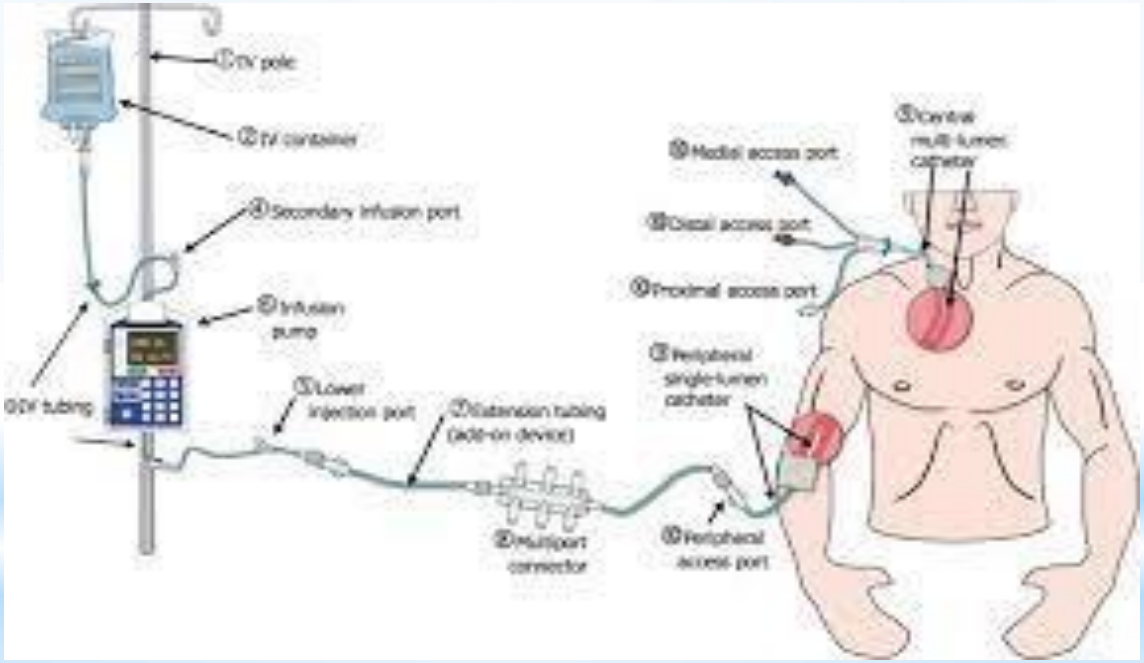
AL-Mustaqbal university
college of Pharmacy

Pharmaceutical calculation

Intravenous infusions, *parenteral admixture*, rate-of-flow calculations

Lec 5



Injections

are sterile pharmaceutical solutions or suspensions of a drug substance in an aqueous or nonaqueous vehicle .

They are administered by needle into almost any part of the body, including the joints (intra-articular), joint fluid (intrasynovial), spinal column (intraspinal), spinal fluid (intrathecal), arteries (intra arterial), and in an emergency, even the heart (intracardiac)

However, most injections are administered into

A vein intravenous, I.V.

Muscle - intramuscular, I.M

Skin - intradermal, I.D. intracutaneous ,

Under the skin subcutaneous, sub- Q, SQ, hypodermic

Depending upon their use, injections are packaged in small volumes

- **ampules**
- **prefilled disposable syringes** for single-dose use;
- **vials**
- **pen-injectors** for single- or multiple-dose use
- large volume **plastic bags** or **glass** containers for administration by slow intravenous Infusion.

Some injections are available as prepared **solutions** or **suspensions** with their drug content labeled as, for example, “10 mg/mL”.

Others contain dry **powder for reconstitution** to form a solution or suspension by adding a specified volume of diluent prior to use and are labeled as,

For example, "10 mg/vial." Small-volume injections may be administered as such or they may be used as additives to large-volume parenteral fluids for intravenous infusion.

The term **parenteral** is defined as any medication route other than the alimentary canal and thus includes all routes of injection.

Intravenous (IV) infusions are sterile, aqueous preparations administered intravenously in relatively large volumes .

They are used to extend blood volume and/or provide electrolytes, nutrients, or medications. Most intravenous infusions are administered to critical care, infirm, dehydrated, or malnourished patients, or to patients prior to, during, and/or following surgery.

Intravenous infusions are widely employed in emergency care units, in hospitals and other patient care institutions, and in home care. Pharmacists participate in the preparation and administration of institutional as well as home intravenous infusion therapy.

Most intravenous infusions are **solutions**; however, some are very fine **dispersions** of nutrients or therapeutic agents, or blood and blood products .

Although some intravenous solutions are **isotonic** or nearly isotonic with blood, isotonicity is not absolutely necessary because the volumes of fluid usually administered are rapidly diluted by the circulating blood .

Commercially prepared infusions are available in glass or plastic bottles or collapsible plastic "bags" in volumes of 50 mL (a *minibag*), 100 mL, 250 mL, 500 mL, and 1000 mL .

The smaller volumes find particular application in treating pediatric patients and adults who require relatively small volumes to be infused.

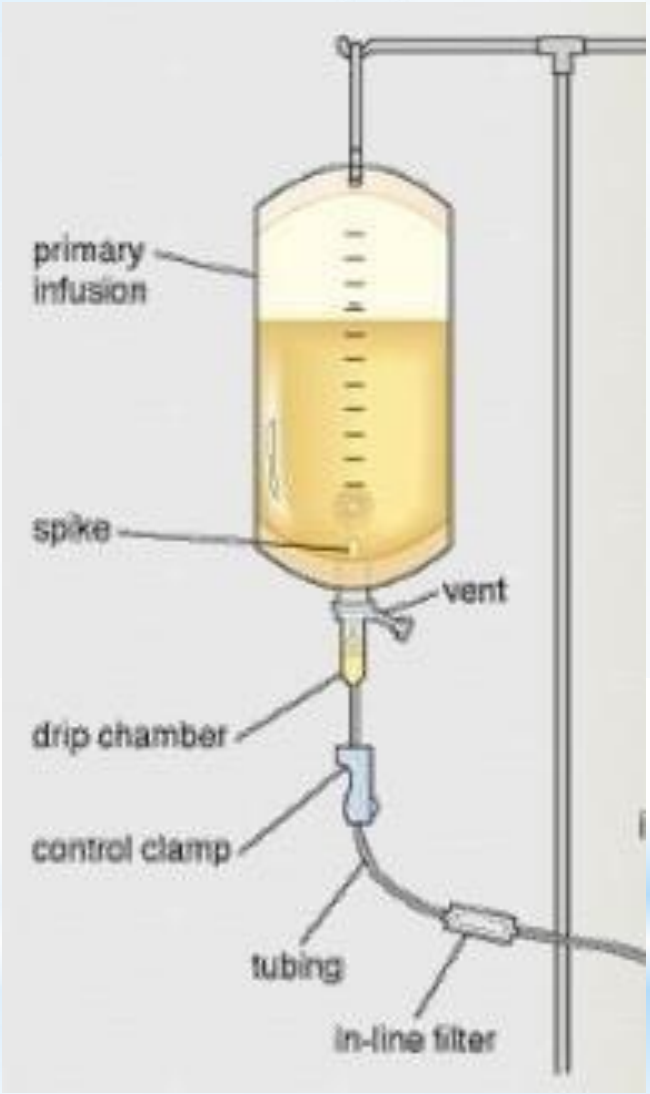

primary infusion
spike
vent
drip chamber
control clamp
tubing
in-line filter

TABLE 13.1 SOME COMMON INTRAVENOUS INFUSION SOLUTIONS

SOLUTION[a]	ABBREVIATION
0.9% Sodium Chloride	NS (Normal Saline)
0.45% Sodium Chloride	½NS
5% Dextrose in Water	D5W or D_5W
10% Dextrose in Water	D10W or $D_{10}W$
5% Dextrose in 0.9% Sodium Chloride	D5NS or D_5NS
5% Dextrose in 0.45% Sodium Chloride	D5½NS or $D_5$1/2NS
Lactated Ringer's (0.86% Sodium Chloride, 0.03% Potassium Chloride, 0.033% Calcium Chloride)	LR
5% Dextrose in Lactated Ringer's	D5LR or D_5LR

[a] All solutions are prepared in Water for Injection, USP. In addition to the solutions listed, other concentrations of dextrose and sodium chloride are commercially available. These solutions may be administered as such or used as vehicles for therapeutic agents, nutrients, or other additives.

Example Calculations of Basic Intravenous Infusions

- How many grams each of dextrose and sodium chloride are used to prepare a 250-mL bag of D5 ½NS for intravenous infusion?

250 mL × 0.05 (5% w/v) = 12.5 g dextrose, and
250 mL × 0.0045 (0.45% w/v) = 1.125 g sodium chloride, *answers.*

- **A medication order for a patient weighing 154 lb. calls for 0.25 mg of amphotericin B per kilogram of body weight to be added to 500 mL of 5% dextrose injection. If the amphotericin B is to be obtained from a constituted injection that contains 50 mg/10 mL, how many milliliters should be added to the dextrose injection?**

Weight in kg: 1 kg = 2.2 lb.

154 (lb.) / 2.2 (lb.) = 70 kg

Dose in mg: 0.25 mg x 70 = 17.5 mg

Constituted solution contains 50 mg/10 mL

50 (mg)	10 (mL)
17.5 (mg)	X

X = 3.5 mL

Compare (a) the number of drops and (b) the length of time, in minutes, required to deliver 50-mL of intravenous solutions when using a microdrip set, at 60 drops/mL, and a standard administration set, at 15 drops/mL, if in each case one drop is to be administered per second.

Microdrip set:

(a) 60 drops/mL x 50 mL = 3000 drops

(b) 3000 drops / 60 drops/minute = 50 minutes.

Standard set

(a) 15 drops/mL x 50 mL = 750 drops

(b) 750 drops 60 drops/minute 12.5 minutes

Intravenous admixtures

The preparation of intravenous admixtures involves the addition of one or more drugs to large volume sterile fluids such as sodium chloride injection, dextrose injection, lactated Ringer's injection, and others .

The additives are generally in the form of small-volume sterile solutions packaged in ampuls, vials, small- volume minibags for use as piggybacks, or sterile solids, some requiring constitution with a sterile solvent before transfer.

Although a wide variety of drugs and drug combinations are used in preparing dilute infusions for intravenous therapy, some of the more common additives include electrolytes, antibiotics, vitamins, trace minerals, heparin, and, in some instances, insulin.

Rate of flow of intravenous fluids

On medication orders, the physician specifies the rate of flow of intravenous fluids in milliliters per minute, drops per minute, amount of drug (as milligrams per hour), or, more frequently, as the approximate duration of time of administration of the total volume of the infusion.

Pharmacists may be called on to perform or check rate-of-flow calculations. Oftentimes, the following equation finds use in rate-of-flow calculations:

$$\text{Rate of flow (drops/minute)} = \frac{\text{Volume infusion (mL)} \times \text{Drip set (drops/mL)}}{\text{Time (minutes)}}$$

Examples of Rate-of-Flow Calculations

- *A medication order calls for 1000 mL of D5W to be administered over an 8-hour period. Using an IV administration set that delivers 10 drops/mL, how many drops per minute should be delivered to the patient?*

$$\text{Volume of fluid} = 1000 \text{ mL}$$
$$8 \text{ hours} = 480 \text{ minutes}$$
$$\frac{1000 \text{ (mL)}}{480 \text{ (minutes)}} = 2.08 \text{ mL per minute}$$
$$2.08 \text{ mL/min} \times 10 \text{ (drops/mL)} = 20.8 \text{ or } 21 \text{ drops per minute, } \textit{answer.}$$

- *If 10 mg of a drug are added to a 500-mL large-volume parenteral fluid:*

a) what should be the rate of flow, in milliliters per hour, to deliver 1 mg of drug per hour?

$$\frac{10\ (\text{mg})}{1\ (\text{mg})} = \frac{500\ (\text{mL})}{x\ (\text{mL})}$$

$$x = 50\ \text{mL per hour, } \textit{answer.}$$

b) If the infusion set delivers 15 drops/mL, what should be the rate of flow in drops per minute?

$$15\ \text{drops/mL} \times 50\ \text{mL/hr} = 750\ \text{drops per hour}$$

$$\frac{750\ (\text{drops})}{x\ (\text{drops})} = \frac{60\ (\text{minutes})}{1\ (\text{minute})}$$

$$x = 12.5\ \text{drops/minute, } \textit{answer.}$$


Thank You