IV Solution: Preparing and Administering

What is The Process of Preparing and Administering an IV Solution?
› Preparing and administering an intravenous (IV) solution involves verifying that the solution is ordered by the treating clinician, priming the administration set, evaluating the patient’s IV site for infusion readiness (e.g., absence of signs of infection, infiltration, phlebitis), disinfecting the port or needleless connector, and infusing the solution at the prescribed rate. This Nursing Practice & Skill provides general information on preparing and administering a maintenance IV solution without added medication; see the related series of Nursing Practice & Skill topics for information about administering IV medications
• What: IV fluids are prepared and administered to prevent and treat a wide range of physiologic conditions (see below for Why is Preparing and Administering an IV Solution Important?)
• How: After confirming the patient’s IV access site is viable and verifying the clinician’s orders, the solution is prepared by removing the protective cover from the IV bag, labeling the bag, spiking the bag, priming the IV tubing, hanging the bag on an IV pole, and connecting the IV tubing to the patient’s vascular access device (VAD); the IV solution is then administered at the prescribed flow rate via gravity or using an infusion pump. Aseptic non-touch technique (ANTT; i.e., a type of aseptic technique in which the skin is not touched after it has been prepared with antiseptic cleanser, and sterile items are not permitted contact with any nonsterile items before introduction into the patient) is used when administering IV solutions. Maintaining ANTT helps to reduce the risk for catheter-related bloodstream infections (CRBSIs)
• Where: IV solutions are prepared and administered in all healthcare settings where IV therapy is provided
• Who: Generally, physicians and advanced-practice clinicians order IV therapy and registered nurses are responsible for preparing and ensuring proper administration of the IV solution. The procedure cannot be delegated to assistive personnel

What is the Desired Outcome of Preparing and Administering an IV Solution?
› The desired outcome of preparing and administering IV solutions is to deliver the fluid as prescribed while avoiding CRBSI and other potential complications of IV therapy (see Red Flags, below)

Why is Preparing and Administering an IV Solution Important?
› IV solutions are prepared and administered to maintain the body’s fluid balance, replace lost volume, and/or provide supplemental electrolytes. Conditions which can necessitate replacement of fluid volume include acute burns, trauma, hemorrhage, polyuria, fever, dehydration, and third spacing (i.e., accumulation of fluid in the peritoneal, pleural, or other body cavity)
Facts and Figures

› Guidelines for IV fluid therapy in pediatric patients issued by the U.K.’s National Institute for Health and Care Excellence (NICE) recommend administration of isotonic crystalloid solutions for fluid resuscitation to treat dehydration and hypovolemic shock, as well as for maintenance therapy. It is further recommended that if hypernatremia (i.e., elevated blood sodium level) develops, the prescriber consider switching to a hypotonic solution to correct the electrolyte imbalance (see What You Need to Know Before Preparing and Administering IV Solution, below); (NICE, 2015)

› Cochrane reviewers examined data from 70 randomized, controlled trials comparing outcomes between critically ill burn, trauma, and postoperative patients receiving colloid solutions and those receiving crystalloid solutions. They found no evidence that colloid solutions improve survival rates and they advocate for routine use of crystalloid solutions for IV fluid therapy in critically ill patients, instead of colloid solutions, because crystalloid solutions are less expensive than colloid solutions (Perel et al., 2013)

› Guidelines for the management of sepsis recommend early, aggressive fluid resuscitation which is commonly achieved using normal saline (NS; i.e., 0.9% saline in sterile water), an isotonic crystalloid solution (see What You Need to Know Before Preparing an IV Solution, below). In a 10-month study of pediatric patients with sepsis, however, researchers found that fluid resuscitation using lactated Ringer’s solution (LR; a more “balanced” isotonic crystalloid solution) resulted in better clinical outcomes, including lower mortality rate, lower rate of metabolic acidosis, lower fluid requirements, and less fluid overload (Samransamruajkit et al., 2017)

What You Need to Know Before Preparing an IV Solution

› Before preparing and administering IV solutions, the clinician should be familiar with the following:

  • Types of IV solutions. There are more than 200 types of IV fluids used in current clinical practice. These fluids can be classified based on tonicity or based on the state of the particles in the solution (dissolved or insoluble)

  – Tonicity describes the solute concentration of a solution outside a cell and reflects osmotic activity or osmotic pressure (i.e., the force or pressure exerted by a solution with higher ion concentration against a solution with a lower ion concentration) that causes fluid movement toward the area of higher concentration. There are three tonicity categories of IV solutions: isotonic, hypertonic, and hypotonic

  - Isotonic (or iso-osmotic) fluids are fluids that are of equal or near-equal to normal blood osmolarity (270–300 milliosmoles per liter [mOsm/L]). In an isotonic condition there is no net movement of fluid into or out of the cell because the isotonic solution has the same osmolarity as the cells. NS is an example of an isotonic fluid

  - Hypotonic fluids have a tonicity of < 270 mOsm/L. Hypotonic solutions (i.e., solutions with a lower ion concentration than blood plasma, which has an average osmolality of approximately 290 mOsm/L) will move fluid into cells and interstitial tissue to provide hydration. Caution must be used when administering hypotonic solutions to prevent over-hydration, cellular swelling, and cell destruction/bursting. Examples of hypotonic solutions are 0.45% NS and D5NS

  - Hypertonic fluids have a tonicity of > 300 mOsm/L. Hypertonic solutions cause fluid to move from the cell to the extracellular fluid compartment (ECF; i.e., all body fluid outside the cells)—hypertonic solutions cause the cells to shrink and are used to replace electrolytes. Hypertonic dextrose solutions move ECF from the interstitial spaces (area surrounding tissue) to intravascular spaces. Hypertonic fluids include 2.5%NS or 5% NS

  - Osmolarity and osmolality are units of measurement that calculate osmotic activity—osmoles and milliosmoles describe the molecular weight of a solute particle in grams

  - Osmolarity is the number of milliosmoles/liter (mOsm/L) of a solution—the concentration of an osmotic solution

  - Osmolality is the number of milliosmoles/kg (mOsm/kg) of solvent—the concentration of the particles dissolved in a fluid

  – When classifying IV solutions based on the state of particles within the solution (e.g., dissolved or insoluble), they are divided into two categories: crystalloid and colloid

  - Crystalloids are aqueous solutions of mineral salts or other water-soluble molecules that shift easily between vascular and intravascular spaces. Crystalloids include

    - 0.9% NS

    - 0.45% NS

    - LR

    - 5% dextrose in water (D5W)

    - dextrose 5% in saline (e.g., D5 0.45% saline or D5 0.9% NS)

    - hypertonic saline (3% or 5%)
Compared to crystalloids, colloids are solutions that contain larger microscopic insoluble molecules dispersed and suspended in solution that tend to remain within the intravascular space, making this type of fluid useful for expansion of intravascular fluid volume. Colloids include:
- dextran (i.e., polysaccharide)
- hetastarch (i.e., hydroxyethyl, plasma volume expander), also known as Hespan, Hextend
- mannitol (i.e., sugar alcohol), also known as Osmotrol
- Natural colloidal solutions include red blood cells, fresh or frozen plasma, albumin (i.e., plasma protein)

• The potential complication of fluid overload (i.e., excessive intravascular volume beyond the capacity of the heart to pump effectively). Signs and symptoms include:
  – jugular venous distention
  – increased weight
  – hypertension
  – intake > output
  – elevated respiratory rate, adventitious breath sounds, shortness of breath—acute dyspnea, possible pulmonary edema
  – elevated rise in heart rate
  – exacerbation of cardiac conditions (e.g., heart failure with fatigue, pitting edema)
  – exacerbation in renal conditions

• Nursing responsibilities regarding IV therapy, which include:
  – Monitoring the patency and condition of the IV infusion
  – Maintaining infection control protocols and standard precautions. ANTT must be strictly followed when spiking IV bags and when connecting IV tubing to the VAD to avoid contamination of the IV solution, tubing, or VAD
  – Changing the IV dressing, VAD, and administration set according to facility guidelines will help prevent CRBSIs. The Infusion Nursing Society (INS) guidelines recommend the following schedule for replacing/changing
    - dressings, unless the dressing is damp, loosened, is visibly soiled:
      - Transparent semipermeable membrane (TSM): every 5–7 days (a gauze dressing underneath a TSM dressing is considered a gauze dressing)
      - Gauze: at least every 2 days
    - VADs are not removed based solely on a length of dwell time. INS recommends VADs be removed
      - if no longer included in the patient’s plan of care
      - if not accessed within previous 24 hours
      - if clinically indicated, based on signs and symptoms of complications
    - primary and secondary continuous administration sets (i.e., used for continuous infusions [excluding those used to administer parenteral nutrition, lipid, blood, or blood products] that are not disconnected from and reattached to the patient’s VAD): no more frequently than every 96 hours—avoid disconnecting primary administration sets from the VAD
    - secondary administration sets detached from primary administration sets: every 24 hours
    - intermittent administration sets: every 24 hours
    - administration sets used for
      - parenteral nutrition solutions: at least every 24 hours
      - intravenous fat emulsions/lipids with each new container of solution
      - propofol every 6–8 hours or when the container is changed
      - blood and blood components: after the completion of each unit or every 4 hours (if more than a single unit can be transfused in 4 hours, the administration set can be used for the 4-hour period unless prohibited by facility/unit-specific or blood bank protocol)
  – Back-priming infusion methods (i.e., a method of removing air in secondary set administration set tubing without disconnecting the tubing from the primary set; involves lowering the secondary set below the level of the primary tubing that is infusing and allowing the primary infusion solution to prime the secondary line, clamping the secondary line, and attaching the secondary set solution) are preferred when IV solutions are compatible to reduce the risk of contamination caused by disconnecting secondary intermittent administration sets
  – The potential for infection increases with the number of add-on devices (e.g., stopcocks, VAD hubs, extension sets, needleless systems) and each time the system is opened (i.e., tubing detached and reattached)
The nurse clinician must regularly assess the IV insertion site and related equipment per facility protocol using both inspection and palpation to identify infiltration (Figure 1), infection, phlebitis (Figure 2), or other complication; if a complication cannot be resolved, the VAD must be removed and treatment administered per clinician’s order.

- INS guidelines recommend that short peripheral VADs be assessed minimally
- for adults at least every 4 hours and every 1—2 hours for patients who are critically ill/sedated, or have cognitive deficits
- hourly for neonatal/pediatric patients
- more frequently for patients receiving vesicant medication(s)

For more information on preventing IV therapy-related complications, see Nursing Practice & Skill... Intravenous Therapy: Preventing Complications.

![Image](image1.png)

**Figure 1:** The Infusion Nurses Society has established a scale for evaluating infiltration that ranges from Grade 0 (no symptoms) to Grade 4 (skin blanched and translucent; skin tight and leaking, discolored, bruised and swollen; gross edema > 6 in/15 cm in any direction, deep pitting tissue edema, circulatory impairment, moderate to severe pain). Grade 4 is automatically applied to infiltration of ANY amount of blood product, irritant, or vesicant solution. Copyright © 2014, EBSCO Information Services.

![Image](image2.png)

**Figure 2:** Example of phlebitis at IV site. Copyright © 2014, EBSCO Information Services.

- Medication administration. IV solutions are prescribed medications; adherence to the six “rights” of medication administration (i.e., right patient, right drug, right dose, right time, right route, and right documentation [following administration]) is essential to reduce the risk for medication errors and complications such as allergic reaction (for more information on preventing medication errors, see Nursing Practice & Skill... Medication Errors: Preventing Errors Associated with Intravenous Medications and Infusions).

- How to calculate the flow rate if the solution is to be administered using an IV pump and the drip rate if the solution is to be administered via gravity (for more information, see Nursing Practice & Skill... Intravenous Infusions, Continuous:...
Calculating Doses and Flow Rates and Administering and Nursing Practice & Skill ... Intravenous Infusions, Continuous: Calculating the Drip Rate for a Gravity Flow Administration Set

Preliminary steps that should be performed before preparing and administering IV solutions include:
- Review facility/unit-specific protocol for preparing and administering an IV solution, and for the schedule for changing VAD dressings, VADs, and administration sets, if these are available
- Review the treating clinician’s order for prescribed IV solution to be administered
- Verify completion of facility informed consent documents, as necessary. Typically the standard “consent to treat” document completed on admission is sufficient to allow administration of IV therapy
- Review the patient's medical history/medical record for
  – indications for IV therapy
  – any allergies (e.g., to latex, medications, or other substances); use alternative materials as appropriate

Gather the necessary supplies, which typically include:
- Gloves; additional personal protective equipment (PPE; e.g., gown, face shield, mask and eye protection) can be required depending on the need for special precautions or if exposure to body fluids is anticipated
- Medication administration record (MAR)
- Prescribed IV solution and facility-approved IV solution label
- IV administration set and facility-approved label
- IV infusion pump, if indicated
- IV pole
- Facility-approved antiseptic solution
- Sterile gauze to cleanse VAD
- Written information to reinforce verbal education

How to Prepare and Administer an IV Solution

- Perform hand hygiene and don PPE
- Identify the patient using at least two unique identifiers or per facility protocol
- Establish privacy by closing the door to the patient’s room and/or drawing the curtain surrounding the patient’s bed
- Introduce yourself to the patient and family member(s) and explain your clinical role
- Assess the patient and the family for knowledge deficits and anxiety regarding IV therapy
  - Determine if the patient/family requires special considerations regarding communication (e.g., due to illiteracy, language barriers, deafness); make arrangements to meet these needs if they are present
  - Use a professional certified medical interpreter when a language barrier exists
  - Explain the procedure, its purpose, and the patient’s expected participation during the procedure; answer questions and provide emotional support as needed
- Observe standard precautions and use ANTT throughout the procedure
- Assess the patient’s I.V site for complications (e.g., swelling, redness, drainage, and pain), indications of infiltration, drainage, or infection. If the complications cannot be resolved, remove the VAD
- Insert a VAD at a different location (see Nursing Practice & Skill ... Peripheral Intravenous Cannula: Over-the-Needle Catheter Insertion)
- Verify the first 5 “rights” of medication administration by checking the solution against the MAR and the clinician’s order to ensure it is the right dose of the right solution, being prepared for the right patient, at the right time; verify the solution is infusing at the prescribed rate
- Remove the protective cover from the IV solution bag
- Inspect the IV solution
  - Check the bag for punctures, cracks, or leaks, and the solution for clarity, color, and absence of particulate matter
  - Verify the expiration date indicates the solution remains viable
- Label the IV solution bag with the date, time, patient’s name/room number, and initial
- Unwrap the administration set and close the roller clamp
- Invert the IV solution and remove the protective covering the IV solution port
- Hold the spike port of the IV administration set in your dominant hand (do not allow the excess tubing to drop to the floor) and remove the cap from the spike
Using ANTT, insert the spike port of the administration set into the IV solution bag tubing port; verify the entire length of the spike is inserted securely into the port
Hang the IV solution bag on the IV pole, while maintaining hold of the administration set tubing
Rhythmically compress the drip chamber until the chamber is half full
Loosen the cap from the proximal end of the IV administration set, open the roller clamp, and prime the tubing (i.e., allow the tubing to fill with IV fluid and displace all air)
Once the tubing is completely primed, close the roller clamp and tighten the cap
Cleanse the patient’s VAD by rubbing vigorously with a facility-approved antiseptic agent; remove the cap from the proximal end of the IV administration set and connect to the VAD
Open the roller clamp on the IV administration set and begin the infusion:
  • If by gravity, adjust the roller clamp to regulate the flow of IV fluids at the prescribed drip rate
  • If by infusion pump, thread the administration set tubing through the infusion pump, and program the pump to deliver the IV solution at the prescribed infusion rate
Label the administration set tubing with the date, time, and initial
Discard used materials into the appropriate receptacle(s); perform hand hygiene
Document the following information in the patient’s medical record and the MAR:
  • Date and time solution was prepared and the infusion initiated; record intermittent monitoring and assessment information
  • Type of solution infused and rate of infusion
  • Patient assessment information, including assessment of IV access site before, during, and after administration
  • Any unexpected patient events or outcomes, interventions performed and if the treating clinician was notified, and patient outcome
  • Patient/family education, including topics presented, response to education provided/discussed, plan for follow-up education, and details regarding any barriers to communication and/or techniques that promoted successful communication

Other Tests, Treatments, or Procedures that Can be Necessary Before or After Preparing and Administering an IV Solution
Frequently monitor the patient, IV insertion site and related equipment, especially for adverse effects related to the infusion and for IV complications

What to Expect After Preparing and Administering an IV Solution
The IV solution is prepared correctly using aseptic technique
The IV solution is infused at the rate ordered by the treating clinician

Red Flags
Monitor for fluid overload in all patients receiving IV fluids. The treating clinician should be notified immediately, and the patient is generally treated with diuretics and oxygen therapy
Risk for hypersensitivity and anaphylaxis is increased in patients who are receiving colloids, particularly albumin
LR can increase serum potassium levels which increases risk for cardiac arrhythmias; monitor electrolyte levels in patients receiving LR

What Do I Need to Tell the Patient/Patient’s Family?
Explain the purpose of and steps involved in IV fluid therapy, and address any questions or concerns
Reinforce to the patient the importance of notifying the clinician of discomfort or other symptoms experienced during the infusion

References


