Exercise-2**
- What is Millimole concentration of 2.5% solution of KCl (MW= 74.5)?

- **Exercise-3**
- Prepare 500ml of 0.2M potassium dihydrogen phosphate (KH_2Po_4) buffer stock solution. (MW = 136)
- Prepare 200ml of 50mM potassium dihydrogen phosphate buffer from this stock solution.
- **Exercise-4**
- Prepare 1.5L sodium chloride 0.9% solution (MW=58.5)
- What is Millimole concentration of this solution?
- **Exercise-5**
- What is the Millimole concentration of 1.5L dextrose 5% solution? (MW=180)

Equivalent Solutions

An equivalent is the weight of a substance which combines with or replaces one gram atomic weight of hydrogen ion. It can be calculated by dividing the molecular weight of a radical by its valency. Gram equivalent weight of a solute dissolved in one liter of solvent gives one Equivalent(Eq) Solution. One milliequivalent (mEq) is 1/1000 of an equivalent.

Interconversion of a mole into equivalent

The valency of a radical determines the number of electrons released or accepted by it in a reaction medium. An equivalent of radical corresponds to molecular weight divided by its valency. Therefore, one mole of a momovalent ion, half mole of a divalent ion and one third mole of a trivalent ion are all equal to an equivalent solution of these respective ions.

Cont--

For Example: EQ weight of K+(which has a valency =1)

Eq t = 39/1 =39mg

mEq wt = 39/1000 =0.039 =39mg

Whereas for Ca++ (which has a valency =2)

Eq wt =40/2 =20mg

M Eq wt =20mg

Example :

Calculate the amount of NaCl required to prepare 100ml solution which contain 200 mEq of Na+ (MW NaCl 58.5)

Data:

Volume required =100ml

Strength of solution =200 mEq

MW =58.5

Calculations:

If 1Eq of NaCl solution contains =58.5g

1 mEq of NaCl solution contains =58.5mg

200 mEq of NaCl solution contains =58.5x200mg

=11700mg

If 1000ml of NaCl solution contain =11700mg

1ml of NaCl solution will contain =11700/1000mg

100 ml of NaCl solution will contain =11700/1000x100

=1170mg=1.17g

Exercise-1:

Calculate the mEq of ions in ORS if the milli molar concentration of ORS is glucose 111.11, NaCl 59.83,NaHCO3 29.76, KCl 20.134.

Exercise-2:

How many mEq of Na+ are present in one liter of 5% of Na saccharine solution?

Exercise-3:

Calculate the amount of $NaOH^{+}$(MW=40) required to make 600ml solution so that it contains 300 mEq of Na.

Exercise-4:

A patient is taking injection ticarcillin disodium one gram daily. How many mEq of Na^+ is being injected? (M.W of ticarcillin disodium 428.4)

Exercise-5:

How many milli-equivalents of Calcium are present in a 600 mg tablet of calcium lactate pentahydrate used as calcium supplement (MW of calcium lactate pentahydrate is 308.3)

Osmolar Solutions

Osmole is gram molecular weight divided by number of particles or ions into which a substance dissociates in solution.

Osmolarity is one of the colligative properties of a solution which is based on the concentration of solute particles. One mole in case of non-electrolytes is equal to 1 Osmole. In case of electrolytes it is equal to Mole X number of particles into which it dissociates in solution.

Milliosmole is 1/1000 of an Osmole.

For Example:

1 M of Glucose = 1 Osm (because glucose is a non-electrolyte and gives one particle in solution)

Whereas, 1 M of NaCl = 2 Osm of NaCl (because one molecule gives two ions in solution).

Example:

How many grams of glucose are required to prepare 500ml solution having 300milliOsmole per liter concentration. What is the percentage of this solution? [MW=180]

Data:

Amount of solution required =500ml

Concentration of solution required =300mOsm/L

Gram molecular weight of glucose =180g

Calculation:

One molecule of glucose gives one ion when in solution form.

1 mole of glucose =1 Osmole =180g

1mM of glucose =1mOsm =180mg

If 1 mOsm of glucose require =180mg

300 mOsm of glucose will require =300x180mg

=54000mg

1000ml of glucose solution require =54000mg

1ml of glucose solution require =54000/1000mg

500ml of glucose solution require =54000/1000x500

=2700mg

=27g

Answer of example: 27g of glucose, 5.4%

Exercise-1:

Calculate the amount of NaCl required to prepare 500ml solution having 300 milliOsmole per liter concentration. What is the percentage of this solution?

Exercise-2:

how many milliOsmole of Na are present in one liter of sodium lactate solution if the strength is 1.68%?[MW=12].

Exercise-3:

calculate the milliOsmole per liter concentration of dextran 40. the composition is [dextran 100g/L(M.W=4000) Glucose 50g/L(M.W=180)]

Exercise-4:

A solution contains 0.66g of calcium chloride per liter.

(i)Express the strength of solution in terms of milliequivalents of calcium chloride per liter ($CaCl_2$. H_2O M.W.147).

(ii)How many milliOsmoles of Ca^{++} are present per liter?

References

- Pharmacology practical manual by;

Prof.Dr.Muhammad Akram Randhawa

Beneficence

The principle of beneficence is the obligation of physician to act for the benefit of the patient and supports a number of moral rules to protect and defend the right of others, prevent harm, remove conditions that will cause harm, help persons with disabilities, and rescue persons in danger.

It is worth emphasizing that, the language here is one of positive requirements. The principle calls for not just avoiding harm, but also to benefit patients and to promote their welfare.

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