Tech Lectures®

For the Pharmacy Technician

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Lecture 17 - About IV Admixtures

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Principles of IV Admixtures

Introduction

The term, parenteral drugs is used to indicate medications that are given by any route other than through the alimentary canal[i]. In most cases these drugs are administered by injection. Today in the hospital setting, injectable drugs account for a high percent of all administered medications.

The most common route of administration of parenteral drugs is intravenous or directly into the vein. Although some medications are injected directly into the vein, most medications are added to a compatible solution such as Dextrose 5% in Water (D5W) or 0.9% NaCl (Normal Saline), and infused intravenously. By using small or large volume of solutions, drugs can be administered slowly over a period of time and diluted enough to not cause any damage or harm to the patient, more importantly, medications given intravenously act quicker than oral medications because they are administered directly into the bloodstream.

Most intravenous solutions or IV Admixtures are prepared in the Pharmacy setting by Pharmacy Technicians. Specific training is essential not only to ensure the appropriate selection of the drug (additive) and solution (vehicle) being used, in the correct amount, but also to facilitate the proper application of aseptic technique. This CE offering will not only give basic information about parenteral products, but more importantly, it will accentuate the Pharmacy Technician's need to use aseptic technique.

Basic Pharmacokinetics

The correct route of administration of a parenteral drug depends on the medication being used, the site of action and the desired effect. There are some medications that can only be given by a certain route. Site of action is where the drug exerts its effect or where it works. The desired drug effect is the therapeutic effect. A drug may have either a local effect, being confined to a limited area, such as novocaine, or xylocaine injection into the gums for localized anesthesia, or a drug may have a systemic-effect, which means that the blood or circulatory system carries the drug to the site of action (it gets into the bloodstream). A drug having a systemic effect may very well have an effect on more of the body than the specific site of action. The route of administration is how the drug is administered to the patient to facilitate reaching the site of action.

Routes of Administration

Intradermal (ID) administration –

In general, used to administer diagnostic tests, such as the tuberculin test, allergy tests and certain vaccines. The needle placement would be just below the epidermis with a dose not to exceed 0.1 ml. The effect would be local.

Subcutaneous (SC) administration –

Used to administer non-irritating, water-soluble drugs, such as insulin, heparin and certain immunizations. The needle placement would be in the subcutaneous tissue between the epidermis and the muscle with a dose of not to exceed 1.0 ml. The effect would be systemic.

Intramuscular (IM) administration –

Used to administer injectable drugs for slow release. The needle placement would be directly into a muscle mass such as the anterior thigh, deltoid (upper arm) or one of the buttocks with a dose not to exceed 3 ml. The effect would be systemic.

Intrathecal (IT) administration –

Used to administer injectable drugs such as anesthetics and chemotherapeutics. The needle placement would be in the spinal fluid. The effect would be systemic. Must use preservative-free drugs

Intravenous (IV) administration –

Used for fluid and/or electrolyte replacement or to administer injectable drugs such as antibiotics. The needle placement would be directly into the vein. The effect would be systemic.

Intra-arterial (IA) administration –

Used to administer injectable drugs such as heart medications. The needle placement would be directly into the artery. The effect would be systemic.

Epidural - Injection of anesthetic solution or other medicine into the epidural space of the spinal chord. The effect would be local.

Intravenous Solutions

The human body contains two fluid (water) compartments. The *Intracellular Fluid Compartment* which is fluid found inside the cells of the body, accounts for approximately 40% to 50% of total body weight. The *Extracellular Fluid Compartment* which is fluid outside the cells, accounts for approximately 20% of total body weight.

Interstitial fluid would include the following: fluid outside blood vessels, plasma (fluid inside the blood vessels) as well as lymph, cerebrospinal fluid, and *synovial* fluid.
Type of intravenous replacement solutions to use is dependent on fluid replacement required, or Fluid Compartment affected.

There are two types of intravenous solutions:

Crystalloid - a non-colloid substance resembling a crystal. A substance which, in solution passes readily through cell membranes. Examples would include: Dextrose 5% Water (D5W) and Sodium Chloride 0.9% Injection (NS or Normal Saline). Dextrose would be a source of calories and water for hydration while Sodium Chloride would be a source of sodium chloride and water for hydration. Dextrose and Sodium Chloride are also found and used in combination. Oftentimes, electrolytes such as potassium chloride (KCl) are added.[ii]

Colloids - Colloid solutions are large molecular weight substances composed of proteins, carbohydrates or gelatin. Colloids cause a shift of fluid from interstitial spaces into the intravascular space or circulation. Its main use is to provide plasma volume expansion. Intravenous administration of colloids increases intravascular volume and restores normal blood volume.. Examples would include: Albumin Human, Plasma Protein Fraction, Dextran 40, Dextran 70 and Hetastarch.[iii]

Electrolyte solution is used in the hospital setting to replace electrolytes. Electrolytes is a substance that conducts electrical current and is found in all the cells of the human body which help in neural transmission to allow muscles, blood vessels, etc. to work. One of the most common electrolytes is potassium chloride (KCl). Electrolytes are measured in millequivalents (mEq).

Characteristics of Intravenous Solutions

Intravenous solutions must possess certain characteristics in order to be infused directly into the vein. Whether manufactured or prepared by the Pharmacy Technician, these characteristics are mandatory.

Sterility - IV solution must be free of any *pathogen* or disease causing microorganism

Clarity - IV solution must be free of unintentional particulates such as glass, rubber, cloth fibers, etc. Particulate matter in an IV solution could cause serious harm to a patient by lodging in small blood vessels and blocking blood flow.

pH - The pH of the solution is also important as it should be close to physiologic pH (7.4) as possible. A solution that is too acidic or too basic can cause serious systemic problems.

pH less than 7.0 is considered Acidic

pH greater than 7.0 is considered basic or alkaline

I*sotonicity* - An isotonic solution contains the same number of solutes as blood and has equal osmotic pressure as the cells of the body. IV solutions should be as isotonic as possible in order to reduce patient discomfort and damage to red blood cells. The idea of tonicity is to create an environment where osmotic pressure is equal.

Osmosis is the passage of pure solvent from a solution of lesser or greater solute concentration through a cell membrane. Isotonic solution has <u>equal</u> osmotic pressure. Hypertonic solution has <u>greater</u> osmotic pressure and will cause the net flow of water outside of cell while hypotonic solution has <u>lesser</u> osmotic pressure and will cause the net flow of water into the cell.

Any solution that is greater than 0.9% NaCl is considered to be hypertonic
Any solution that is equal to 0.9% NaCL is considered to be isotonic
Any solution that is less than 0.9% NaCl is considered to be hypotonic

Types of IV Solutions

Intravenous solutions can be classified as either *Small Volume Parenterals* (SVP) or *Large Volume Parenterals* (LVP). A small volume parenteral is usually 50 to 250 ml in size. Small volume parenterals are generally used as vehicles for medications. An example would be the Intravenous Piggyback (IVPB) which serves as a vehicle for the administration of specific medications such as antibiotics. The term piggyback refers to the IV piggyback administration via a secondary line with an established running IV solution or primary line.

Large Volume Parenterals (LVP) are used mainly to provide fluid or electrolyte replacement with a volume of 250ml or higher. Generally 1000ml is the standard volume for a LVP. LVP are used for fluid and/or electrolyte replacement and also when *infusion* or the gradual injection of a volume of fluid is needed.

Administration of IV medications

- *IV Push or IV bolus* - injection of a small amount of drug by means of a needle or syringe
- *Infusion* - administration of a large amount of fluid (LVP) over a prolonged period of time
- *Piggyback* - IV piggyback administration via a secondary line with an established running IV solution or primary line. Used to deliver medications

Fluid and Electrolyte Therapy

Intravenous solutions are not only given as vehicles for medications, but also as a way to give fluid or electrolyte replacement. Generally, upon hospital admission, most patients are placed on some sort of IV Admixture. The IV may then be used as a means to provide fluid and or electrolyte replacement, as a port for an Intravenous Piggy Back (IVPB), to deliver medication or most commonly, as a port for medications that may be needed in case of an emergency.

Maintenance therapy is used to replace fluids and electrolytes lost normally during the course of a day. *Replacement therapy* replaces fluids and electrolytes lost abnormally from extraordinary means. While fluids can be replaced by mouth, emergency situations require the use of intravenous solutions.

Instead of the administration of Intravenous solutions…"the practice of *bloodletting* seemed logical when the foundation of all medical treatment was based on the four body humors: blood, phlegm, yellow bile, and black bile. Health was thought to be restored by purging, starving, vomiting or bloodletting."

"The art of bloodletting reached unbelievable heights in the 18th and early 19th centuries. The draining of 16 – 30 ounces of blood was typical. Blood was often caught in a shallow bowl. When the patient became faint, the "treatment" was stopped."

Doodle Space

Preparation of IV Solutions

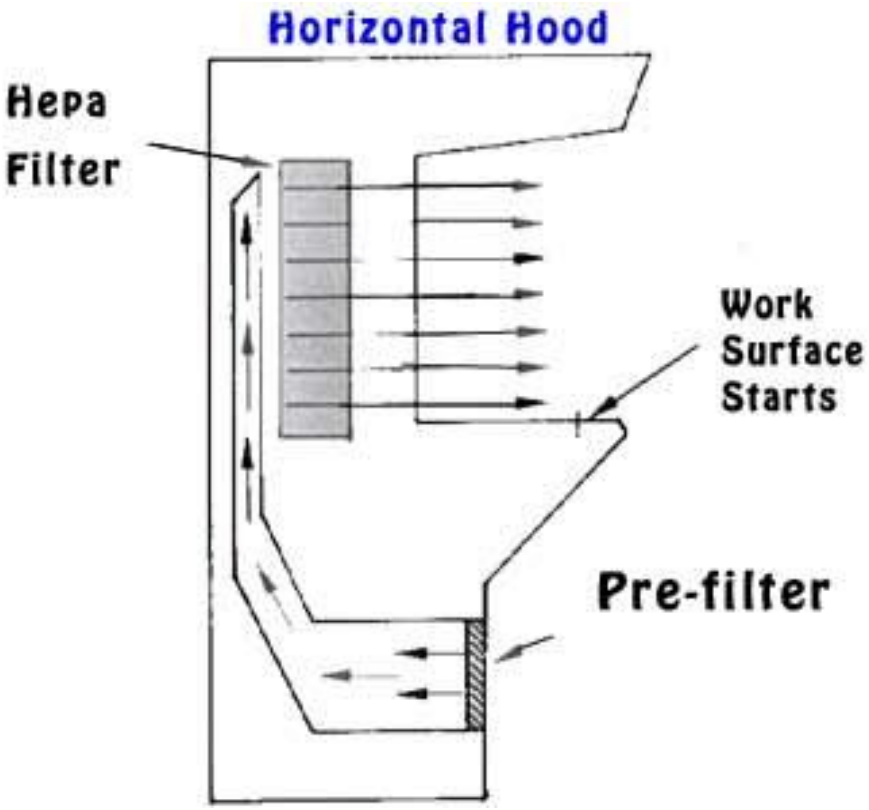
In the preparation of IV Solutions it is most important to understand and use *Aseptic Technique*. Aseptic Technique defined is the ability to handle materials and supplies without introducing any particles or viable microorganisms into the final product. The environment in which it is being prepared or the person preparing a sterile product can easily cause contamination.

Laminar Flow Hood

The Laminar Flow Hood is an area used to provide a *clean* environment in the preparation of sterile products and should be used in the preparation of all parenteral admixtures.

The hood works by employing the use of pre-filters(take out particles greater than 5 microns or dust particles) and High-Efficiency Particulate Air (HEPA) bacterial filters(take out particles greater than 0.22 microns or the smallest bacteria). The air flow within the hood is essentially sterile and sweeps all dust and airborne particles from the chamber through an open side. The horizontal hood is the most common type of hood used although when infectious or chemotherapeutic material is involved, the vertical hood is recommended.

The use of the Laminar Flow Hood does not ensure that a product will not be contaminated, as the airflow does not remove microbial contamination from the hoods surface or the surface of objects within the confines of the hood. To ensure non-contamination of a product, aseptic technique must be practiced. Laminar-air flow devices can be in the form of rooms, cabinets or benches.


Horizontal Hood
Hepa
Filter
Work
Surface
Starts
Pre-filter

Laminar Flow Hood Guidelines:

- Wash hands with *antimicrobial* agent. No jewelry on hands or wrist.
- Turn on airflow hood at least 30 minutes prior to preparation
- Clean hood on inside:
    a. use suitable disinfectant such as 70% Isopropyl alcohol on gauze or manufactured pre-soaked swab pads
    b. use long, back to front, side to side, top to bottom with overlapping strokes
    c. avoid spraying or solutions into the HEPA filter
- Gather all materials outside of hood. All packing material stays out of hood.
- Check IV bags for expiration dates, particulate matter and leaks
- Place materials in the hood 6 inches from the edge
    a. place materials in a horizontal line
    b. large objects should never be placed in back of the hood
    -so you don't obstruct clean airflow from HEPA Filter
- Additive ports of IV bags should face toward the back of the hood
- Swab or spray the additive port of IV bag and the top of vial using separate alcohol swabs
- Work six inches inside the hood
- Before and after preparing a series of IV admixtures, or anytime a spill occurs , the work surface of the laminar flow hood should be cleaned with alcohol or manufactured pre-soaked swab pads
- Always use aseptic technique

Aseptic Technique

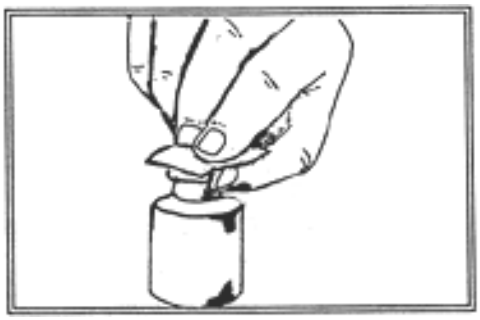
The importance of aseptic technique cannot be overstated. When preparing an intravenous solution, realize the solution will bypass the protective skin barrier and enter a patient's body via the blood stream. There is no room for error in preventing contamination of a product. When preparing a product, steps must be taken to ensure sterility of the product.

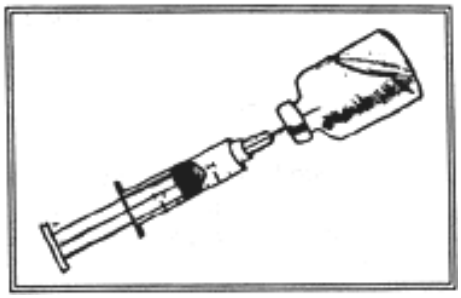
"The number one source of contamination is when an individual does not wash their hands correctly or often enough"

Three major sources of contamination include personnel, (the individual preparing the sterile product), environment (where the product is being prepared), and materials or equipment being used. Contamination from these three major sources can be avoided if proper guidelines and steps are followed to ensure sterility of a final product.

The first and foremost step in preventing contamination is hand washing. Hand washing or lack of hand washing is the number one cause of contamination in the hospital setting. Suitable antimicrobial cleansers (germicidal soaps or detergents) must be used as well as proper hand washing technique. Hand washing is not limited to a few times. It is vital that hand washing occur anytime the individual preparing the product leaves the laminar flow hood or if the individual feels they may have been contaminated. Although gloved hands may be used, use of gloves does not guarantee sterility. Gloved hands can become contaminated just as easy as ungloved hands.

Vials, especially multidose vials should be swabbed before each use or insertion of needle with using a minimum of Isopropyl Alcohol 70%





Never touch the tip of the needle or the plunger if using the syringe more than once, as this will cause contamination. Practical training is necessary to withdraw mediation correctly from vials

Recommendation for limiting contamination for parenteral products

use of multi-dose vials should be avoided

use single dose vials whenever possible and discard after use

the date and time the multi-dose vial was opened should be recorded on the multi-dose vial, along with the initials of the tech/RPh and any calculated concentration

indicate expiration date clearly and refrigerate when appropriate

refrigerate multi-dose vials unless contraindicated by manufacturer

each time a multi-dose vial is used, the stopper must be cleaned with an alcohol pad, always clean all injection ports with alcohol pad prior to entry

use sterile supplies, sterile needles and syringes and sterile water or sterile saline for solution

use light-device to check IV solutions for dark particulate matter

Clean work surface and leave clean for the next process

Wash hands when IV Admixture is removed from hood or completion of each IV

IV Admixtures Review

Parenteral

used to indicated medications that are administered by any route other than through the digestive system

Routes of Administration

Intradermal (ID) - injected just below the skin
volume does not exceed 0.1 ml

Subcutaneous (SQ) - injected into the loose tissue layer beneath the skin
volume does not exceed 1.0 ml

Intramuscular (IM) - injected into muscle mass
volume does not exceed 3 ml

Intra-arterial (IA) - injected directed into an artery

Intrathecal (IT) - injected into the spinal fluid
must use preservative-free drugs

Intravenous (IV) - injected directly into a vein

Medications by this route act quicker than oral medications because they are absorbed more rapidly into the bloodstream

a. available in liquid (solution) or powder

Forms of Parenteral medications

1. ampules - sealed glass containers designed to hold a single dose of medication. Need to use filter needles or straws to remove contents, each will remove particles greater than 0.22 microns.

2. vials - plastic or glass containers that have a rubber stopper (diaphragm) on them which is covered with a metal lid

3. mix-o-vials - contains two compartments that are separated by a rubber stopper

4. cartridge - prefilled glass or plastic container which requires a special holder called a tubex to release the medication from the cartridge

5. prepackaged syringes - medication prepared for administration in a syringe with the needle attache

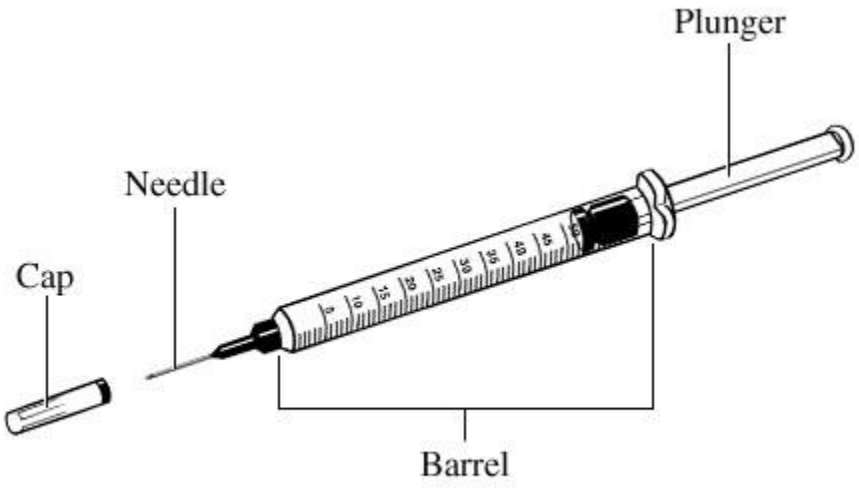
Syringes

Syringes have three parts

1. the barrel - the outer portion that has the calibrations of the syringe on it

2. the plunger - the inner device that is pushed to eject the medication from the syringe

3. the tip - the end of the syringe that holds the needle



Types of Syringes

1. hypodermic - comes in variety of sizes

   a. labeled in cc or ml

Small size:	1 to 3 ml
Middle size:	5 to 10 ml
Large size:	10 to 60 ml

2. tuberculin - total capacity of 1 ml

   a. calibrated in hundredths of cc

3. Insulin - designed for the administration of Insulin

   a. measured in units

   b. calibrated to match dosage strength of insulin

   Lo-Dose : used for small doses
   0 to 50 units

   1 ml Syringe: designed to hold up to 100 units

Conversion: U-100 Insulin Syringe - 1 ml = 100 units

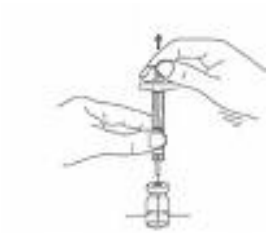
Example: How many mls would you need to remove from a U-100 vial to give a dose of 35 units?

Setup: 1 ml / 100 units = x ml / 35 units

Answer: 0.35 ml

Medications

Powdered Drugs : Drugs that are unstable in liquid form for long periods of time are packaged in powdered form. must be diluted with a liquid (Reconstituted)



- diluent

Reconstitution:

1. Carefully read the directions for reconstitution on the vial or in the package insert

2. The diluents commonly used for reconstitution are sterile water for injection

3. After adding the diluent to the powdered medication the total reconstituted volume will be greater than the amount of diluent

Information needed for Reconstitution:

1. type of diluent to use for reconstitution
2. the amount of diluent to add
3. the length of time the medication is good for once it is reconstituted
4. directions for storing the medication after mixing
5. the strength or concentration of the medication after its reconstituted

After mixing the powdered drug, you must place the following information on the medication vial: (multi dose)

1. your initials
2. date and time prepared
3. expiration date
4. final concentration of vial

Sample Label of medication multidose vial: Reconstitute with 23ml, 18ml, 8ml of diluent to provide concentration of 200,000units; 250,000units;500,000units per ml respectively.

Reading Parenteral Labels

Drugs labeled in Percentage Strength

give information such as percentage of the solution and the total volume of the large volume solution, vial or ampule

example: Dextrose 5% Water 1000 ml

0.9% NaCl 500 ml

50% $MgSO_4$ 25 ml

Solutions expressed in Ratio Strength

oftentimes ordered by ml or cc

example: Epinephrine 1:1000

Parenteral Medications measured in Units

Measured in units for parenteral administration

example: heparin 100 units / ml
1000 units / ml

Insulin 100 units / ml

Penicillin 500,000 units / ml

Parenteral Medications in Millequivalents

Millequivalents (mEq) have no conversion to another system

example: KCl 10mEq/ml

Administration of IV medications

IV Push - injection of a small amount of drug by means of a needle and syringe

Infusion - administration of large amount of fluid over a prolonged period of time

Piggyback - administration of medication in small amounts of fluid are infused into the tubing of a running IV solution

Heparin Lock - short tubing inserted into the veins

a. receives IV tubing
b. maintained (filled) with heparin solution so that blood does not clot and block the tube

Labeling of an IV Admixture

Label is used to identify a product and patient receiving the product. It should contain the following information:

0. Date
1. Patient Name
2. Patient Room Number
3. Time dose is due
4. Rate of administration
5. Name and strength of Drug and Fluid drug is in
6. Total Volume of fluid
7. initial of Pharmacy Technician making IV Admixture

example:

Smith, Howard	9/17/2013
1400	Room 232A
Cefazolin 1 Gram in	
D5% Water 50ml	
infuse over 20 minutes	initial:

Doodle Space

Other Types of Parenteral Admixtures

Total Parenteral Nutrition

Total Parenteral Nutrition (TPN) or Hyperalimentation is an intravenous admixture which provides a complete form of nutrition, containing either of the following: dextrose, amino acids, electrolytes, and additives including MVI, trace elements and insulin. Sometimes included in the TPN is intralipids. Due to the large number of ingredients, Pharmacy Technicians need to ensure correct calculations, correct constituents, doses, and aseptic technique is employed.

Chemotherapeutics

Chemotherapeutic intravenous admixtures are also prepared by Pharmacy Technicians. Many safety protocols need to be followed that not only deal with the preparation itself, but also the safety for the individual preparing the IV admixture. In general the use of a vertical Laminar Flow Hood and gowning, including mask and gloves must be practiced. All material used to make the Chemo IV Admixture must be disposed in a specific marked container labeled "*Hazardous Waste Container*."

Nuclear Pharmacy

The measuring of radioisotopes in prescription filling is done in a vertical laminar flow hood, with a protective lead *glass shield.*

A syringe using a "syringe shield" (to help reduce radiation exposure), punctures the small empty evacuated container containing the radioisotope. A dose calibrator unit, inside of the hood, is used to ensure the volume to be dispensed on the printed label matches the actual radioactivity of the product and is correct for time of administration.

Carefully the drawn up volume of radioisotope is dispensed or is mixed with an organ specific carrier or biological molecule. The final product (vial or syringe) is then placed in a tungsten or lead container and labeled accordingly for delivery

Conclusion

Although the compounding of Intravenous Admixtures is not used often in the average retail Pharmacy setting, Pharmacy Technicians do prepare IV Admixtures in Hospitals. Much hands-on experience is needed to ensure a product is not only calculated correctly, but also prepared correctly including proper aseptic technique. With proper training and guidance and final check by a Pharmacist, there is no reason why a Pharmacy Technician cannot become an expert at preparing Intravenous Solutions.

One vital ingredient in the preparation of IV Admixtures is the individual Pharmacy Technician's "**attitude**." Attitude is a mind set that is never absent. Attitude should control a Pharmacy Technician's behavior and technique in the preparation of sterile drugs or drug products. Attitude for a Pharmacy Technician is based on the knowledge of aseptic technique principles and more importantly, skills.

Commonly Administered Crystalloid IV Solutions

IV Solution	Contents	Tonicity
D5W	Dextrose 5%	Isotonic
D10W	Dextrose 10%	Hypertonic
NS	0.9% NaCl	isotonic
1/2 NS	0.45% NaCl	hypotonic
1/4 NS	0.2% NaCl	hypotonic
D5NS	Dextrose 5% 0.9% NaCl	isotonic
D5 1/2NS	Dextrose 5% 0.45% NaCl	isotonic
D5 1/4 NS	Dextrose 5% 0.2% NaCl	isotonic
LR (Lactated Ringers)	Na, K, Ca, Cl, Lactate	isotonic
D5LR	Dextrose 5% Na, K, Ca, Cl, Lactate	isotonic

Lecture 17 - IV Admixtures Worksheet

True or False

_____ 1. Intradermal injection is injected in the loose tissue layer beneath the skin

_____ 2. In the preparation of IV solutions, use the size of syringe which is the next size larger than the volume to be measured

_____ 3. The total volume of a reconstituted vial is equal to the amount of diluent used

_____ 4. The concept of Isotonicity is to create an environment where osmotic pressure is equal

_____ 5. A pH of 9.4 would be considered basic or alkaline

_____ 6. Mixing Calcium Gluconate with Sodium Phosphate in a syringe most likely will precipitate

_____ 7. The Laminar flow hood is an area used to provide a sterile environment in the preparation of sterile products

_____ 8. The smaller the gauge of a needle the larger the diameter of the needle

_____ 9. A hypertonic solution has less osmotic pressure therefore causing a net flow of water into the cell

_____ 10. IVPB is used as a vehicle to administer medications

_____ 11. D5W and D5 1/4NS or both considered isotonic solutions

_____ 12. The horizontal laminar flow hood actually has two filters

Submit our answers online at the following URL:

https://form.jotform.com/241496962225160

Doodle Page