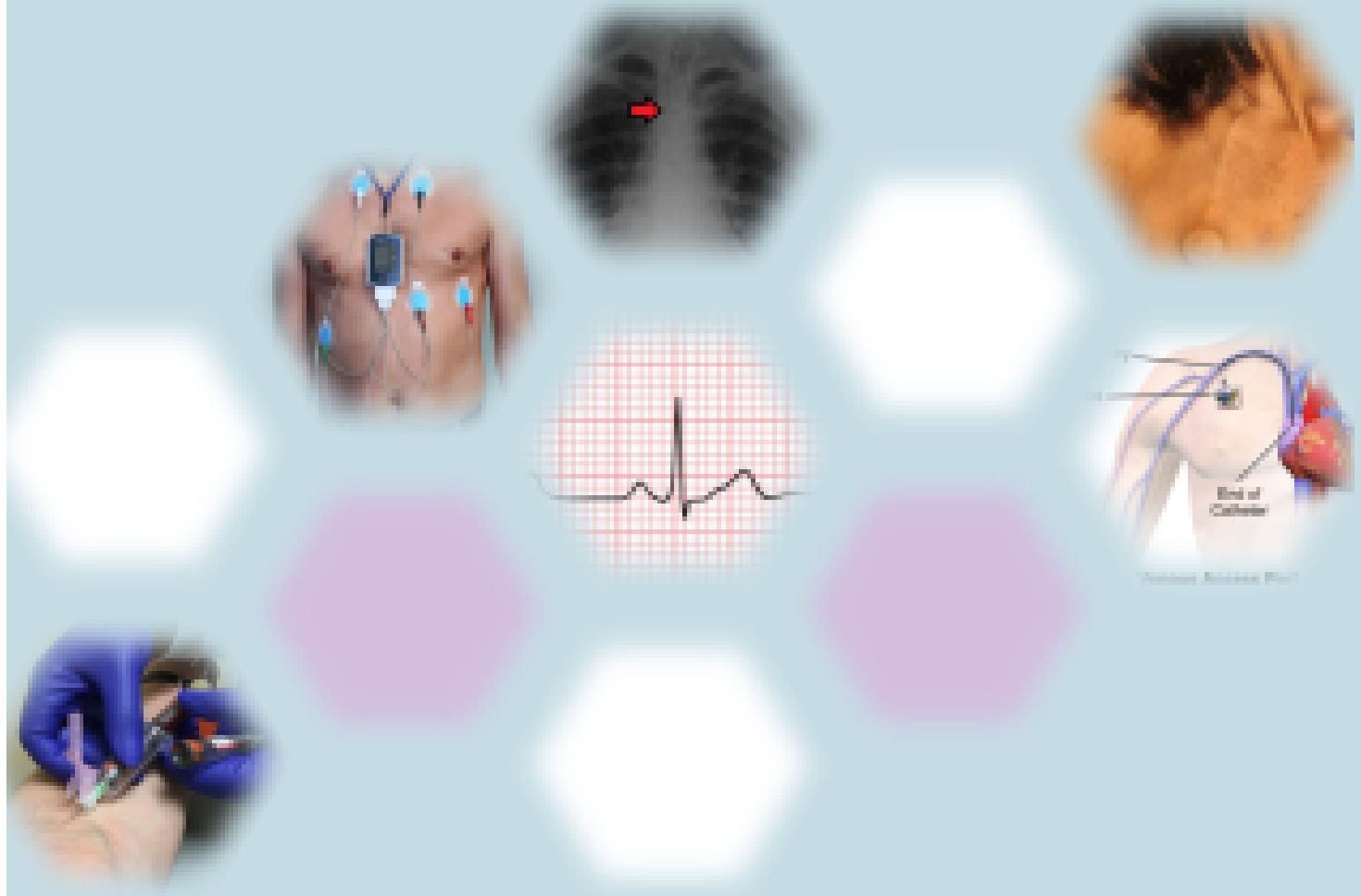
Nursing Advanced Skills



Nursing Advanced Skills

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OPEN RESOURCES FOR NURSING (OPEN RN)

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Part IV. Chapter 4 Manage Central Lines

Part V. Chapter 5 Insert Nasogastric and Feeding Tubes

Part VI. Chapter 6 Manage Chest Tube Drainage Systems

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Part VIII. Answer Keys

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Content is based on the Wisconsin Technical College System (WTCS) statewide nursing curriculum for the Nursing Advanced Skills course (543-112) and the NCLEX-RN Test Plan.[1] Content includes advanced skills for registered nurses, such as intravenous infusion, blood product administration, management of central lines and chest tube systems, basic electrocardiogram interpretation, and nasogastric/feeding tube insertion, and builds on basic nursing skills discussed in the Open RN *Nursing Skills* OER textbook.

The following YouTube video provides a quick overview of how to navigate the online version.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/nursingadvancedskills/?p=4#oembed-1

1. NCSBN. (n.d.). *2023 NCLEX-RN test plan*. https://www.ncsbn.org/exams/testplans.page

Preface

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Standards and Conceptual Approach

The Open RN *Nursing Advanced Skills* textbook is based on several external standards and uses a conceptual approach.

External Standards

American Nurses Association (ANA)

The ANA establishes Standards for Professional Nursing Practice and the Nursing Code of Ethics.[1,2,3]

- https://www.nursingworld.org/ana/about-ana/standards/

The National Council Licensure Examination for Registered Nurses: NCLEX-RN Test Plans

The NCLEX-RN test plans are updated every three years to reflect fair, comprehensive, current, and entry-level nursing competency.[4]

- https://www.ncsbn.org/nclex.htm

The National League of Nursing (NLN): Competencies for Graduates of Nursing Programs

NLN competencies guide nursing curricula to position graduates in a dynamic health care arena with practice that is informed by a body of knowledge to help ensure the public receives safe, quality care.[5]

- https://www.nln.org/education/nursing-education-competencies/competencies-for-graduates-of-nursing-programs

1. American Nurses Association. (2021). *Nursing: Scope and standards of practice* (4th ed.). American Nurses Association.
2. American Nurses Association. (2015). *Code of ethics for nurses with interpretive statements*. American Nurses Association. https://www.nursingworld.org/practice-policy/nursing-excellence/ethics/code-of-ethics-for-nurses/
3. American Nurses Association. (2014). *Psychiatric-mental health nursing: Scope and standards of practice* (2nd ed.). Nursesbooks.org.
4. NCSBN. (n.d.). *2023 NCLEX-RN test plan*. https://www.ncsbn.org/exams/testplans.page
5. National League of Nursing. *Competencies for graduates of nursing programs*. https://www.nln.org/education/nursing-education-competencies/competencies-for-graduates-of-nursing-programs

American Association of Colleges of Nursing (AACN): The Essentials: Competencies for Professional Nursing Education

The AACN provides a framework for preparing individuals as members of the discipline of nursing, reflecting expectations across the trajectory of nursing education and applied experience.[6]

- https://www.aacnnursing.org/Portals/42/AcademicNursing/pdf/Essentials-2021.pdf

Infusion Nurses Society

Infusion therapy standards of practice, established by the Infusion Nurses Society, are incorporated into the chapters regarding initiating intravenous (IV) therapy, administering IV push medications, administering blood products, and managing central lines..[7]

- https://www.ins1.org/

Quality and Safety Education for Nurses (QSEN) Institute: Prelicensure Competencies

Quality and safety competencies include knowledge, skills, and attitudes to be developed in nursing prelicensure programs. QSEN competencies include patient-centered care, teamwork and collaboration, evidence-based practice, quality improvement, safety, and informatics.[8]

- https://qsen.org/competencies/

Wisconsin State Legislature, Administrative Code Chapter N6

6. American Association of Colleges of Nursing. (2021). *The essentials: Core competencies for professional nursing education*. https://www.aacnnursing.org/Portals/42/AcademicNursing/pdf/Essentials-2021.pdf
7. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org
8. QSEN. (n.d.). *About*. https://qsen.org/about-qsen/

The Wisconsin Administrative Code governs the Registered Nursing and Practical Nursing professions in Wisconsin.[9]

- https://docs.legis.wisconsin.gov/code/admin_code/n/6

Healthy People 2030

Healthy People 2030 envisions a society in which all people can achieve their full potential for health and well-being across the life span. Healthy People provides objectives based on national data and includes social determinants of health.[10]

- https://health.gov/healthypeople

Conceptual Approach

The Open RN *Nursing Advanced Skills* textbook incorporates the following concepts:

- **Evidence-Based Practice (EBP).** Evidence-based practices are referenced by footnotes throughout the textbook. To promote the development of digital literacy, links are provided to credible, free online resources that supplement content. The Open RN textbooks will be updated as new EBP is established and after the release of updated NCLEX Test Plans every three years.
- **Clinical Judgment.** Learning activities include case studies written to reflect verbiage by the NCSBN Clinical Judgment Measurement Model used on the NCLEX-RN. Formative assessments encourage students to recognize cues, analyze cues, prioritize hypotheses, generate solutions, take action, and evaluate outcomes.[11]

9. Wisconsin State Legislature. (2018). *Chapter 6: Standards of practice for registered nurses and licensed practical nurses.* Board of Nursing. https://docs.legis.wisconsin.gov/statutes/statutes/441
10. Healthy People 2030. (n.d.). *Social determinants of health*. U.S. Department of Health and Human Services. https://health.gov/healthypeople/objectives-and-data/social-determinants-health
11. Dickison, P., Haerling, K. A., & Lasater, K. (2019). Integrating the National Council of State Boards of Nursing clinical judgment model into nursing educational frameworks. *Journal of Nursing Education*. *58*(2), 72-78. https://doi.org/10.3928/01484834-20190122-03

- **Cultural Competency.** Nurses have an ethical obligation to practice with cultural humility and provide culturally responsive care to the clients and communities they serve based on the ANA Code of Ethics[12] and the ANA Scope and Standards of Practice.[13]
- **Safe, Quality, Patient-Centered Care.** Content reflects the priorities of safe, quality, patient-centered care.
- **Clear and Inclusive Language.** Clear language is used based on preferences expressed by prelicensure nursing students to enhance understanding of complex concepts.[14] "They" is used as a singular pronoun to refer to a person whose gender is unknown or irrelevant to the context of the usage, as endorsed by APA style. It is inclusive of all people and helps writers avoid making assumptions about gender.[15]
- **Open-Source Images and Fair Use.** Images are included to promote visual learning. Students and faculty can reuse open-source images by following the terms of their associated Creative Commons licensing. Some images are included based on Fair Use as described in the "Code of Best Practices for Fair Use and Fair Dealing in Open Education" presented at the OpenEd 2020 conference. Refer to the footnotes of images for source and licensing information throughout the text.
- **Open Pedagogy.** Students are encouraged to contribute to the Open RN project in meaningful ways by reviewing content for clarity and assisting in the creation of open-source images.[16]

Supplementary Material Provided

Several supplementary resources are provided with this textbook.

12. American Nurses Association. (2015). *Code of ethics for nurses with interpretive statements*. American Nurses Association. https://www.nursingworld.org/practice-policy/nursing-excellence/ethics/code-of-ethics-for-nurses/
13. American Nurses Association. (2021). *Nursing: Scope and standards of practice* (4th ed.). American Nurses Association.
14. Verkuyl, M., Lapum, J., St-Amant, O., Bregstein, J., & Hughes, M. (2020). Healthcare students' use of an e-textbook open educational resource on vital sign measurement: A qualitative study. *Open Learning: The Journal of Open, Distance and e-Learning*. https://doi.org/10.1080/02680513.2020.1835623
15. American Psychological Association. (2021). *Singular "they."* https://apastyle.apa.org/style-grammar-guidelines/grammar/singular-they
16. The Open Pedagogy Notebook by Steel Wagstaff is licensed under CC BY 4.0

- Supplementary, free videos promote student understanding of how to perform procedures.
- Online, interactive, and written learning activities provide formative feedback.
- Critical thinking questions encourage the development of clinical judgment as students apply content to realistic patient scenarios.
- Free downloadable textbook versions are available for offline use.
- Affordable soft cover print versions are published by XanEdu and available on Amazon and in college bookstores based on the finding that over 65% of students prefer a print version of their textbooks.[17]

17. Verkuyl, M., Lapum, J., St-Amant, O., Bregstein, J., & Hughes, M. (2020). Healthcare students' use of an e-textbook open educational resource on vital sign measurement: A qualitative study. *Open Learning: The Journal of Open, Distance and e-Learning*. https://doi.org/10.1080/02680513.2020.1835623

PART I

CHAPTER 1 INITIATE IV THERAPY

1.1 Introduction

Learning Objectives

- Discuss methods for blood sampling
- Compare/contrast management of peripheral venous access devices and central venous access devices
- Review infection control principles associated with peripheral venous access devices
- Explain the principles of peripheral intravenous site selection and contraindications
- Discuss appropriate selection of IV catheter type and size
- Explain nurse management of IV therapy and peripheral IV access devices
- Identify modifications for performing IV therapy across the life span
- Outline nursing management for patients with a patient-controlled analgesia (PCA) pump
- Describe nursing implications for a patient with an epidural infusion for pain management

Intravenous (IV) therapy is an important part of clinical care. It can be used to restore fluids, administer blood products or medications, or serve as an alternate route for nutrition when the gastrointestinal tract is not functioning adequately. IV therapy is a common intervention in nursing practice and useful for rapidly addressing symptoms and restoring hemostasis. Although initiating IV therapy is a common nursing intervention, it is an invasive skill and requires diligent safety practices to prevent and address complications.

1.2 Basic Concepts of Venipuncture and Intravenous Therapy

Nurses access clients' veins to collect blood (i.e., perform phlebotomy) and to administer intravenous (IV) therapy. This section will describe several methods for collecting blood, as well as review the basic concepts of IV therapy.

Blood Collection

Nurses collect blood samples from clients using several methods, including venipuncture, capillary blood sampling, and blood draws from venous access devices. Blood may also be drawn from arteries by specially trained professionals for certain laboratory testing.

Venipuncture

Venipuncture involves the process of introducing a needle into a client's vein to collect a blood sample or insert an IV catheter. See Figure 1.1[1] for an image of venipuncture. Blood sampling with venipuncture may be initiated by a nurse, phlebotomist, or other trained personnel. Venipuncture for collection of a blood sample is an important part of data collection to assess a client's health status. It is commonly performed to examine hematologic and immune issues such as the body's oxygen carrying capacity, infection, and clotting function. It is also useful for assessing metabolic and nutrition issues such as electrolyte status and kidney functioning.

1. "Venipuncture_using_a_BD_Vacutainer.JPG" by MatthewLammers is licensed under CC BY-SA 4.0

Figure 1.1 Venipuncture

Blood collection is commonly performed via venipuncture from veins in the arms or hands. The most common sites for venipuncture are the large veins located on the antecubital fossa (i.e., the inner side of the elbow). These veins are often preferred for venipuncture because their larger size increases their ability to withstand repetitive blood sampling. However, these veins are not preferred for intravenous therapy due to the mechanical obstruction that can occur in the IV catheter when the elbow joint is contracted.

To perform the skill of venipuncture, the nurse performs many similar steps that occur with IV cannulation. The process of venipuncture for blood sample

collection is outlined in the "Perform Venipuncture Blood Draw" checklist later in this chapter.

Blood Samples From Central Venous Access Devices

Blood may also be collected by nurses from a client's existing **central venous access device (CVAD)**. A CVAD is a type of vascular access that involves the insertion of a catheter into a large vein in the arm, neck, chest, or groin.[2] CVADs are discussed in more detail in the "Manage Central Lines" chapter that also contains the "Obtain a Blood Sample From a CVAD" checklist.

Capillary Blood Sampling

Nurses also collect small amounts of blood for testing via capillary blood sampling. **Capillary blood testing** occurs when blood is collected from capillaries located near the surface of the skin. Capillaries in the fingers are used for testing in adults whereas capillaries in the heels are used for infants. An example of capillary blood testing is bedside glucose testing. See Figure 1.2[3] for an image of capillary blood glucose testing.

2. Centers for Disease Control and Prevention. (2010, November 25). *Central line-associated bloodstream infection (CLABSI)*. https://www.cdc.gov/hai/bsi/bsi.html
3. "Blood_Glucose_Testing.JPG" by David-i98 is licensed under CC BY-SA 3.0

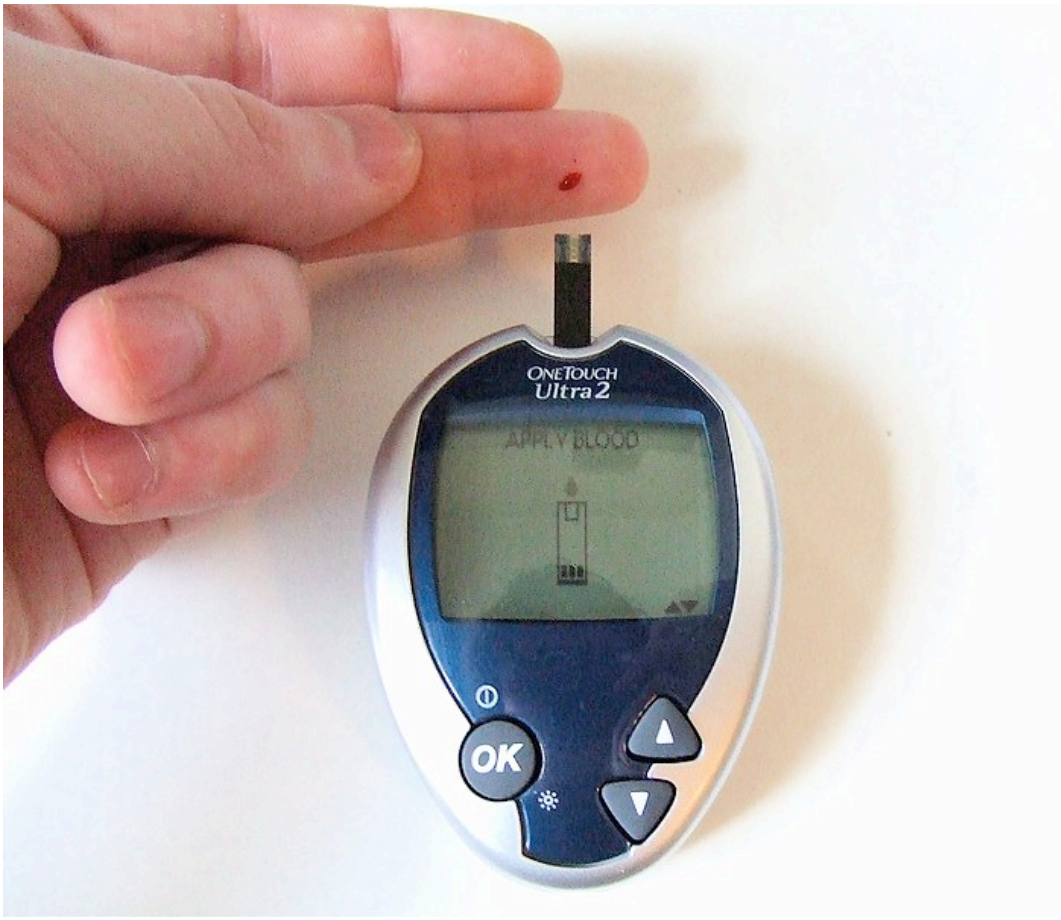

Figure 1.2 Capillary Blood Glucose Testing

Capillary blood testing is typically used when repetitive sampling is needed. However, not all blood tests can be performed on capillary blood, and some clinical conditions make capillary blood testing inappropriate, such as when a client is hypotensive with limited venous return.

> Review how to perform capillary blood glucose testing in the "Blood Glucose Monitoring" section of the "Specimen Collection" chapter of Open RN *Nursing Skills*.

Arterial Blood Sampling

Arterial blood sampling occurs when blood is obtained via puncture into an artery by specially trained registered nurses and other health care personnel,

such as respiratory therapists, physicians, nurse practitioners, and physician assistants. Arterial blood collection is most commonly performed to assess the body's acid-base balance in a diagnostic test called an arterial blood gas. (For more information on arterial blood gas interpretation, please review Open RN *Nursing Fundamentals* Chapter 15). The most common access site for arterial blood sampling is the radial artery. See Figure 1.3[4] for an image of arterial blood sampling. Arterial blood tests are known to be more painful for the patient than venipuncture and have a higher risk of complications such as bleeding and arterial occlusion with subsequent ischemia to the area distal to the puncture.

ARTERIAL LINES

For clients who require repetitive arterial blood sampling or are hemodynamically unstable, an arterial line may be inserted by specially trained personnel. Arterial lines are specialized tubes that are inserted and maintained in an artery to assist with continuous blood pressure monitoring. They also allow for repeated blood sampling without repetitive puncture, thus decreasing the amount of discomfort for the client. The radial artery is the most common site used for arterial lines. Nurses must not confuse arterial lines with peripheral or central vein access devices. Arterial lines can be distinguished from venous lines by their specialized pressure tubing, which is firm and non-pliable and is connected to a pressure bag to maintain constant pressurized fluid in the tubing. Medications, fluid boluses, and maintenance IV fluids must never be infused through an arterial line. See Figure 1.3[5] for an image of arterial lines. The condition of the arterial access site, as well as perfusion of the client's hand, is continually monitored when an arterial line is in place to prevent complications.

4. American Nurses Association. (2021, April). Use of medication assistant/aides/technicians. *ANA Issue Brief.* https://www.nursingworld.org/~498e32/contentassets/a2ff1bd2d5ca467699c3bc764f7d9198/issue-brief-medication-aides-4-2021.docx
5. "Arterial line.jpg" by Chippewa Valley Technical College is licensed under CC BY 4.0

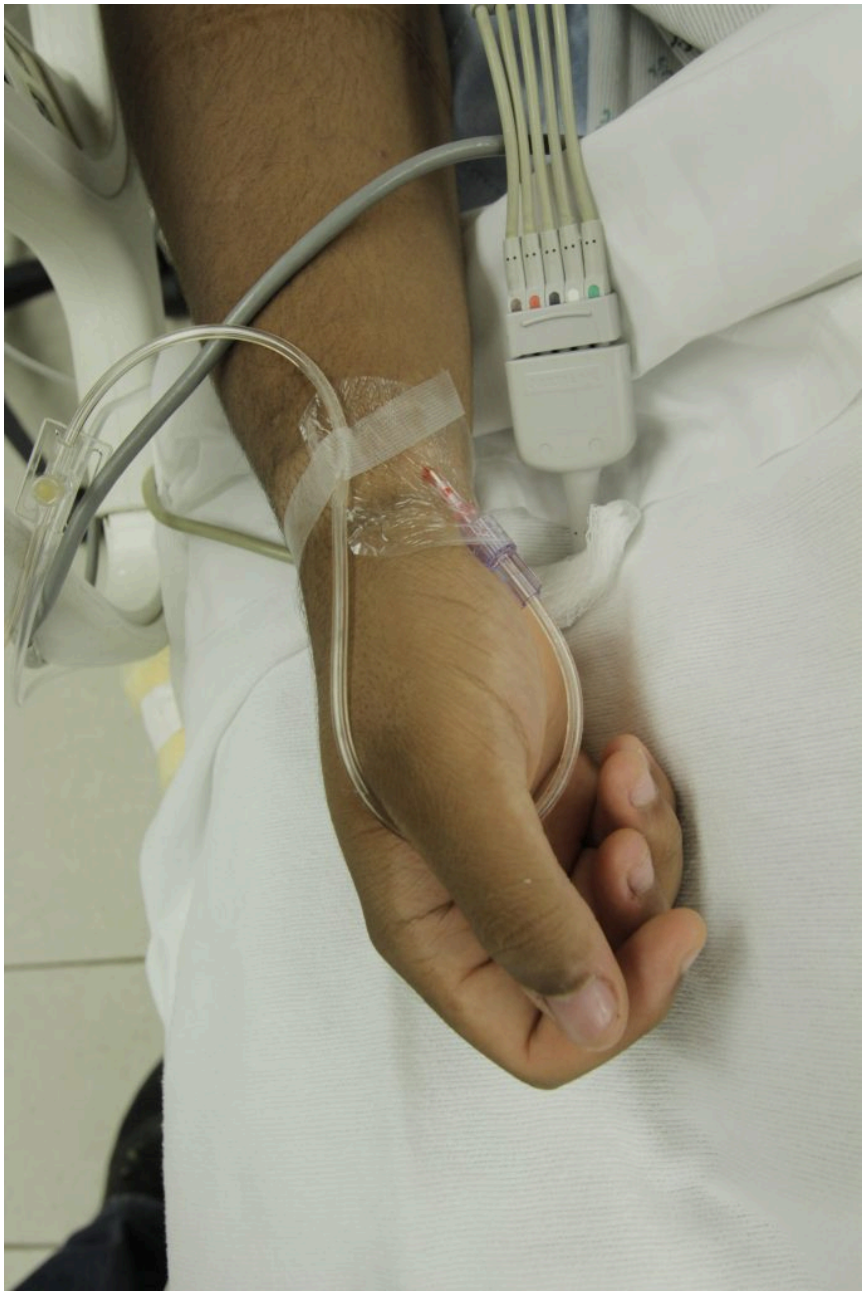

Figure 1.3 Arterial Lines

Intravenous Therapy

In addition to collecting blood samples, nurses also access clients' veins to administer intravenous therapy.**Intravenous therapy (IV therapy)** involves the administration of substances such as fluids, electrolytes, blood products, nutrition, or medications directly into a client's vein. The intravenous route is preferred to administer fluid and medications when rapid onset of the medication or fluid is needed. The direct administration of medication into the bloodstream allows for a more rapid onset of medication actions,

restoration of hydration, and correction of nutritional deficits. IV therapy is often used to restore fluids and/or electrolyte balances more efficiently than what would be achieved via the oral route.

Fluid Balance

Fluid balance is an important part of optimal cellular functioning, and administration of fluids via the venous system provides an efficient way to quickly correct fluid imbalances. Additionally, many individuals who are physically unwell may not be able to tolerate fluids administered through their gastrointestinal tract, so IV administration is necessary.

When clients experience deficient fluid volume, intravenous (IV) fluids are often used to restore fluid to the intravascular compartment or to facilitate the movement of fluid between compartments through the process of osmosis. There are three types of IV fluids: isotonic, hypotonic, and hypertonic.[6]

> Review movement of fluid between compartments of the body in the "Basic Fluid and Electrolyte Concepts" section of the "Fluids and Electrolytes" chapter in Open RN *Nursing Fundamentals*.

ISOTONIC SOLUTIONS

Isotonic solutions are IV fluids that have a similar concentration of dissolved particles as found in the blood. Examples of isotonic IV solutions are 0.9% normal saline (0.9% NaCl) or lactated ringers (LR). Because the concentration of isotonic IV fluid is similar to the concentration of blood, the fluid stays in the intravascular space, and osmosis does not cause fluid movement between

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cells. See Figure 1.4[7] for an illustration of isotonic IV solution administration that does not cause osmotic movement of fluid. Isotonic solutions are typically used for patients with fluid volume deficit (also called hypovolemia) to raise their blood pressure. However, infusion of too much isotonic fluid can cause excessive fluid volume (also referred to as hypervolemia).[8]

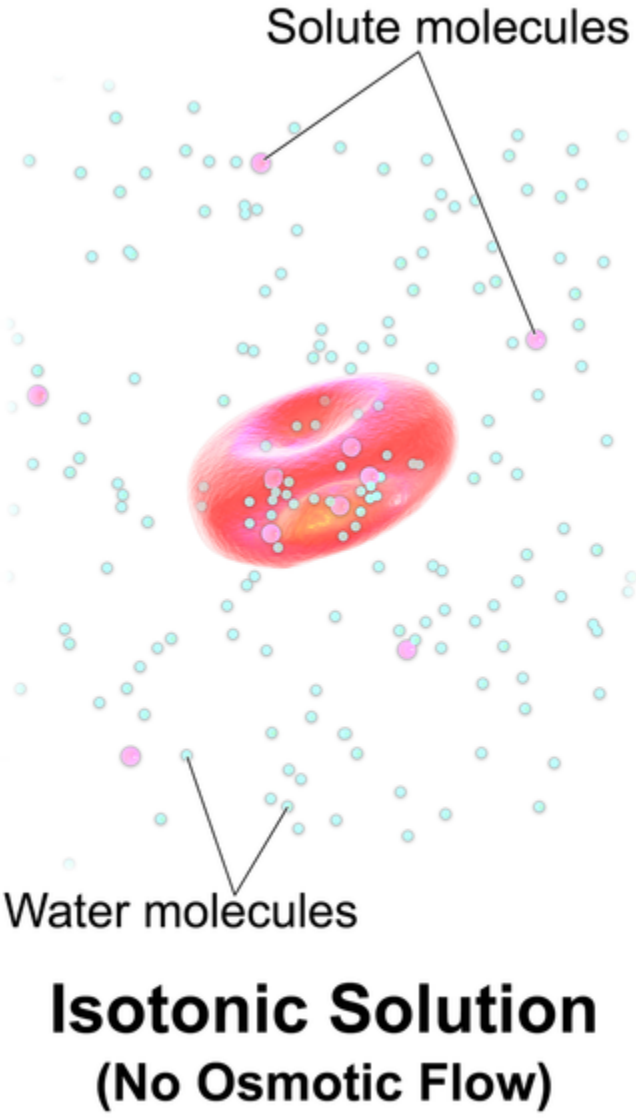

Figure 1.4 Isotonic IV Solution Causes No Osmotic Fluid Movement

7. "Blausen_0685_OsmoticFlow_Isotonic.png" by BruceBlaus.com staff is licensed under CC BY 3.0
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HYPOTONIC SOLUTIONS

Hypotonic solutions have a lower concentration of dissolved solutes than blood. An example of a hypotonic IV solution is 0.45% normal saline (0.45% NaCl). When hypotonic IV solutions are infused, it results in a decreased concentration of dissolved solutes in the blood as compared to the intracellular space. This imbalance causes osmotic movement of water from the intravascular compartment into the intracellular space. For this reason, hypotonic fluids are used to treat cellular dehydration. See Figure 1.5[9] for an illustration of the osmotic movement of fluid into a cell when a hypotonic IV solution is administered, causing lower concentration of solutes (pink molecules) in the bloodstream compared to within the cell.[10]

However, if too much fluid moves out of the intravascular compartment into cells, cerebral edema can occur. It is also possible to cause worsening hypovolemia and hypotension if too much fluid moves out of the intravascular space and into the cells. Therefore, client status should be monitored carefully when hypotonic solutions are infused.[11]

9. "Blausen_0684_OsmoticFlow_Hypotonic.png" by BruceBlaus.com staff is licensed under CC BY 3.0
10. This work is a derivative of Nursing Fundamentals by Open RN and is licensed under CC BY 4.0
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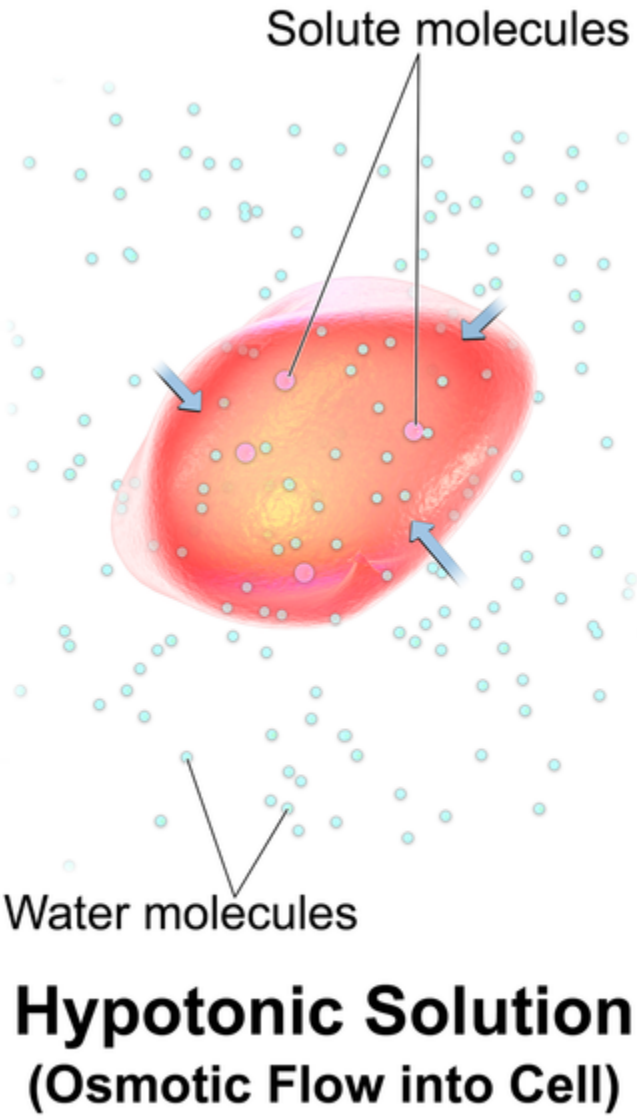

Figure 1.5 Hypotonic IV Fluid Causes Osmotic Fluid Movement Into Cells

HYPERTONIC SOLUTIONS

Hypertonic solutions have a higher concentration of dissolved particles than blood. An example of hypertonic IV solution is 3% normal saline (3% NaCl). When infused, hypertonic fluids cause an increased concentration of dissolved solutes in the intravascular space compared to the cells. This causes the osmotic movement of water out of the cells and into the intravascular space to dilute the solutes in the blood. See Figure 1.6[12] for an illustration of osmotic movement of fluid out of a cell when hypertonic IV fluid is

12. "Blausen_0683_OsmoticFlow_Hypertonic.png" by BruceBlaus.com staff is licensed under CC BY 3.0

administered due to a higher concentration of solutes (pink molecules) in the bloodstream compared to the cell.

When administering hypertonic fluids, it is essential to monitor for signs of hypervolemia, such as breathing difficulties and elevated blood pressure. Additionally, if hypertonic solutions with sodium are given, the client's serum sodium level should be closely monitored.[13]

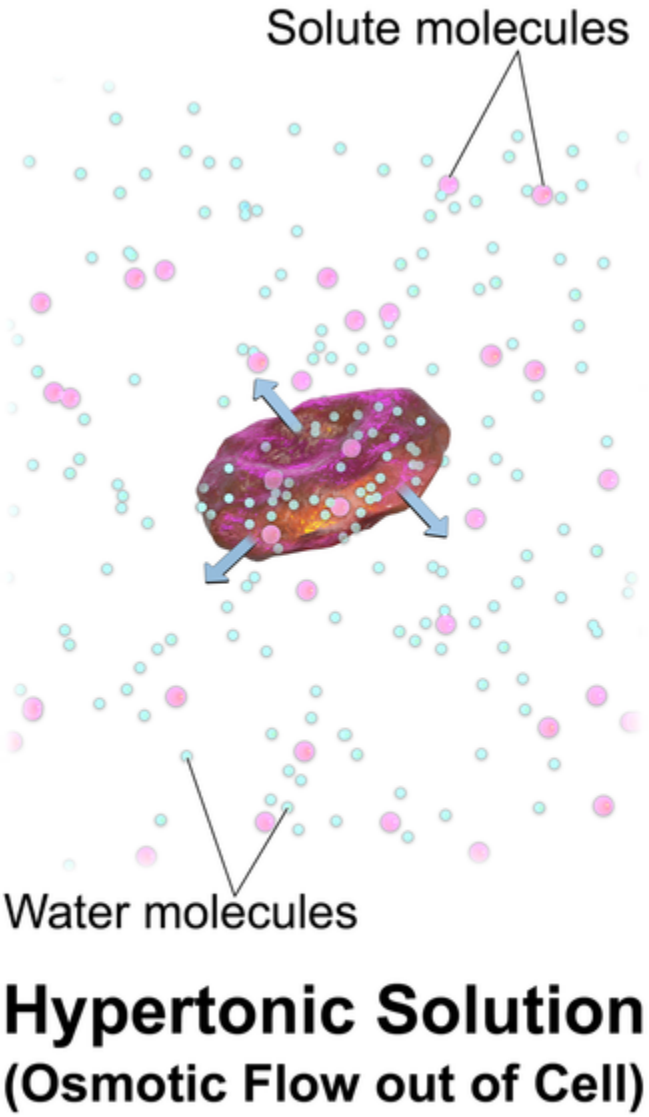

Figure 1.6 Hypertonic IV Solution Causes Osmotic Movement of Fluid Out of Cells

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See Figure 1.7[14] for an illustration comparing how different types of IV solutions affect red blood cell size.

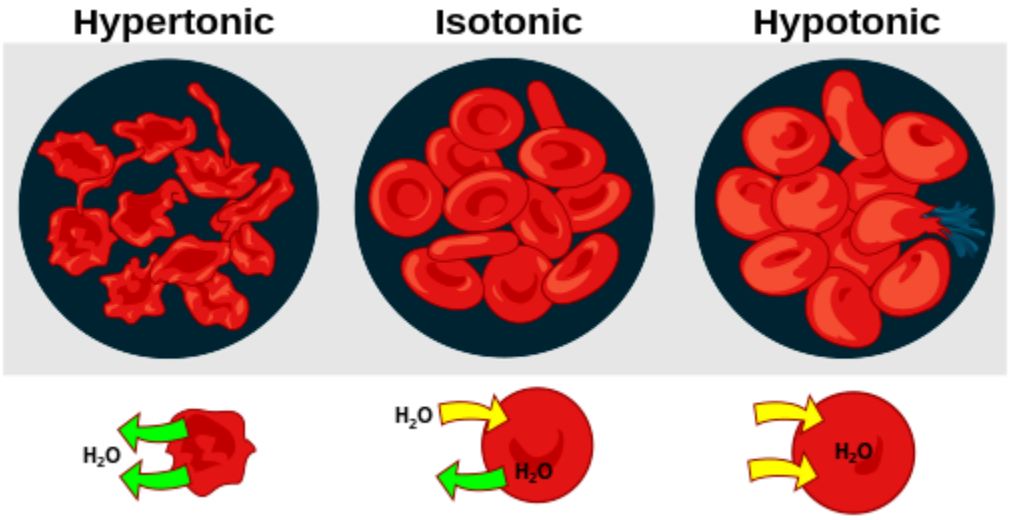

Figure 1.7 Comparison of Osmotic Effects of Hypertonic, Isotonic, and Hypotonic IV Fluids on Red Blood Cells

IV fluids are considered medications. As with all medications, nurses must check the rights of medication administration according to agency policy before administering IV fluids. What began as five rights of mediation administration has been extended to eight rights according to the American Nurses Association. These eight rights include the following[15]:

- Right Patient
- Right Medication
- Right Dose
- Right Time
- Right Route
- Right Documentation
- Right Reason
- Right Response

14. "Osmotic pressure on blood cells diagram.svg" by LadyofHats is in the Public Domain.
15. American Nurses Association. (2021, April). Use of medication assistant/aides/technicians. *ANA Issue Brief.* https://www.nursingworld.org/~498e32/contentassets/a2ff1bd2d5ca467699c3bc764f7d9198/issue-brief-medication-aides-4-2021.docx

With any IV infusion, it is important for the nurse to pay close attention to the provider's order and make sure that it contains the specific type of fluid, any additives or medications, amount to be infused, rate of infusion, and the length of time that the therapy should continue. The nurse should also carefully assess a client's hydration status and oral intake to ensure that IV fluids are stopped appropriately as a client's condition changes. For example, weight should be assessed daily for clients receiving IV fluids to monitor for fluid overload.

> Review how to check the rights of medication administration in the "Administration of Enteral Medications" chapter of Open RN *Nursing Skills*.

Electrolyte Imbalance

In addition to rapidly improving hydration status, IV fluids may also be administered to rapidly correct electrolyte imbalances. Infusing fluids with electrolytes such as potassium, calcium, and magnesium can correct electrolyte imbalances more rapidly and effectively than by oral supplementation.

Electrolytes administered via the IV route must always be administered cautiously at the correct infusion rate because over supplementation can be deadly. For example, potassium infusions administered too rapidly into a client's system can cause sudden cardiac arrest.

Blood Administration

Whole blood and blood components are administered by IV infusion. Blood is typically administered through larger-sized IV catheters. Read more information about blood administration in the "Administer Blood Products" chapter.

Nutrition

Nutritional therapy can be administered through an intravenous route for clients who do not have an adequately functioning gastrointestinal tract and/or are unable to take in food or fluids appropriately. Peripheral nutrition may be ordered through a peripheral IV site for nutritional needs such as albumin replacement.

Total parenteral nutrition (TPN) may be ordered for a client based on their specific electrolyte and/or nutritional needs. TPN is a very concentrated solution that must be administered via a central line. Central lines are placed in a larger vessel rather than a smaller, peripheral vessel. Accessing a central vessel requires additional training and expertise to prevent complications with insertion and is further discussed in the "Manage Central Lines" chapter. If a nurse receives an order for TPN therapy for a client who does not have central line access, the order should be clarified with the prescribing provider.

Medications

The IV route is preferred for the administration of many medications when immediate onset is required. For example, many types of pain medications can be given directly into the bloodstream with a much more rapid onset of action than if they were to be administered orally. Rapid relief of pain can be achieved in minutes rather than hours required for oral medications to reach their peak. Rapid onset can also be achieved with other medications such as those used to treat cardiac emergencies or severe allergic reactions to quickly restore clients to optimal body functioning. Additional information about IV administration of medications is discussed in the "Administer IV Push Medications" chapter. Additional information about administration of patient-controlled analgesia (PCA) is discussed in the "Specialized Infusions" section of this chapter.

IV Administration Equipment

Intravenous (IV) substances are administered through flexible plastic tubing called an IV administration set. The IV administration set connects the bag of

solution to the client's IV access site. There are two major types of IV administration sets: primary administration sets and secondary administration sets. Administration sets require routine replacement to prevent infection. Follow agency policy regarding tubing changes before initiating a new bag of fluid or medications.

Primary Administration Sets

Primary administration sets can be used to infuse continuous or intermittent fluids, electrolytes, or medications. These substances may be administered by infusion pump or by gravity, and each method requires its own type of administration set.

Primary fluids are typically administered using an IV pump. An IV pump is the safest method of administration to ensure specific amounts of fluid are administered. The rate of infusion through an IV pump is typically calculated in mL/hour.

For infusion by gravity, a primary IV administration set can be a macro-drip or a micro-drip solution set. Macro-drip sets are used for routine primary infusions for adults. Micro-drip IV tubing is used in pediatric or neonatal care where small amounts of fluids are administered over a long period of time. A macro-drip infusion set delivers fluid at 10, 15, or 20 drops per milliliter, whereas a micro-drip infusion set delivers 60 drops per milliliter. The drop factor is located on the packaging of the IV tubing and is important to verify when calculating medication administration rates.

Primary IV administration sets consist of the following parts:

- **Sterile spike:** Used to spike the IV fluid bag and must be kept sterile.
- **Roller clamp:** Used to regulate the speed or stop an infusion by gravity.
- **Drip chamber:** Allows air to rise out from a fluid so that it is not passed onto the client. The drip chamber should be kept ¼ to ½ full of solution. When setting a rate by gravity to "drops per minute," the dripping from this chamber is counted.
- **Backcheck valve:** Prevents fluid or medication from travelling up into the primary IV bag.

- **Access ports:** Used to infuse secondary medications and to administer IV push medications. These may also be referred to as "Y ports."

Secondary Administration Sets

Secondary IV administration sets are used to intermittently administer a secondary medication, such as an antibiotic, while the primary IV is also running. Secondary IV tubing is shorter in length than primary tubing and is connected to a primary line via an access port above the infusion pump. The infusion pump is then set at the prescribed secondary infusion rate while the secondary medication is administered. By hanging the secondary medication bag higher than the primary bag, gravity pulls fluid from the secondary bag until it is empty rather than the primary bag.

Secondary medications may be "piggybacked" into primary infusion lines so the solution from the primary fluid line can be used to prime the secondary tubing. To prime the secondary tubing, after the secondary tubing is connected to the primary tubing, the bag connected to the secondary tubing is held lower than the primary bag, causing fluid from the primary tubing to backflow up the secondary tubing. This eliminates air from the secondary tubing.

See Figure 1.8[16] for an illustration of the setup of primary and secondary administration sets for primary administration of fluids and secondary administration of medication by gravity. See Figure 1.9[17] for an image of an IV infusion pump.

16. "intravenous_equipment_labels-2.png" by British Columbia Institute of Technology is licensed under CC BY 4.0. Access for free at https://opentextbc.ca/clinicalskills/chapter/8-2-types-of-iv-therapy/
17. "DSC_0738-e1443533768679-678x1024.jpg" by British Columbia Institute of Technology is licensed under CC BY 4.0. Access for free at https://opentextbc.ca/clinicalskills/chapter/8-2-types-of-iv-therapy/

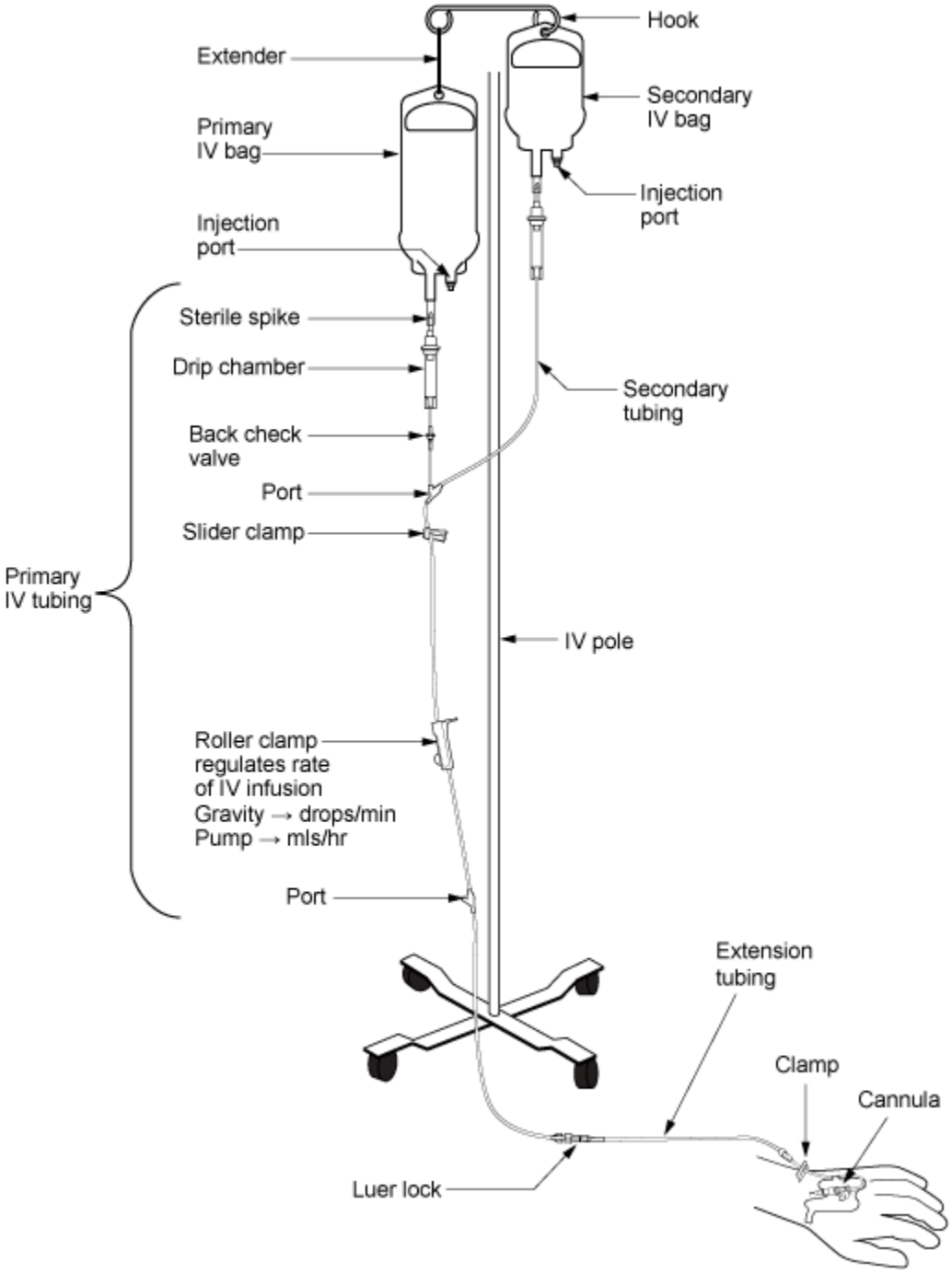

Figure 1.8 Setup of Primary and Secondary Administration Sets

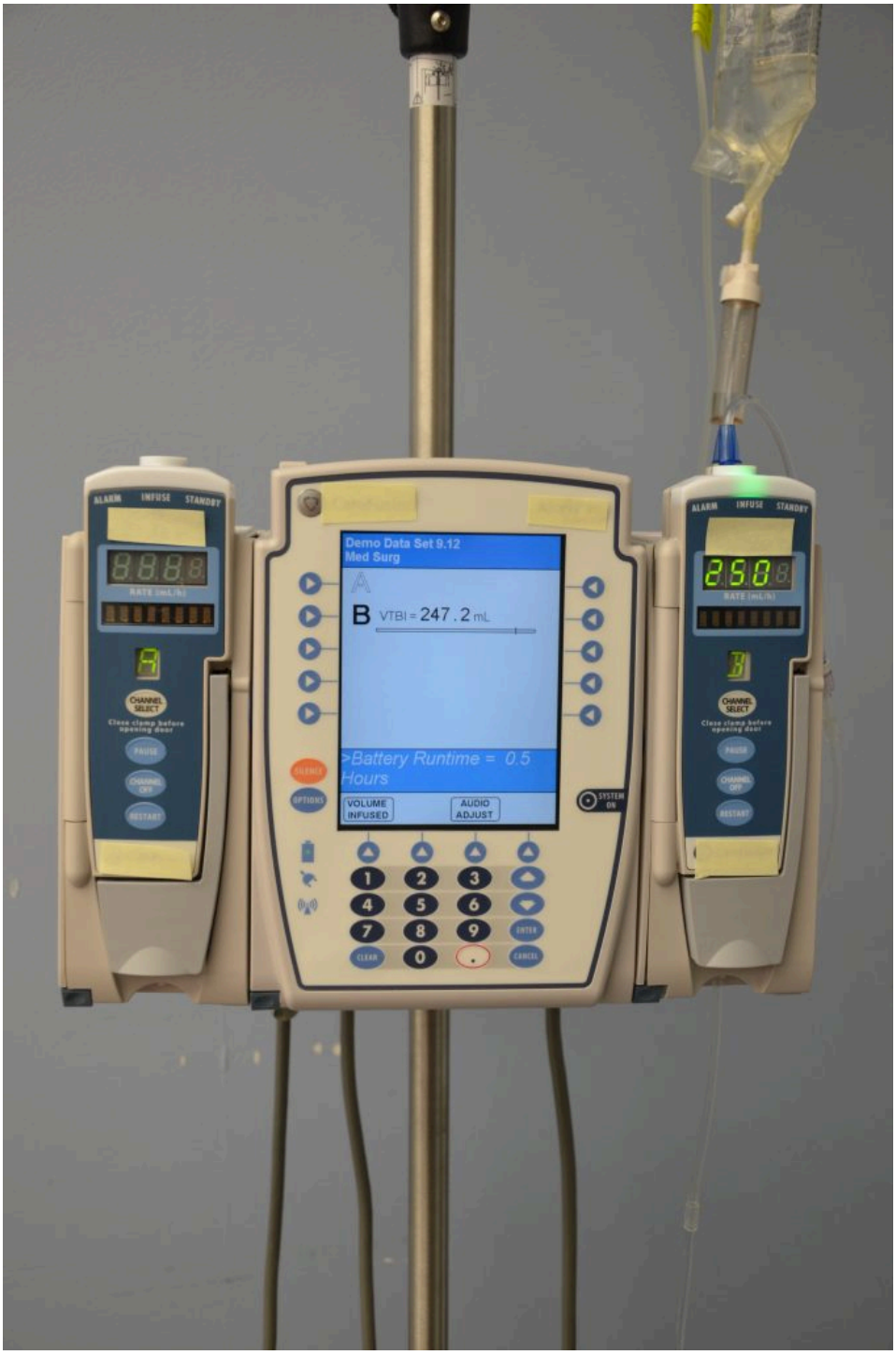

Figure 1.9 IV Infusion Pump

Priming IV Tubing

Primary administration sets, secondary administration sets, and extension tubing must be primed with IV solution to prevent air from entering the client's circulatory system and causing an air embolism. Priming refers to the process of filling the IV tubing with IV solution prior to attaching it to the

client. Review steps for setting up and priming primary and secondary administration sets using the information in the following box.

> Review checklists of steps for "Primary IV Solution Administration" and "Secondary IV Solution Administration" in the "IV Therapy Management" chapter of Open RN *Nursing Skills*.

Infection Control

Aseptic technique must be maintained throughout all IV therapy procedures, including initiation of IV access, preparing and maintaining IV equipment, administering IV fluids and medications, and discontinuing an IV system. Hand hygiene and strict aseptic technique must be performed when handling all IV equipment. These standards can be reviewed in the "Aseptic Technique" chapter in Open RN *Nursing Skills*. Additionally, if an IV catheter or IV administration set should become contaminated by contact with a nonsterile surface, it should be replaced with a new one to prevent introducing bacteria or other contaminants into the system.

Types of Venous Access

There are several types of venous access devices used to administer IV therapy that are categorized as peripheral devices or central devices. Venous access device selection is tailored to each client's needs and to the type, duration, and frequency of infusion.

Peripheral Devices

Peripheral venous access devices are commonly used for short-term IV therapy in the hospital setting. A **peripheral IV** is a intravenous catheter inserted by percutaneous venipuncture into a peripheral vein and held in

place with a sterile transparent dressing. The transparent dressing helps to keep the site sterile, prevents accidental dislodgement, and allows the nurse to visualize the insertion site through the dressing. A securement device may be added to prevent accidental dislodgement.

The client's upper extremities (hands and arms) are the preferred sites for insertion. However, a potential limitation of using the hand veins is they are smaller than the cephalic, basilic, or brachial veins in the arm. If the client requires rapid infusions where a larger gauge IV is warranted, the larger veins in the upper arm should be considered.

Peripheral IVs are used for short-term infusions of fluids, medications, or blood. Peripheral IVs are easy to monitor and can be inserted at the bedside by nurses and other trained professionals. After IV access has been obtained, the hub of an intravenous catheter is attached to a short extension set or a primary IV administration set. Luer lock connectors on the extension tubing and/or administration sets permit syringes to be attached to administer medications or fluid flushes.

Saline lock refers to the use of a short extension set that allows IV access without requiring ongoing IV infusions. When not in use, the lock is flushed with saline according to agency policy and clamped to ensure the site remains sterile and blood does not flow out of the extension tubing. See Figure 1.10[18] for an image of a saline lock.

18. "DSC_0896.jpg" by Glynda Rees Doyle and Jodie Anita McCutcheon is licensed under CC BY 4.0. Access for free at https://opentextbc.ca/clinicalskills/chapter/3-3-care-of-iv-tubing-administration-sets/

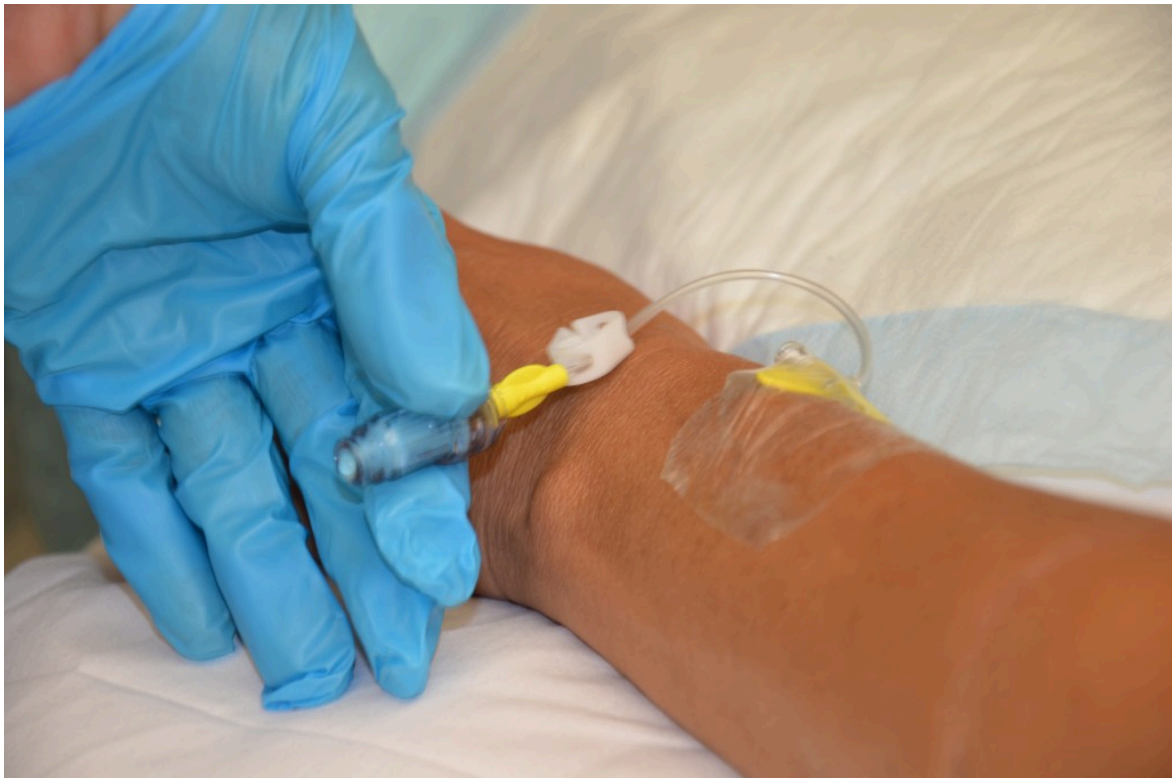

Figure 1.10 Saline Lock

If the client requires continuous infusion of IV fluids, the extension tubing from the IV catheter is connected to a primary IV administration set. The IV tubing can be run through an infusion pump to administer fluids or medications at a programmed rate of infusion (typically calculated in mL/hour) or via gravity by setting a drip rate with the roller clamp (typically calculated at drops/minute). Manufacturers list the drop rate on the IV packaging. Because of the risk of error that can occur with infusion by gravity, many agencies require the use of an infusion pump to ensure correct flow rate.

CONTRAINDICATIONS TO PERIPHERAL IV ACCESS SITES

Before inserting a peripheral IV, the client should be assessed for contraindications related to insertion sites in the upper extremities. For example, clients who have a history of lumpectomy or mastectomy, an arteriovenous fistula, or current lymphedema often have restrictions that

prohibit venipuncture into the affected extremity.[19] Additionally, deep vein thrombosis (DVT), fractures, contractures, or extensive scarring may also prohibit the placement of a peripheral IV. Hospitalized patients may have signage or a bracelet stating "limb alert" to alert heath care professionals to these conditions.

MIDLINE PERIPHERAL CATHETERS

Midline peripheral catheters have a larger catheter (i.e., 16-18 gauge) that allow for rapid infusions. Insertion is ultrasound-guided and can be inserted by RNs with additional training or other trained professionals. Midline catheters are typically inserted into the basilic, cephalic, or brachial veins of the upper arm with the tip placed near the level of the axilla. They are much longer and inserted deeper than a peripheral IV, but do not extend into a central vessel, so are not considered a central line. Therefore, they have a lower risk of infection than central venous access. Any medication that can be administered through a peripheral line can be administered via a midline peripheral catheter. They can also be used for longer duration than traditional peripheral venous access, which is ideal for clients needing extended hospital stays or IV access. Based on agency policy, midline catheters may also be used for blood sample collection, thus limiting the number of venipunctures a client receives. Site care for a midline peripheral catheter is similar to a peripheral IV dressing change.[20,21]

Central Venous Access Devices

A **central venous access device (CVAD)** is a type of vascular access that involves the insertion of a tube into a vein in the neck, chest, or groin and

19. This work is a derivative of Clinical Procedures for Safer Patient Care by British Columbia Institute of Technology and is licensed under CC BY 4.0
20. Villalba-Nicolau, M., Chover-Sierra, E., Saus-Ortega, C., Ballestar-Tarín, M. L., Chover-Sierra, P., & Martínez-Sabater, A. (2022). Usefulness of midline catheters versus peripheral venous catheters in an inpatient unit: A pilot randomized clinical trial. *Nursing Reports*, 12(4), 814–823. https://doi.org/10.3390/nursrep12040079
21. Nickel, B. (2021). Does the midline peripheral intravenous catheter have a place in critical care? *Critical Care Nurse, 41*(6), e1-e21. https://doi.org/10.4037/ccn2021818

threaded into a central vein (most commonly the internal jugular, subclavian, or femoral) and advanced until the tip of the catheter resides within the inferior vena cava, superior vena cava, or right atrium.[22] Only specially trained health professionals may insert central venous access devices, but nurses provide routine care of CVADs, including dressing changes. See Figure 1.11[23] for an image of a central line requiring a dressing change.

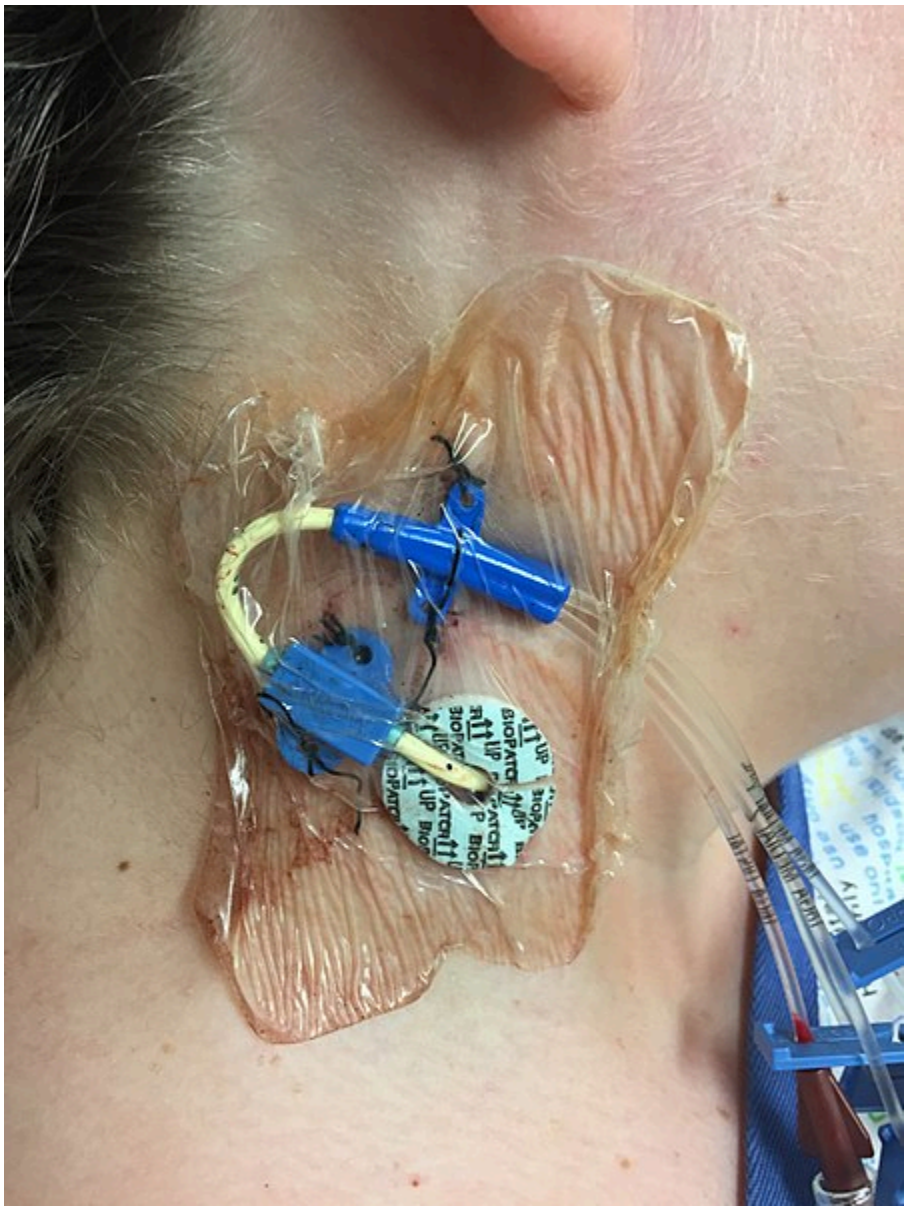

Figure 1.11 Central Line

22. This work is a derivative of StatPearls by Kolikof, Peterson, and Baker and is licensed under CC BY 4.0
23. "Central_Line_Sutures.jpg" by Red minx is licensed under CC BY-SA 4.0

A central venous access device can be left in for longer periods of time and is useful for administering concentrated medications and fluids, such as TPN or hyperosmotic fluids, that would be otherwise irritating to smaller peripheral veins. However, central venous access devices have an increased risk for the development of bloodstream infections, so strict aseptic technique is required during insertion and maintenance. Central venous access devices are further discussed in the "Manage Central Lines" chapter.

PERIPHERAL INSERTED CENTRAL CATHETERS

A **peripheral inserted central catheter (PICC)** is a thin, flexible tube inserted into a vein in the upper arm and guided into the superior vena cava. It is used to give intravenous fluids, blood transfusions, chemotherapy, and other medications requiring a central line. It can also be used for blood sampling. A PICC may stay in place for weeks or months and helps avoid the need for repeated needlesticks. PICC lines are further discussed in the "Manage Central Lines" chapter.

General Guidelines for IV Therapy

The following are general guidelines for peripheral IV therapy[24]:

- IV fluid therapy is ordered by a provider. The order must include the type of solution or medication, total amount of fluid, rate of infusion, duration, date, and time.
- IV therapy is an invasive procedure. Significant complications can occur if the wrong amount of IV fluids or incorrect medication is given or if aseptic technique is not strictly followed.

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- Nurses must understand the indications and duration for IV therapy for each client. Practice guidelines recommend that clients receiving IV therapy for more than six days should be assessed for an intermediate or long-term device such as a central venous access device (CVAD).
- Hospitalized patients may have an order for a small hourly infusion rate, such as 10-20 mL/hour, historically referred to in practice as a "to keep open" (TKO) or "keep vein open" (KVO) rate.
- IV administration sets require routine replacement to promote client safety and reduce the risk of infection. Primary and secondary continuous administration sets used to administer solutions other than lipids, blood, or blood products are typically changed every 96 hours, or up to every 7 days, as directed by agency policy and/or the manufacturer's instructions. Administration sets should also be changed if contamination or compromise in the integrity of the product or system is suspected. Secondary administration sets that are detached from a primary administration set are typically changed every 24 hours or as directed by agency policy. Administration sets should be labelled according to agency policy with the date of initiation or the date of change indicated.[25]

25. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org

1.3 Peripheral IV Access

The initiation and maintenance of a peripheral venous access includes selecting an appropriate site, selecting an appropriate IV catheter and size, establishing IV access, and monitoring for potential complications. The nurse also incorporates life span considerations while following general guidelines for maintaining peripheral venous access sites.

Selection of Venous Access Site Selection

The process of IV start and vessel cannulation includes a comprehensive vein search, identification, and assessment process. Veins in the upper extremities (hands and arms) are typically the preferred sites for insertion. The nurse should be systematic when assessing potential vessels for insertion, examining potential sites both visually and through palpation while progressing up the patient's extremity. The arms should be rotated so that vessels on the dorsal surface can be considered as well. Taking time to identify the best access site will increase the chances for successful cannulation and decrease discomfort for the patient. See Figure 1.12[1] for an illustration of vein anatomy in the upper extremity.

1. "2134_Thoracic_Upper_Limb_Veins.jpg" by OpenStax College is licensed under CC BY 3.0. Access for free at http://cnx.org/content/col11496/1.6/

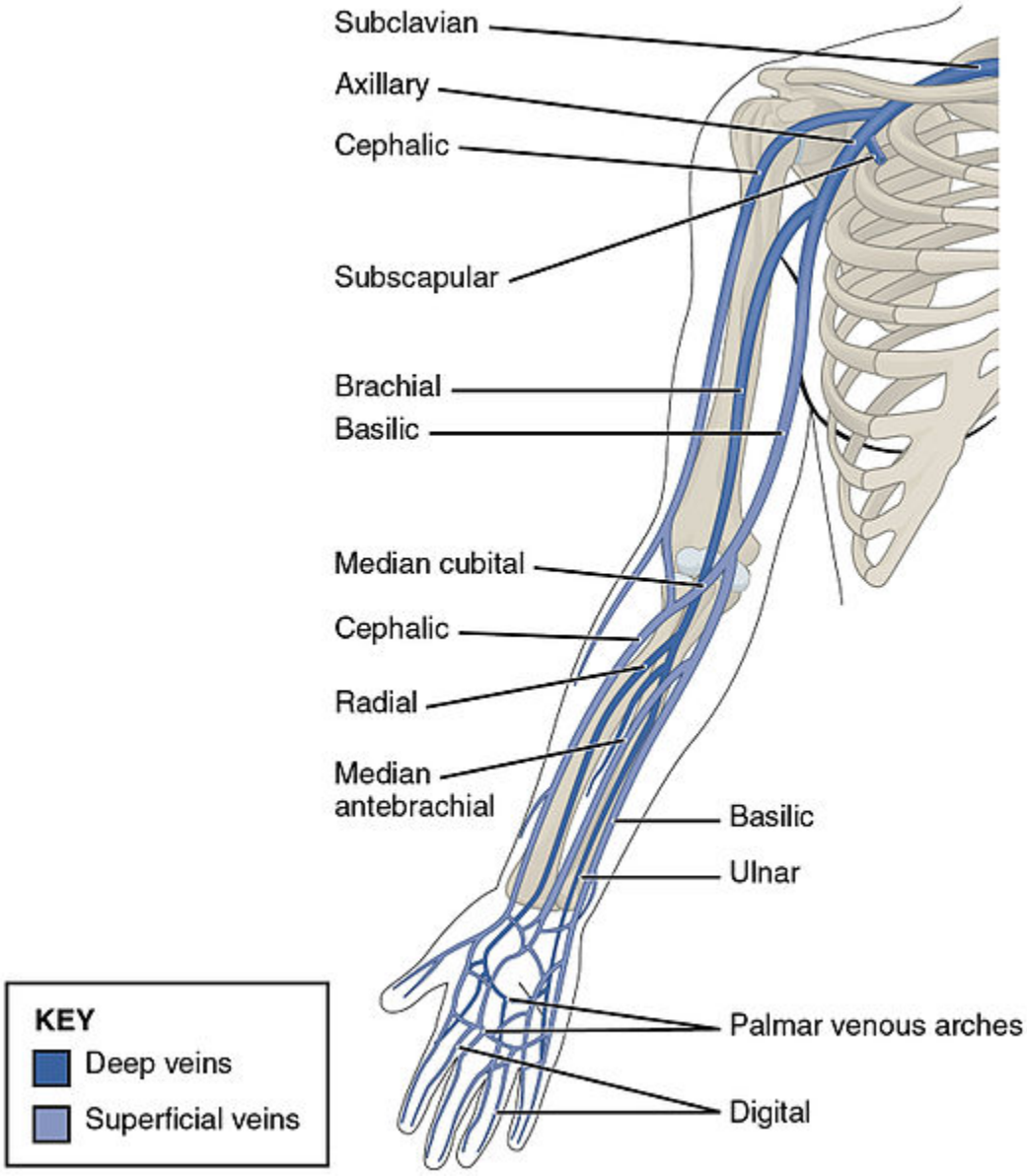

Figure 1.12 Upper Extremity Veins

The veins of the hands are common places to begin one's assessment. These veins on the dorsal surface of the hand are typically easily visualized and palpated due to the proximity to the surface of the skin. See Figure 1.13[2] for an image of the veins in a hand. Veins on the palmar side of the wrist should be avoided due to potential nerve damage. A limitation of using hand veins for venous access is they are smaller than the cephalic, basilic, or brachial veins in the arm. For example, if the patient requires rapid infusion of fluid or

2. "3029775415_7458f6461b_o.jpg" by charcoal soul is licensed under CC BY-ND 2.0

administration of blood products, a large-gauge IV cannula is typically placed in large vein in the upper arm.

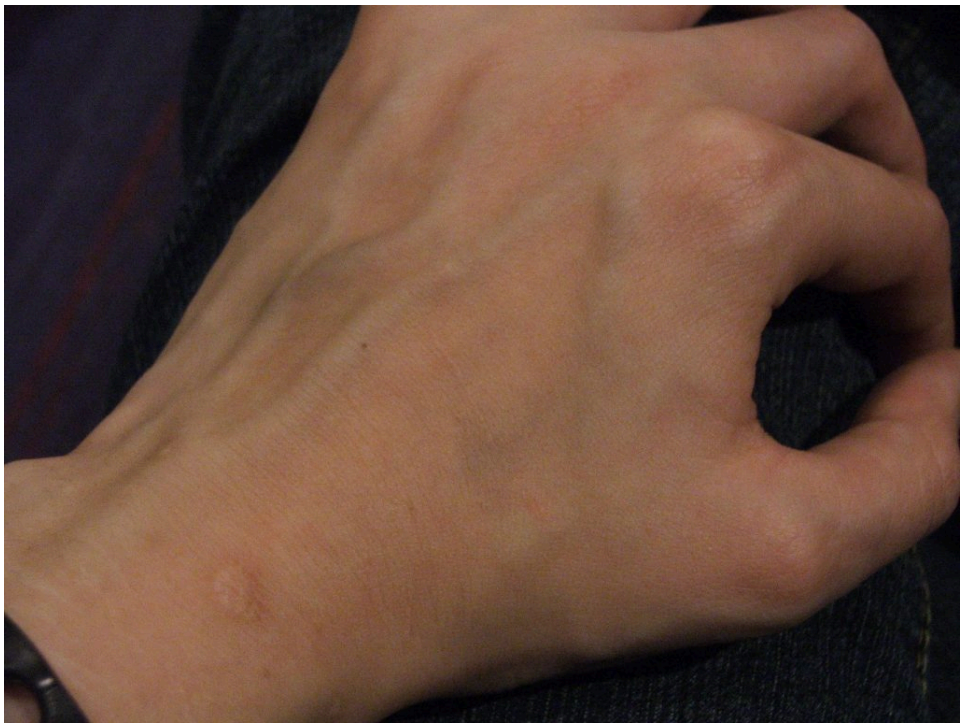

Figure 1.13 Veins in a Hand

If no suitable veins are found on the hand, the nurse should progress up the arm and continue to assess for good access sites. The basilic and cephalic veins are good alternatives for establishing IV access. The brachial vein can be considered, but caution must be used due to its location near the brachial artery in the antecubital fossa. Palpating for a pulse and then avoiding the area where the pulse is located can help ensure cannulation occurs into a vein rather than the artery.[3]

Nurses must also reflect on the purpose for venous access to determine the appropriate access site and catheter lumen size. For example, consider the venous access site required to obtain a blood sample specimen versus that to provide intravenous fluid administration. For blood sampling, the nurse should direct attention to the large veins located in the antecubital fossa (i.e., the interior aspect of the elbow) because the veins are larger in size and can

3. Engström, Å., & Forsberg, A. (2019). Peripheral intravenous catheter difficulty – A clinical survey of registered nurse and critical care nurse performance. *Journal of Clinical Nursing, 28*(3-4), 686-694. https://doi.org/10.1111/jocn.14668

be accessed frequently. However, these veins are not optimal for routine IV fluid administration because every time the patient bends their elbow, a mechanical obstruction in the IV catheter may occur. Despite the potential disadvantage of mechanical obstruction when accessing veins in the antecubital fossa, the nurse may still decide to access veins in the antecubital fossa if rapid IV access is needed or if the patient is only receiving intermittent short-term infusions. In this manner, the purpose for a patient's venous access plays a strong role in determining the appropriate access site.

When considering a potential site for IV cannulation, it is important to note that a catheter must be inserted and threaded for a short distance into the vein. Veins that have ¼- to ½-inch sections of straight surface are usually easily accessed. Suitable IV access sites include lengths of veins that feel spongy and resilient to the touch. Veins that bifurcate (i.e., divide into branches), narrow significantly, or are curved can be difficult to access and thread the cannula. Nurses should also palpate for knobby bumps in a vein that may indicate the presence of valves in that area. Valves can be difficult to cannulate through and, therefore, should be avoided.

If a patient has several suitable venous access sites, preference should be given to establishing an access site on their nondominant hand or arm. Patients typically use their dominant hand when moving to reposition themselves, take meals or fluids, or operate the television remote. These movements can increase the chance of the cannula dislodging from the vein.[4]

Additional considerations for vein selection include avoiding extremities with restrictions such as those with a previous history of mastectomy, lymph node dissection, or arteriovenous (A/V) fistula; the presence of a cast or other assistive device; or those with conditions causing reduced sensation such as paralysis or stroke. The presence of an IV cannula in extremities with these conditions increases the risk for localized infection and other complications.

The nurse should also consider the condition of the patient's skin when selecting an access site. Skin that is scarred can be fibrous and tough to

4. Takahashi, T., Ryoko, M., Abe-Doi, M., Miyahara-Kaneko, M., Chiho, K., Nakamura, M., Mariko, M., Chieko, K., & Hiromi, S. (2020). Preventing peripheral intravenous catheter failure by reducing mechanical irritation. *Scientific Reports, 10*(1), 1550. http://dx.doi.org/10.1038/s41598-019-56873-2

penetrate with a needle, causing increased discomfort. Sites below a recent venipuncture or IV access site should also be avoided due the potential for fluids to seep out of the site. Additionally, skin that is tattooed or extremities with edema should also be avoided whenever possible. Tattoos and edema make a vein not only more difficult to identify, but also more difficult to assess for signs of complications such as cannula dislodgement and the presence of fluid leaking into subcutaneous tissues.

There are many methods that nurses can use to dilate veins and determine the presence of suitable access sites if the veins are not visually apparent. A simple method is to apply a single-use tourniquet. The tourniquet should be snug but still allow for the presence of arterial blood flow. Blood flow can be easily assessed by applying the tourniquet and assessing the presence of the radial pulse. Tourniquets should only be applied for short periods of time and released periodically during the vein search and selection process to ensure resolution of systemic blood flow. In a similar manner, a blood pressure cuff can be also applied and pumped up for a short period of time.

Application of warmth can also be helpful for vein identification. Wrapping the upper extremities in warm blankets, or applying warm compresses, promotes vessel dilation. The blankets or compresses should be in place for short intervals (i.e., 3-5 minutes) to allow time for the vessels to respond to the warm stimuli.

Placing the upper extremities in a dependent position is another useful method for enhancing vessel dilation. Allowing the arm and hand to hang dependently (i.e., below the level of the heart) allows venous blood to migrate by gravity into the lower arms and hands. The pooling of venous blood into the small vessels of the hands promotes vessel dilation and vein identification.

In addition to promoting vessel dilation, nurses may also be trained in some facilities to use equipment to visually detect veins, such as illumination lights or ultrasound equipment. Some agencies also have specially trained venous access teams who insert intravenous lines and can be consulted if vascular access proves challenging.

Many patients have had previous experience with IVs and can provide helpful information regarding strategies for success. For example, if a patient

states, “My veins often ‘roll’ when they try to start an IV,” the nurse should take special caution to anchor the vessel when puncturing the skin.

Nurses should restrict IV insertion attempts to no more than two attempts per clinician. Multiple unsuccessful attempts cause pain to the client, delay treatment, limit future vascular access, increase cost, increase the risk for complications, and decrease trust in the nurse. After two unsuccessful attempts, the nurse should seek a clinician with a higher skill level or consider alternative routes of medication administration.[5]

Catheter Size and Type Selection

Peripheral IV catheters are available in a variety of sizes, most commonly ranging from 14 gauge to 24 gauge. Note that the lower the gauge size, the wider the diameter of the catheter, with 14-gauge catheters allowing for the greatest flow rate.[6] Catheter sizes are color coded to allow for easy identification of the catheter size after a vein is accessed. See Figure 1.14[7] for colors associated with IV catheter sizes and their associated flow rates.

5. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org
6. This work is a derivative of StatPearls by Beecham & Tackling and is licensed under CC BY 4.0
7. "Color-coding_of_IV_cannulas.jpg" by Dr.Vijaya Chandar is licensed under CC BY-SA 4.0

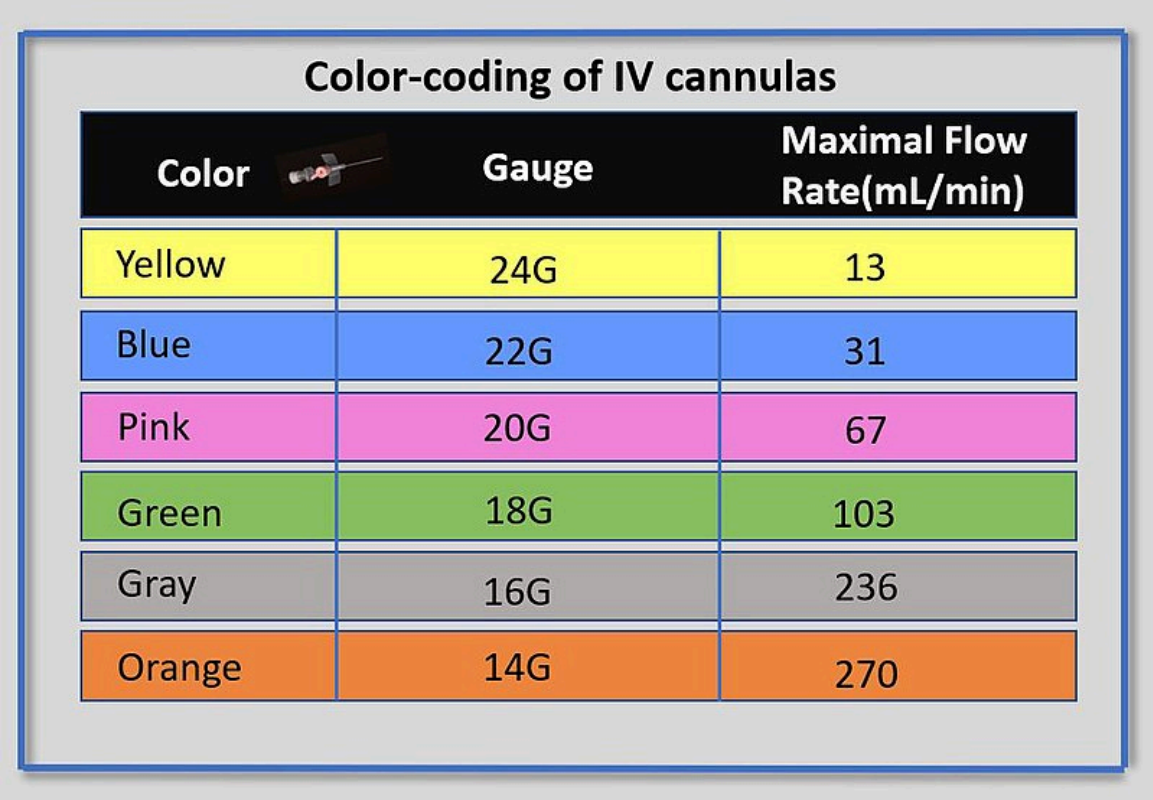

Figure 1.14 Color Coding of IV Catheters

Nurses must consider the purpose for venous access, along with assessment of the client's vessel size, when selecting an IV catheter to attempt cannulation. Catheters with a smaller gauge (i.e., larger diameter) permit infusion of viscous fluids, such as blood products, at a faster rate with decreased opportunity for catheter occlusion.[8] Additionally, an appropriately sized catheter also allows for adequate blood flow around the catheter itself. The most common IV catheter size for adult patients is 18- or 20-gauge catheters. However, frail elderly patients and children have smaller vasculature, so a 22-gauge catheter is often preferred.

There are different manufacturer brands of IV catheters, but all include a beveled hollow needle, flashback chamber in which one can visualize blood return when entering the vein, and a flexible catheter that is left in the vein after the catheter has been threaded into the vein and the needle removed.

IV insertion equipment varies among institutions, but common types include shielded IV catheters or winged (i.e., "butterfly") devices. Variation is

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often related to the presence of a stabilizing device at the site of insertion, as well as the presence of short extension tubing. For shielded catheter types, the stabilizing device and extension tubing are typically added to the catheter itself and not included with the cannulation needle. See Figure 1.15[9] for an image of shielded IV catheters.

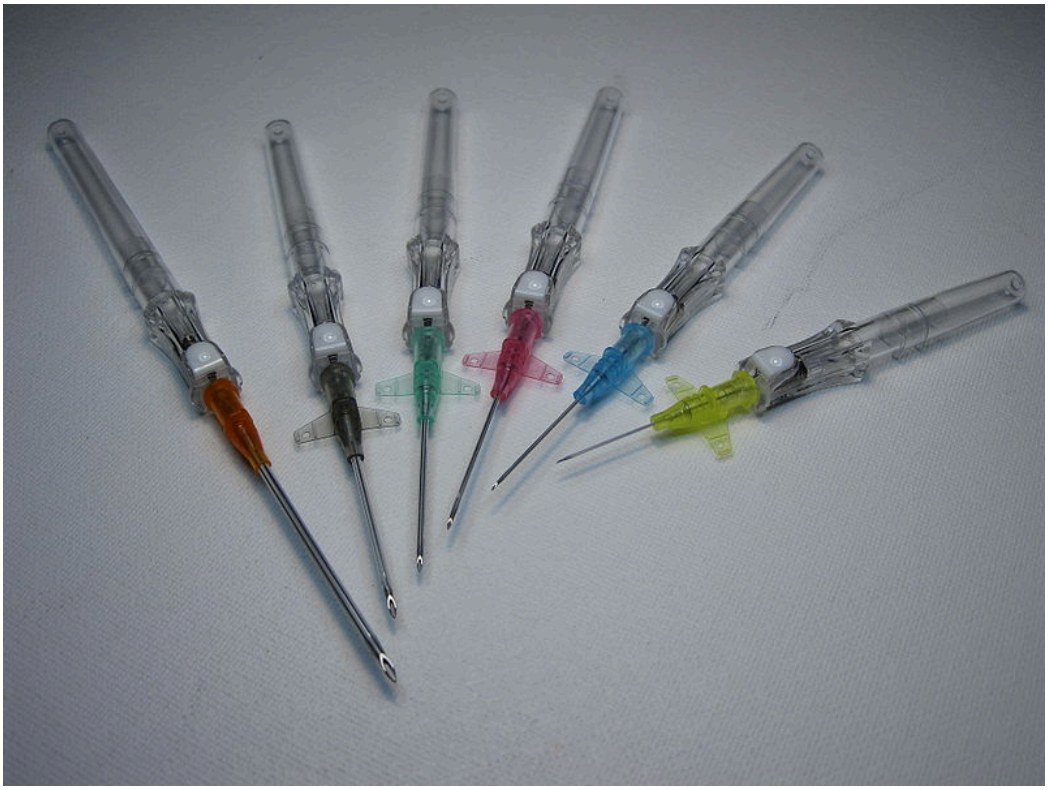

Figure 1.15 Shielded IV Catheters

Nurses must ensure the selected size and type of IV catheter are appropriate for the procedure or infusion that is ordered because not all peripheral IV catheters are suitable for all procedures. For example, if a procedure requires the infusion of contrast dye, a specific size infusion port is required.

Despite the wide variation in catheter equipment that is available, there has been significant focus among manufacturers regarding the need for safety equipment during venipuncture. Many devices utilize mechanisms to self-contain needles within a plastic sheath after withdrawal from the client. These devices can be activated through a button in the devices or a manual trigger initiated by the individual attempting cannulation. Regardless of the

9. "IV_Catheters_(9).JPG" by Intropin is licensed under CC BY-SA 3.0

type of safety lock, it is important to utilize the equipment as intended and never attempt to disable or override the mechanism. These mechanisms are important to help prevent accidental needlesticks or injury with a contaminated needle after it has been removed from the patient. Additionally, after cannulation is attempted, the individual who attempted cannulation is responsible for ensuring all needles are disposed of in a sharps container. It is good practice to be aware of how many sharps were brought into the room, opened, and disposed. This helps to ensure that any needles are not inadvertently left in a patient's bed, tray table, floor, etc. Nurses must be familiar with the equipment used at the health care facility and receive orientation on the specific mechanics related to the equipment and safety practices.

Initiating Peripheral IV Access

The steps for initiating peripheral IV access are described in the "Perform IV Insertion and IV Removal" checklist later in this chapter.

Monitoring for Potential Complications

Several potential complications may arise from peripheral intravenous therapy. It is the responsibility of the nurse to monitor for signs and symptoms of complications and intervene appropriately. Complications can be categorized as local or systemic. See Table 1.3a for potential local complications of peripheral IV therapy.

Table 1.3a Local Complications of Peripheral IV Therapy[10,11]

10. This work is a derivative of Clinical Procedures for Safer Patient Care by British Columbia Institute of Technology and is licensed under CC BY 4.0
11. Simin, D., Milutinović, D., Turkulov, V., & Brkić, S. (2018). Incidence, severity and risk factors of peripheral intravenous cannula-induced complications: An observational prospective study. *Journal of Clinical Nursing, 28*(9-10), 1585-1599. https://doi.org/10.1111/jocn.14760

Complications	Potential Causes and Prevention	Treatment
Phlebitis: The inflammation of the vein's inner lining, the tunica intima. Clinical indications are localized redness, pain, heat, purulent drainage, and swelling that can track up the vein leading to a palpable venous cord.	**Mechanical causes:** Inflammation of the vein's inner lining can be caused by the cannula rubbing and irritating the vein. To prevent mechanical inflammation, use the smallest gauge possible to deliver the medication or required fluids. **Chemical causes:** Inflammation of the vein's inner lining can be caused by medications or fluids with high alkaline, acidic, or hypertonic qualities. To avoid chemical phlebitis, follow the parenteral drug therapy guidelines in a drug reference resource for administering IV medications, including the appropriate amount of solution and rate of infusion. **Infectious causes:** May be related to emergent VAD insertions, poor aseptic technique, or contaminated dressings.	**Chemical phlebitis:** Evaluate infusion therapy and the need for different vascular access, different medication, slower rate of infusion, or more dilute infusate. If indicated, remove the Vascular Access Device (VAD).[12] **Transient mechanical phlebitis:** May be treatable by stabilizing the catheter, applying heat, elevating limb, and providing analgesics as needed. Consider requesting other pharmacologic interventions such as anti-inflammatory agents if needed. Monitor site for 24 hours post-insertion, and if signs and symptoms persist, remove the catheter.[13] **Infectious phlebitis:** If purulent drainage is present or infection is suspected, remove the catheter and obtain a culture of the purulent drainage and catheter tip. Monitor for signs of systemic infection.[14]

12. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224.

https://doi: 10.1097/NAN.0000000000000396.org

13. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org
14. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org

Infiltration: A condition that occurs when a nonvesicant solution is inadvertently administered into surrounding tissue. Signs and symptoms include pain, swelling, redness, the skin surrounding the insertion site is cool to touch, there is a change in the quality or flow of IV, the skin is tight around the IV site, IV fluid is leaking from IV site, or there are frequent alarms on the IV pump.	Infiltration is one of the most common complications in infusion therapy involving an IV catheter.[15] For this reason, the patency of an IV site must always be checked before administering IV push medications. Infiltration can be caused by piercing the vein, excessive patient movement, a dislodged or incorrectly placed IV catheter, or too rapid infusion of fluids or medications into a fragile vein. Always secure a peripheral IV catheter with tape or a stabilization device to avoid accidental dislodgement. Avoid sites that are areas of flexion.	Stop the infusion and remove the cannula. Follow agency policy related to infiltration.

15. Wang, J., Li, M. M., Zhou, L. P., Xie, R. H., Pakhale, S., Krewski, D., & Wen, S. W. (2022). Treatment for grade 4 peripheral intravenous infiltration with type 3 skin tears: A case report and literature review. *International Wound Journal, 19*(1), 222–229. https://doi.org/10.1111/iwj.13624

Extravasation: A condition that occurs when vesicant (an irritating solution or medication) is administered and inadvertently leaks into surrounding tissue and causes damage. It is characterized by the same signs and symptoms as infiltration but also includes burning, stinging, redness, blistering, or necrosis of the tissue.	Extravasation has the same potential causes of infiltration but with worse consequences because of the effects of vesicants. Extravasation can result in severe tissue injury and necrosis. For this reason, known vesicant medications should be administered via central lines.	Stop the infusion. Detach all administration sets and aspirate from the catheter hub prior to removing the catheter to remove vesicant medication from the catheter lumen and as much as possible from the subcutaneous tissue.[16] Follow agency policy regarding extravasation of specific medications. For example, toxic medications have a specific treatment plan.
Hemorrhage: Bleeding from the IV access site.	Bleeding occurs when the IV catheter becomes dislodged.	If dislodgement occurs, apply pressure with gauze to the site until the bleeding stops and then apply a sterile transparent dressing.
Local infection: Infection at the site is indicated by purulent drainage, typically two to three days after an IV site is started.	Local infection is often caused by nonadherence to aseptic technique during IV initiation or IV maintenance or the dressing becomes contaminated or non-intact over the access site.	Remove the cannula and clean the site using sterile technique. If infection is suspected, remove the catheter and obtain a culture of the purulent drainage and catheter tip. Monitor for signs of systemic infection.
Nerve injury[17]	Paresthesia-type pain occurring during venipuncture or during an indwelling IV catheter can indicate nerve injury.	Immediately remove the cannula, notify the provider, and document findings in the chart.

16. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org
17. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org

In addition to local complications that can occur at the site of IV insertion, there are many systemic complications that nurses must monitor for when initiating peripheral IV access, as well as monitoring a client receiving IV therapy. See Table 1.3b for a list of systemic complications, signs, symptoms, and treatment.

Table 1.3b Systemic Complications of Peripheral IV Therapy[18]

18. This work is a derivative of Clinical Procedures for Safer Patient Care by British Columbia Institute of Technology and is licensed under CC BY 4.0

Complication	Signs, Symptoms, and Treatment
Pulmonary Edema	Pulmonary edema, also known as fluid overload or circulatory overload, is a condition caused by excess fluid accumulation in the lungs due to excessive fluid in the circulatory system. It is characterized by decreased oxygen saturation; increased respiratory rate; fine or coarse crackles in the lung bases; restlessness; breathlessness; dyspnea; and coughing up pink, frothy sputum. Pulmonary edema requires prompt medical attention and treatment. If pulmonary edema is suspected, raise the head of the bed, apply oxygen, take vital signs, complete a cardiovascular assessment, and immediately notify the provider.
Air Embolism	Air embolism refers to the presence of air in the cardiovascular system. It occurs when air is introduced into the venous system and travels to the right ventricle and/or pulmonary circulation. Air embolisms can occur during catheter insertion, changing IV bags, adding secondary medication administration, and catheter removal. Inadvertent administration of 10 mL of air can have serious and fatal consequences. However, small air bubbles are tolerated by most patients. Signs and symptoms of an air embolism include sudden shortness of breath, continued coughing, breathlessness, shoulder or neck pain, agitation, feeling of impending doom, light-headedness, hypotension, wheezing, increased heart rate, altered mental status, and jugular venous distension. If an air embolism is suspected, occlude the source of air entry. Place the patient in a Trendelenburg position on their left side (if not contraindicated), apply oxygen at 100%, obtain vital signs, and immediately notify the provider. To prevent air embolisms, perform the following steps when administering IV therapy: ensure the drip chamber is one-third to one-half filled, remove all air from the IV tubing by priming it prior to attaching it to the client, use precautions when changing IV bags or adding secondary medication bags, ensure all IV connections are tight, and ensure clamps are used when the IV system is not in use.
Catheter Embolism	A catheter embolism occurs when a small part of the cannula breaks off and flows into the vascular system. When removing a peripheral IV cannula, inspect the catheter tip to ensure the end is intact. Notify the provider immediately if the catheter tip is not intact when it is removed.

Catheter-Related Bloodstream Infection (CR-BSI)	Catheter-related bloodstream infection (CR-BSI) is caused by microorganisms introduced into the bloodstream through the puncture site, the hub, or contaminated IV tubing or IV solution, leading to bacteremia or sepsis. A CR-BSI is a hospital-acquired preventable infection and considered an adverse event. A CR-BSI is diagnosed when infection occurs with one positive blood culture in a patient with a vascular device (or a patient who had a vascular device within 48 hours before the infection) with no apparent source for the infection other than the vascular access device. Treatment for CR-BSI is IV antibiotic therapy. To prevent CR-BSI, it is vital to perform hand hygiene prior to care and maintenance of an IV system and to use strict aseptic technique for care and maintenance of all IV therapy procedures.

Life Span Considerations

IV initiation procedures vary significantly for pediatric patients and older adults due to patient size and variation in vessel size and condition. For example, in neonatal patients, venous access may be achieved through cannulation of a vein in their hand, foot, or scalp. However, IV initiation into a scalp vessel requires specific modifications and additional training. Additionally, use of a lower extremity for venous access should be specifically addressed with the provider prior to any attempt at cannulation to ensure that a lower extremity site is appropriate based on the patient condition.

When working with pediatric patients, it is important to consider the stability of the IV access. Many pediatric patients are very mobile and may not be able to understand the need to leave a saline lock or continuous infusion line in place. Utilizing stabilizing arm boards or gauze wraps may be helpful reminders that also create stability in the line and access site. Many health care organizations have additional tools and strategies to ease IV cannulation for pediatric patients, such as topical anesthetics including lidocaine cream, to minimize discomfort with insertion. Special procedural rooms oriented toward children are often used with helpful visual distractors like dolls, toys,

stuffed animals, videos, or support of child life specialists.[19] See Figure 1.16[20] for an image of toys used as distractors with a hospitalized pediatric patient.

Figure 1.16 Hospitalized Pediatric Patient With Toys

Providing education to the parents regarding the process of the IV start and what might work best for the child ahead of the procedure can be helpful for ensuring cannulation occurs with minimal complications. Parents can often be excellent sources of support when pediatric patients undergo invasive procedures, but it is important that the parents are comfortable and informed regarding their role and the manner in which they will offer assistance.

There are also modifications nurses can make independently based on their

19. Olsen, K., & Weinberg, E. (2017). Pain-less practice: Techniques to reduce procedural pain and anxiety in pediatric acute care. *Clinical Pediatric Emergency Medicine, 18*(1), 32–41. https://doi.org/10.1016/j.cpem.2017.01.007
20. "DN-SD-06-07603.jpeg" by Department of Defense. American Forces Information Service. Defense Visual Information Center. (1994 - 10/26/2007) is licensed in the Public Domain.

clinical knowledge of a patient's condition. For example, many elderly patients who receive steroids have vessels that are very fragile and difficult to cannulate. Nurses may modify the procedure by omitting the use of a tourniquet. This decreases pressure in the vessel during venipuncture and helps to prevent the vein from rupturing or **"blowing"** (i.e., leaking blood due to rupture). The use of a tourniquet may also be omitted to prevent skin tears.

Many elderly patients have less subcutaneous tissue as a result of the aging process, and the nurse may note that their vessels, particularly those located in the hands, appear more superficial than is seen in younger patients. See Figure 1.17[21] for an image of superficial veins. As a result, the experienced nurse may modify their vessel cannulation technique by inserting the needle at a decreased or shallower angle when attempting cannulation. Decreasing the angle of insertion will provide less chance of passing the needle through the vessel when first puncturing through the skin.[22]

Figure 1.17 Superficial Veins

21. "the-elderly-g2ddfbcc36_1920.png" by f_qian on Pixabay is licensed under CC0
22. Simin, D., Milutinović, D., Turkulov, V., & Brkić, S. (2018). Incidence, severity and risk factors of peripheral intravenous cannula-induced complications: An observational prospective study. *Journal of Clinical Nursing, 28*(9-10), 1585-1599. https://doi.org/10.1111/jocn.14760

General Guidelines for Maintaining Peripheral Venous Access Sites

Health care agencies have policies regarding site assessment, flushing, maintenance, and dressing changes. The following general guidelines apply to maintaining peripheral IV access sites:

- **Site assessment:** In inpatient and nursing facilities, peripherally inserted IV sites should be assessed at least every four hours and more frequently for patients receiving infusions of vesicant medications. Sites should be assessed every 1-2 hours for patients who are critically ill/sedated or have cognitive deficits and every hour for neonatal/pediatric patients.[23] In outpatient or home settings, the patient or caregiver should be taught to check the site every four hours during waking hours for signs of complications and immediately report concerns to their health care provider.[24]
- **Duration of site:** Traditionally, IV access sites were changed every 72-96 hours, but research indicates no clear difference in rates of infection, phlebitis, mortality, or pain if catheters are kept in place until IV therapy is complete or a complication occurs requiring site discontinuation.[25]
- **Routine flushing of saline locks:** When not in continuous use, saline locks should be flushed with two times the amount of external catheter length plus catheter (i.e., 5 mL in adults) with normal saline every 8-12 hours to ensure patency.[26]
- **Securement devices:** To maintain integrity of the IV site and prevent infiltration and other complications, proper securement devices should

23. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org
24. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org
25. Webster, J., Osborne, S., Rickard, C. M., & Marsh, N. (2019). Clinically-indicated replacement versus routine replacement of peripheral venous catheters. *The Cochrane Database of Systematic Reviews, 1*(1), CD007798. https://doi.org/10.1002/14651858.CD007798.pub5
26. Lee, P. T., & Terry, J. (2021). Changing practice to using pre-filled syringes for flushing IV cannulas. *British Journal of Nursing*, *30*(14), S14–S22. https://doi.org/10.12968/bjon.2021.30.14.S14

be used, when available, to keep the IV secure and prevent dislodgement. Examples of securement devices are stat locks, chevron tape, arm boards, and arm wraps.

- **Peripheral IV dressing changes:** Gauze dressings should be changed at least every two days and transparent dressings at least every seven days. They should be changed immediately if the dressing becomes visibly soiled, loosened, dislodged, or if there is any moisture, drainage, blood, or compromised skin.[27]
- **Site care:** Protective measures for the IV site include no tub baths or soaking and wrapping with a protective covering if showering. Restrictive clothing should be avoided, and blood pressure should be taken in an arm without an IV site present.

27. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharp, E., & Alexander, M. A. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(Suppl 1S), S1–S224. https://doi: 10.1097/NAN.0000000000000396.org

1.4 Checklist: Perform Venipuncture Blood Draw

**Disclaimer: Always follow agency policy and manufacturer recommendations*

Checklist: Perform Venipuncture Blood Draw[1,2]

- Verify the provider's order.
- Review the patient's medical record for conditions that increase the risk of bleeding or hematoma formation and allergies to antiseptics, adhesive, and latex. Use an alternative product if necessary. Also, check the patient's medical record for factors that may affect peripheral vasculature.
- Gather the necessary supplies:
    - Clean gloves
    - Antiseptic solution/agent (such as an alcohol wipe, chlorhexidine, or povidone-iodine)
    - Needleless blood sampling access device (vacutainer) or syringes
    - Venipuncture needle or winged collection device
    - Single patient-use tourniquet
    - Blood specimen tubes and labels
    - Needleless connector
    - Labels
    - 2" x 2" gauze pads
    - Tape or adhesive bandage
    - Biohazard specimen transport bag or container
- Perform hand hygiene.
- Confirm the patient's identity using two patient identifiers per agency policy and ask if they have any allergies.
- Provide privacy.
- Explain the procedure.
- Ask whether the patient has ever felt faint, sweaty, or nauseated when having blood drawn. If so, place the patient in a supine position.

1. *Clinical skills: Essentials collection* (1st ed.). (2021). Elsevier.
2. Lippincott procedures. http://procedures.lww.com

- Raise the bed to a working level.
- Perform hand hygiene.
- Put on gloves and, as needed, other personal protective equipment.
- Position the patient's arm horizontally or slanting slightly downward.
- Inspect the patient's veins.
- Check if the patient has a history of easy bruising, increased risk of bleeding, compromised circulation, or fragile veins or skin.
- Apply a tourniquet about 2" (5 cm) above the site. Make sure that you can palpate an arterial pulse distal to the tourniquet. Be aware the tourniquet should only be applied for 2 minutes or less.
- Prepare the venipuncture site using an antiseptic agent. Apply the agent using a single-use sterile applicator. Allow the agent to dry completely.
- Immobilize the vein with the nondominant thumb or forefinger and thumb.
- Position the needle holder or syringe with the needle bevel up and the shaft parallel to the path of the vein at a 30-degree angle to the arm.
- Tell the patient you are about to perform the venipuncture.
- Insert the needle into the vein. Push the collection tube into the holder when the vein is cannulated.
- Release the tourniquet when blood begins to flow.
- Remove the first tube from the holder when the first tube fills. Continue to fill the tubes using the correct order of draw to avoid cross-contamination of the sample by additives found in different collection tubes (Review information about Order of Blood Draw Tubes.)[3] Remove each tube from the holder, gently invert it, and return it to its upright position.
- After drawing all samples, place a gauze pad over the puncture site, disengage an evacuated tube, and remove the needle from the vein. Do not remove the needle with the collection tube still in the vacutainer.
- Activate the needle protector safety device, if applicable.
- Apply pressure to the puncture site until bleeding stops.
- Apply an adhesive bandage or tape a gauze bandage to the needle

3. Clinical Lab Standards Institute. (2019, March 19). *Order of blood tube draws and additives*. https://clsi.org/about/blog/order-of-blood-draw-tubes-and-additives/

insertion site.
- If a syringe was used to collect the sample instead of a vacutainer, transfer the blood sample immediately to a collection tube.
- Carefully invert each collection tube according to the additive.
- Label all samples in the presence of the patient.
- Place the labeled specimen in a biohazard bag and transport it to the laboratory immediately per agency policy.
- Discard used supplies and place sharps into a sharps container.
- Remove the gloves and perform hand hygiene.
- In an inpatient setting, help the patient into a comfortable position and place personal items, the tray table, and the call light within easy reach. Make sure the patient knows how to use the call light to summon assistance. To ensure the patient's safety, raise the appropriate number of side rails and lower the bed to the lowest position. Ensure the bed is locked.
- Perform hand hygiene.
- Document the procedure and assessments.

Documentation Cues:

- Site and location of vein used, the appearance of the site, and the condition and type of dressing used over the blood draw site
- Date, time, and blood samples drawn
- Patient teaching
- Any unexpected outcomes, related nursing interventions, health care provider notification, and the patient's response to treatment
- Communication of laboratory results to the provider (if applicable)

View a YouTube video[4] showing an instructor demonstration of this skill:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/nursingadvancedskills/?p=63#oembed-1

4. Chippewa Valley Technical College. (2023, January 5). *Performing venipuncture* [Video]. YouTube. Video licensed under CC BY 4.0. https://youtu.be/CLVyxRY8lZU

1.5 Checklist: Perform IV Insertion & IV Removal

**Disclaimer: Always follow agency policy and manufacturer recommendations*

Checklist: IV Insertion[1,2]

- Verify the provider's order.
- Review the patient's medical record for allergies to antiseptic solutions, adhesives, latex, and anesthetic agents. Also, review the medical record for factors that may affect peripheral vasculature.
- Gather the necessary supplies:
    - Clean/nonsterile gloves
    - Single-use tourniquet
    - Appropriate type and size of peripheral IV catheter based on patient status
    - Needless cap/extension tubing set
    - Appropriate antiseptic agent/pad based on client's allergy status (chlorhexidine-based, povidone-iodine, or 70% alcohol)
    - Prescribed IV solution or medication with attached and primed administration set (Refer to the "Checklist for Primary IV Solution Administration" in Open RN *Nursing Skills*.)
    - Sterile 10-mL prefilled syringe (or a syringe specifically designed to generate lower injection pressure) containing preservative-free normal saline solution
    - IV pole
    - Securement device (integrated securement device, subcutaneous anchor securement system, tissue adhesive, or adhesive securement device)
    - Transparent semipermeable dressing
    - Label

NOTE: Commercial IV insertion kits come with or without an IV access

1. *Clinical skills: Essentials collection* (1st ed.). (2021). Elsevier.
2. Lippincott procedures. http://procedures.lww.com

device. Many facilities keep venipuncture equipment on a tray or cart, enabling increased choice of access devices and easy replacement of contaminated items.

- Perform hand hygiene.
- Confirm the patient's identity using at least two patient identifiers and ask if they have any allergies.
- Provide privacy.
- Explain the procedure.
- If the patient is in bed in an inpatient setting, raise the patient's bed to waist level. Place the patient in a comfortable sitting or reclining position, leaving the arm in a dependent position.
- Apply a tourniquet on an upper extremity to dilate the veins and assess for an appropriate insertion site. Verify the radial pulse. If the intended site is visibly soiled, clean it with soap and water. Clip the hair around the insertion site if needed. Administer a local anesthetic, if indicated and prescribed.
- Assess the veins in the upper extremity and identify potential sites that are easily seen or palpated. Choose an insertion site based on the assessment findings.
- Lightly palpate the site of the selected vein without visible valves or bifurcations with the index and middle fingers of the nondominant hand. Stretch the skin to anchor the vein. If it feels hard or ropelike, select another vein. If the vein is easily palpable but not sufficiently dilated, place the extremity in a dependent position for several seconds or lightly stroke the vessel. Apply dry heat, if necessary.
- Release the tourniquet for site preparation.
- Perform hand hygiene and put on gloves**.**
- Open and prepare the supplies. Flush the needleless cap/extension set with normal saline and keep the syringe attached. Maintain the sterility of the end of the connector.
- Clean the intended insertion site and surrounding skin with a facility-approved antimicrobial, and then allow it to dry completely.
- Reapply the tourniquet. Verify the radial pulse.

- Using the thumb of the nondominant hand, stretch the skin taut below the puncture site to stabilize the vein.
- Tell the patient that the device will be inserted.
- Place the short peripheral catheter on top of the vein at a 10- to 15-degree angle from the skin. Puncture the skin and anterior vein wall, watching for blood to appear in the catheter, flashback chamber, or both. Lower the catheter until almost flush with the skin. Advance the needle slightly into the vein after flashback is observed to ensure the needle tip and cannula are inserted into the vein.
- After inserting the IV catheter into a patient's vein, do not let go until it has been properly secured to prevent accidental dislodgment.
- While continuing to hold the skin taut, use the device's push-off tab to separate the catheter from the needle stylet. Advance the catheter into the vein.
- Release the tourniquet.
- Activate the device's safety mechanism, as applicable, to cover the needle following the manufacturer's instructions for use.
- Stabilize the catheter hub while attaching the extension set to the catheter hub and tighten the Luer lock, making sure the Luer lock does not come in contact with the patient's skin and maintaining sterility of the insertion site and Luer lock.
- Slowly aspirate to assess for blood return that is the color and consistency of whole blood. If no blood return occurs, take steps to locate an external cause of obstruction. It may be necessary to slightly withdraw the catheter if the tip is against a valve in the vein.
- If blood return occurs, slowly inject preservative-free normal saline solution into the catheter according to facility policy while ensuring there is no swelling of surrounding tissue.
- Clamp the catheter.
- Remove and discard the syringe.
- Stabilize and secure the catheter using an engineered stabilization device, if available. If an engineered stabilization device is unavailable, secure the catheter with sterile tape.
- Using sterile technique, apply a transparent semipermeable dressing over

the insertion site, following the manufacturer's instructions.
- Curl the extension set to the side and tape it to the inside of the patient's arm if needed for extra securement.
- Label the dressing with the current date or the date the dressing is due to be changed, as directed by agency policy.
- Discard needle(s) into a sharps container.
- Dispose of used equipment in appropriate receptacles.
- Remove and discard gloves and other personal protective equipment, if worn.
- Perform hand hygiene.
- In an inpatient setting, help the patient into a comfortable position and place personal items, the tray table, and the call light within easy reach. Make sure the patient knows how to use the call light to summon assistance. To ensure the patient's safety, raise the appropriate number of side rails and lower the bed to the lowest position. Ensure the bed is locked.
- Perform hand hygiene.
- Document the procedure and assessments.

View a YouTube video[3] showing an instructor demonstration of the IV insertion skill:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/nursingadvancedskills/?p=65#oembed-1

3. Chippewa Valley Technical College. (2023, January 5). *Inserting an IV* [Video]. YouTube. Video licensed under CC BY 4.0. https://youtu.be/Vl7VPU6oo8U

Checklist: IV Removal[4,5]

- Gather the appropriate equipment:
    - Disposable gloves
    - Sterile 2” X 2” dressing
    - Antiseptic swab
    - Tape
- Remove the tape and dressing while keeping the cannula secure (pull toward insertion site).
- Clean the site with an alcohol swab if noted by facility policy. Use caution around the open puncture site, which may be sensitive to alcohol.
- Remove the cannula with slow steady motion and then apply light pressure to the site with a 2” X 2” sterile dressing for a minimum of 30 seconds until bleeding has stopped. *Note:* Apply pressure for at least 5 to 10 minutes if the patient is on anticoagulant therapy or has bleeding tendencies.
- Maintain the folded pressure dressing over the insertion site and secure with tape.
- Inspect the catheter for intactness after removal by noting the integrity and length of the catheter tip.
- If specimen cultures of the catheter tip are ordered, cut the distal tip of the catheter with sterile scissors and place it in a sterile specimen container.
- Monitor for complications such as bleeding, pain, exudate, and swelling.
- Inspect the IV insertion site for signs of complications resulting from infusion therapy and report any concerns.
- Apply a sterile, folded gauze dressing over the insertion site, and secure it with tape.
- Discard the IV catheter in the regular trash or sharps container, based on agency policy.
- Discard the used supplies, remove gloves, and perform hand hygiene.

4. *Clinical skills: Essentials collection* (1st ed.). (2021). Elsevier.
5. Lippincott procedures. http://procedures.lww.com

- If in an inpatient setting, help the patient into a comfortable position and place personal items, the tray table, and the call light within easy reach. Make sure the patient knows how to use the call light to summon assistance. To ensure the patient's safety, raise the appropriate number of side rails and lower the bed to the lowest position. Ensure the bed is locked.
- Remove other personal protective equipment, if worn.
- Perform hand hygiene.
- Document the procedure and assessments.
- Monitor for complications such as bleeding, pain, exudate, and swelling.

Documentation Cues

- Procedure, location, and IV site assessment prior to removal
- IV catheter tip assessment and intactness
- Type and size of cannula removed
- Type of dressing applied
- Patient's tolerance of procedure and patient education provided
- Unexpected outcomes and related nursing interventions

View a YouTube video[6] showing an instructor demonstration of the IV removal skill:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/nursingadvancedskills/?p=65#oembed-2

6. Chippewa Valley Technical College. (2023, January 5). *Removing an IV* [Video]. YouTube. Video licensed under CC BY 4.0. https://youtu.be/-FOvDjZkIv4

1.6 Documentation for IV Initiation

Documentation Cues:

Accurate and complete documentation regarding IV initiation should include the following:

- Date/Time of procedure
- Manufacturer's brand name of device
- Gauge and length of device
- Location of the accessed vein
- Use of local anesthetic
- Number of attempts for a successful IV start
- Description of the insertion site, such as "cephalic vein on dorsal surface of right lower arm, 2.5 cm (1 inch) above the wrist"
- Condition of extremity and IV site
- Type of dressing with which the cannula was secured
- Patient's tolerance of the procedure and patient education provided
- If saline lock was established or if fluid was infused after IV initiation. If fluid was infused, the method of infusion (gravity or infusion pump), type and rate of infusion should be included.
- Patient's status and integrity and patency of the system according to agency policy

Sample Documentation:

12/7/20XX 0845

Obtained peripheral IV access as ordered by provider. A suitable vein was identified in the patient's right hand, and the site was cleansed with chlorhexidine per protocol. A 20-gauge 1-inch Protect IV was placed in the patient's right hand. The vein was cannulated with one attempt, and no complications were noted during cannulation. The catheter was freely threaded into the vein after blood return was noted, and the site was flushed with normal saline and clamped. The site was dressed with a sterile tegaderm dressing and extension set tubing was secured. Following application of the dressing, the site was saline locked. The patient tolerated the procedure well with no signs of redness, swelling, or other complications.

Janika Smith, RN

1.7 Specialized Infusions

In addition to the provision of IV fluid therapy and medication administration via the intravenous route, nurses must also be aware of specialized infusions and the safety implications that may be associated with these types of infusions. Two types of specialized infusions include medication administered via a patient-controlled analgesia (PCA) pump and those administered via epidural infusion. There are many unique advantages and risks associated with specialized infusions, and nurses must be aware of the safety implications and associated interventions to ensure quality patient care.

Patient-Controlled Analgesia

Patient-controlled analgesia (PCA) is a method of pain management that allows hospitalized patients with severe pain to safely self-administer opioid medications using a programmed pump according to their level of discomfort. A computerized pump contains a syringe of pain medication and is connected directly to a patient's intravenous (IV) line. Doses of medication can be administered as either a basal (i.e., continuous) rate, self-administered as needed on demand, or a combination of both methods. Doses are self-administered by the patient by pressing a button that initiates a "demand" for medication. However, the pump is programmed to only allow administration of medication every set number of minutes with a maximum dose of medication every hour. These pump settings and the design of the system require the patient to be alert enough to press the button to receive a demand dose. These design features are safety measures to help prevent overmedication that can cause sedation and respiratory depression. However, despite these safety measures it is vital for nurses to closely monitor patients receiving PCA for respiratory depression.[1] See Figure 1.18[2] for an image of a PCA pump.

1. Soffin, E. M., & Liu, S. S. (2018). Patient-controlled analgesia. In H. T. Benzon, S. N. Raja, S. M. Fishman, S. S., & S. P. Cohen's (Eds.). *Essentials of pain medicine* (4th ed., pp. 117-122.e2). Elsevier. https://doi.org/10.1016/B978-0-323-40196-8.00013-9
2. "alaris-pca-module-IF-0518-0034" by unknown author used on the basis of Fair Use. Access original image at https://www.bd.com/en-us/products-and-solutions/products/product-families/bd-alaris-pca-module.

Figure 1.18 PCA Pump. Used under Fair Use.

Patient-controlled analgesia can be very beneficial for select patients, reducing the time for medication administration and allowing pain medication to reach the patient more rapidly to reduce pain symptoms. This can help prevent out-of-control pain levels that require a significant length of time to resolve. The principles behind the method of patient-controlled analgesia involve the patient's experience of pain, subsequent administration of a drug via the PCA pump, the drug action within the bloodstream, and the patient response. Depending on the level of pain relief, the patient may experience symptom resolution or may proceed with a dose demand process by activating the PCA pump at a subsequent interval. The patient becomes an active party in medicating themselves to help control the pain experience.

It is critical that patients who are prescribed a PCA pump with demand dosing understand the safety principles behind the medication administration. Patients and their family members must be aware that only the patient is allowed to initiate the demand dose by pressing the medication button to ensure they are alert enough to do so. In this manner, oversedation

and life-threatening respiratory depression can be avoided with demand dosing.

Additionally, patients should receive education regarding the frequency with which they will receive a demand dose in order to be reassured that they cannot accidentally overdose themselves by pressing the demand button too frequently. Cues such as an audible “beep” often accompany the demand dose and can help cue the patient that the medication was administered. Conversely, if the demand button has been initiated too closely within the programmed interval, an audible “chirp” may signal to the patient that the demand dose was too soon. The patient should receive instruction that if the chirp has been noted, they may wish to wait a few minutes and reinitiate the demand.

Patients with impaired cognition or restricted upper extremity dexterity may not be appropriate for PCA. If a nurse has concerns regarding the appropriateness of self-administration of pain medication via a PCA pump based on characteristics and clinical condition of an individual patient, the prescribing provider should be notified, and alternate pain control measures should be considered.

The basic principles of a PCA medication order include the following:

Loading dose: Ordered amount of medication administered at the time of PCA initiation

Demand dose: Medication dose given on activation of demand (pressing the demand button)

Lockout interval: Time period in which no follow-up demand dose may be administered (even if demand button is activated)

Basal infusion: Continuous rate of medication administration, regardless of demand attempts

Lockout maximum: The maximum dose of medication that can be administered within a certain period, commonly prescribed to 1 hour limit

Breakthrough bolus dose: A dose of opioid or non-opioid medication administered by the nurse for breakthrough pain.

Medications that are commonly prescribed for PCA administration include opioids such as morphine, hydromorphone, and fentanyl. Nurses must be familiar with specific institutional policies and protocols regarding the use of

PCA administration. These protocols commonly include the use of specific provider orders, safety checks, and patient monitoring. Many organizations have transitioned to the use of preprinted PCA order sets to help guarantee that required PCA dosing parameters are appropriately addressed. Within a PCA order, the prescriber must include the following information: identification of the specific medication to be used in the PCA pump, the medication concentration, the specific quantity of the demand dose, the lockout interval, and the order lockout maximum. When a nurse is initiating a PCA pump, it is critical that the order be reviewed and verified with another registered nurse according to agency policy. The double-check verification helps ensure that the pump is programmed correctly, and lockout limits are included to decrease the risk of accidentally self-administering too much medication.[3]

Due to the potential adverse effects of opioids administered via a PCA pump, there is a significant risk for patient safety requiring specific monitoring by the nurse. Continuous pulse oximetry, end tidal carbon dioxide monitoring, and frequent vital signs monitoring may be required with initiation and ongoing use of a PCA pump. Individuals with obstructive airway disease, sleep apnea, obesity, renal or hepatic impairment, and recent analgesia, sedation, or anesthesia are at increased risk of complications associated with PCA administration, such as decreased level of consciousness, respiratory distress, and hypotension.[4] Dosing parameters must account for patient specific factors and individualized clinical need when initiated by the prescribing provider. Additionally, nurses must be especially vigilant when first initiating PCA infusion because initial infusion is when administration complications may be more frequently observed.

3. Soffin, E. M., & Liu, S. S. (2018). Patient-controlled analgesia. In H. T. Benzon, S. N. Raja, S. M. Fishman, S. S., & S. P. Cohen's (Eds.). *Essentials of pain medicine* (4th ed., pp. 117-122.e2). Elsevier. https://doi.org/10.1016/B978-0-323-40196-8.00013-9
4. Soffin, E. M., & Liu, S. S. (2018). Patient-controlled analgesia. In H. T. Benzon, S. N. Raja, S. M. Fishman, S. S., & S. P. Cohen's (Eds.). *Essentials of pain medicine* (4th ed., pp. 117-122.e2). Elsevier. https://doi.org/10.1016/B978-0-323-40196-8.00013-9

Please review the "Adverse Effects of Opioids" section in Open RN *Nursing Fundamentals* for more information about potential patient side effects.

Nursing staff must also be cognizant of the post-administration assessment and individualized response of each patient to PCA. Even though the patient is actively participating in their pain control plan through self-administration, pain response must be thoroughly documented. Nurses must frequently assess the patient's number of demands and subsequent doses received. Nurses should also carefully monitor the patient's vital signs, pain self-report, and nonverbal indications of the pain experience. This focused pain assessment helps ensure that the pain level is adequately controlled.

The use of PCA pumps require vigilant checks by two licensed registered nurses minimally at the start of every shift. The secure PCA pump holds the prescribed opioid medication in a locked device with a demand button that is given to the patient. Keys to the PCA pump are safely stored in secure areas such as within an automated drug dispensing machine. The pumps also have an access code to ensure that tampering with the pump settings does not occur. To document the amount and frequency of pain medication the patient is receiving, as well as to prevent drug diversion, the settings on the pump are checked at the end of every shift as part of the bedside report. The incoming and outgoing nurses double-check and document the pump settings, the amount of medication administered during the previous shift, and the amount of medication left in the syringe. When a PCA is discontinued, nurses must carefully document the remainder of medication left in the PCA syringe and follow organizational policies related to narcotic wasting and documentation.

PCA pumps often have specialized tubing and connections to prevent inadvertent connection of secondary medication to the dedicated PCA line above the pump. If a bolus of medication is administered via a dedicated PCA

line below the pump, the nurse must ensure it is compatible with the PCA medication.

Epidural

Epidural medication administration is a type of specialized infusion that is different than intravenous infusion. The use of an epidural involves administering analgesics and anesthetics directly into the spinal fluid via an epidural catheter for severe pain management. It is inserted by specially trained health professionals and requires additional safety measures and nurse monitoring to help prevent patient complications. Safety measures such as specially colored tubing and different Luer lock systems are incorporated to ensure only epidural medications are administered via the epidural line.

Epidurals are typically used with surgical procedures or during labor and delivery. Epidural infusions may also be used to treat chronic pain that has not responded to more conservative treatments. Common anesthetics that are used in epidural infusions include bupivacaine and ropivacaine administered alone or in combination with opioid medications. Anesthetics and analgesics administered via the epidural route work synergistically (i.e., cooperatively) to provide greater pain relief at lower doses.[5] See Figure 1.19[6] for an image of an epidural pump with colored tubing and an image of freshly inserted lumbar epidural catheter. The epidural site has been prepared with tincture of iodine, and the dressing has not yet been applied.

5. Benzon, H. T., Raja, S., Liu, S. S., Fishman, S., Cohen, S. P., & Hurley, R. W. (Eds.). (2018). *Essentials of pain medicine* (4th ed., pp. 117-122.e2). Elsevier. https://doi.org/10.1016/C2014-0-03837-3
6. "PCA-01.JPG" by DiverDave is licensed under CC BY-SA 3.0 and Epidural.JPG" by User:Ravedave is licensed under CC BY-SA 3.0

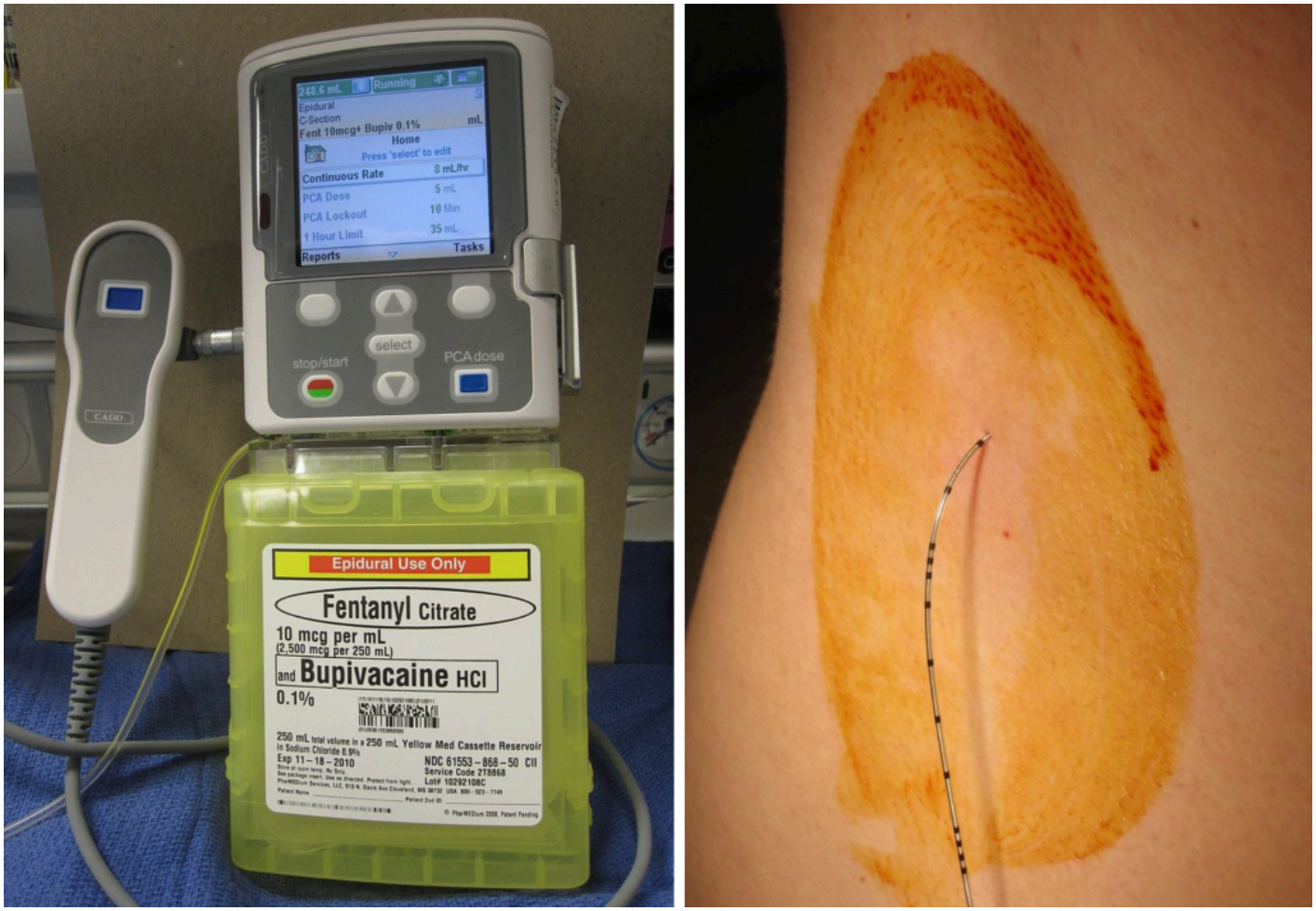

Figure 1.19 Epidural Pump and Epidural

Epidural catheters are inserted and may only be repositioned by trained anesthesia professionals. The anesthesia provider will administer a test dose of medication into the epidural to ensure that it is appropriately positioned. Once adequate positioning has been confirmed, the anesthesia provider will record the documented **block height** by assessing the patient's response to cold at various levels of the thoracic spine. This should be recorded in the patient's chart and is the subsequent block height for all future neurosensory assessments. Any block level that progresses up the body or is recorded above a level of T4 (fourth thoracic vertebra) must be immediately

communicated to the anesthesia provider to prevent respiratory distress and cardiovascular collapse.[7]

Once the catheter has been inserted and the position safely confirmed, a prescribing provider will order the medication for epidural infusion. The order must contain the medication name, concentration, and infusion rate. The epidural pump is similar to a PCA pump in that it must be locked and the infusion settings securely programmed. Some epidural pumps allow patients to self-administer on-demand doses. The initiation of the epidural medication may involve setting the pump to infuse at a constant rate or by providing an initial bolus dose and then a constant infusion rate.

Nurses caring for patients receiving epidural medications must monitor patient response to the medication and the epidural insertion site for potential complications associated with epidural infusion. Follow agency policy regarding focused assessments that typically include the patient's pain management response, vital signs, and motor/sensory checks. Signs of respiratory depression must be carefully monitored and reported to the provider if the patient exhibits a respiratory rate of less than eight breaths/minute, declining oxygen saturation, or decreased level of consciousness. Nurses must also carefully observe the patient's blood pressure and heart rate with epidural analgesia. Changes in vital signs may be associated with the epidural infusion but can also be the result of post-procedural complications, so vigilant postoperative monitoring must occur. Patients receiving epidural administration are also at risk for bradycardia, so atropine should be readily available in case the patient experiences symptomatic bradycardia.[8,9]

Nurses should be prepared to assess for signs of potential clinical problems associated with epidural usage. Table 1.7 summarizes common clinical problems associated with epidural infusions.

7. Galligan, M. (2020). Care and management of patients receiving epidural analgesia. *Nursing Standard, 35*(12), 77-82. https://doi.org/10.7748/ns.2020.e11573
8. Galligan, M. (2020). Care and management of patients receiving epidural analgesia. *Nursing Standard, 35*(12), 77-82. https://doi.org/10.7748/ns.2020.e11573
9. Woodall, W. G. (2019). Care for the patient receiving epidural analgesia. *Medsurg Nursing, 28*(3), 194-195. https://go.openathens.net/redirector/liberty.edu?url=https://www.proquest.com/scholarly-journals/care-patient-receiving-epidural-analgesia/docview/2242627838/se-2?accountid=12085

Table 1.7 Clinical Problems and Interventions With Epidural Infusions[10,11]

Clinical Problem	Potential Interventions
Inadequate pain control; partial block	Work with the anesthesia provider to adjust the patient's position or increase infusion rate. If the block is one-sided, position the patient painful side down to allow gravity to assist the medication to travel down the nerves on the side of pain.
Hypotension	Hypotension may occur with epidural use due to the dilation of blood vessels. Notify the provider. The epidural rate may need to be decreased or bolus fluids administered. The patient may require placement in Trendelenberg position.
Bradycardia	May occur as the result of blockage of sympathetic nerves. If symptomatic, notify the provider and anticipate possible administration of atropine.
Increasing sensation block height/difficulty breathing	The patient may first report signs of tingling in fingers, especially the fifth digits. Notify the provider, turn off infusion, elevate the patient's head, and administer oxygen.
Motor blockage	Leg weakness may occur as a result of an epidural block to the low motor nerves. A reduction in rate may be needed if significant paralysis is experienced. Be cautious of mobility implications associated with reduced sensation.
Respiratory depression	If a patient experiences respiratory depression of less than eight breaths per minute, stop the infusion and notify the provider. If indicated, request emergency assistance and administer rescue breaths via a bag-valve-mask.
Catheter disconnection	Disconnection of the epidural line presents an increased infection risk. Immediately contact the anesthesia provider, but do NOT reconnect the line. The end of the line may be covered with sterile gauze, according to agency policy, until the anesthesia provider arrives.
Catheter migration	Migration of the epidural catheter into a blood vessel may result in exacerbated respiratory depression and sedation. Monitor the patient for any report of tingling around the mouth, numbness, twitching, convulsion, or cardiac arrest. Immediately stop the epidural infusion and provide emergency assistance and cardiopulmonary support.

10. Galligan, M. (2020). Care and management of patients receiving epidural analgesia. *Nursing Standard, 35*(12), 77-82. https://doi.org/10.7748/ns.2020.e11573
11. Woodall, W. G. (2019). Care for the patient receiving epidural analgesia. *Medsurg Nursing, 28*(3), 194-195. https://go.openathens.net/redirector/liberty.edu?url=https://www.proquest.com/scholarly-journals/care-patient-receiving-epidural-analgesia/docview/2242627838/se-2?accountid=12085

Common side effects of epidural medication infusion include nausea and itching associated with the specific medications included in the infusions. Many times, these side effects can be adequately managed with medications, and the epidural infusion may continue. Another common side effect is urinary retention. Nurses should monitor urine output for patients who do not have a urinary catheter in place. Intermittent or indwelling catheterization may be required to drain the bladder and prevent discomfort.[12,13]

Review a handout on how to assess sensation and motor function for a patient receiving epidural anesthesia.

12. Galligan, M. (2020). Care and management of patients receiving epidural analgesia. *Nursing Standard, 35*(12), 77-82. https://doi.org/10.7748/ns.2020.e11573
13. Woodall, W. G. (2019). Care for the patient receiving epidural analgesia. *Medsurg Nursing, 28*(3), 194-195. https://go.openathens.net/redirector/liberty.edu?url=https://www.proquest.com/scholarly-journals/care-patient-receiving-epidural-analgesia/docview/2242627838/se-2?accountid=12085

Exercises

(Answers to the exercises are located in the Answer Key at the back of the book).

Case Study #1

Eli, age 4, arrives at Urgent Care with his grandmother; he is staying with his grandparents while his parents are on vacation. Eli was playing in the woods behind his grandparents' home today while his grandpa was clearing brush and returned to the house with a raised, red rash on the left side of his face and arms and hands bilaterally. "I am really itchy," Eli says, "And my face and arms really hurt." His grandmother states that they have seen poison ivy in the woods in the past, and Eli's grandpa didn't warn him before they went out today. You notice as you observe Eli that he is itching his arms, and his left eye appears swollen.

The MD gives you the following orders:

- Start a peripheral IV STAT
- Administer diphenhydramine 25 mg IV now and q8h prn for rash

1. What should you consider when initiating an IV for Eli?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/nursingadvancedskills/?p=69#h5p-1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/nursingadvancedskills/?p=69#h5p-2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/nursingadvancedskills/?p=69#h5p-3

Test your knowledge using a NCLEX Next Generation-style question. You may reset and resubmit your answers to this question an unlimited number of times.

I Glossary

Air embolism: The presence of air in the vascular system that occurs when air is introduced into the venous system and travels to the right ventricle and/or pulmonary circulation.

Arterial blood sampling: Blood is obtained via venipuncture into an artery.

Basal infusion: Continuous rate of medication administration, regardless of demand attempts.

Block height: Level of epidural nerve block recorded by assessing the patient's response to cold at various levels of the thoracic spine.

Blown vein: A ruptured vein that is leaking blood.

Breakthrough bolus dose: A dose of opioid or non-opioid medication administered by the nurse for breakthrough pain when a patient is receiving patient-controlled analgesia.

Capillary blood testing: A blood sample collected from the capillary blood vessels (i.e., tiny blood vessels located near the surface of the skin).

Catheter embolism: An embolism that occurs when a small part of the cannula breaks off and flows into the vascular system.

Catheter-related bloodstream infection (CR-BSI): An infection caused by microorganisms introduced into the bloodstream through the puncture site, the hub, or contaminated IV tubing or IV solution, leading to bacteremia or sepsis. A CR-BSI is a hospital-acquired preventable infection and considered an adverse event.

Central venous access device (CVAD): A type of vascular access that involves the insertion of a tube into a vein in the neck, chest, or groin and threaded into a central vein (most commonly the internal jugular, subclavian, or femoral) and advanced until the terminal lumen resides within the inferior vena cava, superior vena cava, or right atrium.

Demand dose: Medication dose given on activation of demand (pressing the demand button).

Epidural: Administration of analgesics and anesthetics into the spinal fluid via an epidural catheter for severe pain management associated with surgical procedures or during labor and delivery.

Extravasation: A condition that occurs when vesicant solution (medication) is administered and inadvertently leaks into surrounding tissue, causing

damage to surrounding tissue. It is characterized by the same signs and symptoms as infiltration but also includes burning, stinging, redness, blistering, or necrosis of the tissue.

Hypertonic solutions: IV fluids with a higher concentration of dissolved particles than blood.

Hypotonic solutions: IV fluids with a lower concentration of dissolved solutes than blood.

Infiltration: A condition that occurs when a nonvesicant solution (IV solution) is inadvertently administered into surrounding tissue. Signs and symptoms include pain, swelling, redness, the skin surrounding the insertion site is cool to touch, there is a change in the quality or flow of IV, the skin is tight around the IV site, IV fluid is leaking from IV site, or there are frequent alarms on the IV pump.

Intravenous therapy (IV therapy): Administration of a substance directly into a person's vein.

Isotonic solutions: IV fluids with a similar concentration of dissolved particles as blood.

Loading dose: Ordered amount of medication administered at the time of PCA initiation.

Lockout interval: Time period in which no follow-up demand dose may be administered (even if demand button is activated).

Lockout maximum: The maximum dose of medication that can be administered within a certain period, commonly prescribed to 1 hour limit.

Midline peripheral catheters: Larger peripheral catheters (i.e., 16-18 gauge) that allow for rapid infusions and blood sampling and can be used for longer duration that traditional peripheral catheters. They are ultrasound-guided and can be inserted by RNs with additional training or other trained professionals.

Patient-controlled analgesia (PCA): A method of pain management that allows hospitalized patients with severe pain to safely self-administer opioid medications using a programmed pump according to their level of discomfort.

Peripheral IV (PIV): A short intravenous catheter inserted by percutaneous

venipuncture into a peripheral vein and held in place with a sterile transparent dressing.

Peripheral inserted central catheter (PICC): A thin, flexible tube inserted into a vein in the upper arm and guided into the superior vena cava used to give intravenous fluids, blood transfusions, chemotherapy, and other medications.

Phlebitis: The inflammation of the vein's inner lining, the tunica intima. Clinical indications are localized redness, pain, heat, and swelling that can track up the vein leading to a palpable venous cord.

Pulmonary edema: A condition caused by excess fluid accumulation in the lungs due to excessive fluid in the circulatory system. It is characterized by decreased oxygen saturation; increased respiratory rate; fine or coarse crackles in the lung bases; restlessness; breathlessness; dyspnea; and coughing up pink, frothy sputum. Pulmonary edema requires prompt medical attention and treatment.

Saline locks: A short extension set that allows intermittent IV access without ongoing infusion.

Total parenteral nutrition (TPN): A concentrated solution that is ordered for a patient based on their specific electrolyte and nutritional needs.

Venipuncture: The process of introducing a needle into a patient's vein to collect a blood sample or insert an IV catheter.

PART II

CHAPTER 2 ADMINISTER IV PUSH MEDICATIONS

2.1 Introduction

Learning Objectives

- Explain the advantages, disadvantages, and precautions associated with IV medication administration
- Identify information that must be checked before an IV push medication is administered
- Define “speed shock” and measures to prevent it from occurring
- Compare the procedure for administering an IV push medication through a primary IV line versus through a saline lock

In acute care settings, nurses frequently administer medications via the intravenous (IV) route. Medications may be administered through a primary line that is already infusing fluids or through a saline lock inserted into a patient’s vein with direct access to the bloodstream. Medications given via the IV route enter the bloodstream immediately, so extreme caution must be observed while performing this procedure. Administering medications via the IV route requires diligent attention to the rights of medication administration and IV safety. When utilized appropriately, medications administered via IV push can provide rapid symptom resolution and therapeutic effect. There are many advantages and potential disadvantages to using the IV route for administering medications; therefore, a nurse must have a strong understanding of its benefits, risks, and safety implications.

2.2 Basic Concepts of IV Push Medication

There are several advantages, disadvantages, and potential complications that can occur when administering IV push medication, requiring the nurse to implement many safety considerations.

Advantages

Intravenous push (IV push) is a process of introducing a medication or fluid substance directly into the bloodstream via the venous system. When the medication is administered directly into the bloodstream, it immediately enters the circulatory system and travels to a site of action. Administering the medication directly into the bloodstream reduces the **first-pass effect** or the action that occurs when a medication must be first metabolized or broken down prior to entering the blood. First-pass effect results in a diminished volume of available circulating drug and a subsequent decrease in therapeutic action.[1] As a result, when utilizing IV push medications, a decreased dosage of medication can be given compared to an oral dosage to achieve the same therapeutic effect.

First-pass metabolism significantly impacts the bioavailability of many medications. For example, larger oral doses of morphine must be provided than intravenous dosages to obtain the same therapeutic pain relief, but the risks of oversedation and respiratory depression are higher with intravenous doses. Nurses who have concerns about an ordered dose of intravenous medication should clarify the dosage with the pharmacist and/or prescribing provider before administering it.

Intravenous medication administration also has a more rapid onset than oral medication. Because the bioavailability of the medication is directly in the circulatory system, the medication is readily transported to the site of action. This is a significant benefit when a rapid response is needed, such as when clients are experiencing severe hemodynamic instability or severe pain.

Let's consider the following scenario: A nurse on a medical telemetry unit received a direct admission from a cardiac clinic for an 85-year-old male client

1. This work is a derivative of StatPearls by Herman & Santos and is licensed under CC BY 4.0

admitted with an exacerbation of chronic heart failure. The client's vital signs are heart rate 102, blood pressure 144/88, respiratory rate 24, and pulse oximetry reading of 90% on room air. The nurse listens to the client's lung sounds and notes crackles in both posterior lungs. The nurse reviews the admitting orders from the provider and sees an order for furosemide 40 mg IV push STAT. Review furosemide's drug action profile in Table 2.2a and note the different onsets of action for the different routes of furosemide. It is clear that the IV push route of administration will work quickly to remove this client's excess fluid and positively impact their respiratory status.

Table 2.2a Furosemide Drug Action Profile[2]

Route	Onset	Peak
PO	30-60 minutes	1-2 hours
IM	10-30 minutes	Unknown
IV	5 minutes	30 minutes

Intravenous medication administration can also be of great benefit when clients are experiencing gastrointestinal issues that may affect absorption, such as impaired swallowing or esophageal, stomach, or intestinal absorption issues. Administering a medication directly into the cardiovascular system allows the substance to freely circulate throughout the body and bypass the breakdown and absorption barriers created by the gastrointestinal tract. See Figure 2.1[3] for an image of a nurse administering IV push medication.

2. Vallerand, A. H., & Sanoski, C. A. (2023). Furosemide. *Davis's drug guide for nurses* (18th ed.). F.A. Davis. https://www.drugguide.com/ddo/view/Davis-Drug-Guide/51345/all/furosemide
3. "Stem-cells-iv-administration-dmd-ama-regenerative-medicine.jpg" by Alice Pien, MD is licensed under CC BY-SA 4.0

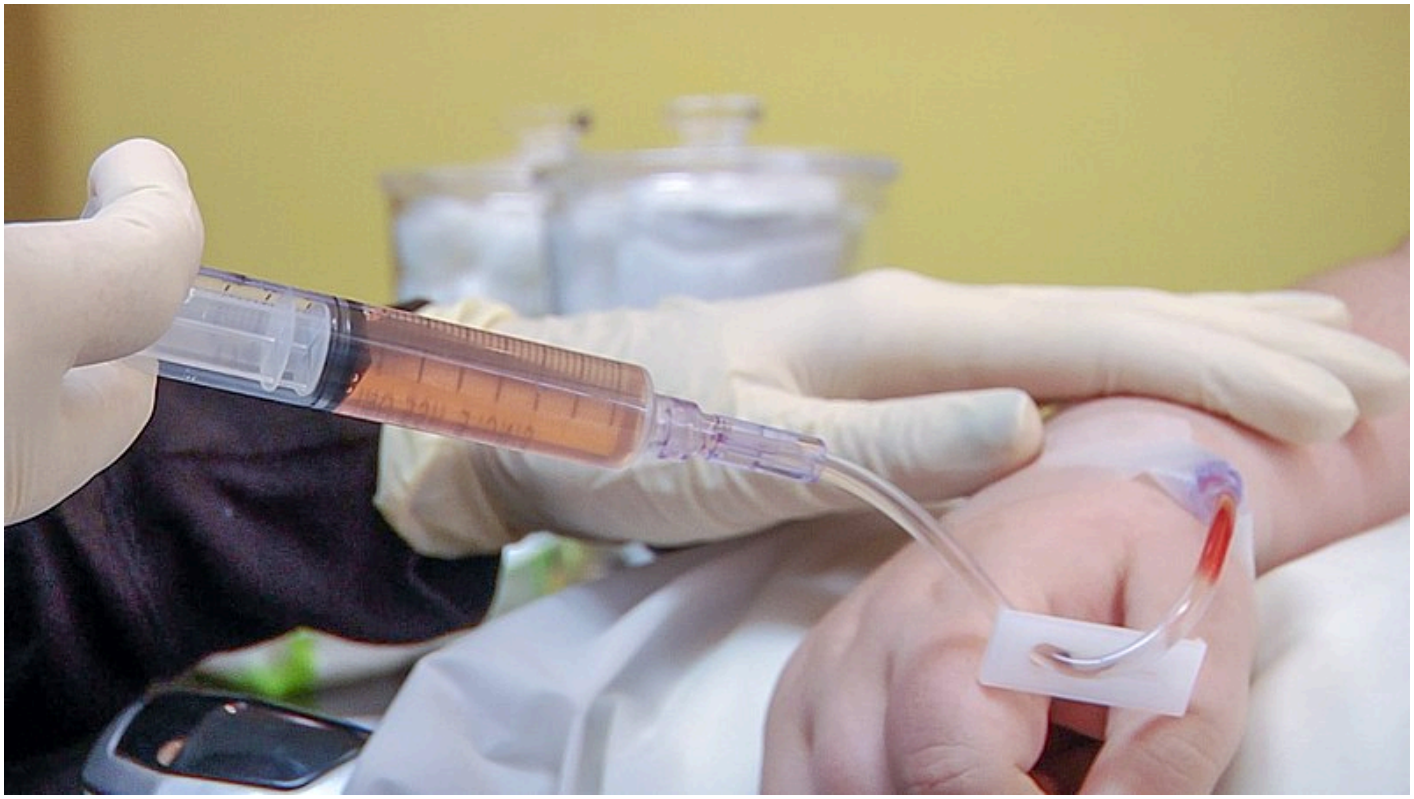

Figure 2.1 Administering IV Push Medication

In addition to rapid onset, some medications are only formulated to administer via the IV route, such as certain vasoactive substances. As a result, many patients who are hospitalized may have an "IV lock" inserted to facilitate rapid IV access if their condition deteriorates. An **IV lock** (also referred to as a "saline lock") is an IV cannula that has been inserted into a peripheral vein with a short extension tube that is filled with saline and clamped to keep the cannula patent. This type of IV access may also be referred to as a "peripheral lock" because it is inserted into the peripheral vasculature. Historically, many IV locks were flushed with heparin to keep the line from clotting, so they were referred to as a "heparin lock" or "hep lock." Although evidence-based practice no longer recommends heparin be used to maintain patency of a peripheral IV access device, the name "hep lock" may still be used in practice. An IV lock is beneficial because it provides rapid access to administering medications in the venous system if needed, but continuous infusion of medication or fluid is not required.

IV push medication can also be a valuable alternative route of administration for clients at risk for fluid volume overload. For example, clients who are experiencing acute renal failure or an acute exacerbation of heart failure may benefit from IV push

medications administered with smaller amounts of fluids compared to a typical IV infusion of medication.[4]

One of the most obvious benefits of IV push medication administration from a client's perspective is that it does not require repeated needlesticks for administering repetitive doses of medications intramuscularly or subcutaneously. As a result, client discomfort is minimized when intravenous access can be maintained.

Disadvantages and Potential Complications

When administering IV push medication, nurses must always proceed with significant caution. Remember that medication administered via IV push cannot be retrieved! For this reason, it is vital for the nurse to perform the rights of medication administration before giving IV push medications. The rights of medication administration are reviewed in the "Safety Concepts" subsection later in this section.

Prior to administration, the nurse must carefully review the client's current IV solutions and/or medications for incompatibilities with the medication to be administered. Many maintenance fluids (i.e., fluids given intravenously to facilitate hydration status) may include additives like electrolytes that may not be compatible with all medications. Nurses must ensure that all components are compatible with one another to ensure that a precipitate does not form when the substances come into contact with one another. A **precipitate** is the formation of small crystals as the incompatible substances come in contact with one another. Precipitate can occlude the infusion catheter line, inactivate the medications, or create an embolism, putting the client at significant risk for harm.[5] See Figure 2.2[6] for an example of a client's existing fluids and medications being infused that must be checked for compatibility

4. Spencer, S., Ipema, H., Hartke, P., Krueger, C., Rodriguez, R., Gross, A. E., & Gabay, M. (2018). Intravenous push administration of antibiotics: Literature and considerations. *Hospital Pharmacy, 53*(3), 157–169. https://doi.org/10.1177/0018578718760257
5. Institute for Safe Medication Practices. (2017, April 6). *Two unsafe practices: Administration of a product with a precipitate and reuse of a saline flush syringe*. https://www.ismp.org/resources/two-unsafe-practices-administration-product-precipitate-and-reuse-saline-flush-syringe#:~:text=If%20a%20precipitate%20is%20observed,organ%20failure%20or%20even%20death
6. "IV_pole_top_portion.JPG" by BrokenSphere is licensed under CC BY-SA 3.0

before IV push medication is administered in the same line and/or access site.

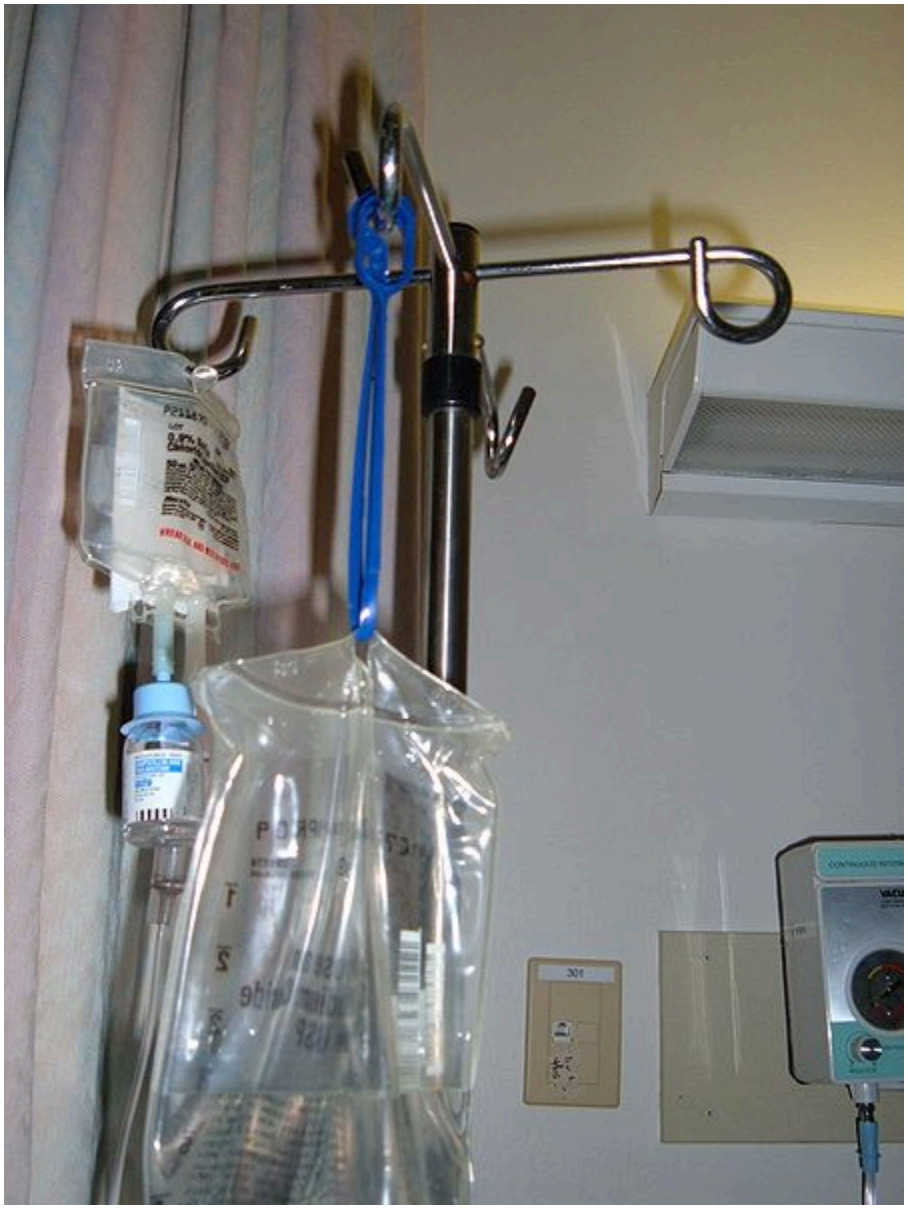

Figure 2.2 Existing IV Fluids and Medications to Check for Compatibility

An additional potential disadvantage of administering medication via IV push when other fluids and/or medications are infusing is that the infusate can move backwards into the existing IV administration set if not performed correctly and thus reduce the amount of medication that reaches the client. For this reason, the nurse should pinch the existing tubing above the site of the hub in which the IV push medication is being administered.

In addition to leaching, many IV push medications require reconstitution to dissolve the medication powder into a fluid for administration. With

reconstitution, there is a potential for nurse error in calculating total volume to be administered so the ordered dose reaches the patient.

The risk of patients experiencing speed shock with IV push medication administration is also a significant potential concern. **Speed shock** is characterized as an adverse systemic reaction when a foreign substance is introduced into the bloodstream. Speed shock may occur with IV push medication administration when the medication peaks very quickly. This sudden peak increases the risk of significant side effects. When medication is administered in a short period of time (typically in less than one minute), there is little opportunity to stop the medication if the client experiences an allergic response. Signs of speed shock include a systemic reaction such as tightness or pressure in the chest, irregular pulse, flushed skin, headaches, change in the level of consciousness, a feeling of impending doom, or cardiac arrest. Clients who have reduced liver and kidney function or those with cardiac problems are at increased risk of speed shock. If a nurse notes the signs of speed shock during IV push administration, they should immediately stop the infusion, maintain the IV line for emergency access, notify the provider, and begin CPR if indicated.

IV site complications are an additional disadvantage with IV push medication administration. Any time a medication or fluid is given into an IV site, there is increased risk for complications such as infiltration, extravasation, and phlebitis. Review information about these complications in Table 1.3a in the "Peripheral IV Access" section in the "Initiate IV Therapy" chapter.

See Table 2.2b for a summary of common advantages and disadvantages associated with the use of IV push medications.

Table 2.2b IV Push Medication Advantages and Disadvantages[7]

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Advantages	Disadvantages
Intravenous medications can deliver an immediate, fast-acting therapeutic effect, which is important in emergent situations, such as cardiac arrest or narcotic overdose. They are useful to manage pain and nausea by quickly achieving therapeutic levels, and they are more consistently and completely absorbed compared with medications given by other routes of injection.	Once an intravenous medication is delivered, it cannot be retrieved. When giving IV medications, there is very little opportunity to stop an injection if an adverse reaction or error occurs. IV medications, if given too quickly or incorrectly, can cause significant harm or death.
Doses of short-acting medication can be titrated according to patient responses to drug therapy. Medication can be prepared quickly and given over a shorter period of time compared to the IV piggyback route.	Any toxic or adverse reaction can occur immediately and may be exacerbated by a rapidly injected medication.
Minimal dilution is required for some medications, which is desirable for a patient's fluid restrictions.	Infiltration and extravasation can cause tissue damage, nerve damage, and scarring.
There is minimal or no discomfort for the patient in comparison to receiving subcutaneous and intramuscular injections.	Not all medications can be given IV route.
Intravenous medications provide an alternative to the oral route for drugs that may not be absorbed by the GI tract. They are ideal for patients with GI dysfunction or malabsorption, as well as for patients who are NPO (nothing by mouth) or unconscious.	There is a high risk for infusion reactions, ranging from mild to severe because most IV medications peak rapidly (i.e., they have a quick onset of effect). A hypersensitivity reaction can occur immediately or be delayed and requires supportive measures.
IV push medication provides a more accurate dose of medication because none is left in the intravenous tubing.	The route for administering medications may damage surrounding tissues. There is an increased risk of phlebitis with highly concentrated medication, especially with small peripheral veins or a short venous access device.

Safety Concepts

Checking Rights of Medication Administration

When administering IV push medications, it is essential for nurses to vigilantly check the rights of medication administration three times. What began as five rights of mediation administration has been extended to eight rights according to the American Nurses Association. These eight rights include the following[8]:

- **Right patient:** Check that you have the correct patient using two patient identifiers according to agency policy (e.g., name and date of birth).
- **Right medication:** Check that you have the correct medication and that it is appropriate for the client in the current context. Understand the purpose of the medication and why the client is receiving it.
- **Right dose:** Check that the dose is safe for the age, size, and condition of the client. Different dosages may be indicated for different conditions, and pediatric dosages are typically much lower than adult dosages. Be aware of the medication side effects, peak, and onset of action. The peak of the medication administration occurs when the medication is at the highest level in the client's bloodstream. The onset of medication administration occurs when the action of the medication begins to take effect. It is important for nurses to be aware of both the peak and onset and of IV administration to help assess when client response to medication may start to be observed.
- **Right route:** Check that the route is appropriate for the client's current condition. Is the medication available to be administered via IV push? Does it require dilution with a substance such as normal saline? Does it require reconstitution? Can it be administered via peripheral access, or does it require central line access into a larger size vein?
- **Right time:** Adhere to the prescribed scheduling of the IV medication.

8. American Nurses Association. (2021). *ANA issue brief: Use of medication assistants/aides/technicians.* https://www.nursingworld.org/~498e32/contentassets/a2ff1bd2d5ca467699c3bc764f7d9198/issue-brief-medication-aides-4-2021.docx

Additionally, the rate of administration of the IV medication and the post-procedure saline flush must be administered according to manufacturer recommendations in a drug reference.

- **Right documentation:** Always verify any unclear or inaccurate documentation prior to administering medications.
- **Right reason:** Verify this medication is being administered to this client at this time for the right reason. If signs and symptoms no longer warrant administration of the prescribed medication, notify the prescribing provider.
- **Right response:** After administering the IV push medication, the nurse must evaluate for expected outcomes with the time frame of expected onset and peak. The nurse must also evaluate for unanticipated adverse outcomes and notify the provider if expected outcomes are not achieved or adverse effects occur.

In addition to checking the eight rights of medication administration, it is important to collect any baseline assessment information and nursing implications for administration. For example, nurses may be required to have certain vital signs monitoring capabilities available when administering certain medications, a certain size vascular access device, or access into the central versus peripheral vascular system.

Additionally, it is important to consider the specific time frame for drug administration. Many IV medications must be infused over a period of time and cannot be pushed into the venous system rapidly due to potential adverse hemodynamic effects. Medications administered by direct IV route are commonly given very slowly per guidelines outlined in a drug reference guide. Nurses must routinely consult drug reference guides when administering IV push medications to check medication and fluid compatibilities and to ensure that medications are given at the correct rate to prevent complications.

Checking for Potential Incompatibilities

When administering medications via the intravenous route, it is also

important to consider potential incompatibilities that may exist. Incompatibilities for the IV route are often organized into three different categories, including physical, chemical, and therapeutic issues.

- **Physical:** When one drug is mixed with other drugs or solutions, a product is produced that is unsafe for administration. An example would be mixing oil with a water base.
- **Chemical:** When a drug reacts with other drugs or solutions, resulting in alterations of the integrity and potency of the active ingredient. A cloudy or crystalline precipitate may form.
- **Therapeutic:** When agents are antagonistic to one another, resulting in an undesired pharmacological action in a patient. This is the largest class of incompatibilities.

It is critical that nurses administering IV push medications are aware of available reversal agents for that medication. For example, when administering an opioid such as fentanyl via IV push, the nurse must monitor for oversedation and respiratory depression. The nurse should have naloxone, the reversal agent, readily available and accessible if an adverse reaction occurs.

Checking Current Status of the Client

As with administration of any medication, nurses must ensure that the medication to be given is appropriate based on the client's current condition. Therefore, associated physical assessment findings, vital signs, pain assessment, and laboratory results must be reviewed before administering IV push medications. For example, if administering morphine via IV push for pain management, the nurse should perform and document a detailed pain assessment prior to administration. Pre-assessment data guides the nurse in determining if morphine is appropriate to administer at this time or if a lower-tier pain medication is more appropriate. It also guides the nurse in determining if a medication should be withheld based on current signs and symptoms and the provider notified. Ultimately, if the medication is

administered, the pre-assessment data will be used to compare post-administration data to determine the therapeutic effect of the medication.

The condition and appropriateness of the specific IV site that will be used for administration of IV push medication must be assessed prior to medication administration and monitored for signs of complications. If infiltration of a medication occurs at the site, there may be neutralizing agents that can be given to minimize the impact of the medication on the surrounding tissues. For example, phentolamine mesylate may be injected into the extravasation site of a vasopressor to prevent dermal necrosis. Furthermore, some medications have pH values that must be controlled with a buffering agent to create a more tolerable pH for infusion. Finally, medications that are more viscous may require larger IV cannula sizes to push the medication through the cannula. Medication administered via IV route should never be forced through the IV cannula line. Pushing medication forcefully through a blocked IV cannula may force a clot into the client's circulatory system.

Select an IV site with a large vein and IV cannula to use for IV push medication administration. Administration of medication through a large cannula allows for greater dilution and minimizes the chance of vascular irritation.

Infection Control

Aseptic technique must be maintained throughout all IV push procedures, including preparing and maintaining equipment and administering IV push medications. Hand hygiene and aseptic non-touch technique (ANTT) must be performed when handling all IV equipment and accessing IV sites. These standards can be reviewed in the "Aseptic Technique" chapter in Open RN

Nursing Skills. Cleansing techniques must be followed when accessing an IV site according to agency policy. Additionally, if a syringe becomes contaminated by contact with a nonsterile surface, it should be replaced with a new one to prevent introducing bacteria or other contaminants into the system.

2.3 Equipment

To perform IV push medication administration, nurses must gather basic equipment to perform the task. The main supplies that are required to administer medications via the IV push route include syringes, needles, needleless vial accesses, saline flush syringes, and antiseptic pads (chlorhexidine-based, alcohol, or tincture of iodine). The syringe and needle sizes that are selected to draw out the medication from the medication vial often depend on the characteristics of the fluid and the volume of medication to be given. For example, medications that are more viscous (such as lorazepam) may require a larger bore needle in order to be easily drawn into the syringe.

Additional equipment that will be needed to safely administer medications via the IV push route include gloves, the specific medication ampule or vial, a drug reference guide, and a watch with a second hand so that a nurse can accurately time the rate of administration for the IV push. Common syringe sizes range from 1 mL- to 60 mL-syringes. See Figure 2.3[1] for an image of various sizes of syringes. Most IV push medication for adult patients will be delivered in sizes ranging from 3 mL, 5 mL, or 10 mL using a Luer lock syringe. Luer lock syringes have interlocking threads to hold the connection together. When selecting a syringe, ensure the size will hold the total volume of medication with reconstitution solution. When reading the volume of medication within the syringe, read the volume where the plunger is in contact with the solution being administered.

1. “Syringes 3I3A0446.jpg” by Chippewa Valley Technical College is licensed under CC BY 4.0

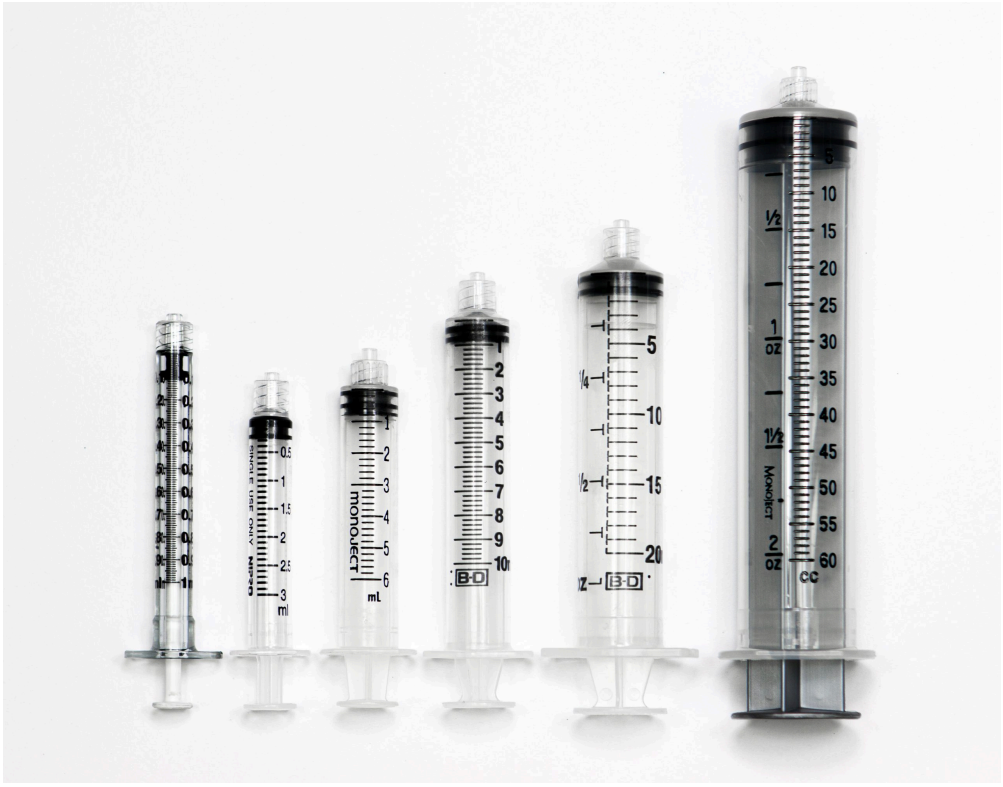

Figure 2.3 Syringes of Varying Sizes

View a YouTube video[2] on how to read a syringe:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/nursingadvancedskills/?p=108#oembed-1

Needles used to withdraw medication from the vial should also be appropriately sized to account for the type of solution being withdrawn. The gauge of a needle is the diameter of the needle. Gauges can vary from very small diameter (25 to 29 gauge) to large diameter (18 to 22 gauge). Note the higher the number of gauge, the smaller the diameter of the needle. A

2. RegisteredNurseRN. (2017, June 12). *How to read a syringe 3 mL, 1 mL, insulin, & 5 mL/cc | Reading a syringe plunger* [Video]. YouTube. All rights reserved. Video used with permission. https://youtu.be/_TnDr8cKums

needle will have its gauge and length marked on the outer packaging.[3] See Figure 2.4[4] for images of various needle sizes.

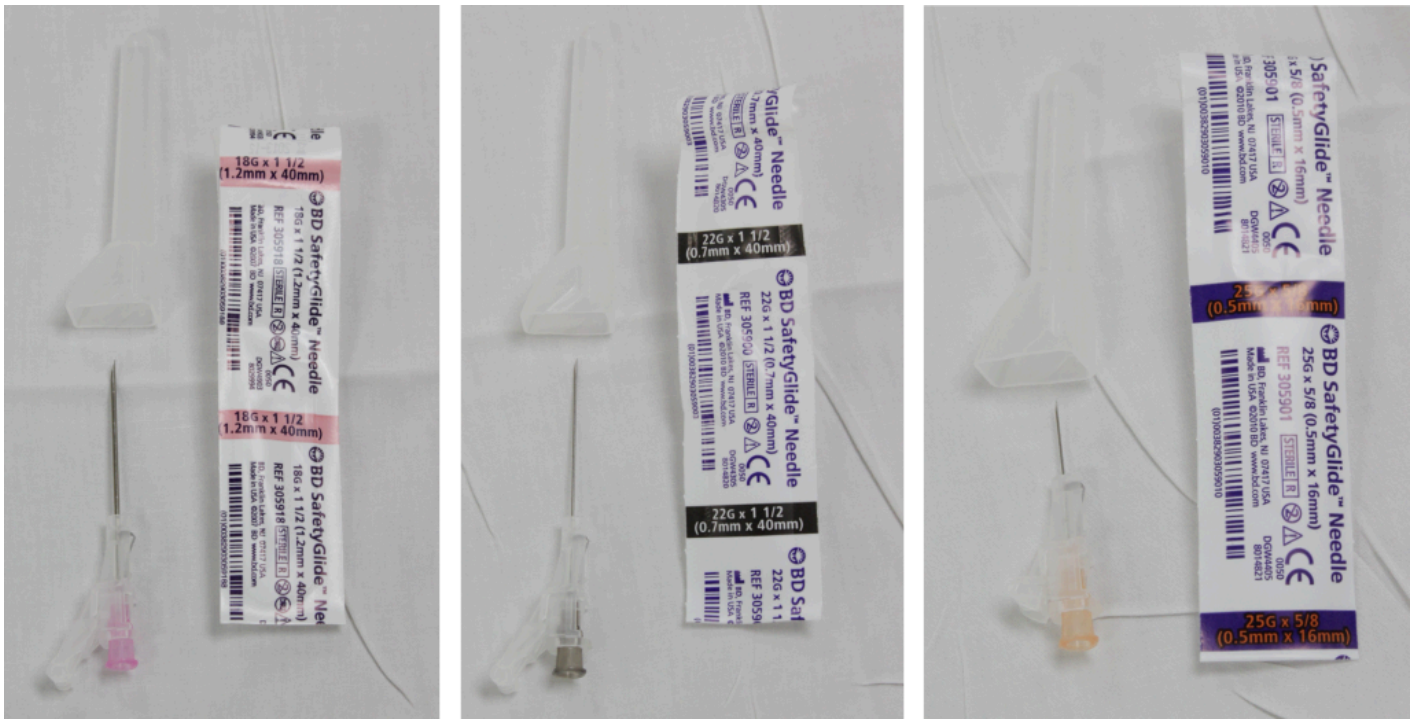

Figure 2.4 Various Needle Sizes (18g, 22g, 25g)

More viscous medications require an 18-gauge or 20-gauge needle to ensure easy withdrawal of the medication from the vial and into the syringe. Smaller gauge needles may bend or break when accessing vial rubber stops, placing a nurse at risk for a needlestick or injury when withdrawing the medication.

There are also many needleless access devices, often referred to as **blunt needle devices**, available in medical facilities. The "blunt needles" can be used to puncture a vial rubber stop and withdraw medication but should not be used to inject medication into patients. These needleless accesses are commonly made of plastic and reduce the danger of needle puncture. Needleless devices should be utilized whenever possible to reduce the risk of inadvertent needlesticks. Some blunt needle devices also have filters and should be used when withdrawing medication from an ampule.

3. This work is a derivative of Clinical Procedures for Safer Patient Care by British Columbia Institute of Technology and is licensed under CC BY 4.0
4. "Needle 18g," "Needle 22g," and "Needle 25g" by Chippewa Valley Technical College are licensed under CC BY 4.0

Ampules, Vials, and Prefilled Syringes

There are various types of parenteral medication containers in which medications may be stored, such as glass ampules, single dose or multi-dose vials, and prefilled syringes.

Ampules are glass containers in 1 mL to 10 mL sizes that hold a single dose of medication in liquid form. They are made of glass and have a scored neck to indicate where to break the ampule. Because there is risk of being cut by glass when opening a glass ampule, the nurse should use an ampule breaker or wrap an alcohol swab package around the neck of the ampule for protection See Figure 2.5[5] for an image of opening an ampule. It is important that the nurse use caution and firmly grasp the ampule neck, breaking the ampule at the neck with firm pressure applied. Nurses should break the ampule away from their hands to help ensure that they do not inadvertently cut themselves in the process of breaking open an ampule. Once the ampule is open, a blunt needle device with a filter must be used when withdrawing medication to prevent glass particles from being drawn up into the syringe. Glass ampule pieces must be disposed of in a sharps containers following medication administration.

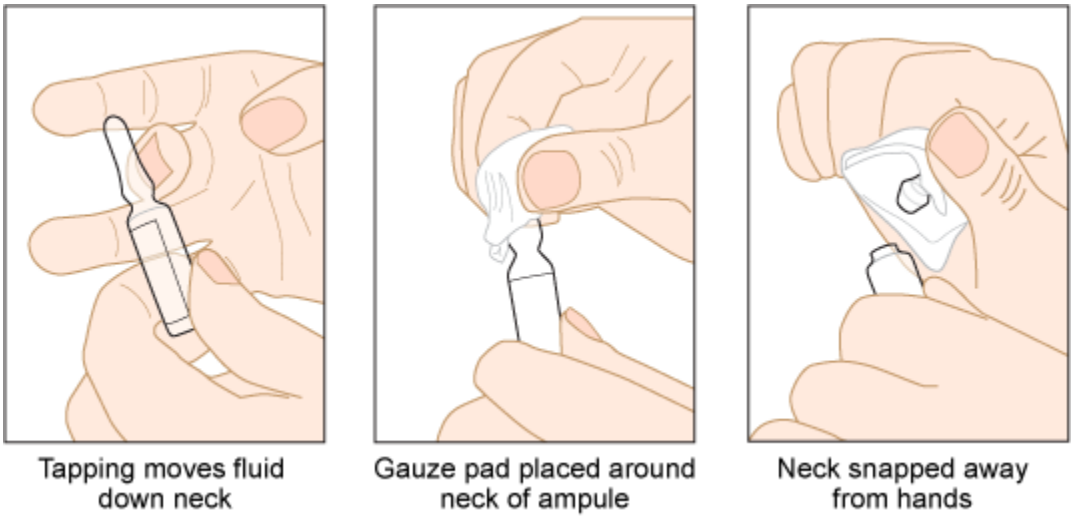

Figure 2.5 Opening an Ampule

5. "preparing-an-ampule-1.png" by unknown author at Thomson Rivers University is licensed under CC BY 4.0. Access for free at https://pressbooks.bccampus.ca/clinicalproceduresforsaferpatientcaretrubscn/chapter/safe-injection-administration-and-preparing-medication-from-ampules-and-vials/

A **vial** is a single- or multi-dose plastic container with a rubber seal top, covered by a metal or plastic cap. A single-use vial must be discarded after one use. A multi-dose vial must be labeled with the date it was opened and its "beyond use date" (BUD). Guidelines indicate a multi-dose vial may be used for up to a maximum of 28 days of opening unless there is a specific expiration date labelled by the manufacturer.[6]

Needless caps on vials are dust covers only and are not considered sterile. After removing the vial cap, scrub the diaphragm of the cap using 70% isopropyl alcohol. If using more than one vial, separate alcohol wipes must be used on each vial.[7]

Because a vial is a closed system, air equal to the volume of solution to be withdrawn must first be injected into the vial to permit the removal of the solution. See Figure 2.6[8] for an image of medication being withdrawn from a vial.

Figure 2.6 Withdrawing Medication From a Vial

6. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharpe, E., & Alexander, M. (2021). Infusion therapy standards of practice (8th ed.). *Journal of Infusion Nursing: The Official Publication of the Infusion Nurses Society, 44*(1S Suppl 1), S1–S224. https://doi.org/10.1097/NAN.0000000000000396
7. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharpe, E., & Alexander, M. (2021). Infusion therapy standards of practice (8th ed.). *Journal of Infusion Nursing: The Official Publication of the Infusion Nurses Society, 44*(1S Suppl 1), S1–S224. https://doi.org/10.1097/NAN.0000000000000396
8. "Book-pictures-2015-620.jpg" by unknown author is licensed under CC BY 4.0. Access for free at https://opentextbc.ca/clinicalskills/chapter/safe-injection-administration-and-preparing-medication-from-ampules-and-vials/

Prefilled syringes contain prefilled volumes of medication. Many medications used during emergency medication situations are contained in prefilled syringes, such as epinephrine or naloxone. See Figure 2.7[9] for an image of a prefilled syringe. Some prefilled syringes require connection to a syringe device containing a plunger. Prior to administering medication via a prefilled syringe, examine the volume of medication within the syringe, verify the amount with the dose in the medication order, and perform any math calculations required. Remove protective caps from the syringe barrel and medication cartridges and secure the plunger device onto the prefilled syringe by screwing the end of the push device into the plunger barrel. Per manufacturer guidelines, advance the plunger to expel air contained within the device.

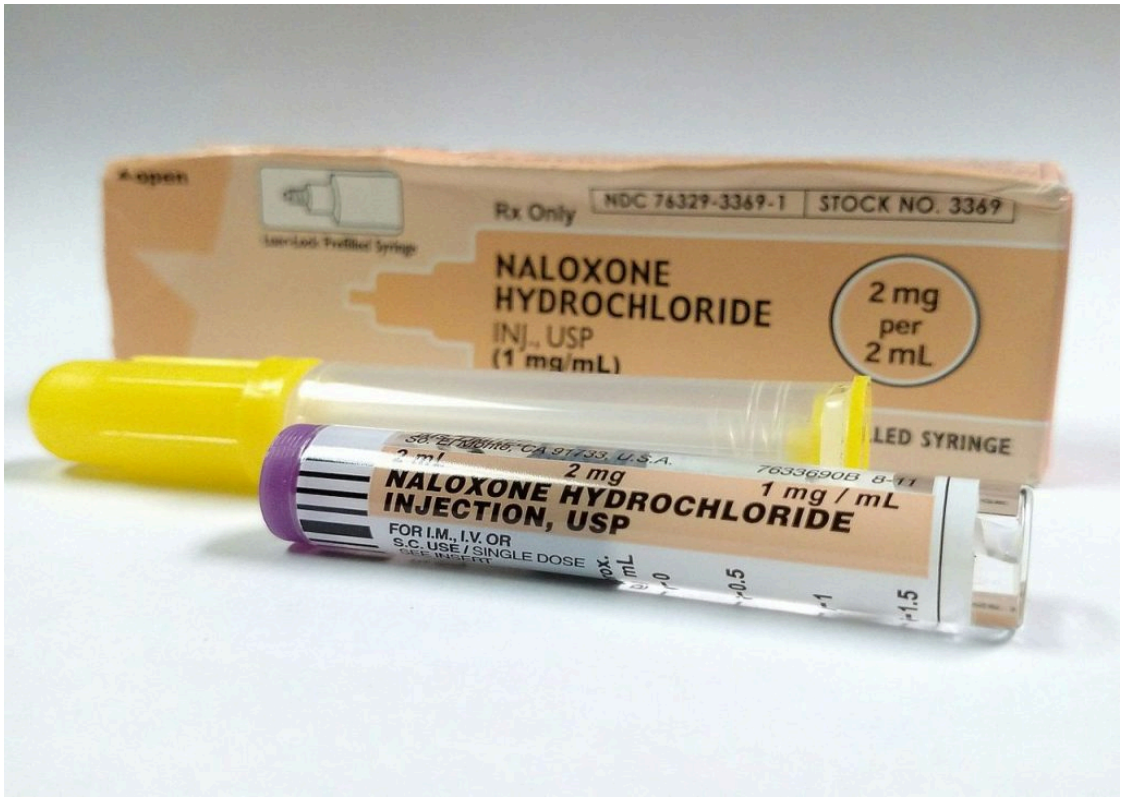

Figure 2.7 Pre-filled Syringe

9. "Naloxone_2_(cropped).jpg" by Mark Oniffrey is licensed under CC BY 4.0

Assessments Prior to the Procedure

Prior to administering medication via IV push, the nurse should assess the patient and the IV site to ensure appropriateness of medication administration. Pre-administration patient considerations ensure vital signs, pain level, laboratory results, and other focused assessments related to the medication to be administered are within the appropriate ranges. The skin around the IV access site must be assessed for swelling, erythema, blanching, warmth, coolness, or pain that may indicate the site is compromised or the cannula is not located in the appropriate position within the vein's inner lumen. Ensure the type of catheter is appropriate for its planned use. For example, if a patient has a peripheral IV ordered prior to a diagnostic procedure using contrast dye, an 18-gauge IV catheter is typically required for this procedure.

To comprehensively examine the IV insertion site following visual observation, the nurse should assess for patency of the cannula by aspirating to check for blood return and infusing 1-2 mL of saline (for adult patients) into the IV site. The site should flush freely, and no significant resistance or pain should be noted. Blood return may not be noted on aspiration, but it should be assessed and documented.[1] If no blood return occurs, the vein may be lightly palpated as the normal saline is injected to feel the fluid travel in a straight line in the vein. While checking the patency of the IV cannula, the nurse should also carefully observe the insertion site for swelling or fluid leakage to confirm the cannula has not dislodged and the solution is properly entering the vein and not leaking into the surrounding tissue. Peripheral sites should be routinely flushed per agency policy, typically once per shift for saline locks.

Additional nursing considerations related to IV push medication administration include measures to decrease potential hazards. Proper hand

1. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharpe, E., & Alexander, M. (2021). Infusion therapy standards of practice (8th ed.). *Journal of Infusion Nursing: The Official Publication of the Infusion Nurses Society, 44*(1S Suppl 1), S1–S224. https://doi.org/10.1097/NAN.0000000000000396

hygiene, aseptic technique, standard precautions, appropriate personal protective equipment, and sharps safety must always be implemented. The nurse should also review a drug reference guide for medication information related to drug dosage requirements, proper rate for administration of the push, and the appropriateness of the existing infusion site. For example, if the medication requires a central line for administration, a peripheral access site should not be used. The nurse should also be aware of the availability of monitoring equipment required for post-administration assessments, such as a pulse oximeter, blood pressure cuff, cardiac monitoring, or hemodynamic monitoring via an arterial line.

Additional safety principles when preparing for IV push medication administration to protect the safety of the patient and the nurse are described in the following section.

Other Safety Considerations for IV Push Administration

- To reduce the risk of needlestick injuries, use a blunt needle or blunt filter needle when preparing injections from vials or ampules. Use a needleless system when injecting medication into existing IV tubing.
- After preparing the medication, label the medication syringe with two patient identifiers, date, time, medication, dose, your initials, and any diluent added. Never leave the syringe unattended.
- Verify the peripheral IV access is appropriate for administration of the IV push medication.
- Always verify the compatibility of the medication with other running IV fluids and medications.
- Check agency policies for flushing and locking peripheral IV sites prior to administering the medication.
- Check the patient's medical record for allergies and also verify by asking them if they have any allergies. This is especially important if a new medication has been prescribed.
- Administer the post-administration saline flush at the same rate as the IV push medication rate (based on rate of administration guidelines in a drug reference guide). Know the volume to be flushed based on type of tubing and equipment to ensure the medication is not under-dosed.

- Always assess the patient's current status and need for the ordered IV medication prior to administration.
- Provide patient education and confirm their understanding of the prescribed medication and potential side effects to report.

Whenever possible, premixed medications should be used to decrease the chance of vial contamination or calculation error with administration.

Review the following table for additional safety principles that should be followed prior to medication administration.

Table 2.4a IV Push Safety Principles[2]

2. This work is a derivative of Clinical Procedures for Safer Patient Care by British Columbia Institute of Technology and is licensed under CC BY 4.0

Principle	Additional Information
Verify your qualifications for administration of this medication on this unit.	Are you qualified to administer this type of medication? For example, administration of chemotherapy agents requires specialized training, and many vasoactive medications require cardiac monitoring.
Review the route of administration for this medication.	Review a drug reference guide to verify this medication can be given by the IV route.
Review preparation and medication administration information.	Review a drug reference guide for how this medication should be administered by the IV route. For example, does it require dilution or reconstitution? Use less-concentrated solutions whenever possible. If diluting the medication, discard (i.e., waste) the unused portion before going to the bedside. • Preparation and supplies: Is a pre-flush required for a saline lock? • Does the patient have any allergies? • Administration rate: What is the correct rate of administration (e.g., over 1 minute, over 5 minutes)? Review agency policy regarding the frequency of vital signs monitoring before, during, and after administration.
Identify when a medication should start to work.	What are the onset, peak, and duration of the medication?
Assess the dosage and safe range for this medication.	Is the ordered dose safe for this patient based on their age, kidney function, liver function, etc.? When did the patient last receive this medication? What was the effect of the medication on the patient the previous time they received it?
Understand the therapeutic effect.	What is the expected therapeutic effect of this medication for this patient, and when is it anticipated to occur? What assessments should be performed to evaluate the effectiveness of this medication for this patient?
Know the adverse effects.	What are the potential adverse effects of the medications? How should severe adverse effects be managed? Is there an antidote for overdose?

Know potential incompatibilities.	Are there any potential incompatibilities with existing IV solutions or medications? Is a second peripheral access site required?
Know how to complete the procedure.	Is a post-saline lock flush required? If so, what is the amount? The amount can vary based on the size of the tubing and equipment, as well as agency policy.
Document the procedure.	Where will you chart the administration of this medication and what will you chart (i.e., Medication Administration Record, intake of IV fluid flush, pre- and post-pain assessment, pre- and post-vital signs, etc.)?

Additional Administration Considerations

Prior to administering an IV push medication, the nurse should consider whether or not the administration will be given via a saline lock or a primary IV line with infusing fluids and/or medications. Procedural considerations vary depending on the type of access that is available.

If medication is being administered via a primary line, the nurse should first assess the insertion site and then determine the compatibility of the ordered medication with the infusing fluid. If the ordered medication is not compatible with the infusing fluids, a second peripheral IV access site may be required, or it may be possible to first flush the primary line with saline to clear it of incompatible fluids.

If continuous IV fluids are being administered, the IV pump should be paused after noting the current infusion rate of the primary line. The port on the IV tubing closest to the IV insertion site must be identified and cleaned per agency policy. Many agencies require caps on unused ports that are impregnated with alcohol. The tubing should be clamped above this port and the IV site flushed with normal saline before administering the IV push medication. If the IV solution is not compatible with the IV push medication, then the site must be flushed with a minimum of 5 to 10 mL. The IV push medication is then administered according to the correct administration rate and followed by a saline flush with the same rate and volume of saline as the medication that was administered. The nurse may restart the infusing fluids at the rate previously noted if the fluids are compatible with the medication.[3]

3. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharpe, E.,

If IV push medication is to be administered into a saline lock, the site must be assessed and determined to be in good condition. The port is cleaned, and a saline flush syringe attached. Prior to pushing saline into the lock, the plunger is pulled back gently to check for blood return. The presence of blood return indicates the cannula is appropriately located within the patient's vein but may not occur. If blood return is not noted, the nurse may proceed to slowly flush a small amount of saline while monitoring for resistance, leaking, pain, or swelling with the first few milliliters of saline flushed into the lock device. If no complications are noted, the flush syringe is removed, the port is cleaned, the medication syringe is attached, and the medication is administered using the recommended administration rate. The timing of the rate of administration begins immediately if a cap is present; otherwise, if a J-loop is present, timing starts after 1 mL of the medication has been instilled. After administration of the medication, the syringe is removed, the port is cleaned, and another saline flush syringe is attached. The saline flush should be administered at the same rate as the medication was administered to ensure that medication still present within the saline lock line is safely administered at the appropriate rate. The connection port should be swabbed with each exchange and attachment of saline and medication syringes.

Clinical Tip: A common acronym for administration of IV push medication into a peripheral IV is SAS (Saline – Administration of medication – Saline). Follow agency policy for maintaining IV patency.

Evaluation After the Procedure

Follow agency policies and procedures regarding IV administration guidelines and the type and frequency of monitoring after IV medications are administered. The nurse performs this monitoring and documents the patient's response to the medication. This includes performing any necessary reassessments. Recall that medications administered via the IV route peak

& Alexander, M. (2021). Infusion therapy standards of practice (8th ed.). *Journal of Infusion Nursing: The Official Publication of the Infusion Nurses Society, 44*(1S Suppl 1), S1–S224. https://doi.org/10.1097/NAN.0000000000000396

much more quickly than oral medications absorbed through the gastrointestinal tract.

2.5 Checklist: Administer IV Push Medications

**Disclaimer: Always follow agency policy and manufacturer recommendations*

Checklist: Administer IV Push Medications[1,2,3,4]

- Verify the provider's order.
- Review the patient's medical record for factors that increase the patient's risk of adverse reactions and toxicity to the prescribed medication. Check for allergies or any other contraindication to the prescribed medication. Verify when the last dose of this medication was administered, the indication for this medication for this patient, and related pre-administration assessments, vital signs, lab results, or other clinical data.
- Gather and prepare the necessary equipment: syringe, medication, saline flush, antiseptic pads, and needle/vial access device.
- If medication preparation is required, do so in a designated clean, quiet environment away from sinks using the aseptic non-touch technique (ANTT).[5]
- Check the expiration date on the medication. If it's expired, return it to the pharmacy and obtain new medication. Inspect the medication for discoloration or compromised integrity.
- Verify the medication can be given by bolus based on agency policy.
- Confirm the following information in a drug reference guide: appropriate dosage, need for dilution or reconstitution, compatibility with running IV fluids and medications, rate of administration, action of medication, potential adverse effects, antidote, and patient education.
- Perform hand hygiene.

1. Dorn, L. (2022). *IV push evidence-based practice checklist*. https://qsen.org/iv-push-evidence-based-practice-checklist/
2. Institute for Safe Medication Practices. (2015). *Safe practice guidelines for adult IV push medications*. https://www.ismp.org/guidelines/iv-push
3. *Clinical skills: Essentials collection* (1st ed.). (2021). Elsevier.
4. Lippincott procedures. http://procedures.lww.com
5. Gorski, L. A., Hadaway, L., Hagle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharpe, E., & Alexander, M. (2021). Infusion therapy standards of practice (8th ed.). *Journal of Infusion Nursing: The Official Publication of the Infusion Nurses Society, 44*(1S Suppl 1), S1–S224. https://doi.org/10.1097/NAN.0000000000000396

- Confirm patient identity using at least two patient identifiers and ask about allergies.
- Provide privacy.
- Explain the procedure to the patient. Provide education regarding the medication, its purpose, and potential side effects.
- Perform necessary pre-administration assessments in accordance with the type of medication being given.
- Raise the bed to waist level when providing care.
- Perform hand hygiene and put on gloves. Adhere to standard aseptic non-touch technique (ANTT) when preparing medication, administering IV push medication, flushing, and locking venous access devices.[6]
- If the medication is not in a prefilled syringe and dilution is required, dilute it and draw it up in a syringe using sterile technique. Do not dilute or reconstitute IV push medications by drawing up the contents in a commercially prefilled saline flush syringe.[7] Only dilute medications when recommended by the manufacturer, supported by evidence in peer-reviewed biomedical literature, or in accordance with approved agency guidelines.
- Check the rights of medication administration X 3 while preparing the medication. When performing three checks, check against the provider order, check as you are reaching for the medication, and check right before administering the medication.
- Prepare one medication syringe at a time. Label all IV push medication syringes unless they are prepared at the bedside and immediately administered. Never pre-label an empty syringe in advance of its use.[8]
- If continuous running IV fluid is compatible with the medication, pause the infusion. Trace the IV line from the patient to its point of origin and use the port closest to the patient and clamp the line.
- If a saline lock is in place, unclamp the catheter.

6. Institute for Safe Medication Practices. (2015). *Safe practice guidelines for adult IV push medications.* https://www.ismp.org/guidelines/iv-push
7. Institute for Safe Medication Practices. (2015). *Safe practice guidelines for adult IV push medications.* https://www.ismp.org/guidelines/iv-push
8. Institute for Safe Medication Practices. (2015). *Safe practice guidelines for adult IV push medications.* https://www.ismp.org/guidelines/iv-push

- Perform a vigorous mechanical scrub of the needleless connector for at least five seconds using 70% alcohol or an alcohol-based chlorhexidine solution and then allow the connector to dry completely. Do not fan or wave over the site.
- Assess the venous access device prior, during, and after administering IV push medication for signs and symptoms of complications, such as pain, infiltration, phlebitis, or extravasation.
- Assess for patency using a single-use 10-mL syringe with 0.9% normal saline. While maintaining the sterility of the syringe tip, attach the syringe to the needleless connector port. Slowly aspirate for blood return. Patency is determined by evidence of brisk, bright red blood return, although blood return is not always present. Slowly inject preservative-free normal saline solution into the catheter. Never forcibly flush a venous access catheter. Remove and discard the syringe.[9]
- Perform a second vigorous mechanical scrub of the needleless connector with a new swab for at least five seconds and allow it to dry completely.
- Maintaining the sterility of the syringe tip, attach the medication syringe to the needleless connector of the venous access device. Administer the medication at the recommended rate of administration according to the MAR, drug reference guide, or manufacturer using a watch or clock with a second hand. Remove and discard the syringe.
- Perform a third vigorous mechanical scrub of the needleless connector with a new swab for at least five seconds and allow it to dry completely.
- Maintaining the sterility of the syringe tip, attach a prefilled 10-mL syringe containing preservative-free 0.9% normal saline to the needleless connector and flush at the same rate of administration as the medication. The volume of the flush should be twice the internal catheter volume (i.e., a J-loop would be 2 mL and extension tubing would be 4 mL). Continue to flush at a slow, steady pace to clear the line, typically another 2 to 7 mL.[10]
- If continuous IV fluids are present, unclamp the tubing and resume the

9. Institute for Safe Medication Practices. (2015). *Safe practice guidelines for adult IV push medications.* https://www.ismp.org/guidelines/iv-push
10. Institute for Safe Medication Practices. (2015). *Safe practice guidelines for adult IV push medications.* https://www.ismp.org/guidelines/iv-push

infusion. If locking the venous access device, follow agency policy regarding the sequence of flushing, clamping, and disconnecting the syringe.
- Discard used supplies in appropriate receptacles.
- Remove and discard the gloves.
- Perform hand hygiene.
- Return the bed to the lowest position. Provide for patient safety and comfort.
- Evaluate patient response to the medication and monitor for adverse reactions based on the onset and peak of the prescribed medication. Instruct the patient to call the nurse if feeling any adverse effects.
- Document the administration of the medication per agency policy.

View a YouTube video[11] showing an instructor demonstration of this skill:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/nursingadvancedskills/?p=114#oembed-1

11. Chippewa Valley Technical College. (2023, January 5). *Administering IV push medications* [Video]. YouTube. Video licensed under CC BY 4.0. https://youtu.be/4w9JndX9-uI

2.6 Documentation

When performing IV push medication administration, documentation must include the following components:

- Date/Time of administration
- Medication amount and dose
- IV site location
- Administration route and rate
- Flush solution
- Indication for medication
- Patient assessments related to medication
- Patient's response

Many electronic health records have integrated electronic medication administration records that allow nurses to document IV push medications and pre- and post-administration assessments directly within the EMAR. If developing a written note regarding the administration, it should include the components listed above.

Sample Documentation:

11/20/20XX 1445

Patient was admitted to the cardiac floor for HF exacerbation, difficulty breathing, and weight increase of 10 pounds in the past three days. Furosemide 40 mg IV push was administered via 20-gauge catheter in the right forearm per order from Margaret Vang NP for HF exacerbation. The IV site flushed freely with appropriate blood return prior to medication administration. Furosemide was administered via slow push at 10 mg/min and followed with 5-mL saline flush at the same rate.

1745 Patient voided 600 mL clear yellow urine one hour post administration. Patient lung sounds are clear, and bilateral ankle pitting edema decreased to 1+. Patient appears comfortable.

Gus Martinez, RN

Exercises

(Answers to the exercises are located in the Answer Key at the back of the book).

Case Study #1

Gary, a 68-year-old male client, arrives in the ED with his wife. During the triage assessment, the client states, “It feels as if there is someone standing on my chest. I can’t breathe, and I have a headache.” His vital signs show hypertension and tachycardia. Gary was walking with his wife in their neighborhood when he began experiencing these symptoms. His wife adds, “I ran into our neighbor’s house, and he drove us here immediately. Our dog is still at the neighbor’s house.”

The client has a history of hypertension, diabetes, and colon cancer. He recently retired from hospital administration, following a long medical leave for treatment of his cancer, including chemotherapy and steroid medications. Gary says to you, “I can’t believe that I am feeling this way. Please help!”

The MD gives you the following orders:

- Start a peripheral IV STAT
- Administer metoprolol 5 mg rapid IV q2min, up to 3 doses for chest pain and MI symptoms

1. What will you consider when initiating an IV for Gary?
2. Based on the provided supply of metoprolol of 10 mg/10 mL,

what will be the amount you will administer for each dose? What will be the rate of administration?

3. What are the following for the ordered medication?

- Indication and action of medication
- Onset, peak, and duration of the medication
- Nursing considerations or special instructions for use
- Assessments pre-, post-, and during administration
- Patient education

Case Study #2

Karen is a 55-year-old female client in the medical-surgical unit. She arrived this afternoon with uncontrolled vomiting. She received oral antiemetics in the ED, with no effect. During your admission assessment, Karen states, "I feel so terrible. My stomach is turning constantly; I haven't eaten anything since yesterday morning, and I have only sipped a little water here and there. I'm worried about becoming dehydrated. Whatever they gave me in the Emergency Department didn't help at all. Can't you give me something that will work more quickly?"

You note that Karen is pale, and her lips are dry. She closes her eyes frequently and is holding her stomach. After arriving on the unit an hour ago, she has vomited a small amount of clear liquid.

Karen has a history of chronic kidney disease and biweekly dialysis, as well as depression. You immediately call the doctor on call for further orders.

The MD gives you the following orders:

- Start a peripheral IV STAT
- Administer ondansetron 8 mg IV now
- Start NaCl 0.9% IV at 500 mL/hr

1. What will you consider when initiating an IV for Karen?

2. Based on the provided supply of 16 mg/8 mL, what will be the amount you will administer? What will be the rate of administration?

3. What are the following for the ordered medication?

- Indication and action of medication
- Onset, peak, and duration of the medication
- Nursing considerations or special instructions for use
- Assessments pre-, post-, and during administration
- Patient education

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https://wtcs.pressbooks.pub/nursingadvancedskills/?p=120#h5p-5

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/nursingadvancedskills/?p=120#h5p-6

Test your knowledge using a NCLEX Next Generation-style question. You may reset and resubmit your answers to this question an unlimited number of times.

II Glossary

Ampules: Glass containers in 1 mL to 10 mL sizes that hold a single dose of medication in liquid form.

Blunt needles: Needleless access devices.

Extravasation: Occurs when medication is administered via an IV site and leaks into surrounding tissues and results in tissue injury such as blisters, redness, or even necrosis.

First-pass effect: The action that occurs when a medication must be first metabolized or broken down prior to entering the blood.

Intravenous push (IV push): Process of introducing a medication or fluid substance directly into the bloodstream via the venous system.

IV lock: An IV cannula that has been inserted into a vein and saline locked or clamped.

Phlebitis: Occurs when there is irritation of the inside of the vessel wall in response to a triggering agent such as medication or dilution solution.

Precipitate: Formation of small crystals as the incompatible substances come into contact with one another.

Prefilled syringe: Syringes that contain prefilled volumes of medication within the device.

Speed shock: An adverse systemic reaction when a foreign substance is introduced into the bloodstream.

Vial: A single- or multi-dose plastic container with a rubber seal and covered by a metal or plastic cap.

PART III

CHAPTER 3 ADMINISTER BLOOD PRODUCTS

3.1 Introduction

Learning Objectives

- Describe the types of blood products prescribed for common conditions
- Explain how a person's ABO blood type and Rh factor impact blood product compatibility
- Describe transfusion reactions and their treatments
- Apply evidence-based guidelines for the safe administration of blood products
- Apply the nursing process to prevent, identify, and treat potential complications associated with blood administration
- Describe autologous blood donation
- Incorporate modifications in blood product administration to reflect variations across the life span and cultural beliefs

A **blood product** is any therapeutic substance derived from human blood, including whole blood and other blood components for transfusion and plasma-derived medicinal products.

Quality-assured blood products contribute to improving and saving millions of lives every year by doing the following[1]:

- Addressing child and maternal health and mortality
- Dramatically improving the life expectancy and quality of life of patients suffering from life-threatening inherited disorders, such as hemophilia, thalassemia, and immune deficiency, and acquired conditions such as

1. World Health Organization. (2022). *Blood products.* https://www.who.int/health-topics/blood-products#tab=tab_1

cancer and traumatic hemorrhage
- Supporting complex medical and surgical procedures, including transplantation

Types of blood products include whole blood, packed red blood cells (PRBCs), individual factor concentrates, fresh frozen plasma (FFP), platelet concentrates, and cryoprecipitate. Transfusion of blood products is a common procedure with nearly 16 million blood components transfused each year in the United States.[2]

Transfusion therapy can restore intravascular volume, increase oxygen-carrying capacity, and provide coagulation factors. However, it also involves risks for the development of life-threatening complications. The nurse plays an integral role in safe transfusion therapy from initiation to completion and must meticulously adhere to best practices and safety guidelines. In this chapter you will be introduced to the basic concepts of blood product administration and apply the nursing process to blood product administration.

2. American Red Cross. (2022). *Importance of the blood supply.* https://www.redcrossblood.org/donate-blood/how-to-donate/how-blood-donations-help/blood-needs-blood-supply.html#:~:text=Facts%20About%20Blood%20Needs&text=Approximately%2029%2C000%20units%20of%20red,each%20year%20in%20the%20U.S

Compatibility and Blood Types

ABO Antigen Markers

There are four main types of blood groups based on antigens on the surface of red blood cells. Some of these antigens are also present on platelets and in other tissues in the body. The ABO system uses the presence or absence of these specific antigens to identify four main blood groups: A, B, AB, and O. See Figure 3.1[1] for an illustration of ABO antigens and blood groups.

1. Derivative of “a9fa9181b953f0a6a9596420b0f714ad4a497b16” by unknown author is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/18-6-blood-typing

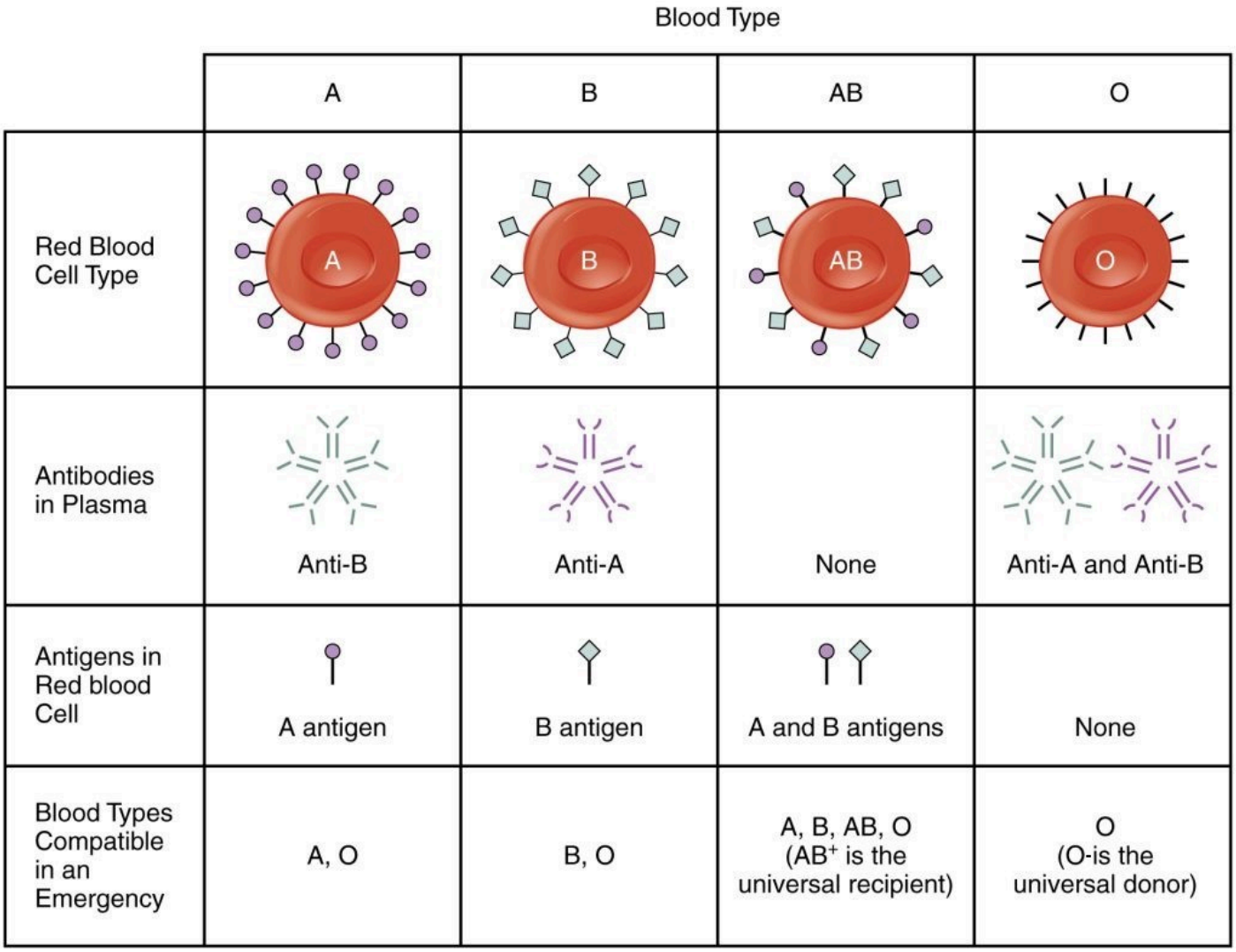

Figure 3.1 ABO Antigens

In addition to the antigens present on the red blood cell, people in certain blood groups have naturally occurring antibodies in the serum against the antigens they don't have. For example, people with blood type A have anti-B antibodies, people with blood type B have anti-A antibodies, people with blood type O have anti-A and anti-B antibodies, and people with AB blood type have no anti-A or anti-B antibodies. For these reasons, the presence of antigens on a person's red blood cells dictates the type of blood they can receive. However, type O blood does not have an antigen, so it can be given to a person with any blood type. As a result, people with type O negative blood are often referred to as "universal blood donors." Likewise, people with type AB blood are referred to as "universal recipients" because they can receive blood from any blood type.

If a person receives blood that is not compatible with their blood type, red

cell destruction called **hemolysis** occurs. ABO incompatibility can cause significant transfusion reactions that can be fatal. Nurses play a major role in safe blood product transfusions and constitute the last link in the chain of the transfusion process to ensure incompatible blood types are not administered and patients are closely monitored for transfusion reactions.[2]

Rh Factor

In addition to ABO blood types, another major consideration for compatibility of blood products is the person's Rh factor. There are over 50 Rh antigens, and five are most antigenic. The most important Rh factor is D, located on the surface of the red blood cell. If a person has the D antigen, they are referred to as "Rh positive" or "Rh+." If the D antigen is not present, the person is considered "Rh negative" or "Rh-."

In contrast to ABO antigens, people do not have naturally occurring antibodies against the Rh factor, but they develop them on exposure. For this reason, a person who is Rh negative develops antibodies against Rh factor only if they are exposed to Rh-positive cells. If this occurs and antibodies develop, subsequent exposure to Rh-positive blood causes a potentially life-threatening immune response with hemolysis of cells.

Rh factor is especially important during maternity care of a mother and her baby. For example, if a mother with Rh-negative blood carries a fetus with Rh-positive blood, her body develops antibodies to the Rh factor. If she becomes pregnant again with a Rh-positive fetus, these antibodies can enter the circulation of the fetus and cause a hemolytic reaction. Therefore, women with Rh-negative blood receive RhoGAM during and after pregnancy to prevent this reaction from occurring in future pregnancies.

See Table 3.2a for an overview of blood types a person can receive based on their ABO blood type and Rh factor.

Table 3.2a Blood Compatibility Based on ABO Blood Type and Rh Factor

2. Bediako, A. A., Ofosu-Poku, R., & Druye, A. A. (2021). Safe blood transfusion practices among nurses in a major referral center in Ghana. *Advances in Hematology, 2021.* https://www.hindawi.com/journals/ah/2021/6739329/

Person's Blood Type	Types of Blood They Can Receive
Type A	Types A and O
Type B	Types B and O
Type AB	Types A, B, AB, and O
Type O	Only Type O
Rh+	Rh+ and Rh-
Rh-	Only Rh-

See Figure 3.2[3] for an image of a unit of blood labeled with blood type and Rh factor.

3. "Blausen_0086_Blood_Bag.png" by Blausen.com staff (2014) at "Medical gallery of Blausen Medical 2014." *WikiJournal of Medicine* is licensed under CC BY 3.0

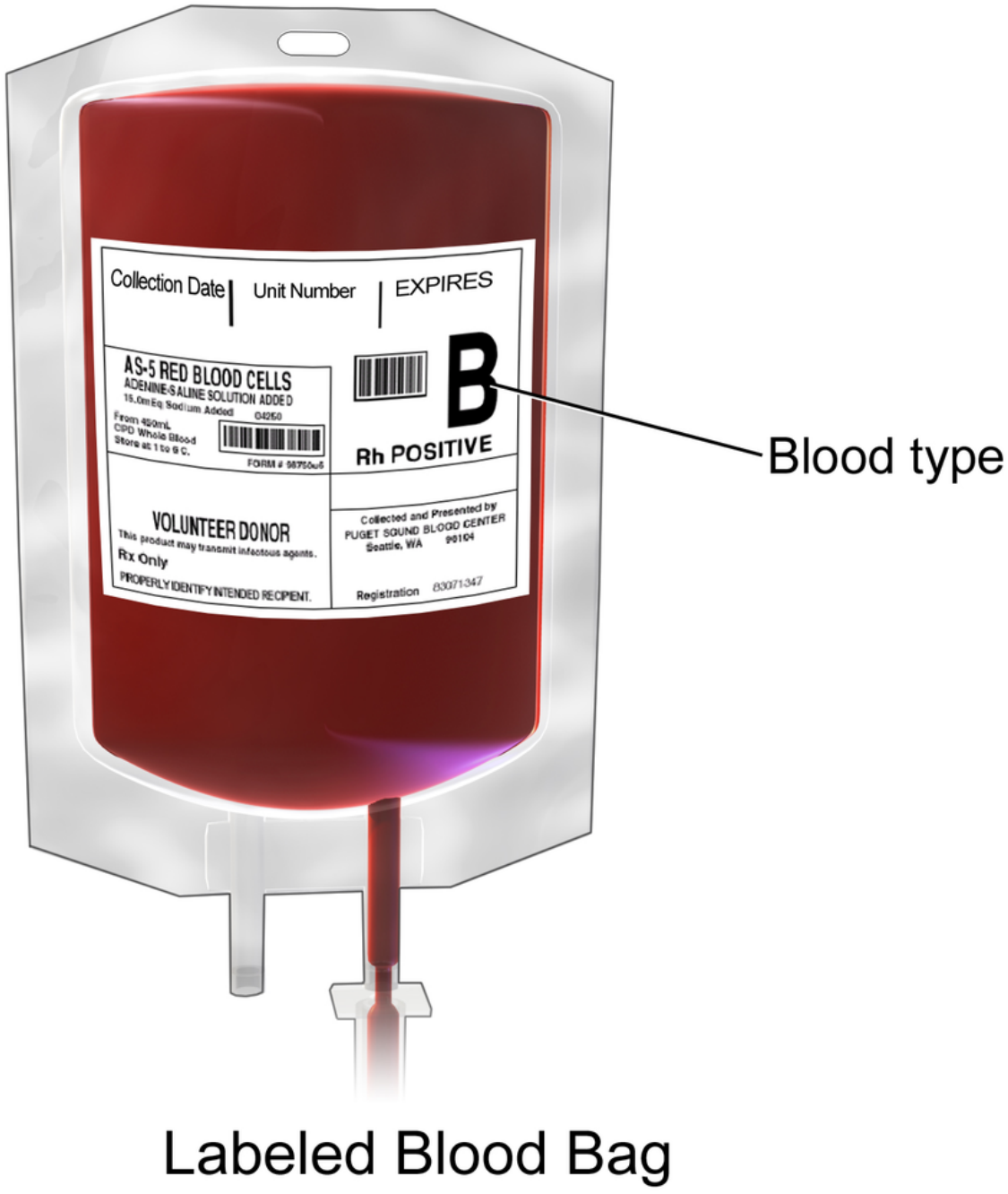

Figure 3.2 Labeled Blood Bag

Human Leukocyte Antigen

The human leukocyte antigen (HLA) is an immune-type antigen that can also pose a serious transfusion complication. HLA is located on the surface of leukocytes and may be found on lymphocytes, granulocytes, monocytes, and platelets. HLA contributes to a person's tissue type and varies among individuals. HLA tests must be completed before any stem cell or organ

transplantation is completed to help ensure that the donor and recipient tissues are a match. HLA antigens are a part of an individual's genetic makeup. Individuals may develop antibodies against HLA antigens following exposure through blood transfusion or pregnancy.

Type and Screen

"Type and screen" refers to pre-transfusion tests that include the determination of client's ABO group, Rh type, and a screen for the detection of atypical antibodies. Nurses ensure type and screen testing has been completed before initiating a blood transfusion and also use this information during a two-person verification of a blood product before it is administered to a client.

Types of Blood Products

Blood transfusion refers to the intravenous administration of whole blood or blood components into a person's circulatory system. Blood components include red blood cells (RBC), white blood cells (WBC), platelets, fresh frozen plasma (FFP), clotting factors, cryoprecipitates, and albumin. Whole blood is rarely used in the United States for transfusion because most clients require a specific element of blood, such as red blood cells or platelets, and the required dose can be optimized according to the client's condition. See Table 3.2b for summarized information about various blood products, including infusion times for adults, ABO/Rh testing requirements, actions, indications, and benefits.[4]

Table 3.2b Blood Products[5,6]

Used for life-threatening hemorrhage where oxygen-carrying capacity,	

4. Association for the Advancement of Blood & Biotherapies. (n.d.). *Regulatory for blood and blood components*. https://www.aabb.org/regulatory-and-advocacy/regulatory-affairs/regulatory-for-blood
5. Association for the Advancement of Blood & Biotherapies. (n.d.). *Regulatory for blood and blood components*. https://www.aabb.org/regulatory-and-advocacy/regulatory-affairs/regulatory-for-blood
6. Bloodworks Northwest. (n.d.) *Transfusion medicine: Typical rates, volumes, and durations for routine (non-emergent) transfusions*. https://www.bloodworksnw.org/medical-services/transfusion-medicine/rates-volumes-duration-transfusions

coagulation factors, platelets, and volume expansion are all needed. Whole blood contains approximately 150 mL of plasma, which provides volume expansion and stabilization of clotting factors.

Blood Product	Volume/ Infusion Time	ABO/Rh Testing Required	Actions/Indications/Benefits
Whole Blood	For massive blood loss, infuse as fast as the client can tolerate.	Yes	Used for life-threatening hemorrhage where oxygen-carrying capacity, coagulation factors, platelets, and volume expansion are all needed. Whole blood contains approximately 150 mL of plasma, which provides volume expansion and stabilization of clotting factors.
Red Blood Cells (RBC)	Typical volume of 350 mL must be infused within 4 hours. Commonly infused within 90 minutes to 3 hours.	Yes	Replaces red blood cells and increases oxygen-carrying capacity. Indicated for symptomatic anemia and gastrointestinal bleeding. One unit increases hemoglobin by 1 g/dL and hematocrit (HCT) by 2-3%.
Leukocyte-Reduced RBCs (Concentrate of RBCs With White Blood Cells Removed)	Infuse within 4 hours.	Yes	Indicated for symptomatic anemia for patients who are immunocompromised or at risk for reactions caused by leukocyte antibodies to the HLA. It is also recommended for children younger than six years old. It has the same actions/benefits as RBC infusion.
Fresh Frozen Plasma (FFP)	Typical volume of 200-250 mL is infused over 60 minutes but must be infused within 4 hours.	Yes	Increases clotting factors and expands blood volume. Indicated for clients with bleeding disorders, thrombotic thrombocytopenic purpura (TTP), and life-threatening hemorrhage in patients who have significant coagulation deficiencies. Also used to reverse a client's elevated INR when it needs to be brought down quickly to prevent complications from occurring. One unit increases clotting factors approximately 2-5%. Plasma is typically frozen within hours of donation to preserve the clotting factors and is thawed by the lab prior to administration.

Platelets	Typical volume of 250-350 mL is infused over one hour.	No	Increases the number of platelets to promote hemostasis (i.e., adequate blood clotting). Indicated for thrombocytopenia or platelet function abnormalities, as well as for patients undergoing treatment for leukemia, cancer, aplastic anemia, and marrow transplants. One unit of platelets is created from a pool of 4-6 whole blood donations or from one apheresis (i.e., harvested from one donor with the return of all other cells). One unit increases the platelet level by approximately 30,000-60,000. The bag should be agitated periodically because platelets may adhere to the bag.
Cryoprecipitate	Typical volume of 90-120 mL is infused over 15-30 minutes.	Yes	Provides Factor VIII, fibrinogen, vWF, and Factor XIII. Indicated for Hemophilia A, von Willebrand's disease, and Factor XIII deficiency. Also used as a part of "Mass Transfusion" protocols where clotting factor deficiencies are common. One pool increases fibrinogen approximately 50 mg/dL.
Albumin (Colloid-Containing Solution)	Refer to hospital policy. Rate is individualized.	No	Expands blood volume and provides plasma proteins. Indicated for the treatment of severe hypovolemia and/or hypoalbuminemia. Albumin helps hold fluid in the vascular space to temporarily prevent and/or correct third spacing. Used for critically ill patients who have a limited response to crystalloid solutions and those with burns, ascites, and anasarca (i.e., swelling of the whole body from fluid retention).

Intravenous Immunoglobulin (IVIG)	Infusion starts at a rate of 0.5 to 1 mL/kg/ hour for the first 15-30 minutes and then can be increased every 15-30 minutes to a maximum of 3 to 6 mL/kg/ hour if no adverse reactions.	No	Provides antibodies the client cannot make on their own (i.e., "humoral immunodeficiency"). Indicated as replacement therapy for immunodeficiencies, autoimmune conditions such as immune thrombocytopenia (ITP) and autoimmune hemolytic anemia (AIHA), Guillain-Barré syndrome, or chronic inflammatory demyelinating polyneuropathy (CIDP).[7]
Autologous	Refer to agency policy for collection and infusion.	No	Provides patient's own blood to prevent potential transfusion reactions but has risk for bacterial infection. Used to replace blood loss during planned elective surgery.

Conditions Requiring Blood Product Transfusion

Blood product transfusions can offer life-saving therapeutic benefits for several conditions, such as non-hemorrhagic anemia, active bleeding or symptomatic anemia, loss of coagulation factors, and platelet deficiency or dysfunction.[8]

Non-Hemorrhagic, Asymptomatic Anemia

The current guidelines from the Association for the Advancement of Blood & Biotherapies (AABB) recommend the use of restrictive hemoglobin thresholds to indicate the need for RBC transfusion for anemia, as well as the

7. Shehata, N. (2023). Patient education: Intravenous immune globulin (IVIG) (Beyond the basics). *UpToDate.* www.uptodate.com
8. Bediako, A. A., Ofosu-Poku, R., & Druye, A. A. (2021). Safe blood transfusion practices among nurses in a major referral center in Ghana. *Advances in Hematology, 2021.* https://www.hindawi.com/journals/ah/2021/6739329/

use of “standard-issue” rather than “fresh” RBCs.[9,10] **Anemia** is a hematological condition where there is a lack of healthy red blood cells and/or hemoglobin to carry adequate oxygen to the body’s tissues.

- Recommendation 1:
  - A threshold of hemoglobin level of 7 g/dL or less is recommended for the indication of RBC transfusion for hospitalized adult patients with asymptomatic anemia who are hemodynamically stable, including critically ill patients.
  - A threshold of 8 g/dL or less is recommended for RBC transfusion for patients undergoing orthopedic surgery, cardiac surgery, and those with preexisting cardiovascular disease.

- Recommendation 2:
  - Patients, including neonates, should receive “standard issue” RBCs (i.e., units selected at any point within their licensed dating period) rather than limiting patients to transfusion of only “fresh” RBCs (i.e., units with storage length less than ten days).

Active Bleeding and Symptomatic Anemia

RBC transfusions are indicated for patients who are actively bleeding or for those with symptomatic anemia whose hemoglobin is less than 8 g/dL. Symptoms of anemia include, but are not limited to, weakness, dyspnea with exertion, and tachycardia. Each case is individually evaluated to compare the patient’s need for transfusion with its risks and benefits. Unless the patient is actively bleeding, it is recommended to transfuse one unit of packed red cells at a time, which typically increases the patient’s hemoglobin level by 1 g/dL

9. Association for the Advancement of Blood & Biotherapies. (n.d.). *Regulatory for blood and blood components*. https://www.aabb.org/regulatory-and-advocacy/regulatory-affairs/regulatory-for-blood
10. Carson, J. L., Guyatt, G., Heddle, N. M., Grossman, B. J., Cohn, C. S., Fung, M. K., Gernsheimer, T., Holcomb, J. B., Kaplan, L. J., Katz, L. M., Peterson, N., Ramsey, G., Rao, S. V., Roback, J. D., Shander, A., & Tobian, A. A. (2016). Clinical practice guidelines from the AABB: Red blood cell transfusion thresholds and storage. *JAMA, 316*(19), 2025–2035. https://doi.org/10.1001/jama.2016.9185

and their hematocrit by 3%. Hemoglobin levels should be checked 4-24 hours post-transfusion or according to agency policy.[11]

Loss of Coagulation Factors

Transfusion of fresh frozen plasma (FFP) is commonly used for prophylaxis in non-bleeding patients. It is also indicated for acutely bleeding patients to replace their lost coagulation factors. Other clinical situations that may indicate coagulation factor replacement include cardiopulmonary bypass, massive transfusion, decompensated liver disease, extracorporeal pulmonary support techniques, acute disseminated intravascular coagulation (DIC), and prior to invasive procedures for patients with decreased clotting factors and/or elevated INR.[12]

Platelet Deficiency/Dysfunction

Platelet transfusions are an effective treatment for patients with platelet deficiency and/or platelet dysfunction, such as bone marrow insufficiency or **thrombocytopenia**. Platelet transfusions for patients who are thrombocytopenic may be done prophylactically to either prevent or reduce the severity of spontaneous patient bleeding with platelet counts less than 10,000/uL and no other risk factors are present for bleeding. If a client is actively hemorrhaging and thrombocytopenia is contributing to the hemorrhaging, platelets should be infused if the platelet count is less than 50,000/uL.[13]

There are different types of platelet infusions, and they yield different results. A typical unit of apheresis platelets should increase the recipient's platelet count by 30,000 to 60,000/uL. Apheresis is a procedure in which whole blood is collected from a donor, part of the blood such as platelets or white blood cells is removed, and the rest of the blood is returned to the

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donor. In comparison to apheresis platelets, whole-blood derived platelets, which are often pooled from several donors, are expected to raise the platelet count by 5,000 to 10,000/uL.[14]

Fibrinogen Deficiency or Disorders

Cryoprecipitate transfusion is indicated in dysfibrinogenemia or fibrinogen deficiency (hypofibrinogenemia) when the patient is experiencing active bleeding, traumatic injury, invasive procedures, or acute disseminated intravascular coagulation (DIC).[15] **Dysfibrinogenemia** is a coagulation (clotting) disorder characterized by an abnormal form of fibrinogen. **Hypofibrinogenemia** is a rare, autosomal dominant condition characterized by bleeding and obstetric problems such as abruption, postpartum hemorrhage, and recurrent pregnancy loss. Fibrinogen is a protein produced by the liver that helps control bleeding by helping blood clots to form; abnormal or deficient fibrinogen results in defective clot formation.

Severe Hypovolemia

Rapid infusion of crystalloid solutions (such as 0.9% normal saline) is the standard, evidence-based first-line treatment for severe hypovolemia or hypovolemic shock. However, in cases where the patient has limited response to crystalloid solutions or for those whom hypoalbuminemia is thought to be a contributing factor, colloid fluids (i.e., albumin) may be infused. Albumin is the main modulator of fluid distribution among the compartments of the body by providing plasma oncotic pressure. It treats hypovolemia by attracting sodium and, therefore, water into the intravascular compartment and increasing circulatory volume.[16,17]

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15. This work is a derivative of StatPearls by Lotterman & Sharma and is licensed under CC BY 4.0
16. Caraceni, P., Tufoni, M., & Bonavita, M. E. (2013). Clinical use of albumin. *Blood Transfusion = Trasfusione del Sangue, 11*(Suppl 4), s18–s25. https://doi.org/10.2450/2013.005s
17. Mandel, J., & Palevsky, P. M. (2022). Treatment of severe hypovolemia or hypovolemic shock in adults. *UpToDate*. https://www.uptodate.com

Transfusion Reactions

Transfusion reactions are adverse events that are directly related to the transfusion of blood products and may range from mild to severe with life-threatening effects. The onset of transfusion reactions may occur during the transfusion (known as acute transfusion reactions) or in days or weeks following the transfusion (known as delayed transfusion reactions). Reactions may be an immune-related reaction or non-immunological condition. Immune-related reactions are often due to a mismatch or incompatibility of the transfused blood product and the recipient's blood type or Rh factor. Non-immunologic reactions are typically caused by the physical effects of the blood component or the transmission of a disease.

It can be difficult to ascertain if a reaction will occur and what kind of reaction is occurring because some reactions can present with non-specific, overlapping manifestations. The most common manifestations of transfusion reactions include fever, urticaria, chills, and itching. Some mild symptoms may resolve without treatment, but some are severe, presenting with high fevers, respiratory distress, hypotension, and hemoglobinuria.[18]

The most common types of transfusion reactions include acute hemolytic, febrile non-hemolytic, delayed hemolytic, anaphylactic, simple allergic, transfusion-associated circulatory overload (TACO), transfusion-related acute lung injury (TRALI), and septic (bacterial contamination).[19] If a patient experiences a blood transfusion reaction, always follow agency policy to manage mild to severe blood reactions. See Table 3.2c for additional information about different types of transfusion reactions, their causes, onset, manifestations, prevention, and related nursing interventions.[20] See Figure 3.3 for an illustration of common manifestations of transfusion reactions.

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Life-threatening transfusion reactions typically occur within 15 minutes of initiating a transfusion. Remain with the patient during this time and monitor their physiologic responses.

Table 3.2c Transfusion Reactions and Related Nursing Interventions[21]

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Transfusion Reaction	Cause	Onset	Manifestations	Prevention	Nursing Interventions
Mild to Moderate Allergic Reaction	Hypersensitivity to a foreign protein in the donor product.	During the transfusion and up to 24 hours post-transfusion.	Pruritus, erythema, local hives, urticaria, and bronchospasm.	If known history of a previous allergic reaction, may require administration of an antihistamine prior to infusion.	Stop transfusion and notify the provider. Administer antihistamine if prescribed and carefully monitor for new or progression of symptoms. Analyze vital signs every 15 minutes.
Anaphylactic	Recipient allergy to donor antigen (most often IgA).	Occurs within 5-15 minutes of initiation of transfusion.	Similar to mild/ moderate allergic reaction, but more severe with nausea/ vomiting, shortness of breath, cough, wheezing, hypotension, and loss of consciousness. May lead to cardiac arrest.	If known history of previous allergic reaction, transfuse with leukocyte – depleted RBCs.	Stop transfusion and notify the provider. Maintain IV access. Administer epinephrine, antihistamines, and corticosteroids as prescribed. Monitor vital signs frequently until stable.
Febrile Non-Hemolytic	Caused by cytokines released from blood donor's leukocytes or platelets. Most common transfusion reaction that typically occurs in immunocompromised patients.	Occurs 30 minutes after initiation of transfusion to 6 hours post-transfusion.	Increased fever greater than 1 degree Celsius above baseline with associated flushing, chills, muscle pain, and headache. Tachycardia, tachypnea, and hypotension may also occur.	If known history of a previous febrile non-hemolytic reaction, use a leukocyte-reduced blood product.	Stop transfusion and notify the provider. If prescribed, administer antipyretics. Monitor temperature every four hours and as needed.
Acute Hemolytic	ABO and Rh incompatibility results in destruction of RBCs.	Occurs within 15 minutes of initiation of transfusion.	Flank pain, chest pain, increased heart rate, chills, increased temperature, low back pain, headache, dyspnea, bronchospasm, anxiety, hypotension, or pain along the accessed vein.	Considered a hospital-acquired condition preventable by diligent patient identification and blood product compatibility verification.	Stop transfusion, remove blood tubing, and maintain access with 0.9% normal saline. Notify the provider and monitor vitals every 15 minutes. Obtain blood and urine samples and send to the lab with unused portion of blood product.
Septic	Contamination of blood product with bacterial microorganisms.	During transfusion and possibly up to two hours post-transfusion.	High fever, skin flushing, hypotension, back pain, abdominal cramping, nausea, and vomiting and diarrhea.	Complete transfusion within four hours to avoid bacterial growth. Proper care of blood product is required from donation through administration.	Stop the transfusion, remove blood product and tubing, and maintain IV access with 0.9% normal saline. Notify the provider. Monitor vital signs. Obtain blood cultures as prescribed. Administer fluids, obtain gram stain, and provide broad-spectrum antimicrobials as prescribed.
Transfusion-Associated Circulatory Overload (TACO)	Occurs when the volume of the transfusing blood component causes volume overload (hypervolemia) from an overly rapid administration rate or amount.	Can occur anytime during the transfusion or within 1-2 hours post-transfusion.	Crackles in lung bases, dyspnea, cough, tachypnea, tachycardia, hypertension, jugular vein distension, and headache.	Follow prescribed rate of infusion, typically 2 – 4 mL/ kg/hr. Use caution with older adults and with those who have cardiac and renal disorders.	Reduce rate or stop transfusion as prescribed by provider. Monitor and manage patient manifestations. Elevate head of bed and administer diuretic as prescribed.

Transfusion – Related Acute Lung Injury (TRALI)[22]	Acute lung injury caused by antibodies in the donor blood products that react with antigens in the recipient. Recipient chemical mediators are released and lead to pulmonary edema.	Within 6 hours to 72 hours of transfusion of blood products that are rich in plasma.	Cyanosis, dyspnea, fever, hypoxemia, hypotension, and pulmonary edema that is not cardiac-related (i.e., due to fluid overload).	Assess for contributing factors that predispose the patient to this condition, including infection, inflammation, or recent surgery.	Stop the transfusion immediately and notify the provider. Administer treatment to support blood pressure as prescribed. Administer supplemental oxygen as prescribed. Prepare for endotracheal intubation and mechanical ventilation. Notify the blood bank so they can screen for certain donor antibodies.

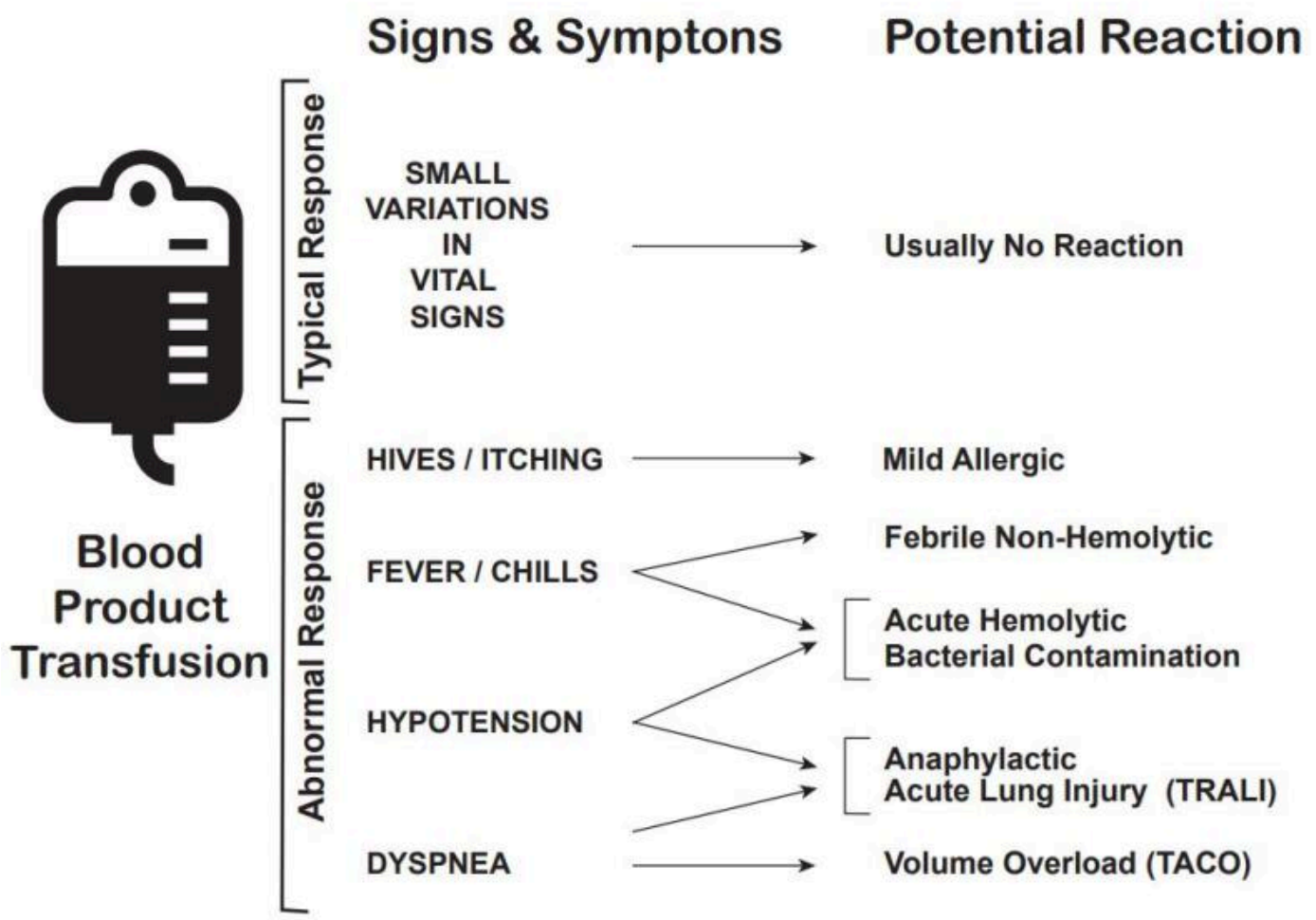

Figure 3.3 Potential Blood Transfusion Reactions

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For more information, review the article "Transfusion Reactions."[23]

View this supplementary YouTube video[24] on blood transfusion reaction types.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/nursingadvancedskills/?p=133#oembed-1

Initiating Blood Product Therapy

Nurses and health care practitioners who administer blood products must complete specific training for safe transfusion practices and demonstrate competency in the transfusion administration process. Always refer to agency policy for guidelines for preparing, initiating, and monitoring blood product transfusions. The nurse is responsible for knowing which blood components are appropriate for specific client situations and serving as the last link in the chain of safety events.

Agency policy and procedures must be strictly followed to prevent client harm. The nurse must verify that the client has signed informed consent for the procedure in their medical record. Prior to blood product administration, the nurse confirms that a blood sample has been collected from the client and transported to the laboratory within the past 72 hours for typing and

23. This work is a derivative of StatPearls by Suddock and Crookston and is licensed under CC BY 4.0
24. RegisteredNurseRN. (2018, March 20). *Blood transfusion procedure nursing | Reaction types, complications (hemolytic/ febrile) NCLEX* [Video]. YouTube. Used with permission. https://youtu.be/v4PHCwvkH24

compatibility screening. This is the first step in maintaining patient safety and preventing errors.

Diligent patient identification and blood product compatibility verification are vital for safe blood product administration. A two-person verification process is used for blood product transfusions. The first individual is the qualified transfusionist who will administer the blood or blood product to the client. The second individual conducting the identification verification process is qualified to participate in the verification process, as determined by the hospital.

Blood is stored within a refrigerated area. Blood products should never be heated in a microwave or hot water or vigorously shaken because this will destroy the blood cells. In certain circumstances, such as trauma or surgery, blood may be warmed with an appropriate blood warmer, but this is prescribed within designated conditions and not a routine practice.

Health Care Team Collaboration

Blood product transfusion therapy is implemented by several members of the health care team. Nurses must be knowledgeable of the transfusion process, potential complications, and management of possible complications. The majority of transfusion reactions occur because of clinical error. Engaging in interprofessional teamwork, utilizing effective communication, and adhering to evidence-based protocols improve patient outcomes and safety. If there are any concerns during any step in the blood product administration process, the nurse must advocate for patient safety.[25]

Blood product transfusion therapy cannot be delegated to unlicensed assistive personnel (UAP). However, if the client is stable, UAP may obtain vital signs as instructed during the transfusion and report any concerns or complaints to the supervising nurse.

Cultural Considerations

When administering blood products, be aware of the client's beliefs (and in

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the case of minors, their parents' religious beliefs). Some religions, such as Jehovah's Witnesses, oppose blood transfusions. They may be excommunicated from their church and the facility can be sued, even if the transfusion is implemented to save their life. This is another reason why it is critical to obtain written informed consent prior to initiating blood or blood product administration. It is essential to follow agency policies and procedures if a client (or the parent of a minor) refuses blood therapy.[26]

Autologous Blood Transfusion

Autologous blood transfusion is a procedure in which blood is removed from the client and returned to their circulation at a later time, instead of relying on blood donated by others (referred to **allogeneic blood**). Autologous blood transfusion can be performed in different ways, such as elective preoperative blood collection and retransfusion of blood during surgery or intraoperative hemodilution.

Autologous blood transfusion avoids the risks of transfusion reactions that can occur with allogeneic blood. It may also be acceptable for clients prior to stem cell transplantation, clients with leukemias or lymphomas, or clients with religious beliefs who oppose blood transfusions.

26. Sagy, I., Jotkowitz, A., & Barski, L. (2017). Reflections on cultural preferences and internal medicine: The case of Jehovah's Witnesses and the changing thresholds for blood transfusions. *Journal of Religion and Health, 56*(2), 732–738. https://doi.org/10.1007/s10943-016-0353-1

3.3 Applying the Nursing Process

The procedural steps for blood product administration while applying the nursing process are described in Table 3.3 with associated rationale.

Table 3.3 Blood Product Administration Procedure and Rationale[1]

1. Blood and blood product transfusion. (2022). *Lippincott procedures.* http://procedures.lww.com

Assessment	Rationale
Verify written informed consent has been received for the procedure. Check the form to ensure it is properly completed and signed and assess client understanding of the procedure.	Infusion of blood is an invasive procedure with inherent risks and requires specific informed consent. Patient understanding of the procedure and its rationale must be assessed by the nurse prior to its initiation.
Verify provider order for the blood product to be administered. Note any pre- or post-transfusion medications that have been prescribed.	A prescription from a health care provider is necessary before transfusing any blood product. Verifying the order and associated medications ensures they are appropriately administered.
Obtain client allergies, previous transfusion history, and transfusion reactions.	Gathering this data helps prevent transfusion reactions. If the client has had previous transfusion reactions, measures can be taken to help prevent another one from occurring.
Assess the recent laboratory values and results related to the blood product being transfused.	Ensure the type and screen has been completed. Assessment of other laboratory values provides a baseline comparison when evaluating the patient's response to the transfusion or in the event of a complication.
Analyze recent vital signs and notify the provider of any concerns. For example, if the client has a fever, clarify the order with the provider before obtaining the blood product from the blood bank.	If the client has any vital signs that are out of range and require clarification from the provider, this clarification should be addressed before obtaining the blood product because it typically must be initiated within 20-30 minutes of retrieval and cannot be returned.
Perform a respiratory assessment, skin assessment, and pain assessment.	Establish a baseline to use to trend future assessments and recognize changes in the event a transfusion reaction occurs.
Planning	
Review the indication for the transfusion with clinical supportive data.	The nurse develops a plan of care and formulates expected outcomes of the procedure based on the indication for the transfusion.
Determine expected outcomes for the client receiving a blood product transfusion. Expected outcomes of the transfusion are based on the indications for the transfusion.	Examples of expected outcomes for a PRBC transfusion include improved activity tolerance and improved hemoglobin and hematocrit to target range.

Determine if pre- or post-medication is needed for this specific client.	Diphenhydramine and acetaminophen are commonly prescribed for clients with a previous history of reactions. Anticipate that a client with a history of heart failure who will be receiving multiple units of blood may require furosemide to prevent fluid overload.
Implementation	
Start or verify venous access. Use short peripheral catheters (20G to 24G) based on vein size and patient preference or 18G to 20G if rapid transfusion is required. Verify the integrity and patency of IV catheters already in place. The distal lumen of a central venous access device may also be used to administer blood. Consider establishing a second peripheral venous access site for administration of other medications while blood is transfusing.	Correct catheter use ensures appropriate size, gauge, and viable intravenous access for the blood product. A second venous access site may be required for administration of other fluids, medications, or other substances while blood is transfusing because they cannot be administered using the same line.
Retrieve appropriate Y-infusion tubing set specific to blood product administration (for example, a microaggregate filter for leukocyte-reduced RBC) and 0.9% normal saline IV fluid. Inspect the tubing and filter.	Only IV normal saline is compatible with simultaneous blood product administration. Lactated ringers, dextrose, hyperalimentation (artificial nutrients supplied intravenously), and other intravenous solutions with medications are not compatible with blood products. A **microaggregate filter** is a blood filter with a pore size of 20–40 µm that removes 75–90% of white cells. Inspection of the tubing and the filter ensures it is suitable for the specific blood product prescribed.
Obtain blood or blood product from facility blood bank (follow agency policy).	Blood should not remain in the client care area for more than 30 minutes before the transfusion begins, so the nurse must be prepared to begin the transfusion shortly after the blood is delivered.

Perform the following checks with a second nurse or agency-defined trained health professional: compare the blood unit to the order, verify the client's identity, verify the client's blood type and Rh factor against the type of blood that will be infused, check the expiration of the blood component, and compare the client's number against the blood product number. The nurses should also visually inspect the blood for any unusual color, precipitate, clumping, and any other unusual signs.	Checks by two nurses prevent transfusion reactions through proper client identification, verification of the prescription, and blood product compatibility. **Note:** The Joint Commission classifies a blood incompatibility error as a sentinel event (i.e., an event that is an unexpected occurrence resulting in death or serious physical or psychological injury, or the risk thereof).[2]
Obtain and document pre-transfusion vital signs and a baseline physical assessment. If the client is febrile (i.e., above 37.8° C or 100.4° F), notify the provider before starting the transfusion.	Baseline data and hemodynamic status must be established immediately before the transfusion begins so that manifestations of a transfusion reaction can be quickly recognized. For example, if a client develops fluid overload, a baseline assessment, including lung sounds, can be used for comparison with new findings.
Initiate the blood transfusion. The nurse must remain with and monitor the client for at least 15 minutes as the transfusion begins at a slow rate of 2 mL/min (i.e., 120 mL/hour). Ask the client to report unusual sensations (i.e., chills, hives, itching, shortness of breath, and chest pain). Note: All blood products must be completely administered in less than four hours. Administration sets are changed based on agency policy, commonly at the completion of every unit or every four hours.	Most transfusion reactions occur within the first 15 minutes of starting the transfusion. Blood products should not hang for more than four hours, and administration sets should be changed at the completion of each unit or every four hours to reduce bacterial contamination.
After 15 minutes, obtain another set of vitals. Determine an appropriate rate of transfusion based on agency policy and client considerations.	Most transfusion reactions occur within the first 15 minutes of starting the transfusion. The rate of infusion can be adjusted after the initial 15 minutes based on patient tolerance. For example, a client with an active hemorrhage requires a fast rate whereas an elderly, symptomatic anemic patient with a history of heart failure requires a slower rate.

If signs of a transfusion reaction occur, stop the transfusion and perform appropriate steps based on the agency's transfusion reaction policy and protocol. Assess the patient and obtain vital signs. Start normal saline with new primed tubing attached directly to the venous access device and notify the health care provider immediately. Do not infuse saline through the existing tubing because it will cause the blood in the tubing to enter the patient. Do not discard the blood product or tubing; prepare it for lab analysis according to agency policy.	These steps prevent increased risks to the client. New tubing ensures that none of the blood product will further infuse into the client. Agency policy typically requires additional steps such as labs drawn, urine collection, and forms to be filled out and sent to lab.
Frequently monitor and assess the IV site and surrounding area.	Early detection of IV site complications improves patient outcomes.

Never store blood in an agency refrigerator. Never inject medication into the same line with a blood component. Never use the same IV line to administer medication and blood because preservatives in the medication could cause hemolysis or clotting of the blood. Maintain a separate access line if IV solutions or medications are to be administered.

Delegation Tips:

Each state's Nurse Practice Act specifies if the skill of blood product transfusion can be delegated to a licensed vocational/

2. World Health Organization. (2022). *Blood products*. https://www.who.int/health-topics/blood-products#tab=tab_

practical nurse (LVN/PN) and if unlicensed assistive personnel (UAP) may collect vital signs after the first 15 minutes of the transfusion and the client's stability has been confirmed. During the delegation process, the registered nurse (RN) should specify the frequency in which the client should be monitored and vital signs collected, as well as the parameters for vital signs and symptoms that should be immediately reported. Examples of parameters include an increased temperature, decreased pulse oximetry reading, shortness of breath, chest pain, hives, or chills. The RN retains responsibility and accountability for monitoring the client's status during the transfusion. Read more information about delegation in the "Delegation and Supervision" chapter in Open RN *Nursing Management & Professional Concepts*.

Post-Procedure

Evaluation	
Evaluate and document client response and tolerance of the infusion, comparing current status to baseline data, such as physical assessment, vital signs, and lab results. Assess IV site to ensure integrity and patency after the infusion.	Evaluation determines if the goals of the transfusion therapy were achieved or if late onset transfusion complications are developing. **Note:** Some laboratory results may not reflect anticipated targets for several hours after the transfusion is completed.

3.4 Checklist: Administer Blood Products

**Disclaimer: Always follow agency policy and manufacturer recommendations*

Checklist: Administer Blood Products[1,2]

- Verify the provider's order. Confirm the order and the medical record are labeled with the client's first and last name and assigned identification number.
- Unless the transfusion is an emergency, confirm the provider has obtained written informed consent before initiating transfusion therapy and the consent is in the client's medical record.
- Review prescribed medications to be administered before, during, and after the transfusion.
- Ensure that a blood sample was obtained for compatibility testing according to agency policy, typically within the past 72 hours. Obtain a blood sample if needed.
- Ensure the agency's transfusion services receives a request with the client's first and last name, an identification number, the prescribed blood component and amount ordered, and the name of the provider.
- Gather the necessary equipment:
    - Blood or blood product administration set (with standard blood filter)
    - IV pole
    - Gloves
    - Blood or blood product
    - Preservative-free normal saline solution
    - 3-mL syringe
    - Antiseptic pad (chlorhexidine-based, povidone-iodine, or alcohol)
    - Disinfectant pad
    - Stethoscope
    - Vital signs monitoring equipment

1. *Clinical skills: Essentials collection* (1st ed.). (2021). Elsevier.
2. Lippincott procedures. http://procedures.lww.com

    - Blood request
    - Premedications (if prescribed), 250 mL of normal saline solution, IV catheter equipment (should include 18G to 24G catheters), electronic infusion device indicated for blood transfusion use, PPE, and pulse oximeter
- Perform hand hygiene and put on gloves.
- Confirm the client's identity using at least two patient identifiers.
- Ask the client if they have any allergies or any prior transfusion reactions.
- Assess the client's previous knowledge and understanding of the procedure. Assess the client's anxiety level and respond therapeutically.
- Ensure that the client has adequate venous access; insert an IV catheter if necessary.
- Remove and discard your gloves.
- Perform hand hygiene.
- Obtain the client's vital signs within 15 minutes of initiating the transfusion.
- Assess the client's breath sounds, skin color, and current laboratory tests, such as hemoglobin and hematocrit. Identify any conditions that may increase the risk of a transfusion reaction, such as a fever, heart failure, kidney disease, or the risk of fluid volume excess.
- Question the client about any symptoms that may later be mistaken for a transfusion reaction.
- Assist the client to the bathroom if necessary. Help the client to a comfortable position.
- If the client is in bed, raise the bed to waist level.
- Obtain the blood or blood product from transfusion services, making sure to verify the blood component with a transfusion services representative. Wear gloves or transport the component unit in a container that prevents direct contact with the unit bag. Start blood transfusion within 30 minutes of obtaining it from the blood bank.
- Perform hand hygiene.
- Put on gloves and other personal protective equipment, as needed.
- Use a two-person verification process in the presence of the client to match the blood or blood component to the provider's order and the

patient. Compare the name and identification number on the client's wristband with those on the blood bag label. Check the blood bag identification number, ABO blood group, Rh compatibility, and interpretation of compatibility testing. Compare the client's transfusion services identification number with the number on the blood bag.

- Check the expiration date and the integrity of the product; return expired or abnormal blood to transfusion services.
- Prime the administration set. When using a Y-type set, use normal saline solution to prime the tubing.
- Perform a vigorous mechanical scrub of the vascular access device for at least five seconds using an antiseptic pad. Allow it to dry completely.
- Trace the blood administration set from the client to its point of origin before beginning the transfusion. Route the tubing in a standardized direction if the client has other tubing and catheters that have different purposes. Label the tubing at the distal and proximal ends.
- Start the transfusion at a slow rate per agency policy, typically 2 mL/minute (i.e., 120 mL/hour).
- Remain with the client during the first 15 minutes to monitor for signs of transfusion reaction.
- If a reaction occurs, immediately stop the transfusion and notify the provider and transfusion services according to agency policy.
- During the first 15 minutes of the blood transfusion, obtain and analyze vital signs based on agency policy.
- If no evidence of a transfusion reaction occurs, increase the infusion rate to the prescribed rate to ensure administration is complete within a 4-hour time frame.
- Instruct the client to immediately report any unusual symptoms such as chills, itching, hives, shortness of breath, or chest pain and leave the call light within reach.
- Observe the client periodically during the transfusion and assess their respiratory status, skin appearance, and urine output. Monitor vital signs during the transfusion as directed by agency policy and/or the client's condition.
- Closely monitor the flow rate and inspect the IV insertion site for signs of

infiltration. If signs of infiltration are present, stop the transfusion immediately, disconnect the administration set, and aspirate fluid from the catheter using a 3-mL syringe. Remove the catheter and estimate the volume of fluid infiltrated. Notify the provider and insert a new IV catheter in a different location and restart the transfusion.

- Remove and discard gloves and any personal protective equipment.
- Perform hand hygiene.
- After the completion of the blood product administration, assess the IV site and obtain the client's vital signs and compare them with the baseline measurements.
- If additional units must be administered, repeat the procedure. If additional units aren't needed, perform hand hygiene, put on gloves, and reconnect the original IV fluid, saline lock the catheter, or discontinue the IV infusion, as prescribed.
- Appropriately discard the used equipment, blood bag, filter, and tubing in a biohazard bag or bin.
- Dispose of used equipment in appropriate receptacles.
- Remove and discard gloves and other personal protective equipment, if worn.
- Perform hand hygiene.
- In an inpatient setting, help the patient into a comfortable position and place personal items, the tray table, and the call light within easy reach. Make sure the patient knows how to use the call light to summon assistance. To ensure the patient's safety, raise the appropriate number of side rails and lower the bed to the lowest position. Ensure the bed is locked.
- Perform hand hygiene.
- Document the procedure and assessments.
- Continue to assess and monitor the client for 4 to 6 hours after the transfusion.
- Teach the client and family about the signs and symptoms of a delayed reaction.

View a YouTube video[3] showing an instructor demonstration of this skill:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/nursingadvancedskills/?p=139#oembed-1

3. Chippewa Valley Technical College. (2023, January 5). *Administering blood products* [Video]. YouTube. Video licensed under CC BY 4.0. https://youtu.be/1JzL1GTd99E

3.5 Documentation

All aspects of the administration of blood products are documented. Documentation must minimally include the following components:

- Date and time that the blood transfusion began
- Name of the second nurse who did the two-person verification process
- Name and amount of the specific type of transfusion (for example, 1 unit of packed red blood cells)
- Blood product number
- Confirmation that written informed consent was obtained
- Indications for the transfusion
- Premedications administered
- Donor identification number
- IV site location
- Size and gauge of IV catheter access
- Duration of the transfusion
- Vital signs before, during, and post-transfusion according to agency policy
- Pre- and post-transfusion focused assessments (lungs, heart, etc.) according to agency policy
- Indication that the client was informed about when and why to contact the nurse after the initial 15-minute monitoring period
- Amount of normal saline solution infused
- Client response to the transfusion
- If a transfusion reaction occurs:
    - Name of the provider notified
    - Time of notification
    - Interventions performed
    - Client's response to those interventions.
- Any teaching provided to the client and family, including their understanding of the teaching and any follow-up that was needed

Sample Documentation:

12/7/20XX 1445

Transfusion of one-unit (250mL) packed RBCs started at 1445 via 20-gauge saline lock in the right forearm. Unit product #G901 301 000 482. Blood product and client identification verified with Jane Smith, RN. Informed consent signed and in client chart. Infusion indication: symptomatic anemia with hemoglobin level at 7.4 mg/dL. Client verbalizes understanding of the reason for transfusion and the need to inform RN as soon as possible if any symptoms develop during transfusion. Microaggregate Y-tubing system attached to packed red blood cells and 0.9% normal saline. Pre-transfusion vital signs and assessments: T 98.2 F (temporal), HR 88 bpm, RR 20, BP 112/68, SpO2 97% on room air, lung sounds clear, regular heart rate with no extra sounds.

1500: Stayed with client for the first 15 minutes of initiation. Client tolerated infusion without any new or adverse signs or symptoms.

1715: Unit (250 mL) was infused within 2.5 hours, with 50 mL of normal saline 0.9%. Time of completion: 1715. Post-transfusion completion vital signs and assessments: T 97.6 F (temporal), HR, 78 bpm, RR 22, BP 128/72, SpO2 97% on room air, lungs sounds clear, regular heart rate with no extra sounds. IV site intact and patent without signs of phlebitis or infiltration. Client appears comfortable and denies discomfort.

Manuel Roberts, RN

Exercises

(Answers to the exercises are located in the Answer Key at the back of the book).

Case Study #1

Helen, age 80, has a history of myelodysplastic syndrome, anemia, and chronic heart failure. She is scheduled to receive a blood transfusion today for a Hgb of 6.5 g/dL this morning. She arrived at the clinic to see her primary care provider for follow-up appointment with her daughter Grace. "I feel so tired this morning," Helen groans, "It was really hard getting out of bed to get here. Grace had to help me into my wheelchair and helped get my hair fixed and get me dressed today too. I'm so exhausted now."

Grace nods as Helen talks, and adds, "I also think she looks really pale. She definitely needs a transfusion today. I'm worried about her."

As you complete your assessment prior to the transfusion, Helen begins coughing and has audible crackles when breathing. Additionally, her BP is elevated from baseline and rhonchi are auscultated bilaterally in the bases of her lungs.

The MD provides the following orders:

- Administer 2U PRBCs today
- Type and screen now
- Administer furosemide 20 mg IV now and

between units of blood

1. What are the indications for a blood transfusion for Helen?

2. Are there any considerations you need to make regarding starting an IV for the blood transfusion?

3. What steps will you take to prepare for the administration of blood for Helen?

4. What precautions or nursing considerations need to be made?

5. What assessments will you complete prior to the blood transfusion? During the blood transfusion?

6. Helen has blood type O-. What types of blood are compatible with this type?

7. You are notified that the blood has been prepared in the lab and is ready for administration. What steps do you take to ensure safety for the client?

8. Explain the remaining steps for the procedure of administering the blood transfusion.

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https://wtcs.pressbooks.pub/nursingadvancedskills/?p=143#h5p-7

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Test your knowledge using a NCLEX Next Generation-style question. You may reset and resubmit your answers to this question an unlimited number of times.

III Glossary

Allogeneic blood products: Blood products donated by other people.

Anemia: A hematological condition where there is a lack of healthy red blood cells and/or hemoglobin to carry adequate oxygen to the body's tissues.

Autologous blood transfusion: A procedure in which blood is removed from the patient and returned to their circulation at a later time, instead of relying on blood donated by others (i.e., allogeneic blood).

Blood product: Any therapeutic substance derived from human blood, including whole blood and other blood components for transfusion, as well as plasma-derived medicinal products.

Dysfibrinogenemia: A coagulation (clotting) disorder characterized by abnormal fibrinogen.

Hemolysis: Red blood cell destruction.

Hypofibrinogenemia: A rare, autosomal dominant condition characterized by bleeding and obstetric problems such as abruption, postpartum hemorrhage, and recurrent pregnancy loss.

Microaggregate filter: A second-generation blood filter with a pore size of 20–40 μm that removes 75–90% of white cells, which is used to transfuse packed red cells.

Thrombocytopenia: Platelet deficiency causing bleeding, bruising, and slow blood clotting after injury.

Transfusion reactions: Adverse events that are directly related to the transfusion of blood products and may range from mild to severe with life-threatening effects. Transfusion reactions may be acute or delayed (i.e., up to days or weeks after the transfusion). Immune-related reactions are often due to a mismatch or incompatibility of the transfused blood product and the recipient's blood type or Rh factor. Non-immunologic reactions are typically caused by the physical effects of the blood component or the transmission of a disease.

PART IV

CHAPTER 4 MANAGE CENTRAL LINES

4.1 Introduction

Learning Objectives

- Outline indications for insertion of a central venous access device (CVAD)
- Compare and contrast the various types of CVADs and where they are inserted
- Describe the processes of verifying placement and securing a CVAD
- Describe infection control techniques to prevent infections associated with CVADs
- Identify potential complications associated with CVADs, prevention, and related nursing interventions
- Discuss how to safely change CVAD dressings and needleless connectors
- Outline the processes of safely accessing, flushing, and locking CVADs
- Describe blood sampling techniques from CVADs
- Discuss the components of routine documentation related to CVADs

As the complexity of client conditions continues to evolve within health care settings, the safe use and management of central lines are imperative. A central line is a thin, flexible, large-bore tube inserted into a client's large vein, also referred to as a **central venous access device (CVAD)**. There are various insertion sites for CVADs (see Figure 4.1[1]). CVADs are commonly guided into

1. "Central-venous-access-sites.png" by unknown author is licensed under CC B-NC-ND. Access for free at https://www.researchgate.net/figure/Central-venous-access-sites_fig1_334584348

the superior vena cava so the distal tip is located in the superior vena cava near the junction with the right atrium. Other CVADs are introduced through the femoral vein so the distal tip sits in the inferior vena cava. CVADs differ from short peripheral IV catheters used for intravenous access because they are placed in central circulation due to the distal tip location.

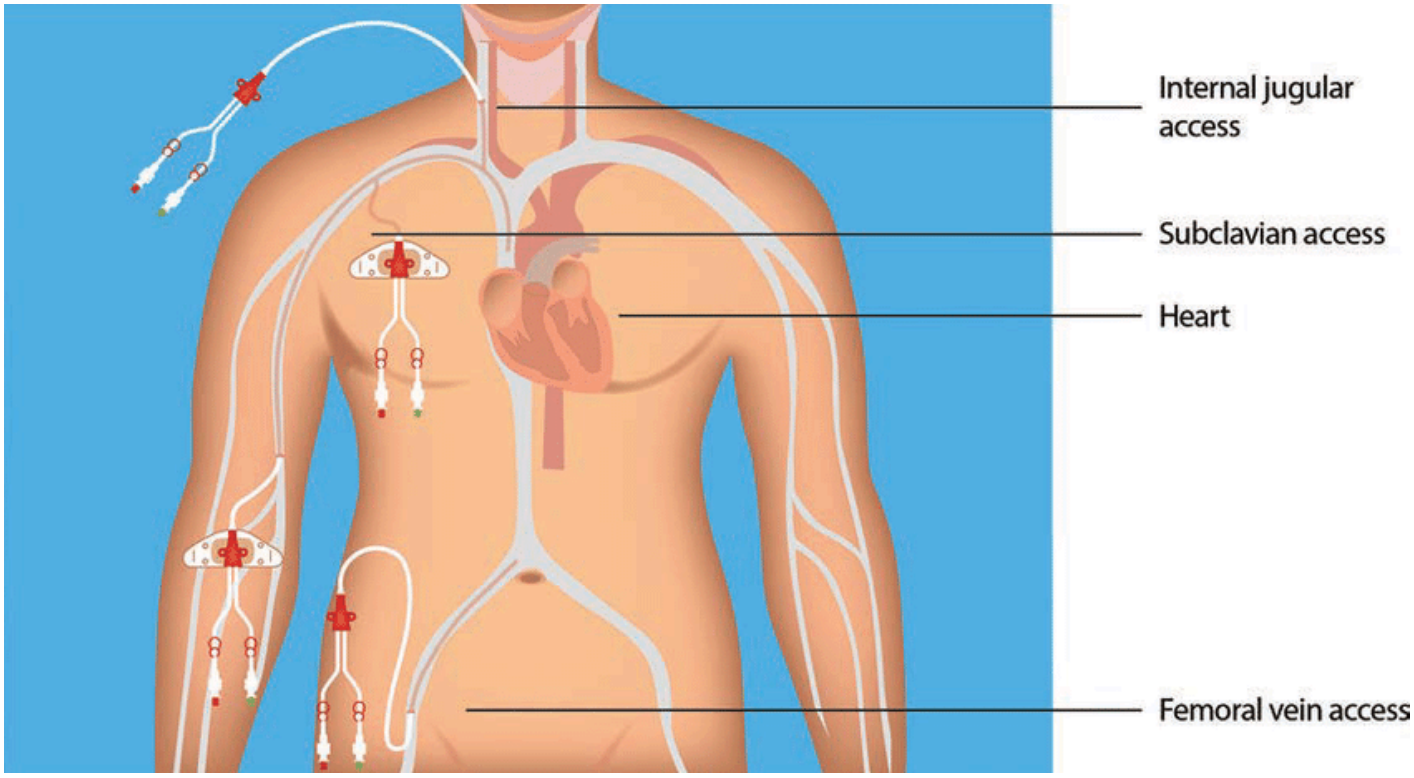

Figure 4.1 CVAD Insertion Sites

CVADs are used for delivery of medication, fluids, and nutrition and can remain in place long-term. They can also be used for blood draws, hemodynamic monitoring, and transvenous pacing. These lines help ensure consistent vascular access can be easily obtained and utilized by the health care team. This chapter will describe indications for CVADs, explore different types of CVADs, outline related nursing procedures, and discuss nursing management of clients with CVADs.

Indications for CVAD

Common indications for CVAD placement include delivery of medication, fluids, and nutrition, especially for clients requiring long-term therapy. CVADs are required for infusion of high osmolarity solutions and vesicant medications. They may also be placed for emergency venous access for clients requiring fluid resuscitation and hemodynamic monitoring.[1] Many clients who require CVADs are older adults, very young children, or those with chronic health conditions.[2]

High osmolarity solutions refer to a highly concentrated solution expressed as the total number of solute particles per liter. High osmolarity solutions, such as total parenteral nutrition and hypertonic IV fluids, are irritating to peripheral vessels and increase the client's risk for phlebitis, thrombosis, and occlusion. Additionally, **vesicant medications** (such as certain antineoplastic drugs, antibiotics, electrolytes, and vasopressors) can cause severe tissue injury or destruction if they extravasate. **Extravasation** refers to leakage of fluid into the tissues around the IV site, causing tissue injury when the catheter has dislodged from the blood vessel but is still in the nearby tissue. For this reason, infusions of high osmolarity solutions and vesicant medications are administered through a CVAD into a large vein such as the superior vena cava. When these solutions enter this larger vessel, the solution is hemodiluted, thus minimizing the risk of these complications from occurring.

Fluid resuscitation refers to infusing a large volume of fluid through the intravenous venous access to restore hemodynamics and optimize tissue perfusion and, ultimately, tissue oxygen delivery. Hemodynamic monitoring is often in place when a client requires fluid resuscitation. **Hemodynamic monitoring** is the assessment of a critically ill client's circulatory status and

1. This work is a derivative of StatPearls by Tse and Schick and is licensed under CC BY 4.0
2. Broadhurst, D., Moureau, N., & Ullman, A. J. The World Congress of Vascular Access (WoCoVA) Skin Impairment Management Advisory Panel. (2017). Management of central venous access device-associated skin impairment: An evidence-based algorithm. *Journal of Wound, Ostomy, and Continence Nursing, 44*(3), 211-220. https://journals.lww.com/jwocnonline/fulltext/2017/05000/management_of_central_venous_access.2.aspx

includes measurements of central venous pressure, cardiac output, and blood volume.[3] **Central venous pressure (CVP)** reflects the pressure in the central veins as they enter the right atrium and is often monitored during fluid resuscitation as measure of preload (i.e., volume status).

Types of Central Venous Access Devices and Locations

There are several types of CVADs, and the selection of which type is used depends upon the specific client's clinical situation, indication, and duration of treatment. The type of CVAD selected is based on the specific client's clinical situation. The decision process for selecting an appropriate CVAD involves collaboration among the provider, the client, and the health care team while considering the treatment requirements. Special considerations include examining the expected length of treatment; the specific prescribed treatment; and the client's vascular characteristics, age, cognitive level, medical history, infusion therapy history, and, if appropriate, their preference for the CVAD site location. Generally, other venous access or alternative delivery methods should be considered prior to inserting a CVAD due to its invasiveness and associated risks. Indications for CVAD insertion and its associated risks should be explained to the client by the provider and documented in their medical record.[4]

CVADs may be inserted centrally or peripherally. A centrally inserted central venous catheter is typically placed into the client's internal jugular, subclavian, or femoral vein. Peripherally inserted central venous catheters (referred to as PICC lines) are primarily placed through the basilic, cephalic, or brachial veins. Insertion is more successful with fewer complications when guided ultrasound is used for placement.[5]

Only specially trained health care clinicians can select and insert CVADs. The determination of which area (peripheral, midline, or central vein) used to

3. McCarthy, C. J., Behravesh, S., Naidu, S. G., & Oklu, R. (2016). Air embolism: Practical tips for prevention and treatment. *Journal of Clinical Medicine, 5*(11), 93. https://doi.org/10.3390/jcm5110093
4. NSW Agency for Clinical Innovation. (2021). *Central venous access devices (CVAD): Clinical practice guide*. Agency for Clinical Innovation. https://aci.health.nsw.gov.au/__data/assets/pdf_file/0010/239626/ACI-CVAD-clinical-practice-guide.pdf
5. Chopra, V. (2022). Central venous access devices and approach to device and site selection in humans. *UpToDate*. Retrieved November 28, 2022, from https://www.uptodate.com/

insert a CVAD is based on a suitable venous pathway, optimal vein characteristics, risk of nerve injury, and anatomical variations.[6]

Table 4.2a outlines various types of CVADs, their uses, expected durations, site considerations, and client safety considerations.

Table 4.2a Central Venous Access Devices

6. NSW Agency for Clinical Innovation. (2021). *Central venous access devices (CVAD): Clinical practice guide*. Agency for Clinical Innovation. https://aci.health.nsw.gov.au/__data/assets/pdf_file/0010/239626/ACI-CVAD-clinical-practice-guide.pdf

Device	Type of Therapy	Expected Duration	Site Considerations	Rationale and Safety Considerations
Peripherally Inserted Central Catheter (PICC) (See Figure 4.2[7])	Long-term use. May be used to infuse high osmolarity solutions or antibiotic therapy. Power ports may be used for high pressure rapid infusions.	Up to six months.	Utilize median cubital, cephalic, basilic, or brachial veins with sufficient diameter size.	Avoid in clients with end-stage renal disease requiring vein preservation for fistulas and grafts or those with a history of thrombosis, hypercoagulability states, or decreased peripheral vascular flow.
Non-Tunneled CVAD (See Figure 4.3[8])	May be used to infuse high osmolarity solutions.	Days to several weeks.	Insertion sites may be subclavian, external/internal jugular, or femoral veins.	The subclavian vein is favored in adult clients due to decreased risk of catheter-related thrombosis and/or infection.
External Tunneled CVAD (Hickman, Broviac, Groshong) (See Figure 4.4[9])	Long-term intravenous therapy, such as chemotherapy or hemodialysis.	May be long-term or permanent.	Inserted in the chest area via a subclavian or jugular vein. Tunneled subcutaneously from the proximal end of the insertion site to an exit site.	Surgery is required to tunnel the catheter so that part of the catheter lies in the subcutaneous tunnel. This helps prevent organisms from entering the bloodstream by separating where the catheter exists the skin from where it enters the vein. Passing the catheter under the skin also helps keep it better secured.

7. "Blausen_0193_Catheter_PICC.png" by Blausen Medical Communications, Inc. is licensed under CC BY 3.0

Implanted Venous Access Device (IVAD), also referred to as an Implanted Port (See Figure 4.5[10])	Long-term medication or IV therapy such as chemotherapy.	May be long-term or permanent.	Placed in a subclavian or jugular vein and attached to a reservoir pocket. The **reservoir pocket** is a small plastic or metal cylinder, usually placed just below the collar bone, that releases medication into the bloodstream. An IVAD is less obvious than a tunneled catheter and requires little daily care, with less impact on a person's activities than a PICC line or a tunneled catheter.	Surgery is required to place the port. The port is accessed with a noncoring needle and can be used immediately after placement.

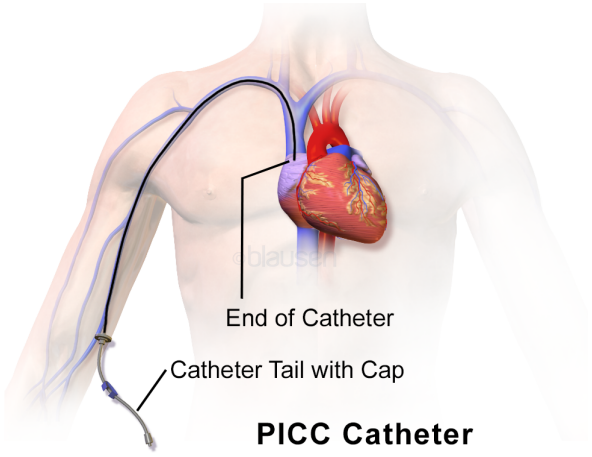

Figure 4.2 Peripherally Inserted Central Catheter (PICC Catheter)

8. "Blausen_0181_Catheter_CentralVenousAccessDevice_NonTunneled.png" by Blausen.com staff (2014) for "Medical gallery of Blausen Medical 2014" is licensed under CC BY 3.0
9. "Tunneled_venous_access_device.png" by Glynda Rees Doyle and Jodie Anita McCutcheon is licensed under CC BY 4.0
10. "Venous_Access_Port_Catheter.png" by BruceBlaus is licensed under CC BY-SA 4.0

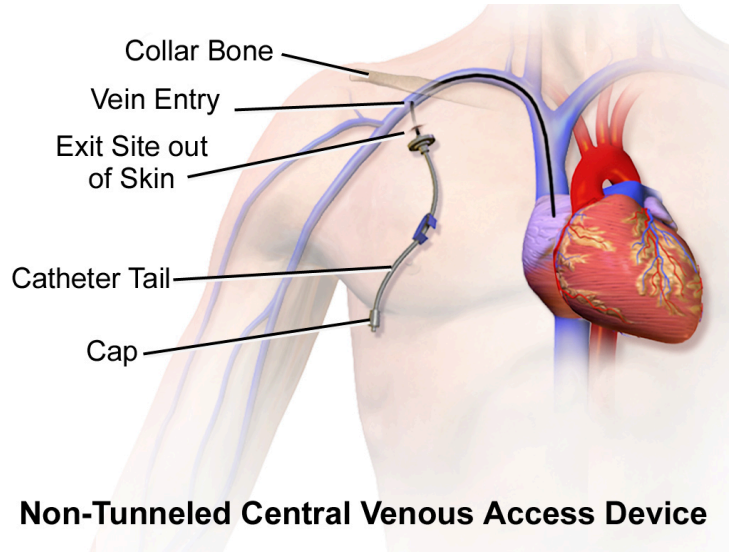

Figure 4.3 Non-Tunneled CVAD

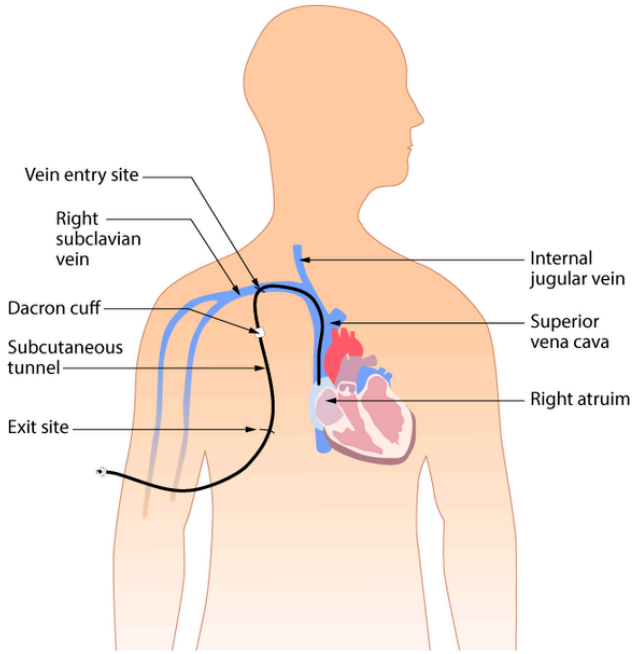

Figure 4.4 External Tunneled CVAD

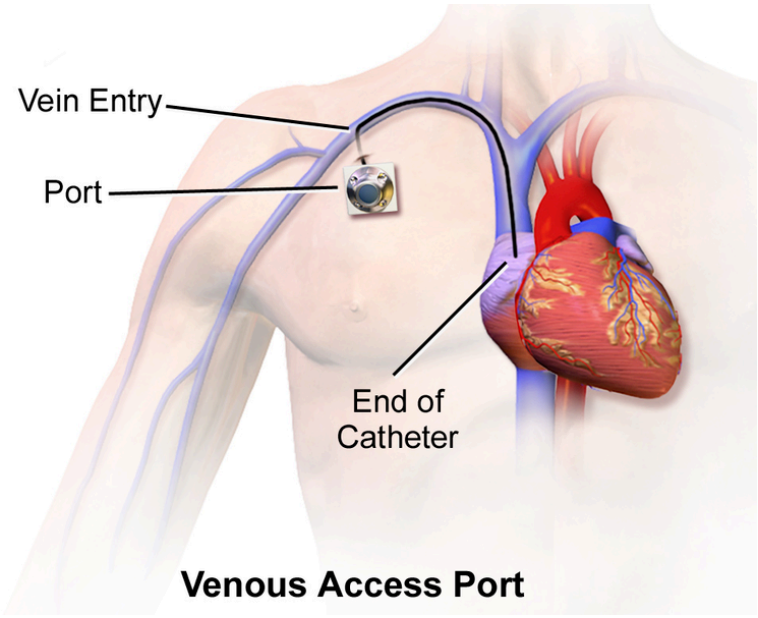

Figure 4.5 Implanted Venous Access Port

Lumens

CVADs may have a single lumen (opening), double lumen, or multiple lumens that exit at various places along the central catheter. See Figure 4.6[11] for an image of a CVAD with two lumens.

11. "xvthfl4exkgi9wdyt2twbf18gfpi3hdf.jpg" by unknown author used on the basis of Fair Use. Access original image at https://www.bd.com/en-us/products-and-solutions/products/product-families/powerline-central-venous-catheter#eifuresources.

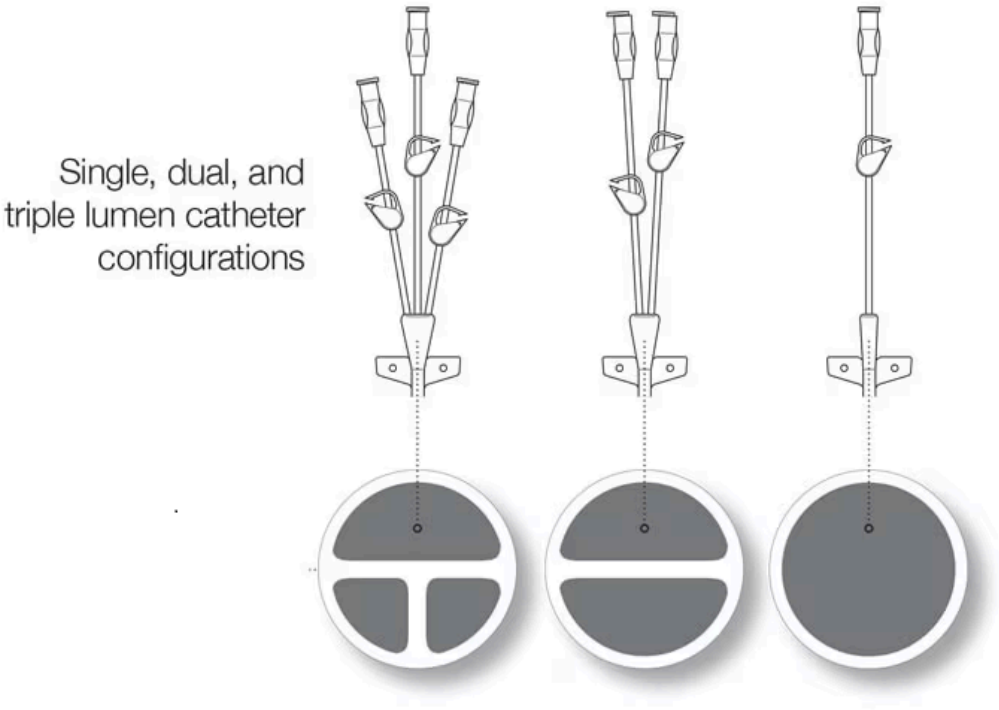

Figure 4.6 CVAD Catheters. Used under Fair Use.

Table 4.2b describes different types of lumens based on their exit points, their size, and their uses.

Table 4.2b Types of Lumens

Lumens	Proximal Lumen	Middle Lumen	Distal Lumen
Size	18 gauge	18 gauge	16 gauge
Uses	Fluids TPN/Lipids Medications	Medications	Blood draw Blood administration Central venous pressure (CVP) monitoring

Insertion of a CVAD

The insertion of a CVAD is an invasive medical procedure requiring informed consent from the client. The insertion should be performed only by a trained, credentialed health professional. Accurate placement of the CVAD tip is confirmed according to agency policy by fluoroscopy during insertion, post-procedure chest X-ray, or a magnet tip locator. **Fluoroscopy** is an imaging

technique that uses X-rays to obtain real-time moving images of the interior of an object within the body. If real-time fluoroscopy is used during the procedure to confirm tip placement, a post-procedure chest X-ray is not required. If fluoroscopy is not used, a post-procedure X-ray is used to confirm tip placement, as well as to check for a possible pneumothorax that can inadvertently occur during insertion. After the tip location is verified, it is essential to document the location in the client's medical record.[12]

Securement of CVADs

After the placement of the CVAD tip is confirmed, the CVAD must be stabilized and secured to the client. Dislodgement and premature removal of the CVAD increase complications such as infections, vessel injury, and treatment delays. Depending on the location and type of CVAD, it may be stabilized with sutures or a sutureless engineered stabilization device. See Figure 4.7[13] for illustrations of stabilization devices.

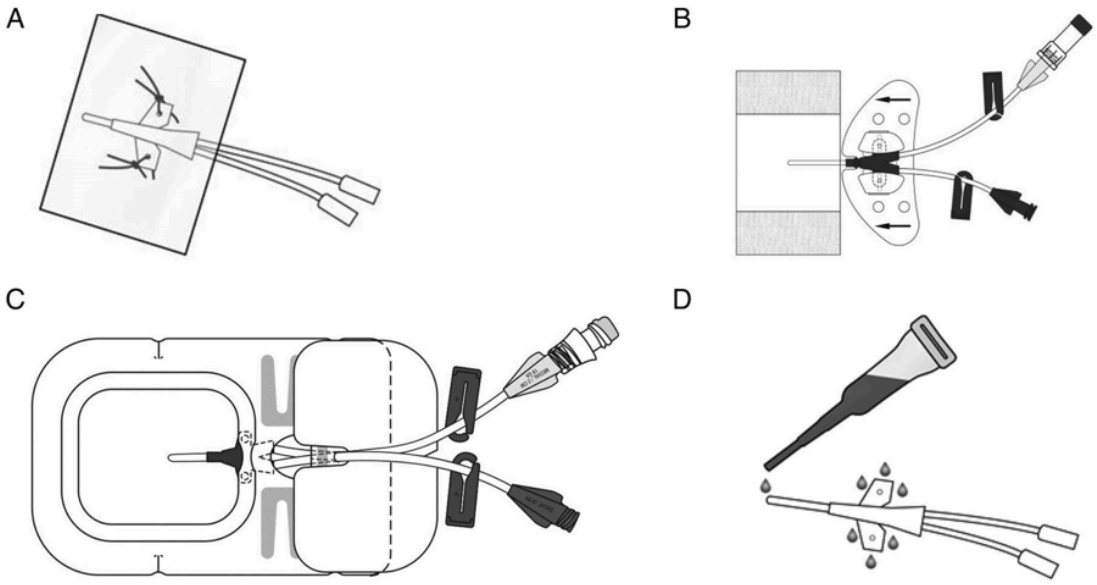

Figure 4.7 CVAD Stabilization Devices (A) Simple polyurethane and suture; (B) Sutureless securement device with simple polyurethane; (C) Integrated securement dressing product; (D) Tissue adhesive

12. NSW Agency for Clinical Innovation. (2021). *Central venous access devices (CVAD): Clinical practice guide*. Agency for Clinical Innovation. https://aci.health.nsw.gov.au/__data/assets/pdf_file/0010/239626/ACI-CVAD-clinical-practice-guide.pdf
13. "F1.medium.png" by Amanda Ullman et al., courtesy of BMJ Open is licensed under CC BY-NC 4.0. Access for free at https://bmjopen.bmj.com/content/6/6/e011197

The goal of the securement device is to maintain a secure hold on the central line and to prevent it from moving in and out of the insertion site. Sutureless devices, if appropriate, have less risk of infection because they maintain intact skin. Adhesive devices have the risk of causing a skin-related injury such as skin tear or a local reaction to the adhesive. Applying a prophylactic skin barrier prior to applying an adhesive device decreases this risk to the client.

After the catheter is secured, a sterile, transparent semipermeable dressing is applied to cover the insertion site. Some transparent dressings have an impregnated chlorhexidine gel or a biopatch that is directly placed over the insertion site to reduce the growth of microorganisms. In some cases, if there is blood or exudate leaking from the insertion site after initial placement, a sterile gauze dressing may be used to absorb the fluid until the leaking resolves.

Prevention of Central Line-Associated Bloodstream Infections (CLABSI)

When a client has a CVAD, it is crucial to follow evidence-based guidelines regarding its insertion, care, and maintenance to prevent the development of a life-threatening infection. Clients with CVADs are at risk for developing **central line-associated bloodstream infections (CLABSI)**. CLABSI is diagnosed when pathogens are found in the client's blood in the absence of another source of infection and the client has had a central line in place for more than two calendar days before the infection occurs. CLABSI continues to be one of the most deadly and costly hospital-acquired infections in the United States.[14]

A group of evidence-based practice standards has been formulated by the Institute of Healthcare Improvement (IHI) to reduce the risk of infection related to the insertion and management of CVADs and improve quality of care. CLABSI prevention strategies encompass three areas: clinical indications,

14. Institute for Healthcare Improvement. (n.d.). *Central line infection.* https://www.ihi.org/Topics/CentralLineInfection/Pages/default.aspx

insertion, and care and maintenance. These strategies include the following elements[15,16]:

- Hand hygiene as directed by CDC guidelines
- Maximal barrier precautions during insertion
- Skin antiseptic using chlorhexidine
- Optimal site selection, such as avoiding femoral vein access, when possible, for central venous access in adults
- Daily assessment of the necessity of the central line and prompt removal if deemed unnecessary
- Routine disinfection of catheter hubs, connectors, and injection ports
- Changing dressings over the site every two days for gauze dressings, every seven days for semipermeable dressings, or as needed if it becomes damp, loose, or visibly soiled

There have been improvements in CLABSI rates with these IHI practice standards, but, unfortunately, CLABSI continues to be an issue in hospitals despite these prevention measures. Read more information regarding the CDC recommendations to prevent CLABSIs in the following box.

Read the Infection Control Guidelines for Central Lines from the CDC's web page.

Potential Complications and Unexpected Outcomes of CVADs

Nursing management of clients with CVADs requires strict asepsis,

15. Institute for Healthcare Improvement. (n.d.). *Central line infection.* https://www.ihi.org/Topics/CentralLineInfection/Pages/default.aspx
16. The Joint Commission. (n.d.) *CLABSI toolkit - Chapter 3.* https://www.jointcommission.org/resources/patient-safety-topics/infection-prevention-and-control/central-line-associated-bloodstream-infections-toolkit-and-monograph/clabsi-toolkit---chapter-3/

knowledge of the purpose and functions of these devices, and routine interventions to prevent complications. Ongoing assessment and monitoring of the client and the CVAD system are essential for safety, quality care, and positive client outcomes. The following table summarizes possible complications associated with CVADs, their assessments, related prevention actions, and associated nursing interventions.

Table 4.2c Complications/Unexpected Outcomes of CVADs

Potential Complication	Assessment	Prevention	Nursing Intervention
Occlusion due to clot formation or malpositioning	Perform recommended site and CVAD system care, including equipment function and checking for blood return and the ability to infuse fluid. Assess for pain and edema at the insertion site (i.e., shoulder, ear, neck, or arm). If an implantable port is in place, assess the noncoring needle for correct placement.	Flush the catheter routinely as recommended and according to agency policy. Do not flush against resistance. Keep the catheter free from kinks. Do not mix incompatible medications during infusion that can cause precipitation within the catheter.	Initially, reposition the client. Raise the client's arm overhead, ask the client to cough and deep breathe, or assist them to stand up and sit down. If appropriate, administer thrombolytics as ordered by the provider. A clogged CVAD may require removal by trained health care personnel per provider order.
Catheter damage or breakage	Assess the site every shift and with flushing. Observe for leaks, tears, pinholes, or drainage after flushing.	Using a 10-mL syringe is preferred for CVADs to avoid increased pressure that can cause a potential rupture. Never flush against resistance. Use needleless system devices and avoid sharp objects such as scissors near the catheter. Follow agency policy regarding the proper clamping procedure if the access device has a closed catheter system.	Clamp the catheter near the insertion site and place sterile gauze over the break or hole until it is repaired. If repair of the catheter is safe and appropriate, use only a repair kit that is recommended by the manufacturer. The CVAD may require removal by trained health care personnel per provider order.

Infection (CLABSI)	Assess the catheter insertion site and surrounding area for redness, edema, drainage, and tenderness. Monitor pertinent laboratory results (e.g., WBC).	Maintain and utilize aseptic technique. Comply with guidelines and agency policies regarding CVAD and follow the recommended CLABSI prevention bundle.	Notify the health care provider and anticipate a blood culture order for suspected CLABSI. Follow agency sepsis prevention and implementation protocol. The CVAD may require removal by trained health care personnel per provider order. Anticipate obtaining a culture of the CVAD tip using sterile scissors and a sterile specimen cup. Diagnosed CLABSIs should be treated as life-threatening. Antibiotics specific to the organism should be initiated. Infection preventionists, vascular access specialists, providers involved with device insertion, and primary nursing staff should review each case in detail, looking for potential contributing factors.[17]
Dislodgment	Measure and document the catheter length per agency policy. Assess for dislodgement by identifying any edema at or around the catheter insertion site. Palpate for coiling of the catheter under the skin.	Ensure the catheter is secured at all times and the dressing is intact. Avoid pulling and manipulating the catheter.	If the catheter is completely dislodged, cover the insertion site and apply direct manual pressure while asking a colleague to call the rapid response team. The client will require monitoring for possible air embolus and reinsertion of a CVAD for critical medications.

17. DeVries, M. (2019). Revisiting CLABSI prevention strategies: Part 2 Learn about central line care and maintenance. *American Nurse Today, 14*(6), 44-47. https://www.myamericannurse.com/wp-content/uploads/2019/06/ant6-INFECTION-CLABSI-2-521a.pdf

Catheter migration (i.e., the catheter moved from its original position)	Assess the patency of the catheter, noting local irritation, swelling, or the inability to aspirate blood. Assess for edema of the arm and hand and distended neck veins. May be able to hear "gurgling" sounds from the catheter. If the catheter tip has advanced into the heart, cardiac dysrhythmias may occur.	Avoid site insertion of a CVAD in areas near the site of a local infection, disrupted skin integrity, or scar tissue.	Notify the provider. A catheter that has migrated externally from its original placement should not be readvanced. A catheter that has migrated internally should be retracted to the original insertion length by a trained health professional.
Skin erosion	Assess the skin at and around the CVAD insertion site. Note any skin separation from the catheter exit site, drainage, contusions, or any indication of skin involvement.	Maintain optimal client nutritional status. For implanted ports, avoid using the same insertion "hole" when accessing it multiple times because this increases the risk of tissue and port breakdown.	Plan for removal of the CVAD per order. Provide effective skin care. Improve nutrition as appropriate to the client's condition.

Air embolism[18]	An **air embolism** is the result of a pressure gradient that allows air to enter the bloodstream when flushing or removing the catheter. An air embolism can subsequently occlude blood flow. Signs and symptoms include sudden dyspnea, continuous coughing, and chest pain. Neurological symptoms include seizures, loss of consciousness, altered mental status, and hemiparesis.	Catheter hubs should not be open to air. Ensure all clamps are engaged appropriately for the device.	Call the rapid response team if an air embolism is suspected. Prevent further air embolism if a clamp is not engaged or a hub is open to air. Administer high-flow oxygen and place the client on their left side with their head down. Begin CPR if indicated.
Pneumothorax[19]	Pneumothorax may inadvertently occur during insertion of a CVAD if the needle in the CVAD placed in the neck or chest goes through the vein or misses the vein and pierces the lung, causing it to collapse. Symptoms of a pneumothorax include sharp, stabbing chest pain that worsens when trying to breathe in; shortness of breath; cyanosis; tachypnea; and a dry, hacking cough.	Not applicable.	Call for assistance and ask a colleague to call the rapid response team and notify the provider. Stay with the patient and administer high-flow oxygen. Anticipate placement of a chest tube if the client is hypoxic.

Infiltration or extravasation	Palpate over the catheter insertion site dressing and around the surrounding area for sponginess and observe for redness or swelling. Note any labored breathing exhibited by the client or complaints of pain with infusions. Observe IV flow rate for free-flowing fluid. Aspirate for blood return.	Stop the infusion and/or administration of the vesicant solution. If extravasation occurs, aspirate any remaining medication from the catheter after disconnection to prevent further damage to vessels. To maintain skin integrity, administer antidote or therapeutic medication as appropriate per protocol.[20]	Discontinue IV solutions. Apply warm/cold compresses as recommended by agency policy. Notify the provider and anticipate an order for a chest X-ray to evaluate catheter integrity and placement.
Incorrect placement	Assess for inadequate blood withdrawal, blood flowing back into the tubing, hypotension, cardiac dysrhythmias, and neck vein distension.	Verification of catheter placement by chest X-ray after insertion or during real-time guided fluoroscopy.	Stop all fluid and medication administration. Anticipate orders for an X-ray and electrocardiogram. The CVAD may require removal or withdrawal to the correct position by trained health care personnel per provider order.

18. McCarthy, C. J., Behravesh, S., Naidu, S. G., & Oklu, R. (2016). Air embolism: Practical tips for prevention and treatment. *Journal of Clinical Medicine, 5*(11), 93. https://doi.org/10.3390/jcm5110093
19. Tsotsolis, N., Tsirgogianni, K., Kioumis, I., Pitsiou, G., Baka, S., Papaiwannou, A., Karavergou, A., Rapti, A., Trakada, G., Katsikogiannis, N., Tsakiridis, K., Karapantzos, I., Karapantzou, C., Barbetakis, N., Zissimopoulos, A., Kuhajda, I., Andjelkovic, D., Zarogoulidis, K., & Zarogoulidis, P. (2015). Pneumothorax as a complication of central venous catheter insertion. *Annals of Translational Medicine, 3*(3), 40. https://doi.org/10.3978/j.issn.2305-5839.2015.02.11
20. Kim, J. T., Park. J. Y., Lee, H. J., & Cheon, Y. J. (2020). Guidelines for the management of extravasation. *Journal of Educational Evaluation for Health Professions, 17*:21.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7431942/