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IV
Therapy

This booklet is part of the 30 hour Administration of Intravenous Therapy Course designed for Florida Nurses. This packet must be reviewed and all exams in the accompanying test booklet must be completed prior to the classroom section.

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IV THERAPY

Course Goals:

This blended course is a combination of home study, classroom didactic information, skills labs and competency evaluation. Participants must review the information provided in this packet, complete each of the written exams (a passing score of 85% is required), and attend the classroom portions. The classroom segment will provide the participants the ability to review and receive education on Intravenous (IV) Theory, Safety, and information relating to all aspects of IV administration. The skills labs will allow the student to perform procedures including, but not limited to: determining the need, preparing the patient, preparing the IV site, choosing the correct fluid, establishing the IV, calculating IV flow rates/drips and administration, trouble shooting, recognizing complications, documentation, and the discontinuation of the IV site.

In summary, this course reviews information about the venous system and:

- Appropriate peripheral veins to use for venipuncture
- Common IV medical terminology and abbreviations
- Venipuncture and the various ways to deliver IV therapy
    - A review of the different catheter types and their use in IV therapy
    - The special attention required before, during and after IV therapy
    - The adverse reactions and complications associated with IV therapy
    - Highlights on different types of IV equipment and their uses
    - Examining appropriate/accurate administration of IV medications and solutions
    - Discussion on IV medications and solutions delivered via a central line
    - Evaluating appropriate care for patients receiving IV therapy
    - The process of providing blood, blood components and parenteral nutrition
    - The need for the incorporation of infection control procedures into all aspects of venipuncture and intravenous therapy

It is crucial that the student be prepared prior to entering the classroom section. All sections of the packet should be reviewed and each pre-course exam must be completed. **Pre-course exams will be collected at the beginning of the classroom section.**

Clinical Competence:
Following successful completion of this program, clinical competence verification must be completed by the employing institution and verified in writing via assigned letter of confirmation by a Florida Licensed Registered Nurse.

Program Objectives:

Participants who complete the program will be able to:

- Compare the RN and LPN Florida Scope of Practice relating to IV therapy
- Clarify at least four uses of IV therapy
- Explain the need for following acceptable policies and protocols relating to IV therapy
- Recognize appropriate procedures for starting and maintaining peripheral IV lines
- List the documentation required for starting and maintaining peripheral IV lines
- Identify the need of psychological support for the patient receiving IV therapy
- Describe and locate the function and sites of peripheral veins used for venipuncture
- Identify at least three ways of providing IV therapy
- List at least four common complications of IV therapy
- Describe and demonstrate various IV procedures of peripheral lines and “locks”
- Describe prevention, accessing, and the treatment of IV therapy complications
- Describe nursing management of patients receiving IV therapy including drug actions, and the compatibility and incompatibility of certain drugs and fluids
- Recognize the differences of patients with arterial lines and their management
- List four complications associated with central lines and the appropriate treatment
- Explain fluids and electrolytes, including imbalances and homeostasis
- Describe nursing management and care for the patient receiving chemotherapy
- Describe nursing management and care for the patient receiving parenteral nutrition, observing metabolism, complications, and measures to ensure therapeutic effects
- List blood products, indications and methods for blood transfusions and treatment
- Describe four common blood transfusion reactions and the nursing management
- Describe and demonstrate principals of Standard Precautions, Infection Control, aseptic technique and appropriate management of infections
- Describe and demonstrate fluid and drug calculation formulas, drop factors and continuous infusion methods
- Describe and demonstrate the use of various types of IV equipment: IV fluids, tubing parts, various IV catheters, IV pumps and additional IV supplies
- Demonstrate in a simulation lab appropriate insertion of an IV catheter, usage of an applicable IV site dressing, and initiation of IV fluids as well as maintenance care.

IV THERAPY: Introduction

Intravenous therapy or “IV therapy” is the delivery of a substance directly into a vein. Intravenous simply means: "within a vein". In regards to the circulatory system, it is the veins (Latin: *vena*) which are blood vessels that transport blood to the heart. Veins are different from arteries in structure and function. The arteries are thicker than veins and are deeper in the anatomy. Veins are most often closer to the skin surface and have valves to help push blood flow toward the heart. In comparison, arteries carry blood away from the heart. When giving medications via the IV route, the action may be immediate; this could be an advantage or disadvantage (if the patient is having a reaction).

Many IV medications may be referred to as “drips” because multiple types of IV administration tubing consist of a drip chamber, which prevents air from entering the blood stream (a potential air embolism) and is controlled by a specific flow rate. A drip chamber is built into the IV tubing permitting air to rise above the IV fluids being used. This delivery system is specifically designed to prevent the air bubbles from traveling to the patient’s blood vessels. As mentioned, the drip chamber is accessed to control the rate at which a fluid is dispensed. In conjunction, the rate of the substance provided is typically controlled by a clamp on the infusion tubing. The usage of the tubing clamp and creating appropriate drip rates takes practice and proper attention throughout the administration of the IV drip.

Managing drips as well as other hands-on IV activities that require steadfast attention will be addressed during practice time in the classroom setting. Intravenous therapy may be used for such things as to remedy electrolyte imbalances, dispense medications, provide blood transfusions, or deliver fluid replacements for dehydration. For patients who are not requiring immediate IV solutions, they may be provided with a slower, continuous IV fluid used to keep the vein open (KVO or TKO) and accessible. Awareness of appropriate fluids and the indications for those fluids is very much the responsibility of the provider.

Medication Administration:

Florida’s Nurse Practice Act determines those who may administer IV medications. Employing institutions may further restrict the scope of practice but may not exceed the Nurse Practice Act limitations. Florida allows LPNs to perform IV therapy if they have had the 30 hours of specialty IV training and have been “signed off” as competent by a Florida Registered Nurse at their facility.

IV administration provides a means of delivering certain medications. Before giving any medication intravenously, the provider must be fully versed on the actions, potential side effects, and the compatibility with other drugs and solutions in order to appropriately monitor the patient and prevent potential complications. The intravenous route is the fastest way to deliver fluids and medications to the patient. Interestingly, blood transfusions, lethal injections and a limited amount of medications can be given only by intravenous route.

Actions of Medications:

Therapeutic effect: The intended or predicted physiological response

Side effect: Predicted, unintended, secondary effect

Toxic effect: Excess amounts of a medication that has deleterious effects

Idiosyncratic reaction: An unpredicted reaction in which a patient's body overreacts or under-reacts to a medication or has a reaction different from normal

Allergic reaction: An unpredicted immunologic response whereby the medication acts as an antigen causing antibodies to be produced. Subsequent administration of the drug will result in an allergic reaction from mild (hives) to severe (anaphylaxis)

Avoiding Errors of IV Fluids and Medication Administration:

Pharmacology is the study of medications and drugs and how they act on the body. The healthcare provider responsible for administering the medications is accountable for a thorough knowledge of all the medications that are to be given. This responsibility can be fulfilled by staying current with the latest pharmacological advances and a continuous professional commitment to refer to credible and current resources. In addition, it is the expectation of the provider to know the drugs to be given, and to explain in a clear and concise manner any information necessary to the receiving patient and attending family or power of attorney (POA) placed in charge.

Uses of IV therapy:

Managing and providing IV fluids related to electrolyte imbalance:
The body is in a constant struggle with homeostasis (maintaining a normal internal balance), there is an ongoing attempt for fluid and electrolyte stability. Daily managing of intake and output is a normal body function. When there is a challenge, i.e.; a patient may experience any number of illnesses, and may become impaired, requiring a need for IV intervention.

The medical professional's knowledge about medications should - at a minimum - include satisfactory competence in the following areas:

- General classifications of medications and similarities between medications
- Brand names and generic names - resources for obtaining medication information
- Actions and mechanisms of action, uses and indications
- Contraindications and precautions
- Side effects and adverse reactions and appropriate treatment
- Interactions of meds with other drugs, foods, herbs, lifestyle, and diagnostic tests
- Recommended dosages and dosage modifications based on the patient and condition
- Age-specific routes for the pediatric patient
- Nursing implications and considerations, including patient and family teaching
- The components of a complete doctor's order for a medication including those administered intravenously
- Knowledge and understanding of the seven rights of medication administration
- Legal responsibilities associated with medication administration
- Pharmacological safety

Medication Interactions:

- Synergistic: A medication potentiates the effect of another
- Antagonistic: A medication diminishes the effect of another
- Advantages: Immediate drug action, greater control over blood concentrations, and less discomfort than subcutaneous or intramuscular injection (therapeutic).
- Disadvantages: Immediate drug action (and adverse reaction), drug incompatibilities.

Types of Incompatibilities: A "physical" type shows a visible reaction to the medication which causes a change in color, turbidity, or the formation of precipitate or gas. With a "chemical" type of reaction: a non-visible reaction results in the decomposition of a drug. And a "therapeutic" type of reaction has been described in Advantages listed above.

Factors affecting Drug Stability: Number of additives, i.e.; the greater the number of additives, the greater the chance that one of the drugs will become unstable. The order of the additives (the order in which multiple drugs are added to a solution can affect compatibility and stability. Time: the length of time a drug or fluid is in contact with another can affect stability. Light: some drugs are light sensitive and exposure can lead to degradation. Temperature: certain drugs need to be refrigerated until they are given. The container can make a difference; some drugs lose their potency due to adherence to PVC containers.

Preparation for providing Continuous Infusions: There are various continuous infusions which come premixed from the manufacturer. In other instances, the admixture may be prepared by pharmacy. Although unlikely, it may be the healthcare provider's responsibility to mix the solution. Follow the facilities protocol and procedure manual of standard concentrations and prepare them consistently. This is important because if the solution is mixed differently by another individual, the rate has to be readjusted to maintain appropriate dosing of the drug.

Intermittent Medications:

These infusions are limited volumes, usually 50 milliliters (mL) up to 250 mL given intermittently. They may be infused via a saline lock site, as a secondary medication infused simultaneously through the low port of a primary system, or as an IV piggyback (IVPB) through the high port of a primary system. If infusing through a primary line, compatibility of the fluids must be established prior to infusion. Remember, it is the caregiver's responsibility to be aware of medication compatibility.

Methods of providing IV medications include the following:

Continuous infusions: Used when the drug must be highly diluted, this method refers to a continuous infusion provided over hours up to days. Fluid overload is a potential concern, titrate the rate based on patient response may or may not be required depending on the drug. Drip rates often need to be calculated as the patient's physician will frequently order the drugs in grams, milligrams, or units per hour. Since most continuous drug infusions are run on a pump, the rate has to be calculated in mL/hr. Some facilities have pumps with an internal calculator that when programmed - accurately can provide all the necessary information and formulas. Formulas will be discussed later.

Saline Lock: The Heparin/Saline lock is first flushed with 1 – 3 mL Saline to ensure patency. The medication is then primed through a basic IV set and plugged into the Saline Lock. It may or may not be run on a pump depending on the type of medication being infused or availability of an IV pump. It is important to disconnect the infusion and flush the lock as soon as it is complete to prevent a backflow of blood that can clot the catheter. Typical protocol for most facilities is to flush with 1 – 3mLof Saline through the lock. Always follow your facilities' protocol.

Simultaneous Secondary Infusion: If the patient is ordered more than 1 medication at a time, first confirm that the two solutions are compatible. Next, connect the secondary medication to the low port of the primary line. It may or may not be run on a pump depending on the type of medication being infused. Observe fluids closely.

Secondary piggyback: In some cases, depending on the IV pump used, the primary solution may be hung on a "hanger" to lower it below the secondary line. The medication is then primed into secondary tubing and connected to the high port of the primary line. The rate is then titrated by use of the roller clamp on the primary set. The primary (because it is now "lower") will not run as long as there is fluid in the secondary. However, once the secondary is complete, the primary will begin to flow again.

It is imperative to know what type of IV pump is being used; it may be designed to run secondary fluids without the need for lowering the primary fluids. The roller clamp on the secondary tubing must be completely "opened" if using a programmable pump. The secondary bag will then run until completed and then switch back to the primary fluid. In either case, the pump will either alarm when it is complete, or it will automatically readjust back to the primary bag and line and resume the original rate. It depends on the pump model and how the pump is programmed by the provider. The patient should be instructed to call if the pump sets off an alarm at any time during the IV therapy.

Preparing Intermittent Infusions: The Secondary intermittent infusions usually come from the pharmacy as pre-mixed. Depending on the stability of the drug, they may be pre-mixed at the manufacturer's plant. In either case, the pharmacy will apply a label to the bag with the patient's name, the name and dose of the medication, the time to administer it, and the rate of infusion. If the rate of infusion is not on the label, the caregiver should look it up in updated drug reference.

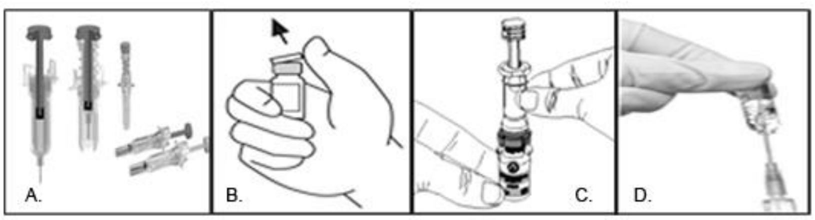
CAUTION: If a pharmacy label is applied on a manufacturer premixed secondary bag, it is the caregiver's responsibility to make sure that they are the same drug. Ideally, the label should be placed on the back of the IV bag so as not to cover the manufacturer's details. Some manufacturers produce "use-activated" containers in which the bag contains the diluent and attached to it is a vial of the drug in powdered form. The nurse activates the system by removing the barrier between the drug and diluent prior to use. Often it is a simple "pop off cap" that sits in the bag after activating the solution. Although this is a cost-effective method that increases the shelf-life of a secondary medication, errors have been reported due to failure of the provider to appropriately remove the barrier and activate the system. Always check in the procedure manual if uncertain.

IV push (IVP): Also known as direct injection or bolus, in this case, the medication is administered directly into the vein via a saline lock or the low port of a primary infusion. Very rapid blood concentrations of the drug are achieved with this method. Therefore, the provider must understand the actions of the drug prior to administering it.

IVP medications have minimum rates over which they may be pushed. An example would be an IV Protonix push which should be pushed slowly over 2 minutes. Consult your drug references. If using a Heparin/Saline lock; begin by flushing with saline to determine patency, provide the medication, and then flush as per protocol. If using the low port on a primary infusion, confirm compatibility first.

Larger volumes (10 – 30 mL) that need to be pushed over an extended period of time (i.e. 20 minutes) may be placed in a syringe pump as long as you continue to monitor your patient's response to the drug. These pumps or mini-infusers have special tubing that adapts to the syringe and is connected to the patient's IV or heparin/saline lock. The pump slowly depresses the plunger on the syringe over a specified period of time.

Preparing IVP medications: IVP medications come in three basic forms:



Pre-filled syringes (figure A) are imprinted with the drug and dose by the manufacturer. Use caution when preparing to administer the IV push as your dose may vary from the dosage in the syringe. Additionally, the syringes often contain a small amount of extra drug that should be expelled when purging the syringe of air.

IVP medication in solute form come in a vial (figure B), are vials that display how much drug is provided per mL and the specific amount to be withdrawn by syringe. They may be rubber-stopper vials or glass ampules.

Powdered IVP medications (figure C) are vials that contain a powdered form of the drug which will need to be reconstituted with a diluent. See accompanying package insert for type and amount of diluting agent (typically saline, sterile water, or D5W).

Note: When withdrawing a medication from a glass ampule, use a filter needle is standard procedure which is then replaced with a regular needle prior to administering the drug. This method has been found to prevent small glass particles from being injected into the patient's blood stream, which could potentially cause complications like phlebitis or pulmonary embolism.

Various Types of Medication Errors:

Prescribing error: example: incorrect drug selection (based on indications, contraindications, known allergies, existing drug therapy, and other factors), dose, dosage form, quantity, route, concentration, rate of medication administration, or instructions for use of a drug product ordered or authorized by a physician (or other legitimate prescriber); illegible prescriptions or medication orders.

Omission error: example: failure to administer ordered dose to the correct patient.

Wrong-time error: example: the administration of a medication outside a pre-defined time interval from its scheduled administration time. This interval, usually a half hour or one hour before or after the scheduled time, should be established by each individual healthcare facility.

Unauthorized - drug error: example: the administration of a medication that is not authorized by a legitimate prescriber for the patient.

Improper-dose error: example: the administration of a dose that is greater than or less than the amount ordered by the prescriber or the administration of duplicate doses to the patient. This can result from a calculation error.

Wrong dosage-form error: example: the administration of a different dosage from that ordered by the prescriber.

Wrong drug-preparation error: example: the drug product was incorrectly formulated or was manipulated before administration

Wrong administration-Technique error: example: an inappropriate administration procedure, such as failure to use the “Z-track” technique for injecting Ferrous Sulfate

COMPLETE EXAM SECTION 1 IN YOUR TEST BOOKLET NOW

It is now time to review the different IV fluids that may be provided by the caregiver and given to the patient. One way to classify IV fluids is by the key ingredients in the solution, for example sodium, dextrose, and various electrolytes. Most of these fluids are available in various combinations.

Sodium-containing IV fluids range from hypotonic (0.45% sodium chloride solution) to isotonic (0.9% sodium chloride solution) to hypertonic (5% dextrose in 0.9% sodium chloride solution). Along with sodium, these fluids provide chloride and free water; some are available in combination with dextrose. A solution of 0.9% sodium chloride is known as "normal" saline (NS) because its tonicity (308 mOsm/liter) closely correlates with the osmolality of plasma.

Isotonic saline fluids such as 0.9% sodium chloride solution can temporarily expand the extracellular compartment during times of circulatory insufficiency, replenish sodium and chloride losses, treat diabetic ketoacidosis, and replenish fluids in the early treatment of burns and adrenal insufficiency. Because the osmolality is similar to that of blood, it is also the standard flush solutions used with blood transfusions. Hypertonic saline fluids such as 5% dextrose in 0.9% sodium chloride solution are used cautiously to treat severe hyponatremia.

Indications: Hypotonic saline fluids such as 0.45% sodium chloride solution, which expand the intracellular compartment, are indicated for hypertonic dehydration, gastric fluid loss, and cellular dehydration from excessive diuresis.

Precautions: The caregiver should closely monitor the patient for complications, such as electrolyte imbalances, calorie depletion, and increased intracranial pressure (ICP). Because hypertonic fluids pull water from the intracellular space into the extracellular space, fluid volume and ICP can increase. In addition, watch for fluid overload in patients with a history of heart failure or hypertension.

Dextrose fluids, which contain dextrose and free water, are available in concentrations of 2.5%, 5%, 10%, 20%, and 50%. Each percentage represents 1 gram of dextrose per 100 ml of fluid. For example, D5W provides 5 grams of dextrose per 100 ml of water, or 50 grams/ liter. Dextrose fluids provide calories for energy, sparing body protein and preventing ketosis, which occurs when the body burns fat. It also makes it easier for potassium to move from the extracellular to the intracellular compartment. Dextrose fluids flush the kidneys with water, helping the kidneys excrete solutes, and improve liver function (glucose is stored in the liver as glycogen). D5W is used to treat a dehydrated patient and to decrease sodium and potassium levels. It is also a decent diluent for many medications.

Precautions: Never mix dextrose with blood because it causes blood to hemolyze. Also noteworthy, prolonged therapy with dextrose in water can cause hypokalemia, hyponatremia, and water intoxication by diluting the body's normal level of electrolytes. Severe hyponatremia can lead to encephalopathy, brain damage, and death; young women are at highest risk. The patient should be observed for signs of confusion and other changes in mental status.

Closely monitoring the patient and the lab results, particularly serum sodium and potassium levels as this can prevent complications. Hypertonic dextrose solutions can cause hyperglycemia which can lead to osmotic diuresis and hyperosmolar coma. Monitor the patient's serum glucose levels, urine output, and fluid intake and output. Watch for polyuria (copious urine output), polydipsia (excessive or abnormal thirst), weight loss, and weakness. And as a matter of interest, dextrose can be given to diabetic patients with an acute illness as long as the patient's blood glucose is closely monitored so the balance of blood glucose and insulin is maintained.

Electrolyte replacement fluids: are generally isotonic replacement fluids containing electrolytes in the same concentrations found in plasma. This includes Ringer's solution; however, these solutions do not contain magnesium and phosphorus - which shouldn't be routinely given. The true electrolyte content depends on the manufacturer. Ringer's injection and Lactated Ringer's solution (LR), the two most common electrolyte fluids, contain potassium, sodium, chloride, and calcium. Lactate, added as a buffer to produce bicarbonate, is contraindicated in patients with liver disease because they cannot metabolize it.

The following are some other types of fluids that are provided via an IV site:

Chemotherapy, simply put, is the treatment choice for an illness by use of chemicals - especially by killing micro-organisms or cancerous cells. Cancer is the uncontrolled growth of cells coupled with some type of malignant behavior with invasion and metastasis. Cancer is thought to be caused primarily by the interaction between genetic susceptibility and environmental toxins. Hence, most chemotherapeutic drugs work by impairing mitosis (cell division), effectively targeting fast-dividing cells and causing damage to those cells (cytotoxicity). There are some chemotherapy drugs that cause cells to undergo apoptosis (a self-programmed cell death). In its non-oncological use, the term chemotherapy may also refer to antibiotics (antibacterial chemotherapy). Interestingly, the first chemotherapeutic agent was arsphenamine, an arsenic compound discovered in 1909 used to treat Syphilis. This was later followed by sulfonamides (sulfa drugs) and penicillin.

Chemotherapy acts by killing cells that divide rapidly, which is one of the characteristics of most cancer cells. This means that it also harms cells that divide rapidly under normal circumstances: cells in the bone marrow, digestive tract and hair follicles; thus resulting in: myelosuppression (decreased production of blood cells - hence, immunosuppression status), mucositis (inflammation of the lining of the digestive tract), and alopecia (hair loss).Other uses for chemo involve treatment of autoimmune diseases such as Multiple Sclerosis, Lupus, Rheumatoid Arthritis and suppression of transplant rejections.

The side effects of receiving chemo may be acute (short-term), chronic (long-term), or permanent. Some side effects may delay immediate treatment. Chemo can include pain, diarrhea, constipation, mouth sores, hair loss, nausea and vomiting, and blood-related side effects such as low infection-fighting white blood cell count (Neutropenia), low red blood cells count (Anemia), and low platelets count (Thrombocytopenia). The patient should be monitored closely by the healthcare providers and with follow up visits with the Oncologist as directed.

An implanted port is the preferred route for chemotherapy and will be discussed later in this program. As for the caregiver that is exposed to chemotherapy as part of their work practice, precautions should be taken to eliminate or reduce exposure as much as possible. Pharmacists that prepare these drugs and the nurses who administer them are the two occupational groups with the highest incidence for exposure to chemotherapy (antineoplastic agents). Studies have concluded that following specific precautions while handling chemotherapy can reduce personnel exposure and risk. All personnel working with chemotherapeutic agents must read the agent’s Material Safety Data Sheet (MSDS) to address the requirement for hazard awareness training.

Precautions for Chemotherapy Administration include: wearing double gloves (latex or nitrile) for any tasks involved with giving chemotherapy. The provider should change gloves after each procedure and be cautious for any tears or punctures that could occur. A protective gown should be worn as well as wearing protective eye gear for any possible spills or splashes of chemo. In the event of accidental exposure to skin, wash the area immediately, for eyes: flush with water for at least 15 minutes. Notify your supervisor and follow up by filing an accident/injury report. When discarding all dangerous materials proper chemical waste containers should be used as instructed by your facility. Be sure to abide by all precautions. There are organizations that provide assistance for chemotherapy waste collection and removal.

Blood Transfusion Therapy:

Indications: Blood transfusion therapy may be ordered for a patient to improve blood volume, to maximize oxygen carrying capacity, and to correct blood dyscrasias and anemia. The nurse should regard blood transfusion therapy as a “living transplant” with significant associated risks and should be employed only when the potential for benefit outweighs the potential for harm.

Signs and Symptoms of Blood Transfusion Reaction:

The patient may display symptoms such as chills, fever, nausea, chest pain or flank pain. Or the patient might present with very vague symptoms like mild rash and/or itching. The caregiver should be aware that on very rare occasions, complications like pulmonaryedema or fluid accumulation in the lungs may occur. This should provoke vigilance in being abreast of the patient’s status and vital signs at all times throughout the blood transfusion.

When to respond to a “reaction” depends on the patient’s reaction, the patient’s vital signs, the facilities policies and procedures and if there are specific/direct orders already in place by the doctor. For instance, the doctor may write orders that “it is okay to still provide the patient with a transfusion”, even with a temperature of 101.5 - and simply give orders to “treat the Temp with Tylenol”. Conversely, the Blood Bank may consider this a significant “reaction” and deem it necessary to have the blood tagged and returned in order to follow through with a complete check on the product. If the patient is symptomatic; having distress and discomfort, the healthcare giver should follow the typical Blood Transfusion Reaction Protocol which is: immediately stop the blood transfusion, immediately provide a Saline bolus flush, contact the Nursing Supervisor, the patient’s doctor and the Blood Bank, and continue to assess the patient’s status with ongoing vital sign checks and close monitoring. The patient should be assessed for comfort level as well as emotional status. Advise them of any further procedures or plan of care changes.

Transmissible disease screening:

Prior to administering blood products, a signed, witnessed, informed consent must be obtained. Follow facility policy, in most cases, a single consent is good for the entire hospital stay. The following is a list of transmissible diseases that all donated blood is tested for: Syphilis - risk is minimal, Hepatitis B & C - risk 1 in 60,000 – 100,000, Human Immunodeficiency Virus (HIV) - risk is 1 in 500,000, Human T-cell Lymphotropic Virus - risk 1in 500,000.

Blood storage and preservation:

In addition to refrigeration, substances are added to blood to extend the shelf life by providing anticoagulation and food source for cells. These include: Citrate which is an anticoagulant that binds with calcium, Phosphate which is a pH buffer, Dextrose which is a food source, Adenine which is an energy source, and Mannitol which is an Osmotic stabilizer that reduces hemolysis.

Immunohematology:

ABO: Blood groupings according to the red blood cell antigen:

Type “A” patients have the A antigen and B antibodies (anti-B): These patients can only safely receive type A and type O blood.
Type “B” patients have the B antigen and A antibodies (anti-A): These patients can only safely receive type B and type O blood.
Type “AB” patients have the A & B antigens: These patients can safely receive type AB blood, type A blood, type B blood, and type O blood.
Type “O” patients have no antigens and anti-A & anti-B: These patients can only safely receive type O blood.

Rh: This is a group of nearly 50 other antigens on the red blood cell. For a routine blood transfusion therapy, the terms Rh positive and Rh negative refer to the presence of the D antigen.Rh negative patients do not have the D antigen: These patients can only receive Rh negative blood. If they receive Rh positive blood, they will develop antibodies to it and if they ever receive it again, they will have an antigen – antibody reaction. This is called Rh immunization. This can occur accidentally when Rh negative mothers have Rh positive babies. Subsequent pregnancies could be compromised if the infant is Rh positive because the mother has been sensitized and now carries the antibody.

Rh positive patients have the D antigen: These patients can safely receive Rh positive and Rh negative blood.

Universal blood donor – O negative
Universal blood recipient – AB positive

Human Leukocyte Antigen (HLA): these are antigens found on the surface of the white blood cells and platelets - must be matched when performing organ transplantation but can also cause febrile reactions to blood transfusions in sensitive patients. Patients who have received multiple transfusions have been exposed to a variety of HLAs and therefore have produced a multitude of antibodies. These patients should have HLA typing and acetaminophen pre-medication prior to their blood transfusion.

Providing Parental Nutrition:

For various conditions, parenteral nutrition (through injection or outside of the GI tract) may be the only way to provide the nutrients necessary to sustain a healthy existence for the patient. As prescribed, peripheral parenteral nutrition (PPN) is similar to liquid meals delivered via the blood stream. Each bag is prepared daily by a pharmacist who includes supplements which are all the proteins, electrolytes, fats and vitamins, etc. that are necessary to meet the daily requirements for the patient.
Most often, the nutrient is based on the patient's daily weight and lab work. Therefore, daily weights and strict intake and output are basic, but important tasks that should be monitored properly. Patients are relying on staff to be attentive to such duties.

Parenteral Nutrition Therapy Indications: (GI Dysfunctions)

Include and are not limited to: surgical procedures, peptic ulcer disease, gastric cancer, inflammatory bowel disease, Paralytic Ileus, bowel obstruction, short bowel syndrome, pancreatic disease, liver failure, hyper-metabolicstates, Intubated patients, coma and acute renal failure (ARF).

Nutritional requirements include fluids; the average healthy adult requires two to three liters a day. Carbohydrates are simple sugars that when broken down in the body, release energy that is used by the cells. Proteins are vital for body growth, maintenance, and repair of tissue. Proteins are broken down by digestion into amino acids that are either nonessential (can be synthesized by the body) or essential (must be contained in the diet). Fats are responsible for a wide range of metabolic and structural functions; fats are also an energy source.

Parenteral Solution Components include:

Carbohydrates: Dextrose in parenteral nutrition solutions should provide 40 – 60% of total caloric intake. Concentrations range from 5 – 70%.

Protein: Crystalline amino acids are provided at .8 gm/kg body weight per day but the amount may vary depending on the patients activity level, nutritional status, renal function, liver function, and the presence of hypermetabolic states.

Fats: Supplied as lipid emulsions that are a concentrated source of energy that prevents or corrects fatty acid deficiency.

Electrolytes: Added to parenteral nutrition solutions based on patient needs as evidence by daily serum levels.

Vitamins: A multi-vitamin preparation is added according to guidelines established by the Nutrition Advisory Group of the American Medical Association.

Trace elements: Zinc, copper, chromium, and manganese are also routinely added to promote normal metabolism and cellular function.

Water: Daily requirements are estimated at 30 to 35 mL/kg. Fluid status must be assessed closely as patients with hypermetabolic conditions may require additional intake and critically ill patients are susceptible to fluid overload.

Standard Solutions:

Peripheral Parenteral Nutrition (PPN): is used for short term weight maintenance or supplemental nutritional support of non-hypermetabolic patients, the dextrose concentration should not exceed 10% due to the potential for phlebitis of peripheral veins. A disadvantage is the high volume of fluid required to meet caloric needs. Lipid emulsions are given daily to twice weekly.

Total Parenteral Nutrition (TPN): is indicated when PPN or enteral feedings are unsuccessful, TPN can provide all of a patient's nutritional requirements. TPN should be initiated when five to seven days of insufficient eternal intake have passed. Lipid emulsions are given daily to twice weekly.

Total Nutrient Admixture (TNA): This is simply TPN and lipids combined.

Administration of Parenteral Nutrition: Lipids come in glass bottles and fat emulsion tubing must be used to prevent leakage. The initial infusion should be given slowly (approximately 30 mL per hour) for the first 30 minutes. Monitor for adverse reaction to lipids such as fever, chills, nausea, chest pain, and urticaria (hives). If your facility requires the use of a filter, it must be 1.2 microns. The fat emulsions should be given with caution to patients with hyperlipidemia. Prolonged administration can result in liver dysfunction, cholestasis (blocked bile), and blood dyscrasias such as thrombocytopenia.

PPN: may be given peripherally but the IV site should be closely monitored for signs of phlebitis. Select the largest vein available for IV site insertion. Use a standard administration set with a .2 micron filter. Tubing is changed every 24hours. Lipids are the only acceptable secondary to run with PPN and are plugged into the low port below the filter. Do not infuse any other IV fluids or medications through the PPN line. Use strict aseptic technique when handling parenteral nutrition solutions as they are an excellent medium for bacterial growth. Monitor daily weight, I & O, labs (electrolytes and WBC) and vital signs. Noteworthy complications include all those associated with any peripheral IV therapy. However, the incidence of phlebitis and sclerosed veins is greater and infiltration can result in extravasation hazard. Other common complications include hyperglycemia, and electrolyte imbalance. Sepsis is the most serious complication.

TPN: Must be given through a central line due to hypertonicity (>12.5% dextrose). Confirm contents of solution each day with the physician order, the facility's policy may require verification with a second nurse. Use a standard administration set with a 0.2 micron filter. Tubing is changed Q 24hr. The rate of infusion should be initiated gradually to allow the pancreas to increase endogenous insulin production. Follow facility protocol.

Do not allow the infusion to run dry, if this happens, hang D10W at the same rate until the next bag arrives to prevent rebound hypoglycemia. Many facilities and physicians require orders for every 6 hour blood-glucose-monitoring (may be more often if the patient is diabetic).Lipids are the only acceptable secondary to run with TPN and are plugged into the low port below the filter. As a rule, do not infuse any other IV fluids or medications through the TPN line. Use strict aseptic technique when handling parenteral nutrition solutions as they are an excellent medium for bacterial growth. Closely monitor daily weight, strict I & O, lab results (electrolyte and WBC) and vital signs. Provide frequent mouth care.

Complications include all those associated with any IV therapy infused through a central line. However, the risk of sepsis can be potentially fatal to your patient. Scrupulous aseptic technique must be observed at all times. Monitor for hyperglycemia and electrolyte imbalance.

TPN can also negatively impact on the patient psychologically. The patient may experience self-esteem/body image disturbance related to central line placement and alteration in activities of daily living. Anxiety related to inability to eat, the length of treatment and financial concerns complicated already strained coping mechanisms.

The caregiver can intervene effectively by providing patient education that reinforces the temporary nature of TPN and the positive benefits, i.e., maintenance of body weight and stamina. If psychological impact is extreme or long-lasting, it may be necessary for the nurse to initiate a social services consult to support the patient who undergoes prolonged TPN therapy.

Discontinuation of TPN should begin after the patient is able to achieve 2/3 of the daily nutritional requirements via the oral (or enteral) route. The infusion should be tapered off over two hours for unstressed patients and over two days for patients with renal or hepatic disease. Follow facilities' protocol and continue to monitor blood glucose levels until they return to normal.

Administering Medications:

Providing IV medications is one of the most important tasks within the nurse's scope of practice. Medications should be clearly intact, no rips or tears to the packaging. In addition, some are time-sensitive medications that should be tagged and dated. Be aware of expiration dates, the specific orders made by the physician, the right route, the right patient, etc. Giving IV medications is one of the most effective and rapid ways to provide the ordered prescription. At the end of the day, it is the provider's responsibility that everything is checked and monitored for the safety of the patient.

Infection Control: Aseptic technique, - or asepsis, is necessary in order to prevent infections. It is an infection control technique that ensures either sterility or the cleanest possible completion of a procedure when sterile technique is not possible.

Monitoring IV therapy and possible infections: As we become more aware of infections and spreading diseases in our communities as well as nationwide, the shift should be about preventing exposure to infection, instead of focusing on treating the infection following exposure. Invasive procedures increase the patient's risks for infections and complications. The staff attending the patient should have a clear understanding of the appropriate measures to be taken to keep the patient free of any undue impediment. Signs and symptoms of complications should be reviewed with the patient. Vital signs and lab work should be observed frequently by the provider.

Things to consider: Hand washing is of the upmost importance. Hand washing with antimicrobial soap under hot water for greater than 15 seconds is expected with any activity including initiating an IV site. Hand washing is expected upon entering the patient's room as well as when leaving the room. If anything is touched while in the room, additional hand washing is expected. That includes touching the patient, any equipment, or any of the patient's belongings. Aeruginosa and Candid Albicans are the organisms most commonly found on the healthcare provider's hands.

Some other things to consider include: IV catheter selection should be considered very important. Larger catheters may provide for an increased risk of infection. IV gauges vary and should be considered with whatever activities the patient is going to receive. However, smaller catheters (higher numbers, ie; #22 gauge) may be less of an infection risk. Monitor the IV closely and document. Although this program is designed to specifically address peripheral IV site insertion, it is important to know that central lines have an increased risk of infection related to location and length of time kept in the patient. Dressings tend to lift and the skin is usually moist and warm (neck or groin area), justifiably, these sites are difficult to keep clean.

Site care begins at the time of IV site insertion. The normal flora found on the surface of the skin includes Staphylococcus Epidermidis, Staphylococcus Aureus, and Bacillus, are all known to cause catheter related complications in the blood stream. Prepping the skin with appropriate antimicrobial cleanser prior to IV insertion should be considered imperative. Such cleansers can reduce the incidence of catheter related infections. Another type of “prep” - now found to be more of a risk than beneficial- is using a razor to remove hair from the skin surface prior to IV insertion. There is a very high probability of cutting the skin and causing micro-abrasions. Strict aseptic technique is essential.

Inspection of fluids, medications, and blood products for signs of contamination is an important task for controlling IV infection. Containers or bags with cracks or leaks, or any noticeable discoloration of fluids must be discarded. Klebsiella and Candida Tropicalis are just 2 of the known organisms that may be possibly responsible for fluid-related infections. All products provided to the patient should be checked for expiration dates as well. Consider making a report for any abnormalities.

Antibiotic medications as well as other IV solutions should be changed every 24 hours. Protocols should be reviewed frequently for changes; your facility should have a procedure manual available for viewing. Remember it is your responsibility to be aware of updates and changes.

Other methods of entry by microorganisms include: The use of IV ports when providing IV flushes, etc. Every time an IV port or cap is used, it should be cleaned with an alcohol swab. Once the cap is pushed by either a needleless system or with a puncture from a needle, organisms may gain access to the IV solution in the line or at the IV site itself. All attempts at proper usage of IV equipment and suitable cleansing technique should be provided to the patient.

IV catheters and tubing are also sources of infection: The nurse must make sure that sterile packages are intact prior to using and that connections are secure to prevent accidental separation once equipment is in used. All sterile supplies must be checked for an expiration date. IV tubing and all associated connections must be changed at a minimum every 72 hours.

To maintain acceptable practice: The IV site dressing should be changed within every 24 - 48 hours. Be sure to check your facility for the most updated protocol available. IV site maintenance includes monitoring the skin for any redness, tenderness, inflammation, skin breakdown, etc. The patient should also be instructed very clearly on when to notify you for any changes in the IV site including if there is pain and/or any drainage. If the IV dressing has been compromised by accidentally pulling on the IV or if when washing perhaps the patient got the area wet, the site must be re-established at another location. It is preferred to establish a new IV site in the other arm. However, if that is not possible, the provider should remember to go above where the original IV site location previously was, noting there is now a punctured vein at that site in that arm.

Our Immune System:

During an IV insertion, the IV catheter has punctured the skin which creates a break in the body's first line of defense. The patient's immune system may be challenged by infection due to an immune response. Of foremost importance to the immune system, are the White Blood Cells (WBC's). Laboratory exams are used to assist with determining infection. An elevation in WBC's is most likely indicative of infection.

Some infectious pathogens that would agitate the WBC's are also known as viruses, bacteria, fungi, and protozoa. Physicians, most often: Infectious Disease doctors, will monitor the patient's lab work and prescribe medications dependent on what type of WBC's are elevated and what the WBC's sensitivity (response) is to the particular antibiotic. Ultimately, this will determine the course of action in treating the patient. Contributing factors that may influence IV related infection include underlying illness (i.e., stress), or age: greater than (>) 60 years or less than (<) 1 year. Additionally, if the patient's status is likely to be immunosuppressed or if there is an immunodeficiency. The terminology*: Blood and Body Fluid Precautions* is a type of infection control practice that should be practiced and enforced every day to minimize any disease transmission.

Safety and Precautions:

The Occupational Safety and Health Administration (OSHA) is an agency of the United States Department of Labor, and was created by Congress under the Occupational Safety and Health Act. The primary mission of this act is to help prevent work-related injuries, illnesses, and occupational fatality by declaring and enforcing standards for workplace safety and health. In 1991 OSHA introduced a Bloodborne Pathogen (BBP) Standard to help eliminate and/or decrease occupational exposure to Hepatitis B (HBV), Human Immunodeficiency Virus (HIV), and other various bloodborne pathogens. The standard medical practice does consider all blood (and any body fluid) as potentially infective. One of the greatest threats blood poses to the health of medical personnel in a laboratory or clinical setting is due to unacceptable needle disposal technique.

Bloodborne Pathogens (Disease) Precautions:

Standard precautions are the "infection control practices" that are used to prevent the transmission of any diseases that can be acquired by contact with blood, body fluids, non-intact skin (including rashes), and mucous membranes. These measures should be practiced by all health care workers when providing care to all individuals, whether or not they appear infectious or symptomatic.

Hand Hygiene: Hand washing - as mentioned previously, is among the most effective and inexpensive ways to prevent complications and illnesses, including: diarrheal diseases and pneumonia, which together are responsible for a majority of child deaths. Hands may frequently act as vectors that carry disease-causing pathogens from person to person, either through direct contact or indirectly via surfaces. The use of soap in hand washing breaks down the grease and the dirt that can carry most germs. Using soap means additional time consumed for the massaging, rubbing, and friction to dislodge "the offenders" from fingertips, and between the fingers. Effective hand-washing with soap takes 8 – 15 seconds, followed by thorough rinsing with running water. Hand hygiene refers to either washing with plain or anti-bacterial soap and water and/or the use of alcohol gel to decontaminate the hands.

In review: Washing must be done before and after contact with the patient, after using the restroom, before eating, after coughing or sneezing, after touching objects and/or medical equipment in the patient-care area, directly after touching blood, body fluids, non-intact skin, mucous membranes, or contaminated items (even when gloves are worn during contact), immediately after removing gloves, and when moving from contaminated body sites to clean body sites during patient care.

Personal Protective Equipment (PPE): includes objects such as gloves, gowns, masks, respirators, and eyewear used as barriers to protect skin, clothing, mucous membranes, and the respiratory tract from possible infectious diseases.

What is used for the task depends on the activity required with the patient and the mode of disease transmission. Remember to always wear gloves when touching any blood, body fluids, non-intact skin, mucous membranes, or contaminated objects. Gloves must always be worn during IV insertion or during blood draws. Wear a mask, goggles and/or face shield if there is a possible chance that a splash of blood or body fluids might have contact to the eyes, mouth, or nose. Wear a protective gown if skin or clothing may be exposed to blood or body fluids. Remove PPE immediately after the task is done and wash hands appropriately. Take care to remove PPE in the correct order to avoid exposure of skin or clothing. If PPE or other items are stained with blood or body fluids: discard these items into a biohazard bag. PPE that is not visibly soaked may be placed directly in the garbage. The OSHA PPE Standards require employers to provide PPE for any and all employees with possible hazard exposure in the workplace. Mandatory training is to be provided for staff on correct practice, proper maintenance, and acceptable discarding of PPE.

Needle-stick and “sharps injury” prevention: The Needle-stick Safety and Prevention Act mandates that employers provide some type of engineered safety device for employees are using any sharps objects. The safe handling of needles and other sharp objects is a part of the “Standard Precautions” created to prevent health care workers from exposure to blood borne pathogens.

Important Facts: Safety devices on needles and other sharps should be used directly after use. Used needles should be discarded immediately after use, and not recapped. Any used needles, or other contaminated sharps should be discarded in a leak-proof, puncture-resistant sharps container that is red and has a biohazard label. Sharps containers should be disposed of after the container is 2/3 full or when contents are at the “full” line indicated on the containers.

Cleaning and Disinfecting: Patient care areas such as waiting rooms, and additional areas where patients may potentially contaminate surfaces or objects that may be exposed to staff or other patients, i.e.; doorknobs, sinks, toilets, other surfaces and items in close proximity to patients should be cleaned routinely with specified disinfectants, following the manufacturers’ instructions on amount, dilution, and contact time. Unless visibly soiled with blood or body fluids, floors and walls may be routinely cleaned with a detergent or a detergent/disinfectant product. Cleaning surfaces first must happen prior to disinfection since most disinfectants do not adequately clean dirt and organic matter. A wet a cloth should be used with the disinfectant, then wipe away the dirt or organic material. Follow with a clean cloth and apply the disinfectant to the area or item and allow air-drying for the time specified by the product manufacturer. Clostridium Difficile and Norovirus are not in-activated by commercial disinfectants used routinely in local public healthcare settings. When contamination with these pathogens is suspected, a bleach solution (1:10) is recommended for disinfecting contaminated surfaces and items. It is possible that items may be damaged or destroyed by certain disinfectants. Check with the manufacturer of the items before using disinfectants.

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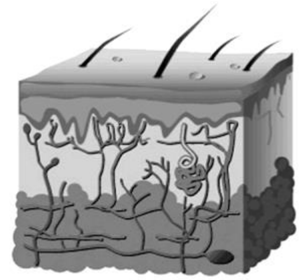
Highlights on Anatomy and Physiology



The skin is comprised of:

Epidermis: the outermost layer and is composed of five layers of squamous cells

Dermis: the thickest layer and is composed of elastin fibers, collagen fibers, blood vessels, sebaceous glands, sweat glands, and hair follicles.

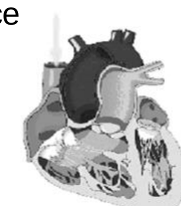
Subcutaneous tissue: meaning: for "beneath the skin" is the lowest-most layer of the integumentary system in vertebrates. Found here are more elastin and collagen fibers and adipose tissue. Nerve endings are also located here. However, most importantly, superficial veins to be accessed for IV insertion are located in the subcutaneous tissue.

Cardiovascular System: The Heart:

The heart is known to beat greater than 100,000 times a day, circulating approximately 6 Liters of blood through the body. The heart weighs less than a pound and is slightly larger than an average fist. The right side of the heart pumps oxygen-deprived blood to the lungs (pulmonary circulation) while the left side pumps oxygen-rich blood to the rest of the body (systemic circulation).

The functions of the Cardiovascular System include:

Transporting nutrients and oxygen to the body, transporting waste products from the cells to the kidneys for excretion, distributing hormones and antibodies throughout the body, and it helps control body temperature and maintain electrolyte balance



- Right Atrium transports blood to the Tricuspid Valve
- Right Ventricle transports blood to the Pulmonic Valve
- Pulmonary Arteries transport blood to the Pulmonic Veins
- Left Atrium transports blood to the Mitral Valve
- Left Ventricle transports blood to the Aortic Valve which transports blood to the Aorta

The vascular system vessels differ in relation to their function and their size:

Arteries: carry oxygen-rich blood from the heart. The aorta, the largest artery in the body, branches off to all other arteries of the body. As they continue to branch, they become smaller and smaller until they become arterioles.

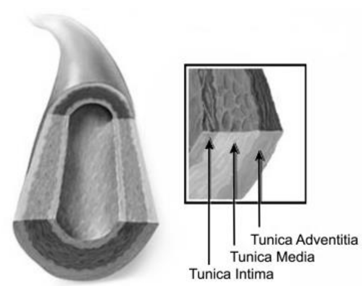
Arterioles: then branch off, become smaller and eventually lead to capillaries.

Capillaries: provide the cells with oxygen and nutrients and they transport cellular wastes away for elimination.

Venules: are the smallest of all the veins in the body, they begin the passage of blood back to the heart after the capillaries have performed their physiological role. Venules and veins carry deoxygenated blood. As the venules get larger, they lead into veins. Eventually, the deoxygenated blood is transported to the Superior Vena Cava.

The Superior Vena Cava: is the largest vein in the body. The superior vena cava is directly connected to the right side of the heart at the right Atria.

The Right Atria: After the blood reaches the right atria, it circulates through the right ventricle to the pulmonary artery and then to the lungs for re-oxygenation. After this oxygenation, the blood flows through the pulmonary veins to the left atrium, the right ventricle, and the aorta and the arterial system of the body.



The Peripheral Vasculature Layers:

Tunica Adventitia: Outer layer of connective tissue

Tunica Media: Middle layer of smooth muscle

Tunica Intima: Innermost layer of single smooth, flat endothelial cells

The arteries carry blood away from the heart first to the lungs, then to the entire body. They are more muscular than veins, dilate and constrict to maintain blood flow, moves blood faster and under more pressure than in veins, carry oxygenated-blood that is bright cherry red in appearance.

The veins carry blood to the heart. They carry three times more blood than arteries due to their ability to distend, they contain valves to prevent back-flow due to low pressure of the system, and they carry partially de-oxygenated blood so its appearance is dark red.

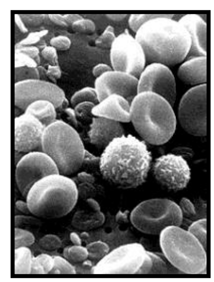
Blood is a specialized bodily fluid that delivers nutrients and oxygen to the body's cells. In addition, it transports waste products away from those same cells. Blood is made up of blood plasma, blood platelets and blood cells.

Blood plasma furnishes the blood its liquid form. Without plasma, blood cells would have no medium to travel on as they moved through the body. With this special design, it helps in the transportation of proteins, glucose, hormones and minerals required for the proper functioning of the body. It is plasma that collects the carbon dioxide released by the cells and transports it to the lungs to be breathed out. Plasma is around 90% water, with proteins, minerals, waste products, clotting factors, hormones, and immunoglobins making up the other 10%.

The functional basic unit of life is the cell. Remarkably, the cell is the smallest unit of life that is classified as a living thing, and is often called the building block of life. A blood cell is a cell of any type normally found in blood. They fall into three general categories: Red Blood Cells (Erythrocytes), White Blood Cells (Leukocytes), and Platelets known as (Thrombocytes).

Red blood cells or Erythrocytes are the most common type of blood cell and the principal means of delivering oxygen (O_2) to the body tissues via the blood flow through the circulatory system. They take up oxygen in the lungs and release the oxygen while squeezing through the body's capillaries.

There are 2.4 million new erythrocytes are produced every second. The red blood cells develop in the bone marrow and circulate from 100–120 days in the body before their components are recycled. Approximately a quarter of the cells in the human body are red blood cells. Red blood cells are red since they contain protein chemicals called hemoglobin which is bright red. Hemoglobin contains the element Iron, which makes it an excellent means of transportation for oxygen and carbon dioxide. Blood passes through the lungs, at which time oxygen molecules attach to the hemoglobin. As the blood passes through the body's tissue, the hemoglobin releases oxygen to the cells. The empty hemoglobin molecules then link with the tissue's carbon dioxide or other waste gases and transport it away.



Leukocytes or White Blood Cells (WBC): The name originates from "leuco" which in Greek means white. The immune system is involved in defending the body against both infectious disease and foreign materials. The WBC's are necessary in the body's defense against invading microorganisms.

There are five different types of leukocytes that exist; however, they are all produced and derived from a specific cell in the bone marrow known as a hematopoietic stem cell. Leukocytes are found throughout the body, including within the blood and the lymphatic system.

A patient with leukopenia is one who does not have enough circulating WBC's to adequately protect them from infection. This can be caused by certain diseases or medications. These types of patients required strict asepsis above and beyond normal precautions and usually are placed on reverse isolation to avoid exposure to germs.

Thrombocytes (AKA: Platelets):

Blood platelets help with blood clotting after an injury, their blood clotting action is an important process needed to prevent excess blood loss from the body. Considered cell fragments, they adhere to tears in the vessel wall. Platelets circulate in the bloodstream and are involved in hemostasis where they release substances that attract fibrin to the tear which inevitably leads to the formation of a blood clot. Once blood flow is stopped by the clotting activity, the natural healing of an injury can begin. Platelets contain no DNA, but do contain clotting enzymes, and energy-producing mitochondria. Mitochondria are often described as "cellular power plants" because they generate most of the cell's supply of adenosine triphosphate (ATP), used as a source of chemical energy.

A deficiency in platelets is referred to as thrombocytopenia and can be very serious. There are various medications and some diseases that may contribute to spontaneous bleeding complications. These patients should be monitored closely for any bleeding and must have injections of any type limited.

Fluids and Electrolytes:

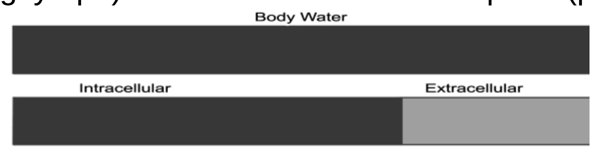
Electrolytes are minerals in the body that have an electric charge. They are in the blood, urine and body fluids. Maintaining the right balance of electrolytes helps the body's blood chemistry, muscle action and other processes. Sodium, Calcium, Potassium, Chlorine, Phosphate and Magnesium are all electrolytes. They are provided in the foods and drinks consumed for daily nutrition. Levels of electrolytes in the body can become too low or too high. This can happen when the amount of water in the body shifts. Electrolytes, especially Sodium, help the body maintain normal fluid levels in these compartments.

How much fluid a compartment contains depends on the concentration of the electrolytes in it. If the electrolyte concentration is high, fluid will move into that compartment. Similarly, if the electrolyte concentration is low, fluid moves out of that compartment. To regulate fluid levels, the body can actively move electrolytes in or out of cells. Having electrolytes in the right concentrations is called electrolyte balance and is important in maintaining fluid balance among the compartments. Problems most often occur with level changes in Sodium, Potassium or Calcium. Some causes may include but are not limited to: medications, vomiting, diarrhea, sweating or various kidney problems. The kidneys help maintain electrolyte concentrations by filtering electrolytes from blood, returning some electrolytes, and excreting any excess into the urine. Thus, the kidneys help maintain a balance between daily consumption and excretion.

Fluid compartments in the body:

Intracellular fluid (ICF): comprises two-thirds of total body fluid and is found inside the cells, including the cells floating in the vasculature (RBCs, WBCs, platelets).

Extracellular fluid (ECF): makes up for the other third of total body fluid and is found in the interstitial spaces (including lymph) and in the intravascular space (plasma).



Mechanisms of Action:

The kidneys filter the electrolytes in the blood and maintain a balance by excreting the proper amount in the urine. An electrolyte's concentration in a solution of dissolved salts can be measured as the amount in milliequivalent (mEq) per volume of solution (i.e. per liter). Electrolytes have many distinct functions and roles in the body. The concentration of electrolytes must be maintained within a narrow range within the blood, otherwise harmful physiological effects may occur.

Osmosis: is the movement of fluid through a semi-permeable membrane. Fluids always move from an area of low solute concentration to an area of high concentration until both sides are equal.

Diffusion: is the movement of solutes from an area of greater solute concentration to an area of lower solute concentration. This is known as moving down the concentration gradient and is a passive process.

Role in human health:

Sodium balance*:* The largest portion of the body's sodium reserves is in the extracellular fluid, which includes the blood plasma. The kidney spurpose is to control the sodium excreted in the urine; this level of sodium in the body is relatively constant on a daily basis. Yet if there is an upset between intake of sodium (through dietary consumption) and output (in urine and sweat), this creates an imbalance affecting the total amount of sodium in the body. Variations in the total amount of sodium are related to the volume of water found in the blood. A reduction in the overall amount of sodium in the body may not necessarily cause the concentration of blood sodium to fall, but it may decrease blood volume. Low blood volume which occurs with a hemorrhage, signals the kidneys to conserve both water and sodium through stimulation of Aldosterone. This helps to return blood volume to normal, by increasing the amount of extracellular fluid sodium. Blood volume might rise with an excess of sodium in the body. This increase in blood volume initiates a build up of extracellular fluid, often in the feet, ankles, and lower legs, resulting in a condition known as pedal edema.

The body maintains extracellular fluid sodium concentration homeostasis through the thirst mechanism and management of kidney water excretion by the antidiuretic hormone (ADH). When sodium concentration -as opposed to too much total sodium- is too high, thirst prompts water intake. At the same time, the ADH signals the kidneys to conserve water, by increasing water absorption by the organs and passing less water into the excretory system.

Common disorders:

The electrolytes involved in disorders of salt balance are most often Sodium, Potassium, Calcium, Phosphate, and Magnesium. The concentration of blood chloride is usually similar to the blood sodium concentration, while Bicarbonate is related to the acid-base balance.

Hyponatremia: The most common electrolyte disorder. It occurs in approximately 1% of all patients' hospital admissions. Hyponatremia is a condition characterized by a low sodium level in the blood; below 136 mEq per liter of blood. In Hyponatremia, the sodium concentration has been over-diluted by an excess of water or a loss of sodium in the body. It may result from intravenous administration of water to a patient. It can also occur with decreased amounts of water consumed by those who have impaired kidney function, liver cirrhosis, heart failure, underactive adrenal glands (Addison's disease), and a multitude of antidiuretic hormone disorders. Over 50% of hospitalized patients with AIDS have been reported to suffer from Hyponatremia. Lethargy and confusion are typically the first signs, muscle twitching and seizures may occur. As Hyponatremia progresses, there is risk of stupor, coma, and possibly death in the most severe cases. Due to the effects on the central nervous system, mortality risk is considerably greater in acute Hyponatremia than in chronic Hyponatremia. Other factors that may diminish survival include the presence of debilitating illnesses such as alcoholism, hepatic cirrhosis, heart failure, or cancer.

Hypernatremia: is a condition characterized by a high concentration of sodium in the blood, above 145 mEq per liter of blood. There is too little water compared to the amount of sodium in the blood, often the result of insufficient water intake. Other causes are profuse sweating, vomiting, fever, diarrhea, or abnormal kidney function. As the body ages, the thirst sensation decreases; consequently, hypernatremia is more prevalent in the elderly. Aging also reduces the kidney's ability to concentrate urine. Taking diuretics may further exacerbate hypernatremia. Major causes of high sodium levels include the use of drugs such as lithium, diuretics, demeclocycline (a tetracycline antibiotic), Diabetes Insipidus(a disorder in which there is an abnormal increase in urine output, fluid intake and often thirst), and Sickle cell disease. This can result in life-threatening conditions, particularly in the elderly.

Similar to hyponatremia, brain dysfunction may be apparent in hypernatremia. Severe hypernatremia may result in confusion, muscle twitching, seizures, coma, and death. In comparison to acute Hypernatremia, The gravity of under-lying illness and the outcome on the central nervous system most often ends in a higher incidence of death in chronic hypernatremia.

Calcium balance: The body's calcium reserves are mostly located in the bones. However, Calcium can also be found in the blood and cells. Calcium is essential for proper functioning in nerve conduction, muscle contraction, and enzyme activity. Similar to electrolytes, the body maintains calcium levels both in the blood and cells. From the diet, calcium is absorbed in the gastrointestinal (GI) tract while the surplus is removed through urination. To maintain a normal calcium concentration in the body, at least 500-1000 mg of calcium is required daily. When functioning efficiently, the body transfers calcium from the bones to the blood to achieve sufficient levels. Osteoporosis may occur if the intake of calcium levels is insufficient; the bones weaken as a result.

The parathyroid hormones and calcitonin hormones aid in regulating the amount of calcium in the blood. If the calcium concentration significantly dips, the parathyroid glands will boost secretion of the parathyroid hormones. Simultaneously, the GI tract is triggered to absorb more calcium from the blood, release a greater amount of calcium from the bones, and to release less calcium in the urine. Additionally, the parathyroid hormones stimulate the kidneys to release vitamin D which then enhances absorption of calcium from the GI tract. It is the hormone calcitonin which helps to lower the calcium concentration in blood by improving the concentration of calcium in the bones.

Common disorders:

Hypocalcemia: is a low calcium blood level. Hypocalcemia can result from many problems. The most prevalent causes include the body’s inability to move calcium from the bones. Also of consideration is the possibility of a chronic depletion of calcium in the urine. Some other causes of hypocalcemia include the following: acute pancreatitis, magnesium depletion, septic shock, parathyroidism, vitamin D deficiency, renal failure, hypoproteinemia, hyperphosphatemia, and excessive release of calcitonin.

Drugs used to treat hypercalcemia would be anti-convulsants. Low blood calcium concentrations may not result in any symptoms. However, memory loss, depression, confusion, delirium, and/or hallucinations may result if low calcium levels are left untreated. Fortunately, if calcium levels are replenished, these symptoms can be reversed in due time. The healthcare provider should be aware that severe cases of hypocalcemia could possibly result in: seizures, tetany (prolonged contraction of muscles, mainly of the face and extremities), or muscle spasms in the throat, often affecting the ability to breath.

Hypercalcemia: A high calcium blood level due to increased GI tract absorption or increased intake of calcium. This may result from someone using excessive amounts of calcium or with those who take calcium containing antacids. Another possibility is if an overdose of Vitamin D occurs. If hypercalcemia does occur, typical symptoms include: constipation, loss of appetite, nausea and vomiting, and/or abdominal pain. Severe hypercalcemia may induce weakness, confusion ,emotional disorders, delirium, hallucinations, or coma. Severe Hypercalcemia may cause abnormal heart rhythms and/or death may occur. With chronic conditions of hypercalcemia, permanent damage may occur from kidney stones or calcium-containing crystals forming.

Potassium: This electrolyte plays a major role in cell metabolism and in nerve and muscle cell performance. Most of the body's potassium (K) is found intra-cellularly, not extra-cellularly, or in the blood. Too high or low levels of blood potassium can cause serious effects such as an abnormal heart rhythm or cardiac arrest. With the assistance of intracellular potassium, the potassium concentration in the blood is properly maintained. Similar to other electrolytes, potassium balance is regulated by GI tract absorption of potassium from food, and by the removal of potassium by the kidneys. Some potassium is lost in the GI tract, but the majority of potassium is lost through urination. There are a number of conditions and some drugs that affect the body’s potassium balance intracellularly, which in turn also affects blood concentrations.

High sources of dietary potassium are: melons, sweet potatoes, most peas and beans, bananas, tomatoes, and green leafy vegetables such as: spinach, turnip greens, collard greens, kale, also salt substitutes (potassium chloride), potatoes, oranges, and K Supplements.

Common disorders:

Hypokalemia: is a low potassium blood level. This happens when the blood potassium concentration falls below 3.8 mEq per liter of blood. Hypokalemia is most frequent in the elderly and the most common causes are during acute illness, with nausea and vomiting, and during treatment with thiazide or loop diuretics. Approximately 20% of patients taking Thiazide diuretics develop hypokalemia. Because many foods contain potassium, hypokalemia is not typically a result of low intake. It is usually caused by kidney malfunction, or abnormal potassium depletion through the GI tract. Those individuals with heart disease must be careful regarding hypokalemia (especially when taking Digoxin), because they are prone to developing abnormal heart rhythms. Potassium typically can be restored easily by eating foods rich in potassium or by taking potassium salts (potassium chloride).

Hyperkalemia: is a high level of potassium in the blood which can happen when the blood Potassium concentration rises above 5.0 mEq per liter of blood. Hyperkalemia often results when the kidneys don't remove enough potassium from the body. Some common causes are: drugs which block potassium excretion (angiotensin converting enzyme [ACE] inhibitors; Triamterene, and Spironolactone), Addison's disease, or due to kidney failure.

Organs that assist with Fluid Regulation:

The Kidneys: reabsorb and excrete fluids, and regulate electrolyte and pH balance. In addition, the kidneys secrete hormones that regulate fluids and electrolytes. As a rule, the kidneys excrete about 1400 ml per day. Strict intake and output should always be considered when treating patients with running IV fluids.

The Heart: Functioning properly- is vital to fluid balance since it directly affects kidney perfusion. Additionally, an impaired pump cannot adequately move blood all through the body. As a result, there may be a backup with third spacing as evidenced by signs of peripheral edema and pulmonary congestion.

The Lungs: fuel the body with oxygen, they are used to breathe in air, then extract the oxygen and pass it into the bloodstream. The oxygen is passed to the tissues and organs that require it to function. Oxygen drives the process of "respiration", which helps provide the body's cells with energy. The "waste gas" - known as carbon dioxide is produced as a byproduct and is disposed of during exhalation of the lungs. Without this crucial exchange, the body's cells would rapidly die leaving the body to end in suffocation.

The Glands and Hormones:
Are a complex system involving many organ systems and the hypothalamus, hormones are released in response to the body's need for fluids. A hormone is a chemical released by a cell or a gland in one part of the body that sends out messages that influence cells in other parts of the body. Only a small amount of hormone is required to change cell metabolism. In effect, a hormone is a chemical courier that transports a signal from one cell to another. Examples are: ADH (antidiuretic hormone) notifies the kidney to hold onto water; Aldosterone informs the kidneys to hold onto Sodium and to excrete Potassium.

The Skin:
Skin plays a role with "insensible fluid loss"- which is about 500 mL per day. What is insensible water loss? The typical healthcare practice is to measure water input as (oral plus IV fluids) and water loss as (urine plus other measured losses),resulting in an estimated fluid intake and output.

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Insensible fluid loss refers to water loss due to the following events:

Transepidermal diffusion: is the process which allows water to pass through skin, and is diminished simply by evaporation as well as evaporative water loss from the respiratory tract. Checking skin turgor is commonly used by healthcare providers to check for fluid loss or dehydration. Infants and young children with vomiting, diarrhea, and decreased or no fluid intake can rapidly lose a significant amount of fluid. Fever speeds up this process. To determine skin turgor, the health care provider grasps the skin on the back of the hand, lower arm, or abdomen between two fingers so that it is tented up. The skin is held for a few seconds then released. Skin with normal turgor snaps rapidly back to its normal position. Skin with decreased turgor remains elevated and returns slowly to its normal position. Edema (a buildup of fluid in the tissues that causes swelling) causes the skin to be extremely difficult to pinch up. Observable signs include: decreased fluid intake, extreme weight loss, vomiting, diarrhea, dehydration, Diabetes.

Heat stroke: is excessive sweating without enough fluid intakes.

The GI Tract: plays a role in water reabsorption and about 100 ml of fluid is secreted in the feces per day. Treatment is aimed at finding the underlying cause of the imbalance to prevent further fluid and electrolyte loss. For instance, anti-emetics or antidiarrheal drugs may need to be given for vomiting and diarrhea. Supporting the patient includes administering I.V. or oral fluid replacement, depending on tolerance and cause of fluid loss. Early recognition/treatment is vital to prevent life-threatening hypovolemic shock. Keep in mind; elderly patients are more likely to develop fluid imbalances.

Fluid Balance: is the concept of the body's homeostasis in that the amount of fluid lost is equal to the amount of intake fluids. A constant supply is needed to replenish the fluids lost through normal physiological activities, such as respiration, sweating and urination. The best measurement of a patient's fluid status is daily weights. This should be done ideally on the same scale at the same time of each day. Clear and precise documentation is very important. Remarkably, changes or an unexplained weight change of 1kg which is 2.2 pounds is equal to 1 liter of fluid.

Third Spacing: is a situation where the total body water ma be unchanged, but signs and symptoms of Hypovolemia are present. Certain disease states such as sepsis, pancreatitis, and liver disease can cause fluid shifts into body cavities. Patients undergoing lengthy surgical procedures can also experience this and usually exhibit reabsorption of the third space fluid within 48 hours after surgery as evidenced by increased urine output.

Fluid volume deficit: hypovolemia is a situation where the patient has an excessive amount of fluid loss in the extracellular compartment. This can be a very serious complication for the patient. Staff should be aware of signs and symptoms - and of course, treatment. Nurses need to educate their assistants on how to report abnormal results immediately. If the patient is not treated within an appropriate time frame, the patient's status can decline quickly. Immediate action may include a transfer to ICU or if outside the hospital setting; transport to the ER. Causes include: bleeding, vomiting, diarrhea, decreased intake of fluids, hypermetabolic states such as fever, skin losses - especially with impaired skin integrity due to wounds, burns, or surgical incisions, respiratory losses -especially if a patient is tachypneic, and the use of diuretics.

What to look for: weight loss (except in third spacing), notable postural hypotension, increased hear rate, weakness, dizziness, confusion, poor skin turgor, and/ or dry mucus membranes. Check labs for increased BUN, increased serum osmolality, and increased sodium.

Fluid volume excess: hypervolemia (or fluid overload) is the term used for an unequal increase of fluids in the extracellular compartment. Causes that may be contributing factors are: renal disease, hormonal imbalance (SIADH, Aldosteronism) and Congestive heart failure (CHF). What to look for: jugular venous distension (JVD), crackles noted upon auscultation (suggesting pulmonary congestion), edema, shortness of breath, and weight gain. Check labs for decreased serum osmolality and decreased sodium levels.

Electrolyte balance: is when electrical chemical compounds that dissociate in water respond to positive ions (cations) or negative ions (anions). Alterations of electrolyte levels in fluid compartments can have a profound outcome on the body. Electrolyte balance refers to the combined levels of the different electrolytes found in the blood. The electrolyte is a substance with free ions that conducts electrical signals. The appropriate balance of these substances in the body is critical to regulating everything from oxygen delivery to fluid balance within the cells.

Electrolyte imbalance: can be caused by reduced elimination of water or excessive intake of electrolytes. This is most often tied to dehydration or excessive hydration. The effects are noticed when the level of Sodium, Potassium, or Calcium in the body is too high or too low. In a healthy person, it is not difficult to maintain the proper electrolyte balance, through regular hydration and elimination. The elderly, children and people with complex medical illnesses are at greatest risk for poor electrolyte balance as a long-term health concern.

Major electrolytes responsible for maintaining a homeostasis within the body:

ELECTROLYTE:	FUNCTIONS:	IMBALANCE:
Sodium (Na+) ECF: 135-145 mEq/L ICF: 10 mEq/L	Controls water distribution	Hyponatremia: Personality changes, irritability, muscle weakness, seizure, anorexia, nausea, vomiting Hypernatremia: Restlessness, weakness, fatigue and seizure. Dry mucus membranes, thirst and fever
Potassium (K+) ECF: 3.5-5.0 mEq/L ICF: 141 mEq/L	Neuromuscular function	Hypokalemia: Muscle weakness, cramps, nausea, vomiting, paresthesias, and cardiac dysrhythmias Hyperkalemia: Paresthesias, abdominal cramps, nausea, diarrhea, and cardiac dysrhythmias
Calcium (Ca++) ECF: 4.5-5.3 mEq/L ICF: 1 mEq/L	Formation of teeth and bones Neuromuscular function	*Hypocalcemia: Numbness, tingling, cramps, tetany, convulsions, and cardiac dysrhythmias Hypercalcemia: Fatigue, muscle weakness, anorexia, nausea, vomiting, constipation, cardiac dysrhythmias, and hypotension
Magnesium (Mg++) ECF: 1.3-2.1 mEq/L ICF: 60 mEq/L	Active in protein and carbohydrate metabolism Neuromuscular function	*Hypomagnesemia: Muscle weakness, paresthesias, tetany, convulsions, agitation and cardiac dysrhythmias Hypermagnesemia: Muscle weakness, respiratory depression, hypotension, and decreased pulse rate
Chloride (Cl-) ECF: 97-110 mEq/L ICF: 4 mEq/L	Helps maintain serum osmolality, acid-base balance, & the balance of cations (i.e. NaCl or KCl)	Hypochloremia: Related to other electrolyte imbalances. Hyperchloremia: Related to other electrolyte imbalances
Phosphorus (P-) ECF: 1.8-2.6 mEq/L ICF: 75 mEq/L	Active in protein, fat, & carbohydrate metabolism Acid-base balance Neuromuscular function	Hypophosphatemia: Weakness, paresthesias, confusion, and seizure. *Hyperphosphatemia: Anorexia, N/V, muscle spasm, and tachycardia

Basic IV Therapy

Healthcare providers should consider the patient's psychological wellbeing of significant importance for. While IV therapy may be viewed as a very routine procedure to the medical staff; the patient may not view it as a "simple task" at all. Lab work may also be ordered and done frequently, so in addition to having blood draws, the patient now has to endure a "needle stick" that requires being taped down and kept in place. Often they may say something like: "I feel like a pin cushion" or "I have no more blood to give". -- Their apparent feeling of "being the victim" spilling out with every word they say. Statistics show, that in the hospital setting alone, over 90% of all patients receive some form of IV therapy. For many, getting an IV may be a very frightening procedure - referred to as "Needle Phobia". It is the extreme fear of medical procedures involving injections and/or needles.

One should also be on the alert for the occasional person who may faint at the sight of blood. This type of syncopal episode results from non-cardiovascular causes particularly due to problems with the autonomic nervous system - which is responsible for many of our bodily functions, including regulating blood pressure, heart rate, and our responses to anxiety, fear and emotional stress.

A vasovagal syncope, typically precipitated by an unpleasant physical or emotional stimuli (ex: pain, fright, sight of blood), usually occurs when a person is standing upright. The feeling of fear or anxiety at the sight of blood is the root cause. As the heart beats faster and stronger (a response of the autonomic nervous system to a person seeing blood) - it sends a wrong message that tells receptors in the heart's chambers that the ventricle is filled with blood. The receptors send a message telling the nervous system that the blood pressure is too high. Yet, the ventricle is not full and the blood pressure is too low. When the brain receives the faulty message, it slows the heart rate and further dilates the blood vessels. The blood pressure drops even lower, less blood is pumped to the brain and fainting results. Therefore, it is highly recommended to advise family and friends to step outside the viewing of IV procedures. In the end, at least you can say you warned them!

Besides feeling ill, the patient may be upset about the unfamiliar environment, and all the unknown people attending them. Keep in mind that every patient is different, but it is pretty safe to say that most do not like getting stuck with a needle. The patient should be advised that the IV therapy procedure is necessary and has been ordered by a doctor. Secure the patient's consent by explaining the task and offering to answer any questions the patient might have prior to preparation. Gaining trust, providing information the patient can easily understand, and acting kindly go a long way. It is always best to approach the patient with the upmost professionalism.

The Role of Patient Educator:

“It is the nurse’s responsibility prior to initiating a particular treatment modality to explain the procedure in sufficient detail for the patient and/or the caregiver to understand”.(Infusion Nursing Practice Standard 22*)*
It is essential to clarify that the initial “IV stick” may be uncomfortable but that it should not hurt once the catheter is in place. The patient should be educated on when to contact you about the IV site such as if the IV site begins to hurt, leak, or swell.

In addition, if an IV pump is going to be used, it needs to be briefly explained. The patient should be made aware to notify the staff if the IV pump is beeping. Consider advising that if the pump alarm sounds, this means the pump has stopped running and the medication is now complete. A simple explanation may be all that is needed to decrease the patient’s anxiety, they should have some sense of justification of what is happening to them and clarity on what they should actively do in the event their status changes (ex: the pump starts beeping because the medication is now complete). As caregivers, we know to expect that the pump will signal, but does the patient? The alarm can be frightening if the patient is not familiar with it. It may be helpful to demonstrate the pump alarm and explain that this is what they will hear when the medication is complete or there are adjustments to be made. Moreover, the patient should be instructed not to touch any of the IV pump settings. Most pumps have a lock-out system that should be used. Be sure to include the family or significant others at bedside when reviewing the plan of care and IV pump education.

Informed consent:
In most situations, consent for IV therapy is covered under the general consent signed upon admission to the facility. However, the patient has a right to refuse any treatment. If the patient is refusing IV therapy, it is our responsibility to sit down and discuss their concerns with them. Examine why they are refusing and offer appropriate patient education about the IV therapy that may ultimately alleviate their concerns. Never force any procedure on a patient. If the consent cannot be secured, notify the physician. Failure to respect the rights of the patient can result in charges of assault and battery.

Remember: health care providers are legally and ethically held accountable for accurate medication administration, observation, documentation, and record keeping. Medications must be documented immediately after administration. All medications, controlled substances, and non-controlled medications must be securely maintained at all times, particularly when there are children and/or cognitively impaired elderly adults present. It is not acceptable practice to leave medications at the bedside unattended. Failure to observe this practice could result in being written up or even lose your job.
Additional responsibilities include follow-up clarification which may be necessary if a doctor’s orders are questionable or unreadable. A thorough knowledge is expected

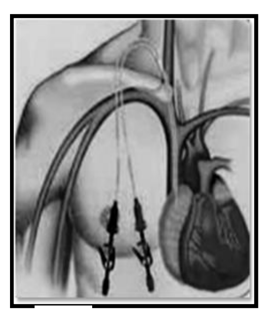
about all medications given to the patient. As well as the expectation that appropriate observation and care will be given to the patient prior to, during and after IV medication administration. For instance, the caregiver is should anticipate taking and assessing the apical rate and checking the heart rhythm of the patient prior to giving IV Digoxin. Another example would be the evaluation of the patient's response to a medication, such as the relief of pain after having been given an analgesic. Remember to follow up with accurate documentation to validate you did what is expected of you.

When giving fluids and medications intravenously, it is important to be aware that the drug is immediately delivered into the bloodstream. Most often, the IV route offers almost an immediate result, which is much quicker than when given by any other route. Consequently, health care professionals must closely monitor patients who receive an intravenous medication for signs that the drug is working or causing undesired side effects. Interestingly, the “effect” of most medications given IV often has less duration. Therefore, some medications must be given by continuous infusion to keep their effect constant.

Before reviewing basic IV therapy, it is extremely important to be aware of what should not be accessed by the untrained nurse. A patient may have a catheter that “looks” like an IV access, but this “access” should not be used. Be sure to know your limitations as well as your expectations.For instance, arterial Lines are a form of hemodynamic monitoring and therefore have little similarity to intravenous lines. Typically found in the critical care area, they are used to directly measure blood pressure. They also provide a means of obtaining blood specimens for arterial blood gases and other laboratory tests.

Care: An arterial line is inserted by the physician, it is the provider’s responsibility to maintain the pressurized system and monitor the site. No fluids or medications are instilled in arterial lines with the exception of heparinized flush solution to maintain patency. Site assessment and dressing changes are the same as for IV lines, however, because the line is in an artery (usually the radial), special care must be taken to avoid accidental dislodgement and hemorrhage. The nurse transitioning to the critical care environment obtains special training on the use and care of arterial lines.

End-stage renal failure is treated with hemodialysis. This is a picture of a temporary dialysis catheter which is used while a surgically inserted dialysis catheter “matures”. The dialysis caps are red and blue; these ports are strictly for dialysis use. Once attached to the dialysis machine, the arterial catheter withdraws blood from the patient and carries it to the dialysis machine, while the venous lumen returns blood to the patient from the dialysis machine.



An indwelling dialysis catheter is typically surgically inserted in the patient's upper extremity. Preserve this access site extremity by avoiding injections, intravenous (IV) needles, blood draws, blood pressure checks and any undue stress to the extremity. In addition, check the temperature and color of the fingers, the distal pulse and for any signs or symptoms(S/S) of infection or irritation. The typical indwelling dialysis catheter is provided as an AV shunt or fistula. It is surgically implanted for dialysis treatments. There are no ports to access; however, the dialysis nurse accesses the site with a catheter. *Remember: Only a trained dialysis nurse should access a dialysis site as well as provide treatment and dressing changes.

There are various types of IV access to consider, including: Central Lines, Implanted Ports, PICC lines, as well as a peripheral IV access.

Central IV lines: flow through a long catheter with its tip ending in the superior vena cava or inferior vena cava (or simply; within the right atrium of the heart). Central lines are most often inserted by a surgeon or sometimes a radiologist. Locations for insertion include: Subclavian (chest), Internal Jugular (neck), and Femoral (groin).

A distinct advantage for this type of IV line is their access to large, deep veins that will not collapse. Other advantages for use of a central line over a peripheral IV include the fact that central lines frequently remain in place much longer than the peripheral IV sites. Often patients can be discharged to home with home health care to maintain the IV site and dressing.

Another benefit that the central line offers is that IV medications reach the heart immediately and are quickly sent to the rest of the body. This obviously can be a great advantage, particularly if the patient is in a critical state and needs emergent care with IV fluid or medication intervention. An added bonus to having a central line is a mechanical feature designed in the catheter tubing itself. There are multiple parallel compartments (lumens) within the catheter so that various medications can be delivered all at the same time and even if otherwise not chemically compatible. This includes medications that are prone to irritating peripheral veins because they are vesicant medications such as: Calcium Chloride, Chemotherapy, Potassium Chloride, Amiodarone, and Vasopressors (examples: Epinephrine and Dopamine).

Indications for the use of a Central Line include: long-term IV antibiotics, long-term parenteral nutrition especially in chronically ill patients, and long-term pain medication. Blood specimens can also be taken from these lines, but are subject to specific waste and flushing protocol. A specific disadvantage to the Central line is its location which has a high infection rate. The caregiver must take extra precautions to keep these sites clean, dry and intact.

An Implanted Port: is as mall medical appliance surgically inserted and placed below the patient's clavicle with the catheter threaded into the right atrium. It is stationed entirely under the skin and appears as a bump under the skin. The port is accessed via a non-coring "Huber" needle which is inserted through the skin. The medicines are injected through this special needle into a small reservoir. After being filled, the reservoir slowly releases the medicine into the bloodstream. This type of "port" has less of an impact on a person's activities than any other IV line and requires very little daily care. As a matter of fact, the implanted port requires no special external maintenance. Because it is completely internal, swimming and bathing are not a problem. Ports can be used for medications, chemotherapy, TPN, and blood.

The health care provider should be aware of the following complications: infection can compromise the device, this requires surgical removal, and jeopardizes the health of the patient. There is the possibility of thrombosis, so flushes are necessary to prevent formation of a blood clot that may block the catheter device. Although extremely unlikely, mechanical failure is possible in rare instances when part of the attached catheter could break and become lodged in the circulatory system. This may be evidenced by the inability to flush or withdraw fluids from the port. In such cases, surgery is required to withdraw the failed vascular access device. The age of the device should also be considered. If it has been placed into a young patient, future growth means that the catheter will become shorter and will pull away from the superior vena cava, also requiring surgical intervention. A pneumothorax is another concern that can happen during insertion. The patient's lungc an be injured (punctured) during the physicians attempt to gain access to the subclavian or jugular vein. If the pneumothorax is significantly large, a chest tube may need to be put in place. And finally, an arterial injury could occur upon insertion as well, this happens when the subclavian artery is accidently punctured, resulting in a hematoma resulting in possible surgery.

A Peripherally Inserted Central Catheter (PICC): is inserted in a peripheral vein such as the Cephalic Basilic or Brachial Vein. It is then advanced until the tip rests in the distal superior vena cava area, resulting in an arterial vascular access. A PICC was first described in 1975, as "an alternative" to an arterial IV line, i.e.; Subclavian IV lines, Internal Jugular IV lines or Femoral IV lines whose placements have a greater risk of a pneumothorax (air in the pleural space of the lung). A PICC line is a peripherally inserted intravenous access which is greater than 25 inches in length. It can be used for a prolonged period of time, even as long as months if cared for appropriately. A patient is likely to get the PICC inserted while in the hospital setting and then discharged home for chemotherapy regimens, extended antibiotic therapy, or during indefinite total parental nutrition. It should be anticipated that the patient will receive home health care to provide proper management of the IV site and dressing.

There are single and multi-lumen catheters. With the multi-lumen catheters, multiple medications can be given all at the same time without concern for incompatibility.

Disadvantage: PICCs tend to clot off because they are so long and there are multiple places a clot can form. The need for specific flushing care needs to be addressed:

Flushing the PICC line depends on the facility protocol and type of PICC line used. The latest testing indicates a saline flush is as effective as using Heparin to keep the line patent. Saline flushes are necessary before and after medications, and if flushes are not provided appropriately, medications in the line may precipitate and create a blockage. Remember: If you inject medication into the line without clearing the heparin flush, the medication may precipitate, causing harm to the patient. Remember: Heparin is not compatible with other medications.

Major aspects of flushing the PICC Line are:

S : Saline flush prior to using the line to administer any medications

A : Administer the medication

S : Saline flush to clear meds from the line before Heparin flush

H : Heparinize the catheter when not in use

Note: Flushing methods and frequency may vary according to facility. The most definitive guideline for flush volume is at least twice the internal volume capacity of the catheter, which is normally 1- 2mL per lumen- which is conveniently documented on the catheter itself (ex: 2 Fr or 4 Fr). Most manufacturers recommend using nothing smaller than a 10 mL syringe to be used for flushing the catheter and tubing. Observe the facility’s protocol.

Observe company’s literature warnings: if there is improper PICC usage or if the PICC Line is used for something other than what the manufacturer recommends, the manufacturer will not stand behind their product. They will call it "operator error."

Caution: to avoid injury to PICC: avoid blood pressure checks on PICC Line extremity.
“Locking” the PICC refers to using a saline or heparin flush to keep the line patent while not in use. There are various companies who make different types of PICC lines, so you will need to establish what type of PICC you have in order to know the flushing technique necessary. Some facilities use end-caps with positive pressure valves that are supposed to negate the need for heplock therapy. The information provided includes recommended flushing volumes; however, the caregiver should always follow the facility’s policies and procedures.

Using a positive pressure flushing technique entails flushing the saline syringe while withdrawing the syringe from the line and then using the tubing clamp to prevent venous drainage. This technique is meant to prevent blood from entering the distal end of the catheter between uses. It creates turbulence in the line to prevent the formation of clots on the catheter wall. The syringe size most commonly used is a 10ml syringe.

Dressings: The Center for Disease Control and Prevention (CDC) recommends the use of a transparent dressing which allows for easy evaluation of the catheter-skin junction. Also, gauze dressings are accepted in some facilities, but require more frequent changes due to decreased visibility of the insertion site. In many places, a chlorhexidine-impregnated sponge is now being used. It is placed under the PICC tubing (directly on the skin surface) and also under the occlusive dressing at the catheter-skin junction as an anti-microbial barrier. The use of such a patch allows for longer intervals between dressing changes. Check with your facility.

PICC sites should be inspected on every shift and more frequently if IVF's are running. Change the PICC dressing and end caps every 7 days and as needed (if wet, soiled, etc.). Notify a trained PICC nurse to provide the necessary care, unless you have already received training. Scissors should never be used near PICC lines for concerns with possible catheter cuts. If this were to occur, emergency care must be provided. The patient needs to be instructed on how and when to notify caregivers for further assistance.

Blood Sampling from PICC Lines: Blood draw from a PICC line is dependent upon the catheter size. It is most appropriate to draw from 18Ga/4Fr lumen or greater. Blood should be collected via syringe following a flush-discard method per the organization's policy. The discarded amount of blood should be of adequate amount to avoid laboratory error without compromising the patient's safety. After collection, the line should be flushed to prevent occlusion which usually includes a saline flush of 10-20ml followed by a Heparin flush.

PICC Line Possible Complications:

The caregiver should be aware of the variety of potential PICC Line problems in order to maintain safety for the patient. Possible concerns to watch for include: bleeding, catheter migration or dislodgement, cardiac arrhythmias, infection (local infection & catheter-related sepsis),Phlebitis/ Thrombophlebitis, occluded catheters, or possibly a leaking catheter.

Bleeding(Immediate Management):First, apply direct pressure to the site. Contact the physician and your immediate supervisor, and administer prescribed fluids to maintain catheter patency. Anticipate that the physician may order a lab work. Recheck the insertion site frequently. Reinforce the PICC dressing once homeostasis is achieved. Remember to document in patient's progress notes care given.

Catheter Migration / Dislodgement (Immediate Management): This may occur due to improper fastening of catheter at incision site or from pressure because of activities such as persistent cough, mechanical ventilation, or if the patient has been lifting heavy objects. First, reassure the patient that you will assist with the care as necessary. Contact the physician and supervisor, and if appropriate, cease all infusions. (Consider the need for short term alternate IV access to maintain IV therapy). Be sure to measure and document "line markings" visible at the insertion site and document observations and condition of the patient. Anticipate a x-ray to confirm the catheter tip position.

Cardiac Arrhythmias:(Immediate Management):this may occur if the tip of the PICC line catheter or guide wire is advanced into the atrium or Ventricle of the heart. Clinical manifestations may include: Sudden onset of an irregular heartbeat. Or the patient may complain of having chest pain or fluttering sensation in their chest. Immediately obtain and document vital signs, summon help if available and notify the physician and supervisor. If available arrange to have a 12-lead Echocardiogram (EKG) done. In addition, if the patient is stable, a chest x-ray should be obtained. Typically, the intervention is that the catheter tip will be retracted according to the findings.

Infection: Catheter Related Sepsis (Immediate Management):notify the physician and supervisor, document findings and patient's current status. If the physician requests the PICC to be removed, expect an order that the catheter tip be collected and cultured and blood cultures ordered. Patients with a suspected sepsis will need urgent clinical review. Anticipate a new IV site will need to be initiated (in another extremity) and IV antibiotics provided as per orders. Be sure to document treatment and results.

Thrombophlebitis (Immediate Management):this is a deep vein thrombosis. Notify the physician and supervisor immediately. Document findings: signs and symptoms, and report vital signs. Anticipate a Radiology referral to confirm catheter patency, the thrombus will be confirmed by ultrasound. The patient will most likely be placed on anticoagulants if not contraindicated. Be sure to document treatment and results.

Catheter Occlusion: this situation presents with the inability to infuse any solution into the catheter together with the inability to aspirate any blood from it. Complete occlusion can result from thrombotic or a non-thrombotic causes. A thrombotic-occlusion develops as a result of a build-up of blood within the catheter. Urokinase may be used to lyse obstructions. The most common non-thrombotic causes of catheter occlusions are: mechanical obstruction, drug or mineral precipitates, and lipid residue. In order to avoid lipid residue, it is necessary to discard parental tubing within every 24 hours.

It cannot be emphasized enough how important it is to flush the PICC line according to the policies and procedure manual of your facility. In the event of any of the complications listed above: DO NOT REMOVE THE CATHETER. Removal of a PICC line is done by a PICC nurse and is a simple procedure in most cases, the catheter line can be safely and quickly removed. After removal, the insertion site is normally bandaged with sterile gauze and kept dry for a few days, allowing the wound to close.

Intraosseous Access (IO access):In the emergency setting, obtaining vascular access may be "accomplished" by placing a bone marrow type needle (needle with a stylette inside of the needle) into the bone marrow cavity. The marrow cavity has a complex mesh of vessels which carry blood both into and away from the bone marrow area then back through the venous system and then back to the heart. The IO insertion technique is used when the peripheral access is not obtainable and the patient requires immediate medication or fluids. While mainly practiced by paramedics and critical care personnel with special training, some of the devices which became common in the mid 2000's could be utilized in any serious situation requiring rapid access.

Intraosseous sites are not new. In fact, this technique was widely used by paramedics during World War II. During the late 1980's, the technique was described and widely utilized in children requiring emergency fluids and resuscitation when an IV site was unavailable; this remains common practice today. Adult IO access has been common practice in emergency cases sing the early 2000's. The marrow cavity (inside of the bone) provides a non-collapsible "series of veins" which can be used to infuse any medication or fluid in the emergency setting. The device is "screwed" or "punched" into the bone cavity of the tibia, ankle, humerus, or sternum. There are several devices available; manual, spring loaded, or a drill type device. Like a peripheral IV, once inserted, a return of blood into the IV line or syringe, followed by the ability for fluid to "flow" into the site without signs of infiltration assure proper placement. Complications of this procedure are the same for any IV site; infection, infiltration, emboli. While there is a slight risk for a bone infection (osteomyelitis), the benefits to this procedure outweigh the risks in the emergency setting when vascular access is required. The procedure cannot be carried out in an area with a fracture to the bone or a serious burn or injury to that particular site.



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Peripheral IV Site Locations:

Peripheral IV lines: A peripheral IV line consists of a short intravenous catheter (a few centimeters in length) that is inserted through the skin into a peripheral vein (veins not inside the chest or abdomen).This is usually in the form of a cannula-over-needle device, in which a flexible plastic cannula comes mounted on a needle. Once the tip of the needle and cannula are located in the vein the needle is withdrawn and discarded (in a sharp's box) and the cannula is advanced inside the vein until the catheter hub is flush with the skin. The site is stabilized in position with an appropriate IV site dressing and secured with tape.

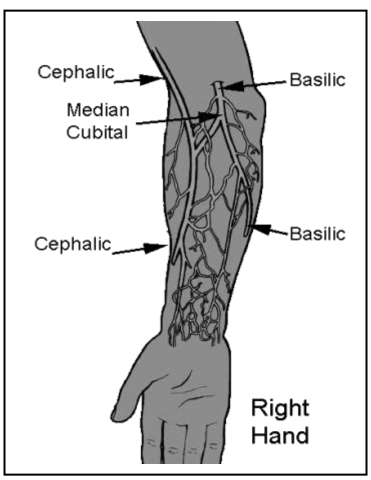
Blood may be drawn at the time of insertion (prior to any flush).Any accessible vein can be used; however arm and hand veins are used most often on adults, with lower extremity veins used much less often (these require authorization for insertion from a physician). On infants, scalp veins are sometimes used.

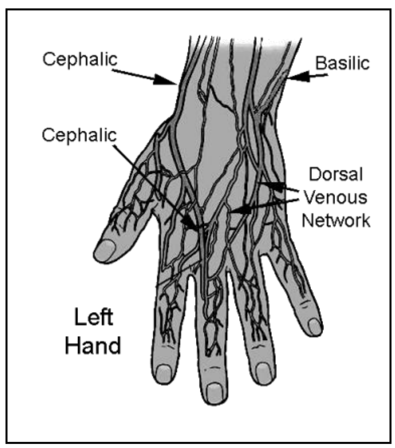
The caliber of the IV cannula is commonly indicated in gauge, with 14 being a very large cannula (preferred when pushing fluids fast into the vein) and 24 - 26 the smallest. The most common needle sizes are 16 - 18 gauge (often used for blood donation and transfusions). The part of the catheter that remains outside the skin is called the connecting hub; it can be connected to a syringe or an intravenous infusion line, or connected to extension tubing that is easily accessible between treatments.

Let's look at Appropriate Peripheral IV Access Sites:

In the hand: The major veins to consider are: →
1) Cephalic
2) Basilic
3) Dorsal Network

In the arm: →
The major veins to consider are:
1) Cephalic
2) Basilic
3) Anticubital





Selecting an Appropriate IV Site: choose distal veins first. Ideally, a full and pliable vein that is long enough to accommodate the IV catheter (at least 1 inch). It is recommended to avoid using: the dominant arm, the “affected arm” (meaning: S/P Mastectomy, CVA, or AV shunt).It is also advisable to avoid flexion areas, bruised or swollen areas, or sites distal to other previous IV sites and valves.

Reasons for Intravenous (IV) Access: a major purpose for providing IV fluids is for maintaining and restoring fluids. An example is dehydration which is very common. The body needs to be replenished in order to have homeostasis (electrolyte balance). Also there may be cause to administer medications, antibiotics or blood transfusions. In certain circumstances, there is need for pain management which could be provided via IV with patient controlled analgesics. And as stroke events continue on the rise, dysphasia (difficulty swallowing) and lack of appetite may require the need for IV parenteral nutrition.

Prior to initiating an IV, it is important to be sure to correctly identify the patient. This is commonly done by verbal confirmation and if your facility has the ability: scanning their identification bracelet. In addition, it is necessary to complete the following: verify the physician’s orders, review the chart for any additional orders or notes, and clarify with the patient if there are any possible allergies to the medications to be infused.

Be Prepared: Prep the patient and Prep the provider:

Literally: for the patient: clean site area, for the provider: wash hands and wear gloves.

Physically: for the patient: stabilize the site location, for the provider: stabilize yourself.
Mentally: for the patient: offer info for IV, for the provider: stay focused, think positive.
Emotionally: for the patient: encourage relaxation, for the provider: decrease stressors!

Have A Plan:

It is the caregiver’s responsibility to educate the patient on what is expected of them. The patient should be told to notify you if there is redness at the IV site, if there is swelling at the IV site, if the IV catheter becomes dislodged, if the IV site dressing gets wet or is lifting up, or if there is drainage at the IV site.

For successful IV insertion, the major trick is controlling the vein. In order to do that, stabilize your patient's vein by stretching the skin and holding it taut with your non-dominant hand. If attempting the cephalic vein above the wrist; stretch the patient's fist laterally downward. For hand veins; stretch the hand and wrist downward and hold your thumb over the patient's top finger knuckles while gently applying pressure to that area. For the basilic vein site at the backside of the arm; have the patient roll to their side, (preferably supported by a pillow) and rotate patient's extended lower arm inward, the back of the arm is now topside and ready for IV insertion. With the saphenous vein: extend the patient's foot downward and inward.

Verify IV Site Patency: the ONLY way to totally confirm a patent IV placement is to aspirate at the IV port. While withdrawing from the port with a syringe, check for good blood return in the tubing. After visible confirmation that the IV catheter is in place, flush the IV site according to facility policy. During the IV flush, observe for pain or swelling above the insertion site. Remember to reinforce the IV site with tape. Consider taping to be one of the most important tasks because it prevents you from having to repeat the IV insertion in the event of an inadvertent tug on the IV tubing. After IV insertion, apply the sterile IV dressing; be sure to use aseptic technique when attaching the extension tubing, IV tubing, and/or while providing IV medications or fluids.

Gathering supplies necessary for IV insertion: once you are ready to insert the IV Catheter, make sure you have all the necessary supplies. It is highly recommended to have all your materials available with you to avoid running back and forth to the supply room. Leaving the room to get "forgotten items" can increase patient anxiety. The provider should demonstrate good organizational skills by being prepared.

You will need – at the very least, the following items to initiate and provide the IV therapy: gloves, gauze, IV catheter, tape, alcohol preps, tourniquet, label with date, sharps box, IV extension tubing as well as regular tubing, IV Dressing, and IV Solution. If necessary (depending on the situation) you may also need: mask, eye gear, and/or gown.

Primary IV Access Devices and Equipment: catheter-over-needle device: this is typical IV catheter that the facility will provide for IV insertion. It has an outer tube (Teflon) which covers the needle except at the tip. During insertion: the needle is withdrawn once the catheter has entered the vein and a visible "flashback" is noted. There are many companies who offer different IV catheters, so be sure to get familiar with what you will be using. During practice time in class, there will be a variety of needles that you will be exposed to in order to get comfortable. All IV catheters you use for your patient should be in their original sterile sealed package.

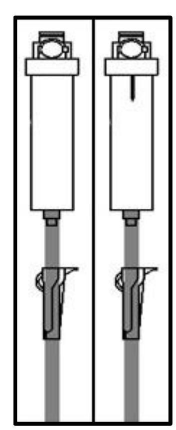
There is a winged steel needle known as the “Butterfly” needle which is easy to insert, since the needle is very small and very sharp. There are flexible “wings” attached to the needle for the provider to pinch while inserting the needle. This makes the insertion technique slightly different from the catheter-over-needle device. The needle is inserted into the vein, having been at an angle approximately 15-30 degrees prior to insertion. Caution: infiltration should be a concern because the needle remains inside the vein and is rigid. Frequent monitoring should be provided.

The caregiver will need to establish when providing IV therapy what type of equipment to use depending on if the procedure is going to last just a few hours or a few days. There are various products that can be used to make the task easier. Extension tubing can (with aseptic technique) be twisted on to the hub of the IV catheter that is now resting on the exterior side of the patient’s extremity.

It is necessary to have the forethought prior to IV insertion. As already noted, you will have lots of time in class to practice attaching the necessary equipment. Since the needless system has taken over, IV insertion is much easier and safer for the medical provider. The needless catheters and access ports are easy to operate, prevent possible exposure to contaminated blood, have an antibiotic material in the hub, and are designed to avoid build-up of a thrombus with a built-in positive pressure mechanism. Multiple types of supplies are available, most importantly; remember to use an alcohol swab when connecting any products.

IV tubing comes in several versions. This becomes very important information in order to address the calculation of drips, particularly when there is no availability of an IV pump. The information for which type of tubing you have can be found on the IV tubing package. Typically included with that information is how much fluid volume the tubing holds as well as the tubing properties (i.e., roller clamp, spike, chamber, ports, etc.)

Macro-drip tubing is a type of IV tubing that provides large drops: it delivers a huge volume of fluid over a short period of time. Depending on which tubing you have, the drops (gtts) are offered in different sizes from 10, 15 or 20 gtts which will then become the equivalent of 1mL while resting in the drip chamber. This is the ideal tubing to use for providing bolus fluids in an emergent situation.



Macro Micro

Micro-drip tubing is a type of IV tubing that provides small drops: the delivery system is a precise volume specific to titration, in this case: 60 gtts is the equivalent of 1mL. This type of tubing is commonly used for potent medications that are given in tiny increments.

Note in the picture how the drip chamber is different from the macro and the micro chamber. The little needle in the center controls the drip.

Calculating manual flow rates.

The following is the formula for(gtt/min):

$$\frac{(\text{Volume in ml}) \times (\text{drip set})}{(\text{time in minutes})} == \frac{\text{gtts}}{\text{min}}$$

Example: the patient is to receive 250 mL of NS over 90 minutes; macro-drip tubing is used: (10gtt/mL) Drip factor (GF). The formula will look like this:

$$\frac{(250\text{ ml}) \times (10\text{ gtts/min})}{(90\text{ min})} = \frac{\text{gtts}}{\text{min}} \rightarrow \frac{2500}{90} = \frac{\text{gtts}}{} = \frac{250}{1} \quad 9 = 27.7 = \underline{28\text{gtts/min}}$$

Practice Examples:

The physician orders:1200 mLD5W over 24 hours, GF = 10

$$1200 \times 10 = 12{,}000 \rightarrow \frac{12{,}000}{1440^*} = 8.3 = \underline{8\text{gtts/min}}$$

*To obtain time in minutes: (24 x 60)

Practice Examples:

The physician orders:LR @ 125 mL/hr, GF = 15

$$125 \times 15 = 1875 \rightarrow \frac{1875}{60} = 31.2 = \underline{31\text{gtts/min}}$$

Practice Examples:

The physician orders: 3L of Normal Saline over 48 hours:

GF = 10 ______gtts/min, GF = 15 ______gtts/min, GF = 60 ______gtts/min

The physician orders:D5 ½ w/20K @ 50 ml/hr:

GF = 10 ______gtts/min, GF = 15 ______gtts/min, GF = 60 ______gtts/min

The physician orders: 1000 mlD5NS over 24 hours:

GF = 10 ______gtts/min, GF = 15 ______gtts/min, GF = 60 ______gtts/min

The physician orders 3 liters LR over 72 hours:

GF = 10 ______gtts/min, GF = 15 ______gtts/min, GF = 60 ______gtts/min

Now let's look at calculating flow rates for the formula for (mL/hr): $\frac{\text{Volume (mL)}}{\text{Hours}}$

Example:

The physician orders 2000 mLD5W over 24 hours: $\frac{2000}{24} =$ 83.3 = 83 mL/hr

Practice Examples:

The physician orders: Levaquin 500 mL over 2 hours: _mL/hr

The physician orders: 1200mLLR over 24 hours: _ _mL/hr

The physician orders: D5 ½ NS @ 75 mL/hr: _mL/hr

The physician orders 100 mL Potassium over 30 minutes: ___mL/hr

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The flow rate is usually expressed as the total volume of IV solution infused over a prescribed interval or as the total volume given in mLs/hr (or drops(gtt) per minute)

Continuous Infusions Calculations:

Example: Heparin

Physician order: Heparin drip @ 900 u/hr
Admixture: Heparin 25,000 u / ½ NS 250 mL

Begin by determining units per mL: 25,000 ÷ 250 = 100 u/mL
Then figure how many mLs are required to deliver ordered dose: 900 ÷ 100 = 9 mL/hr

Short formula for any drug calculation:

$$\frac{\text{Dose x Weight x Drip Set}}{\text{(Concentration x Time)}} = \text{Volume to Administer}$$

Dose =	How much you want to give
Weight =	If it is a weight based medication. Must be in kg (must use full calculation, not simply half of the pounds)
Drip Set =	Usually: 60gtt/mL, unless stated otherwise
Concentration =	The amount of drug you have, divided by the amount of fluid it is packaged in (ex: 10mg in 5mL = 10/5 = 2mg/mL)
Time =	1 minute unless stated otherwise

Practice Examples:

Physician order: Give 4mg Morphine
Admixture: Morphine 10mg/ 2mL

How many mL's need to be administered? __________mL

Physician order: Give 1.5mg/kg of Lidocaine, the patient weighs 100kg
Admixture: Lidocaine 100mg/5mL
How many mL's need to be administered? __________mL

Measurement conversions:

1000 Milliliters (mL) = 1 Liter,

1000 Micrograms (mcg) = 1 Milligram

1000 Milligrams (mg) = 1 Gram

Mathematical calculations:

Formula: $\dfrac{\text{ordered dose x amount of mL per dose on hand}}{\text{dose on hand}}$

Example:

Physician order: Ampicillin 250 mg IV Piggy Back(IVPB)

Dose on hand: 1 gram in 500 mL $\quad$ 250 x 500 = 125,000 $\dfrac{125{,}000}{1000^*}$ = 125 mL (*1 gram converted)

Practice Examples:

Order: Ativan 2 mg IVPB
(On hand: Ativan 4mg/mL) ______________mL

Order: Cardizem 10 mg IVPB
(On hand: Cardizem 100mg/5mL) ______________mL

Appropriate Types of IV Fluids

NS "Normal Saline"

LR Solution

D5W, Pre-op/antibiotics, Potassium

Blood transfusions

Check IV Fluids:

Check bag for clarity, do not use any solution with particles in it. DO NOT USE medications with expired dates. Check the label, date and product information on the medication. DO NOT USE an IV bag with cracks or tears. Check all IV supplies are in the original sealed packages. Check for correct patient name, medication and dose

Label the bag and document: Patient name/ID #, date and time, medication name, amount added, rate of medication, expiration date

Steps To Initiate IV Fluids:

- Close tubing roller clamp
- Remove spike guard from IV bag
- Remove cap from IV tubing spike
- Carefully, insert spike into bag
- Fill drip chamber halfway from IV fluids bag
- Remove tubing end-cap and prime line
- Remove IV tubing end cap ** use aseptic technique**
- Release clamp on IV tubing line
- Prime line, remove any air bubbles
- Close roller clamp, attach tubing to prepared IV site

Peripheral IV, General Maintenance: IV site and dressings should be changed every 72 hours or PRN (if the site gets wet, soiled or the dressing lifts up). IV tubing should be changed every 72 hours (check facility's protocol). For antibiotic IV TX, and parental nutrition fluids, etc., tubing is changed Q 24 hours.

Common Terminology of Manual IV Flow Rates:

"Keep Vein Open" : KVO, TKO, 20-30 mL/hr (15-20 gtt/min on microdrip)
(Just enough IV fluid volume to keep patient's vein patent)

"Wide Open": Bolus within "acceptable limits" check procedure manual. Roller "open", increase IV volume to infuse quickly. Monitor lungs! (Access for fluid overload)

IV Pumps: An infusion pump infuses fluids, medication or nutrients into a patient's circulatory system. It is generally used intravenously, although subcutaneous, arterial and epidural infusions are occasionally used.

Accurately Adjusting Manual Flow Rates: Fill drip chamber, Utilize roller clamp

IV Insertion Steps:

- Hang the patient’s arm down, and apply tourniquet
- Place tourniquet about 4-6” above venipuncture site chosen
  ~Tie just tight enough to prevent venous return and to fill the veins
- Leave tourniquet on No More Than Two Minutes
- Cleanse the site with antiseptic prep
- When rubbing on the skin surface, note visibility of the veins
- Anchor the vein with the thumb of your non-dominant hand
- Advise patient to keep still and for possible momentary discomfort
- Puncture skin with bevel up at a 45 degree angle from skin surface
- Watch for flashback in chamber, continue to advance catheter
- Hub should be pushed up flush with puncture site, while disengaging needle
- Remove tourniquet
- Advise patient of successful procedure
- Elevation of patient’s arm on a pillow may help to control bleeding
- Apply pressure above inserted cath site, attach tubing, tape and apply dressings
- Anticipate blood
- Use asceptic technique

Reasons for having difficulty with IV access:

There are many causes and circumstances that can make inserting and maintaining an IV site a challenging project. Things about the patient that should be considered include: are they dehydrated or experiencing intravascular depletion? Is there significant edema or chronic obesity that will make it more difficult to see the veins? Is there a history of IV drug use which will cause venous scarring and require more effort during insertion of the IV catheter? Or perhaps because of certain disease conditions, steroid use or due to old age; the vessels may be thin and fragile.

Tips, Tricks & Warnings...

- Have the IV catheter, tape, tubing, etc. ready for easy access
- Provide a calm setting, make sure the patient is comfortable/warm
- Check the vein closely: Is it straight? Does it bifurcate?
- A tourniquet is not always necessary; large veins, or in the elderly (fragile skin)
- For quick, emergency fluid replacement choose a 14 or 16 gauge catheter
- Sometimes "floating" the catheter through the vein will open up the valve
- Know your IV catheters! There are many companies with different types
- After needle insertion, place sharps in red box to avoid needle sticks
- If the IV cannot be started with gloves on, it should not be started
- Can't see a vein? Trust your fingers even more than your eyes!
- Twirl you catheter hub prior to insertion for "easier advancement"
- Choose the largest catheter possible that the vein can accommodate
- Confuse the nerves!!! Rubbing with alcohol wipes prior to insertion diminishes the "perception" of discomfort the patient feels.... try it!
- Secure against loss, use Coban wrap when necessary
- Do not tape directly over connectors, it may be necessary to disconnect for example: during emergencies, leaks, medication errors, etc.
- Having the patient hold the extremity in a dependent fashion will help to engorge the veins. Or raise the head of the bed and let the patient's extremity "dangle"
- Use warmth, it increases success rates; applying a dampened, warmed towel to the area (avoid scalding the skin) will likely have adequate vasodilation effect
- Pediatric veins: use a butterfly needle and <u>splint</u>!

Patient's Expectations~ Safety:

For providing appropriate patient safety, the minimum standard of practice for doing medication administration is checking the "Seven Rights": right patient, right drug, right form, right route, right frequency/time, right documentation, right dose (for IV therapy, this means the right flow rate).

Intake Documentation:

Observe for appropriate intake and output during each shift. It will be expected that the caregiver chart intake, output, and daily weights per facility protocol. This often includes PO intake, but for this course, we should remember at a minimum to be conscious of charting what fluid volume is going in the IV site, and what the patient is excreting, specifically urine output. However, stool output is important as well, since many antibiotics can cause diarrhea which can be a huge source of fluid shift. Be sure to advise your patient to notify you if their bowel habits have changed. During the course of IV therapy, if the patient is getting large quantities of IV fluids, you will need to monitor for fluid overload. What are the patient’s lung sounds at the beginning of the shift, have the sounds become “coarse”, or is the patient coughing more than usual? Is the patient showing signs of increased swelling in the extremities: at the IV site, lower extremities or generalized third spacing related to the fluids? Notify the physician for any and discrepancies.

Reasons for discontinuation of IV site:

It is important to address that there are various situations when and IV site may require being removed. The most obvious reason for discontinuing an IV site would be during routine site rotation, when it is imperative you are following facility protocol. Or maybe the IV therapy is now complete and the site can be discontinued. Then again, there may be suspicion of an IV-related complication. If this is the case, the catheter tip should be sent for culture and you must monitor the patient and the site closely.

IV removal documentation includes:

Charting date and time and reason for removal, the condition of catheter upon removal, the location and condition of the site, the type of dressing applied, and how the patient tolerated the procedure. For complications like infiltration, phlebitis, or extravasations, it is extremely important to document information about the site. Is it warm to touch, is it pink and swollen, and is the patient complaining about pain? If so, what have you done to provide appropriate care? Did you call the physician?

Appropriate method to discontinuation of IV site:
Equipment needed: sterile gauze and tape, or Band-Aid. Although probably not entirely necessary to review, let’s recap any way: clarify the order, advise your patient that you will be removing the IV site, wash your hands, don gloves, remove tape (with adhesive remover if necessary), remove the old IV dressing, inspect the old IV site, and discontinue the catheter while applying gauze to the site with your other hand. This should be followed by: cleaning the area and applying sterile gauze. If during removal, resistance is encountered or a complication occurs, stop the procedure and notify the physician immediately. After discontinuation, inspect the catheter tip. If the catheter’s condition is different than the original, notify the physician immediately and closely monitor the patient. Be sure to apply pressure to the site until bleeding has stopped (a minimum of 1-2 minutes, and even more if the patient is on anticoagulants). Instruct the patient to change the dressing at least every 24 hours until the site is healed.

In The Event Of Complications:

Notify the physician and the supervisor, and call for further assistance if it is necessary. Provide the appropriate treatment. You must document in detail your findings and your patient's complaints, as well as the treatment provided and follow up results.

General Complications of IV Therapy:

Pain:

Vein irritation may occur due to solutions with high or low pH and high osmolality. Especially fluids like Potassium Chloride, Phenytoin, Vancomycin, Erythromycin, and Nafcillin. Signs and symptoms of vein irritation may include: pain at the site, possible blanching or erythema (redness of the skin) over the vein during infusion

Treatment includes decreasing the flow rate and diluting the infusions. Stop the IV fluids all together if phlebitis is suspected. Follow Protocol. Contact physician, remove old IV site. Anticipate sending the IV catheter tip for testing if infection is suspected. Provide a new IV site if necessary, preferably on the other extremity.

*Treatment of choice: Antihistamines soothe some of the itching and over-the-counter fever-reducing meds such as Acetaminophen and Ibuprofen may bring down a fever and help alleviate the pain (use only if not contraindicated). A cool or moist compress placed at the site of irritation may help with the pain.

- ***Listen to the patient,* monitor IV sites frequently **

Negligence during IV Therapy:

Healthcare providers can be held liable for negligence. For example, criminal negligence, professional malpractice, patient abuse, and any neglect associated with venipunctures. This includes,but is not limited to: the care and maintenance of the IV therapy.

The medical professional who demonstrates omission(fails to act) or whose action falls below the "accepted standard of care" as established by the law, could be held accountable for injuries and losses incurred by the patient as a result of such omission or act.

Negligence is a "breach of duty", that is, it is a departure from the conduct that can - and should be - expected of a reasonably prudent person under similar circumstances. The

provider can be sited for: not doing the correct thing, not doing something in the correct way, doing the wrong thing, and/or doing something in the wrong way.
Examples of “Provider Administration Error”:

- IV fluids that, left unattended or not cared for appropriately, that leak into the patient’s arm - or the surrounding tissue, causingpain and suffering
- Disregard by the caregiver for monitoring the IV fluids and/or the of lack of follow through required to ascertain proper absorption of the medication
- Improper handling of the medication, resulting in reduction of the drug's efficacy
- Blatant indifference of medications provided possibly resulting in tissue death

The healthcare professional should find this a serious concern, especially in cases of heart attack or stroke, when IV drugs - provided properly - may help prevent or minimize serious damage to the heart or brain and even save lives.

IV Infiltration:

This happens usually a result of an IV that has been dislodged with no immediate treatment. It presents with a grossly enlarged extremity due to IV fluids trapped within the tissue. Remove the present IV site, elevate the extremity, and provide icepacks PRN. Initiate a new IV site, monitor closely, document as an Incident Report.

Extravasation:

Follows when the IV catheter is dislodged from the vein and then inadvertent administration of a vesicant substance leaks into the tissues. Signs and symptoms may include swelling at and above the limb, burning or pain at the site, tightness at the site, a cooler temperature at the site, blanching at the site, and absent backflow of blood. Remove the IV site. Treatment includes stopping the infusion, delivery of a local antidote (if suitable), ice initially and then warm soaks.

Hematoma:

This occurs when blood leaks into the extra-vascular space. The patient will most likely have tenderness at the site, a bruise may be apparent at the site, and the IV infusion will not flow. Remove the present IV site. The course of treatment should include applying pressure at the hematoma site until the bleeding stops, then warm packs to aid in the absorption of the blood.

Local Infection:

This likely develops as a result of: phlebitis, poor taping that allows the IV catheter to move in and out of the vein, prolonged dwell time of the IV catheter, or failure to keep aseptic tech during insertion or site care. The patient may experience malaise, fever, or chills. Notify the attending physician, anticipate culturing the site, and sending the catheter tip for testing. Treatment includes administering antibiotics and hemodynamic support

Thrombophlebitis:

Or inflammation of the vein – is manifested by redness and swelling at the site, clotting at the catheter tip (thrombophlebitis), and/or friction from catheter movement within the vein. It is often caused by poor blood flow around the IV catheter. Medication or fluid with a high or low pH or high osmolality may also be a cause of complication. Treatment includes the removal of the catheter, and application of warm soaks.

Pyrogenic Reaction:

Fever occurs when IV fluids or administration sets are contaminated, characterized by abrupt onset of: fever, chills, backache, headache, and nausea. This occurs directly after infusion is initiated. Discontinue the IV immediately, follow facility policy, and reestablish an IV site in the opposite extremity if possible. Remember: "*When in doubt, throw it out*". (Package the product and send it back to the lab or pharmacy for testing). Do not use an IV solution whose substance is questionable, or an IV bag that does not appear to be intact. Follow up includes reporting and documenting findings. Follow up with treatment for:

- Temperature in the rectum that is at or greater than 37.5 – 38.3 °C (100–101 °F)
- Temperature in the mouth that is at or greater than 37.7 °C (99.9 °F)
- Temperature axillary orotic that is at or greater than 37.2 °C (99.0 °F)

*Note: Fever differs from uncontrolled hyperthermia, in that hyperthermia is an increase in body temperature over the body's thermoregulatory set-point, due to excessive heat production and/or insufficient thermoregulation.

Nerve, Tendon or Ligament Damage

This may occur due to improper IV insertion technique or tight taping. The patient will experience extreme pain at the insertion site, muscle contraction and eventually may exhibit paralysis, numbness and/or visible deformity. Patients often describe the sensation as an “electric shock”. The medical professional must assess for circulatory competence by checking for capillary refill and pulses in the extremity where the IV is in place. In addition, it is important to assess for movement and sensation in the extremity. Nerve damage may repair itself in a few weeks or up to a few months.

Catheter Shear:

This may occur when the catheter is pulled back over the needle once it has been advanced and the tip of the catheter is inadvertently torn off. In actuality, it becomes a plastic embolus. Therefore, if visible; retrieve the broken part of the catheter. Treatment: If the catheter tip is in the bloodstream, place tourniquet above the IV site, place patient flat with head slightly lower, notify your Nurse Supervisor and the doctor.

Remember: *The catheter should never be pulled back over the needle*

Air Embolism:

More common in Central line IV’s. This may occur when air enters the vein - possibly by excessive air in tubing, or leaving the IV end open to air without connecting tubing. S/S: respiratory distress, unequal breath sounds, a weak pulse, increased central venous pressure, decreased blood pressure, and loss of consciousness. Treatment: If air embolism is suspected, discontinue the infusion, place the patient flat with head slightly lower, administer oxygen, and notify your Nurse Supervisor and the doctor.

Circulatory Overload:

Can occur when fluids are given at a higher rate or in a larger volume than the body can absorb or excrete. (ex: if the IV roller clamp is unclamped and the infusion runs into the vein too quickly). Possible consequences include hypertension, heart failure, or pulmonary edema. S/S: the patient may be anxious, present with respiratory distress, have crackles in the lung bases, show increased blood pressure and neck engorgement Treatment: includes raising the head of the bed, administering oxygen and give IV Furosemide as ordered, and prompt notification to the doctor.

Allergic Reaction:

This may occur when the patient is allergic to the catheter inserted or the medication being administered. The patient may have itching, develop watery eyes and nose, may experience bronchospasm, wheezing, and/or possibly anaphylaxis. Treatment: If a reaction occurs, stop the infusion or discontinue the IV catheter, notify attending physician and plan to provide airway support – If authorized to do so, give medications to reverse the reaction (Epinephrine and/or Benedryl, and steroids). Administration of an antihistamine, a steroid, or epinephrine may be indicated.

Arterial Puncture:

You know it's happened when....you see spurting bright red blood. Treatment: Immediately withdraw the present IV catheter, elevate the extremity, and apply direct pressure to the site until bleeding stops - (at least 5 minutes).

COMPLETE EXAM SECTION 6 IN YOUR TEST BOOKLET NOW

Glossary of Common Terminology

Absorption – The process in which a drug or fluid moves from the site of administration into body fluids, which take it to the site of action (e.g., mouth [gastrointestinal system] – blood [circulatory system] – heart).

Acidosis – The accumulation of excess acids (hydrogen ions) of a deficiency of bicarbonate ions, dropping the plasma pH below 7.35.

Adenosine Diphosphate (ADP) – The molecule produced during muscle contraction that combines with inorganic phosphate to produce adenosine triphosphate (ATP).

Adenosine Triphosphate (ATP) – The substance in all cells that produces energy.

Alkalosis – The reduction of acids (hydrogen ions) and the increase of bicarbonate ions, raising the plasma pH above 7.35.

Amino Acids – The building block of protein constructed and the end product of protein digestion (hydrolysis).

Analgesic – Agent used to relieve pain without altering consciousness.

Anesthetic – An agent that produces loss of sensation, with or without loss of consciousness, and may be categorized as general, regional, or local.

Anion – An ion with a negative charge.

Antibiotic – Destructive to life. Used to treat infectious diseases by inhabiting the growth of microorganisms.

Antibody – An immunoglobulin (lg) molecule that develops in response to an antigen that enters the system and combines with it.

Antidiuretic Hormone (ADH) – A hormone produced in the hypothalamus and secreted by the posterior pituitary gland to act on the collecting tubules of the kidneys to promote water reabsorption; also called vasopressin.

Antimicrobial – Any natural or synthetic substance used to prevent the development of infection, kill existing microorganisms, or prevent their growth and development.

Antigen (immunogen) – A molecular agent that is able to elicit an immune response by combining with an antibody.

Antiseptic – A product that can safely be applied to the skin or surface of mucous membranes to inhibit microbial growth or destroy organisms.

Asepsis – Absence of infectious organisms.

Assault – An intentional tort in which an individual threatens bodily harm to another.

Autologous Blood – Blood donated by an individual, in advance of its actual need, and stored for reinfusion at a later time.

Bactericidal – Able to kill bacteria.

Carbohydrate – An organic compound made up of carbon, hydrogen, and oxygen and classified according to the amount of sugar in its chemical makeup.

Cation – An ion with a positive charge.

Chvostek's Sign – Unilateral facial muscle contraction seen following tapping of the 7th cranial (facial) nerve anterior to the ear.

Colloid – Glutinous substance whose particles, when submerged in a solvent, cannot form a solution because the molecules, when thoroughly dispersed, do not dissolve, but remain suspended and uniformly distributed throughout the fluid.

Compartment Syndrome – A condition in which nerves, vessels, or tendons are constricted within a space from the pressure of fluid or inflammation.

Crenate – To shrink.

Crystallization – The ability to form crystals.

Crystalloid – A substance, when placed in solution, can diffuse through membranes.

Cubital Fossa – The triangular area that lies anterior to an inferior to the elbow.

Digital Veins – Veins of the digits, or fingers and toes.

Drop Factor – The number of drops needed to deliver 1 ml of fluid.

Ecchymosis – Extravasation of blood into the interstitial spaces, resulting in skin discoloration; a black-and-blue mark.

Electrolyte – Solute chemical able to ionize and conduct electricity; when dispersed in fluid is able to dissociate into constituent ions and convert the solution into one capable of conduction electricity.

Embolism – The particles of solids, liquids, or gases traveling in the circulatory system.

Endogenous – That which originates within the body.

Enzyme – A highly specialized molecule that coordinates and controls a cellular chemical reaction by serving as a specific activator (catalyst); the enzyme is not altered or diminished in the process.

Erythema – Redness.

Exogenous – That which originates outside the body.

Fomites – Inanimate objects that harbor microorganisms and serve as sources of contamination.

Germicide – Agent capable of killing germs.

Glucose – The most important monosaccharide in the body; the main source of cellular energy.

Glycogen – Glucose that is stored in the body tissues and available when needed for metabolism.

Glyconeogenesis – The formation of glycogen from body fat.

Hemolysis – To break up or burst.

Hemostasis – The prevention of blood loss through the arrest of bleeding.

Histocompatibility – The condition in which the tissue of the donor is compatible with that of the recipient.

Homeostasis – The dynamic process that contributes to a state of internal consistency; the coordination of all bodily processes as well as the coordination of the human being as a dynamically integrated organism encompassing the biologic, physiologic, sociocultural, and religious aspects of the person.

Homologous Blood – Blood collected from volunteer donors from transfer to other human beings.

Host – The living structure (person or animal) that provides the atmosphere in which organisms are able to live.

Immune Response – The ability of the immune system to recognize and response to foreign invaders and prevent damage by neutralizing or eliminating them.

Immunity – The state or condition in which an individual is protected from disease.

Incompatibility – The untoward effects that occur when drugs and/or fluids are mixed.

Indurated – Hardened.

Infection – The process in which a host is invaded by microorganisms that are able to grow, reproduce, and cause injury, the result being disease.

Inflammation – The body's normal immune response to any type of injury or invasion.

Interstitial Fluid (ISF) – The fluid existing in the small spaces and gaps between body structures, cells, and tissues; where lymph forms.

Intraosseous – Within the medulla or marrow of the bone.

Intravascular Fluid (IVF) – The fluid found within the blood vessels of the body, containing serum (the water portion of the blood) and serving as the vehicle for the transport and exchange of nutrients; plasma.

Ion – The electrical charge on a molecule.

Irrigate – To gently flush a canal with fluid.

Ischemia – Loss of blood supply to a part.

Laminar Air Flow – Air that moves along parallel but separates flow paths into filters where contaminants are removed.

Lipid – A molecule that contains the elements carbon, hydrogen, and oxygen.

Lymph – The interstitial fluid (ISF) that circulates with the lymphatic vessel, and filtered in lymph nodes, containing proteins, salts, organic substances, and water.

Microorganisms – All sources of life, not perceptible to the naked eye, that compromise bacteria, fungi, molds, protozoa, viruses, yeasts, and other life forms.

Milliequivalent – The measurement of the concentration of electrolytes in a volume of solution.

Morbidity – Incidence of illness.

Mortality – Incidence of deaths.

Necrosis – Death of tissue.

Negligence – The unintentional tort that wrongs or harms another because of failure to act as an reasonable person would act; carelessness.

Nosocomial Infection – An infection that develops in a person during, or as a result of, a stay in a health care setting.

Nurse Practice Act – Statutory laws that vary from state to state and define the parameters under which only those individuals who are qualified and licenses may practice nurse.

Occlusion – Blockage that interferes with the passage of infusate into the vein, which can occur at any point in the vein, cannula, or tubing.

Paresthesia – Sensation of numbness and/or tingling.

Pathogen – A substance capable of producing disease.

pH – The potential of hydrogen; the chemical unit of measurement used to describe the degree of acidity or alkalinity of a substance.

Phagocytosis – The process whereby the cell selectively ingests large particles of material such as bacteria, other cells, or particles of tissue degeneration.

Phlebotomy – The venipuncture and withdrawal of blood for auto-transfusion or donor transfusion.

Plasma – Liquid portion of blood and lymph containing fibrogen, which converts to fibrin in clot formation.

Precipitation – The suspension or crystallization of particle that occurs due to the mixing of incompatible solutions or adding solutes to incompatible solutions; results in the occlusion of an intravenous line.

Protein – An organic compound composed of carbon, hydrogen, oxygen, and nitrogen molecules and usually phosphorus and sulfur; made up of molecular units called amino acids.

Sepsis – Pathologic state, usually with fever, that is the result of microorganisms and/or their toxic products in the bloodstream.

Serum – The water portion of the blood; plasma.

Solute – Substance dissolved in a liquid (solvent).

Standard of Care – That which is used to determine the minimum acceptable level of nursing care within a practice setting.

Stopcock – A valve that controls the directional flow of infusate through manual manipulation of a direction regulating valve.

Trousseau's Sign – Carpal spasm following the inflation of a blood pressure cuff to the arm above systolic pressure for three minutes.

Universal Donor – A person with blood type O, having no A or B antigens, who is able to donate blood for use by persons of any of the four types, as an emergency measure.

Valence – The electrical charge of an ion.

Vesicant – An agent that irritate and causes blistering.

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Home / Find Articles / Health / Nursing / Oct 1998 A closer look at I.V. fluids, by Young, Judy

Anti-Neoplastic Agent Administration, Handling & Disposal, (SOP Modified from UWMC SOP), Prepared by S. Chou, 5/31/02 (modified by J. Kauffman 9/23/02)

Objective: Individual will correctly and independently demonstrate preparation of IV bag and tubing, insertion of peripheral IV and regulation of flow rate.

Performance Criteria	Performed Independently	Needs Remediation
1) Establishes scene safety		
2) Identifies the patient		
3) Uses standard precautions		
4) Identifies appropriate solution		
5) Chooses appropriate IV tubing		
6) Checks bag for clarity, expiration date, particles		
7) Spikes bag using aseptic technique		
8) Fills drop chamber halfway		
9) Primes tubing and closes clamp		
10) Verbalizes 3 indications for IV therapy		
11) Assembles all necessary equipment		
12) Identifies patient and explains procedure		
13) Applies tourniquet and selects site		
14) Preps site with alcohol, cleansing from center outward		
15) Anchors vein and positions catheter bevel up		
16) Pierces skin & vein &lowers angle of needle		
17) Identifies blood “flashback”		
18) Advances catheter over needle into the vein		
19) Applies pressure over catheter & removes needle; attaches IV line		
20) Removes tourniquet and assesses IV patency		
21) Properly disposes of needle		
22) Secures IV with tape or Tegaderm		
23) Documents insertion on IV site and patient chart		
24) Verbalizes at least 4 complications and accompanying signs and symptoms		

Student Name: ___________________ Instructor: __________________Date:____________

Exam Section 1

Choose the most appropriate answer for the following questions

Pages 1-9

1. Veins are generally closer to the surface of the skin, thus may be more easily viewed or palpated.
   A. True
   B. False

2. Which of the following factors can affect the stability of a drug?
   A. Light
   B. Temperature
   C. The container
   D. All of the above

3. Which of the following is considered both an advantage and a disadvantage of IV drug administration?
   A. Immediate drug action
   B. Control of the rate of flow
   C. Control of absorption of drug
   D. Incompatibility of drugs

4. When drawing medications from a glass ampule, due to small amounts of glass which may be present, the nurse should:
   A. Try to use larger syringes to avoid back pressure
   B. Use 2 syringes to ensure the vial is empty
   C. The medication should be transferred to a secondary vial
   D. Use a filtered needle to prevent small glass particles from being injected

5. The definition of a medication side effect is:
   A. A complication caused only by taking too much of a medication
   B. The intended physiological effect
   C. Medication action with no negative response
   D. A predicted, but unintended, secondary effect

Exam Section 1 (Continued)

Choose the most appropriate answer for the following questions

6. When one medication diminishes the effects of - or counteracts another, this is known as:
   A. Domestic
   B. Simultaneous
   C. Antagonistic
   D. Replication

7. The state of Florida requires LPNs to complete the IV training course, then a section on clinical competence to be verified by their employer.
   A. True
   B. False

8. When one medication potentiates the effect of another, the term for this is:
   A. Double down
   B. Synergistic effect
   C. Extra reaction
   D. Antidote

9. The purpose of the IV drip design focuses on safe administration of medication to the patient.Using IV drips takes practice and requires frequent attention. All are true, except:
   A. A drip chamber is built into the IV tubing which permits air to rise above the IV product
   B. A drip chamberstops the air from traveling to the blood vessels
   C. A drip chamberis controlled by a specific flow rate
   D. A drip chamber helps air to enter the blood stream

10. A piggy-back medication is also referred to as the “secondary” because it allows the medication to do all of the following, except for:
   A. Run until completed and then switch back to the primary fluid
   B. The primary will begin to flow again when the secondary is started
   C. The medication is connected to the high port of the primary line
   D. The primary will not run so long as there is fluid in the secondary

Exam Section 2

Choose the most appropriate answer for the following questions

Pages 10-23

1. A patient receiving blood via the IV route may have an adverse reaction. The nurse should know all of the following are signs of a blood reaction, <u>except</u>:
   A. Malaise (weak & tired)
   B. Fever
   C. Chills
   D. Difficulty speaking

2. Hand washing is one of the most important components for reducing the chance of infection. Which of the following is <u>not</u> a common hand washing policy?
   A. Wash hands only if body contents are contacted
   B. Wash hands when entering the room
   C. Wash hands when leaving the room
   D. Wash hands after touching the patient

3. It is 100% impossible for a patient to receive a blood-borne disease from a blood transfusion.
   A. True
   B. False

4. What should be done if a patient shows signs of a reaction while receiving a blood transfusion?
   A. Notify the supervising nurse
   B. Notify the physician if appropriate
   C. Stop the IV
   D. All of the above

5. TPN and PPN refers to:
   A. Methods for providing nutrition through the IV
   B. Proper pain notice
   C. Methods for inserting central IV's
   D. Total medication policy

Exam Section 2 (continued)

Choose the most appropriate answer for the following questions

Pages 10-23

6. Which of the following will not reduce the incidence of infection during IV therapy?
   A. Utilizing smaller size IV catheters
   B. Using an antimicrobial cleanser on the skin
   C. Cleansing injection “port” sites with alcohol prior to use
   D. Shaving hair from the site prior to starting the IV

7. In general, for sterility and to maintain acceptable practice, IV sites should be changed:
   A. Every Saturday per hospital policy
   B. Every 48-72 hours
   C. There is no need to change IV sites
   D. Only if the patient complains of pain at the site

8. Physicians may choose a specific type of antibiotic based on:
   A. The type of white blood cells elevated and their sensitivity to certain antibiotics
   B. The red blood cell’s response to other medications
   C. The neutrophil count from the lab
   D. The lack of evidence of infection

9. The term “Standard precautions” relates to:
   A. Wearing a mask at all times when starting an IV
   B. Asking the patient about his standard health
   C. As a standard, only being cautious around known infectious body fluids
   D. Treating all blood and certain body fluids as if they were infectious

10. It is appropriate to wear gowns, masks or goggles when what is likely to occur?
   A. A routine blood draw
   B. Splashes, spray or droplet contact
   C. A dressing change from a peripheral IV site
   D. A tear in the epidermis

Exam Section 3

Choose the most appropriate answer for the following questions

Pages 24-33

1. Blood is returned to the heart under lower pressure by way of which vessels?
   A. The aorta
   B. The ventricle
   C. Veins
   D. Arteries

2. Superficial veins used for venipuncture are located where?
   A. In the subcutaneous tissue area
   B. Above the epidermis
   C. Below most muscle in the lower extremity
   D. Near the outer hair follicles

3. The normal life span of red blood cells is:
   A. 40 days
   B. 90 days
   C. 120 days
   D. 180 days

4. Which of the following is <u>not</u> a function of blood?
   A. Carries oxygen to the tissues
   B. Helps regulate body temperature
   C. Transports cellular waste to organs for elimination
   D. Maintains stable glucose level in the patient

5. In relation to human blood, a high leukocyte count (white blood cells) is indicative of:
   A. Leukemia
   B. A rare condition
   C. Some type of infection
   D. A normal finding and no cause for evaluation

Exam Section 3 (Continued)

Choose the most appropriate answer for the following questions

6. Osmosis refers to the movement of fluids and diffusion refers to the movement of solutes.
   A. True
   B. False

7. Electrolytes help control body functions. Electrolytes found in the body include:
   A. Sodium (Na+)
   B. Potassium (K+)
   C. Magnesium (Mg++)
   D. All of the above

8. Water (fluids) make-up 60% of an adult's body weight. Most of this fluid is found in what area of the body?
   A. Intracellular
   B. Intraocular
   C. Extracellular
   D. Intracardiac

9. Cellular and vascular walls can allow certain ions (charged particles) to pass through them, this ability is known as:
   A. Diuretic process
   B. Diffusion
   C. Membrane permeability
   D. Fluid pass by

10. An electrolyte is:
    A. A chemical compound that dissolves in water to become (+) or (-)
    B. A substance found inside cells to produce energy
    C. A substance that fights infection
    D. A chemical to control bleeding

Exam Section 4

Choose the most appropriate answer for the following questions

Pages 34-47

1. Causes of fluid volume deficit include:
   A. Vomiting & diarrhea
   B. Bleeding
   C. Use of diuretics
   D. All of the above

2. Fluid overload (excessive body fluid) can be caused by a number of medical conditions. In these conditions, IV fluids should be kept to a minimum. Signs of fluid overload could include all <u>except</u> which of the following?
   A. Weight gain
   B. Weight loss
   C. Jugular vein distention
   D. Pulmonary congestion (crackles)

3. Psychologically preparing the patient to have an IV placed is an important component of patient care. The following may help reduce the patient's anxiety:
   A. Tell the patient you are going to need to start the IV first
   B. Have all supplies ready and nearby
   C. Explain the procedure to the patient
   D. All of the above

4. No patient can refuse an IV if the nurse feels it is necessary.
   A. True
   B. False

5. A patient whose total body fluid is normal can still exhibit S & S of hypovolemia due to:
   A. Vomiting & diarrhea
   B. Hypermetabolism
   C. Diuretic therapy
   D. Third spacing

Exam Section 4 (Continued)

Choose the most appropriate answer for the following questions

Pages 34-47

6. The term homeostasis refers to:
   A. Maintaining a normal internal environment
   B. Controlling shivering during IV therapy
   C. Blood pressure present during a blood draw
   D. Stopping excessive bleeding

7. Signs and symptoms of Hypokalemia include the following, except:
   A. Paresthesias, muscle weakness, nausea
   B. Potassium levels below 3.5 mEq/L
   C. Vomiting, nausea, cardiac dysrhythmias
   D. Potassium levels between 3.5 – 5.0 mEq/L

8. Flushing IV lines:
   A. Are seldom necessary before and after medications
   B. Keep lines blocked
   C. Depends on the facility protocol
   D. Cause precipitation and blockage

9. A vasovagal syncopal episode is not:
   A. A response of the autonomic nervous system to a person seeing blood
   B. A wrong message that tells receptors in the heart's chambers that the ventricle is filled
   C. Typically precipitated by an unpleasant physical or emotional stimuli
   D. Caused by a feeling of pleasure at the sight of blood

10. Of the following, which is not a potential cause of PICC line Catheter migration (displacement):
   A. Activities such as heavy lifting
   B. Persistent coughing
   C. Mechanical ventilation
   D. Proper fastening of the catheter at incision site

Exam Section 5

Choose the most appropriate answer for the following questions

Pages 48-55

1. When choosing an IV site in a non-emergency (routine IV) you should generally attempt which sites first?
   A. Largest
   B. Smallest
   C. Proximal
   D. Distal

2. Once inserted into the vein, the IV needle is removed and the Teflon catheter is left in place. The catheter is kept in place by:
   A. Securely taping it to the skin
   B. Using an “Ace” bandage
   C. The IV tubing
   D. Having the family assist in holding the arm still

3. Prior to starting an IV, several things should be done. Which of the following is <u>not</u> something that needs to be done routinely?
   A. Check for allergies
   B. Cleanse the arm rail on the bed
   C. Cleanse the IV site
   D. Verify the order and that you are with the correct patient

4. The IV drip tubing used to deliver precise amounts, such as, “medication added” IVs, is the:
   A. Microdrip
   B. Macrodrip
   C. Maxidrip
   D. Grounddrip

5. Which of the following is not a use of IV Therapy?
   A. To provide enteral nutrition
   B. To maintain fluid and electrolyte balance
   C. To provide parenteral nutrition
   D. To administer medications

Exam Section 5 (Continued)

Choose the most appropriate answer for the following questions

6. Which of the following is not an IV/needle/catheter type:
   A. Butterfly
   B. Catheter over the needle
   C. Teflon catheter
   D. Aluminum interface needle

7. The patient should be instructed to notify someone immediately if he/she experiences which of the following:
   A. The site becomes red
   B. The site becomes swollen
   C. The site gets wet
   D. All of the above

8. In which of the following sites should IVs be avoided?
   A. Arms with a "dialysis shunt"
   B. The right arm
   C. The lower arm
   D. The foot

9. Which of the following is used to verify the IV site is patent (in the vein and functioning)?
   A. Aspirate the site checking for blood return
   B. Ask the patient if the IV feels like it is in
   C. Have a CT scan done
   D. Check for babinski response

10. The physician wants 300 mL of saline to be given to Mr. Smith over 1 hour. You have a 10 gtt/mL maxi set. How many drops per minute (gtts/min) would the IV need to be set at?
   A. 25 drops per minute
   B. 200 drops per minute
   C. 50 drops per minute
   D. 500 drops per minute

Exam Section 6

Choose the most appropriate answer for the following questions

Pages 56-67

1. Placing the IV into a tendon or ligament may cause the patient to exhibit which of the following:
   A. “Electric Shock” sensation
   B. Pain
   C. Muscle paralysis
   D. All of the above are possible

2. Air entering the IV site is a serious and potentially lethal condition (air embolism). Some potential causes could include:
   A. Not clearing the air out of the IV line during set-up
   B. Not connecting the IV tubing to the end of the IV after starting
   C. Injecting air into the IV line with a syringe
   D. All of the above

3. Which of the following is <u>not</u> part of the process in discontinuing an IV site?
   A. Inspect the site
   B. Apply gauze
   C. Apply a constricting tourniquet
   D. Hand washing

4. Pulling the catheter back over the needle once it has been removed may cause the catheter to sheer off. If this happens while starting the IV, the catheter becomes free floating in the patient’s blood stream (a plastic embolus). The immediate treatment should include all <u>but</u> which of the following?
   A. Place a constricting tourniquet above the IV site
   B. Notify the attending physician
   C. Notify the nurse supervisor
   D. Apply ice

5. After administering an IV drip medication for 15 minutes, you find the patient complains of a runny nose, watery eyes and hives. You are concerned this could be:
   A. A stroke
   B. A serious allergic reaction
   C. Fluid overload
   D. Hyperkalemia

Exam Section 6 (Continued)

Choose the most appropriate answer for the following questions

6. As you are attempting to start an IV, you find the catheter is spurting bright, right blood. The most likely explanation is?
   A. You have punctured the artery
   B. The patient is dehydrated
   C. The patient has been out in the sun
   D. This is a normal condition

7. In relation to the previous question (bright, red blood spurting from the IV catheter), the best course of action is to do all but which of the following?
   A. Apply a warm compress
   B. Immediately withdraw the catheter
   C. Elevate the extremity
   D. Apply direct pressure to the site for at least 15 minutes

8. The IV site should generally be evaluated by placing a tourniquet:
   A. Below the IV site
   B. Just tight enough to prevent venous return and fill the veins
   C. Tight enough to occlude all bleeding
   D. In line with the level of the heart

9. You have an IV bag with 1 gram (1000 mg) of medication in a 250mL bag. The doctor orders 2mg/min. The IV drip set delivers 60 gtts/mL. How fast should the IV run?
   A. 30 mL/hr
   B. 120 mL/hr
   C. 60 mL/hr
   D. 100 mL/h

10. Use the short formula or any other formula to calculate the following: The doctor orders: Lopressor 5 mg IV. You have 25 mg in 5 mL vial on hand. How much medication (mL) should the patient receive?
    A. 1 mL
    B. 10 mL
    C. 0.1 mL
    D. This cannot be done