3. The label on the medication must be checked for name, dose, and route, and compared with the MAR at three different times: 1. When the medication is taken out of the drawer 2. When the medication is being poured 3. When the medication is being put away/or at bedside	 *Perform seven checks three times before administering medication* These checks are done before administering the medication to your patient. If taking drug to bedside (e.g., eye drops), do third check at bedside.
4. Before instilling nasal medication, don clean non-sterile gloves.	Using gloves protects the nurse from potential contact with patient body fluids and medications.  *Apply non-sterile gloves*
5. Provide patient with tissues and ask that they blow their nose.	This clears the nose prior to medication instillation.
6. Position patient sitting back or lying down with head tilted back over a pillow (underneath neck).	This position allows medication to flow back into nasal cavity. Do not tilt head back if patient has a cervical spine injury.
7. Nose drops: draw fluid into medication dropper with enough for both nares. Do not return excess fluid into stock bottle.	Returning fluid to stock bottle increases risk for contamination of medication.

8. Ask patient to breathe through the mouth. Nose drops: hold dropper about 1 cm above naris and drop medication into one naris and then the other. Nasal spray: have patient hold one nostril closed and breathe gently through the other as the spray is being administered. Do not touch the naris with the dropper/spray bottle.	 *Hold dropper about 1 cm above naris* Breathing through the mouth will help prevent aspiration of the medication. Touching the naris with the dropper/spray tip will contaminate the dropper/spray bottle and the medication.
9. Position patient with head back for 2 to 3 minutes.	This position prevents escape of the medication.
10. Remove gloves and assist patient to a comfortable and safe position.	This ensures patient safety and comfort.
11. Perform hand hygiene.	Hand hygiene prevents the spread of microorganisms.  *Hand hygiene with ABHR*
12. Document as per agency policy. Include date, time, dose, route; which naris the medication was instilled into (or whether it was both nares); and patient's response to procedure.	Timely and accurate documentation helps to ensure patient safety.
Data source: BCIT, 2015; Lilley et al., 2011; Perry et al., 2014	

Critical Thinking Exercises

1. Your patient is due to receive a dose of medication instilled into both ears. You find the ear medication stored in the refrigerator. How should you proceed?

2. Your patient is due to receive medication instilled into her right eye, but you notice that her left eye has crusting and discharge. Discuss how you would proceed in this situation.
3. Your patient is to receive nasal drops for a sinus infection. Describe how you would position this patient to receive the nasal drops.

6.6 Administering Inhaled Medications

Medications administered through inhalation are dispersed via an aerosol spray, mist, or powder that patients inhale into their airways. Although the primary effect of inhaled medications is respiratory, there are likely to be systemic effects as well. Most patients taking medication by inhaler have asthma or chronic respiratory disease and should learn how to administer these medications themselves. A variety of inhalers are available, and specific manufacturers' instructions should always be checked and followed to ensure appropriate dosing.

MEDICATION BY SMALL-VOLUME NEBULIZERS

Nebulization is a process by which medications are added to inspired air and converted into a mist that is then inhaled by the patient into their respiratory system (Lilley et al., 2011; Perry et al., 2014.) (see Figure 6.4). The air droplets are finer than those created by metered dose inhalers, and delivery of the nebulized medication is by face mask or a mouthpiece held between the patient's teeth.

Figure 6.4 Example of a small-volume nebulizer

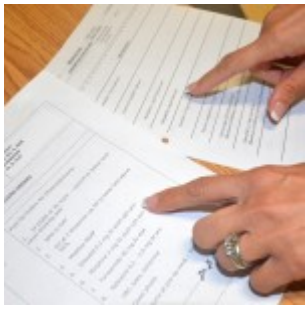
Checklist 51 outlines the steps for delivering medication through a small-volume nebulizer.

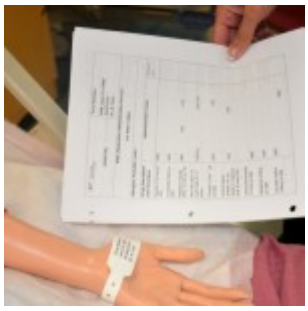
Checklist 51: Medication by Small-Volume Nebulizer

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Check allergy band for any allergies.
- Complete necessary focused assessments and/or vital signs, and document on MAR.
- Provide patient education as necessary.
- Plan medication administration to avoid disruption
    - Dispense medication in a quiet area
    - Avoid conversation with others.
    - Follow agency's no-interruption zone policy.
    - Prepare medications for ONE patient at a time.
    - Follow the SEVEN RIGHTS of medication administration.

STEPS	ADDITIONAL INFORMATION
1. Check MAR against doctor's orders.	Check that MAR and doctor's orders are consistent.  *Compare physician orders and MAR* Night staff usually complete and verify this check as well.

2. Perform the SEVEN RIGHTS x 3 (must be done with each individual medication): • The right patient • The right medication (drug) • The right dose • The right route • The right time • The right reason • The right documentation Medication calculation: D/H x S = A (**D** or desired dosage/**H** or have available x **S** or stock = **A** or amount prepared)	The right patient: check that you have the correct patient using two patient identifiers (e.g., name and date of birth).  *Compare MAR with patient wristband* The right medication (drug): check that you have the correct medication and that it is appropriate for the patient in the current context. The right dose: check that the dose makes sense for the age, size, and condition of the patient. Different dosages may be indicated for different conditions. The right route: check that the route is appropriate for the patient's current condition. The right time: adhere to the prescribed dose and schedule. The right reason: check that the patient is receiving the medication for the appropriate reason. The right documentation: always verify any unclear or inaccurate documentation prior to administering medications.  *Check the right patient, medication, dose, route, time, reason, documentation* NEVER document that you have given a medication until you have actually administered it.

3. The label on the medication must be checked for name, dose, and route, and compared with the MAR at three different times: 1. When the medication is taken out of the drawer 2. When the medication is being poured 3. When the medication is being put away/or at bedside	 *Perform seven checks three times before administering medication* These checks are done before administering the medication to your patient. If taking drug to bedside (e.g., eye drops), do third check at bedside.
4. Assemble nebulizer as per manufacturer's instructions.	Assembly specific to manufacturer's instructions ensures proper delivery of medication.
5. Add medication as prescribed by pouring medication into the nebulizer cup. • Some medications may be mixed together if there are no contraindications. • Some medications may require the addition of saline per prescription for dilution.	This step ensures the proper delivery of medication.
6. Use a mask if patient is unable to tolerate a mouthpiece, and an adaptor specific to tracheostomies if the patient has a tracheostomy.	This ensures the proper delivery of medication.
7. Position patient sitting up in a chair or in bed at greater than 45 degrees.	This position improves lung expansion and medication distribution.  *Position patient sitting up*
8. Assess pulse, respiratory rate, breath sounds, pulse oximetry, and peak flow measurement (if ordered) before beginning treatment.	Determine a baseline respiratory assessment prior to administration of medication.

NOTE: Attach the nebulizer to compressed air if available; use oxygen if there is no compressed air. If patient is receiving oxygen, do not turn it off. Continue to deliver oxygen through nasal prongs with the nebulizer.	
9. Turn on air to nebulizer and ensure that a sufficient mist is visible exiting nebulizer chamber. A flow rate of 6 to 10 L should provide sufficient misting. Ensure that nebulizer chamber containing medication is securely fastened. Ensure that chamber is connected to face mask or mouthpiece, and that nebulizer tubing is connected to compressed air or oxygen flowmeter.	This process verifies that equipment is working properly.  *Check for misting*
10. If mouthpiece is being used, ensure lips are sealed around mouthpiece.	Sealed lips ensure proper inhalation of medication.
11. Have patient take slow, deep, inspiratory breaths. Encourage a brief 2- to 3-second pause at the end of inspiration, and continue with passive exhalations. **Note:** If patient is dyspneic, encourage holding every fourth or fifth breath for 5 to 10 seconds.	This maximizes effectiveness of medication.
12. Have patient repeat this breathing pattern until medication is complete and there is no visible misting. This process takes approximately 8 to 10 minutes.	This maximizes the effectiveness of the medication.
13. Tap nebulizer chamber occasionally and at the end of the treatment.	This action releases drops of medication that cling to the side of the chamber.  *Tap the nebulizer container*
14. Monitor patient's pulse rate during treatment, especially if beta-adrenergic bronchodilators are being used.	Beta-adrenergic bronchodilators have cardiac effects that should be monitored during treatment.
15. Once treatment is complete, turn flowmeter off and disconnect nebulizer.	This promotes patient comfort and safety.
16. Rinse, dry, and store nebulizer as per agency policy.	Proper care reduces the transfer of microorganisms.

17. If inhaled medication included steroids, have patient rinse mouth and gargle with warm water after treatment.	Rinsing removes residual medication from mouth and throat, and helps prevent oral candidiasis related to steroid use.
18. Once treatment is complete, encourage patient to perform deep breathing and coughing exercises to help remove expectorate mucous.	Treatments are often prescribed specifically to encourage mucous expectoration.
19. Return patient to a comfortable and safe position.	This promotes patient comfort and safety.
20. Perform hand hygiene.	This step prevents the transfer of microorganisms.  *Hand hygiene with ABHR*
21. Document treatment as per agency policy, and record and report any unusual events or findings to the appropriate health care provider.	Accurate and timely documentation and reporting promote patient safety.
Data source: BCIT, 2015; Lilley et al., 2011; Perry et al., 2014	

MEDICATION BY METERED DOSE INHALER (MDI)

A metered dose inhaler (MDI) is a small handheld device that disperses medication into the airways via an aerosol spray or mist through the activation of a propellant. A measured dose of the drug is delivered with each push of a canister, and dosing is usually achieved with one or two puffs.

Examples of MDIs, with a spacer on the right

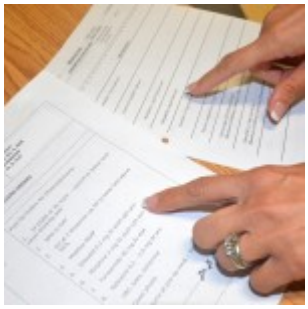
Checklist 52 lists the steps for administering medication by MDI.

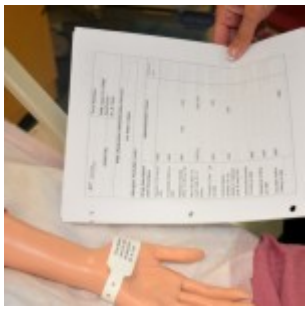
Checklist 52: Medication by Metered Dose Inhaler (MDI)

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Check allergy band for any allergies.
- Complete necessary focused assessments and/or vital signs, and document on MAR.
- Provide patient education as necessary.
- Plan medication administration to avoid disruption:
  - Dispense medication in a quiet area.
  - Avoid conversation with others.
  - Follow agency's no-interruption zone policy.
  - Prepare medications for ONE patient at a time.
  - Follow the SEVEN RIGHTS of medication administration.

STEPS	ADDITIONAL INFORMATION
1. Check MAR against doctor's orders.	Check that MAR and doctor's orders are consistent.  *Compare physician orders and MAR* Night staff usually complete and verify this check as well.

2. Perform the SEVEN RIGHTS x 3 (must be done with each individual medication): • The right patient • The right medication (drug) • The right dose • The right route • The right time • The right reason • The right documentation Medication calculation: D/H x S = A (**D** or desired dosage/**H** or have available x **S** or stock = **A** or amount prepared)	The right patient: check that you have the correct patient using two patient identifiers (e.g., name and date of birth).  *Compare MAR with patient wristband* The right medication (drug): check that you have the correct medication and that it is appropriate for the patient in the current context. The right dose: check that the dose makes sense for the age, size, and condition of the patient. Different dosages may be indicated for different conditions. The right route: check that the route is appropriate for the patient's current condition. The right time: adhere to the prescribed dose and schedule. The right reason: check that the patient is receiving the medication for the appropriate reason. The right documentation: always verify any unclear or inaccurate documentation prior to administering medications.  *Check the right patient, medication, dose, route, time, reason, documentation* NEVER document that you have given a medication until you have actually administered it.

3. The label on the medication must be checked for name, dose, and route, and compared with the MAR at three different times: 1. When the medication is taken out of the drawer 2. When the medication is being poured 3. When the medication is being put away/or at bedside	 *Perform seven checks three times before administering medication* These checks are done before administering the medication to your patient. If taking drug to bedside (e.g., eye drops), do third check at bedside.
4. Assemble MDI as per manufacturer's instructions. If MDI has not been used for several days, give it a test spray into the air, taking care not to inhale the medication.	Assembly specific to manufacturer's instructions ensures proper delivery of medication.  *Assemble MDI as per manufacturer's instructions*
5. Ensure that canister is securely inserted into the holder and remove the mouthpiece cover.	This ensures proper delivery of medication.
6. Shake canister well before delivery (5 or 6 shakes).	This ensures proper delivery of medication.
7. Position patient sitting up in a chair or in bed at greater than 45 degrees.	This position improves lung expansion and medication distribution.
8. Assess pulse, respiratory rate, breath sounds, pulse oximetry, and peak flow measurement (if ordered) before beginning treatment.	This determines a baseline respiratory assessment prior to administration of medication.

<table>
<tr>
<td>9. Without spacer:
Hold inhaler in dominant hand.
Place mouthpiece in mouth with opening toward back of mouth, and have patient close lips around mouthpiece.
Ask patient to inhale deeply and exhale completely.
Ask patient to hold inhaler between thumb at the base and index and middle fingers at the top.
Ask patient to tilt head back slightly and inhale deeply and slowly through mouth, while simultaneously depressing inhaler canister.
Ask patient to hold breath for about 10 seconds without exhaling medication.
Remove MDI while exhaling through nose or pursed lips.
With spacer:
Insert MDI into end of spacer device.
Ask patient to place spacer mouthpiece in mouth and close lips around mouthpiece, avoiding any exhalation openings on spacer.
Ask patient to breathe regularly.
Have patient depress medication canister to spray one puff into spacer device.
Ask patient to breathe in deeply and slowly for about 5 seconds and to then hold breath at the end of inspiration for about 10 seconds.
If one medication: have patient wait 20 to 30 seconds between inhalations
If more than one medication: have patient wait 2 to 5 minutes between inhalations.</td>
<td>This process ensures proper inhalation of medication.
 
Ask patient to breathe regularly
 
Depress medication canister to spray one puff into spacer device
 
Ask patient to breathe in deeply and slowly for about 5 seconds and to then hold breath at the end of inspiration for about 10 seconds</td>
</tr>
<tr>
<td>10. Have patient rinse mouth and gargle with warm water about 2 minutes after treatment.</td>
<td>Rinsing removes residual medication from mouth and throat, and helps prevent oral candidiasis related to steroid use.</td>
</tr>
<tr>
<td>11. Return patient to a comfortable and safe position.</td>
<td>This promotes patient comfort and safety.</td>
</tr>
</table>

12. Perform hand hygiene.	This step prevents the transfer of microorganisms.  *Hand hygiene with ABHR*
13. Document treatment as per agency policy, and record and report any unusual events or findings to the appropriate health care provider.	Accurate and timely documentation and reporting promote patient safety.
Data source: BCIT, 2015; Lilley et al., 2011; Perry et al., 2014	

Critical Thinking Exercises

1. Your patient is receiving supplemental oxygen through nasal prongs, and needs to receive medication via a nebulizer. Please describe whether or not you would remove the nasal prongs and your reasoning for making this decision.
2. Your patient complains that she can't seem to breathe in at the same time as she depresses her inhaler. What action should you take in this situation to ensure that your patient receives the appropriate dose of her medication by inhaler.

6.7 Administering Topical Medications

In this section, we address how to administer topical medication using three distinct delivery methods: transdermal patch; creams, lotions, or ointments; and powder. Always wear gloves and maintain standard precautions when administering topical medications to the skin, mucous membranes, and tissues. Do not touch any preparations to your own skin, and turn your face away from powdered applications. Always clean the skin or wound before applying a new dose of topical medication.

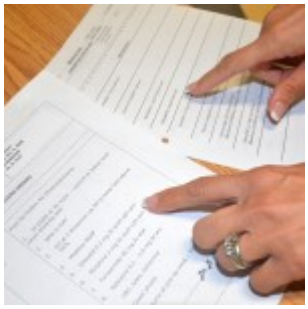
Checklist 53 lists the steps for applying a transdermal patch.

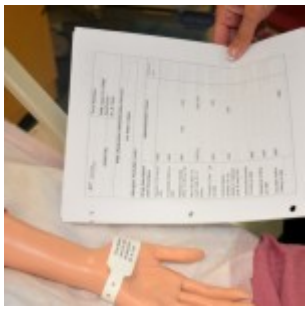
Checklist 53: Applying a Transdermal Patch

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Check allergy band for any allergies.
- Complete necessary focused assessments and/or vital signs, and document on MAR.
- Provide patient education as necessary.
- Plan medication administration to avoid disruption:
    - Dispense medication in a quiet area.
    - Avoid conversation with others.
    - Follow agency's no-interruption zone policy.
    - Prepare medications for ONE patient at a time.
    - Follow the SEVEN RIGHTS of medication administration.

STEPS	ADDITIONAL INFORMATION
1. Check MAR against doctor's orders.	Check that MAR and doctor's orders are consistent.  *Compare physician orders and MAR* Night staff usually complete and verify this check as well.

2. Perform the SEVEN RIGHTS x 3 (must be done with each individual medication): • The right patient • The right medication (drug) • The right dose • The right route • The right time • The right reason • The right documentation Med calculation: D/H x S = A (desired dosage/have available x stock = amount prepared)	The right patient: check that you have the correct patient using two patient identifiers (e.g., name and date of birth).  *Compare MAR with patient wristband* The right medication (drug): check that you have the correct medication and that it is appropriate for the patient in the current context. The right dose: check that the dose makes sense for the age, size, and condition of the patient. Different dosages may be indicated for different conditions. The right route: check that the route is appropriate for the patient's current condition. The right time: adhere to the prescribed dose and schedule. The right reason: check that the patient is receiving the medication for the appropriate reason. The right documentation: always verify any unclear or inaccurate documentation prior to administering medications.  *Check the right patient, medication, dose, route, time, reason, documentation* NEVER document that you have given a medication until you have actually administered it.

3. The label on the medication must be checked for name, dose, and route, and compared with the MAR at three different times: 1. When the medication is taken out of the drawer 2. When the medication is being poured 3. When the medication is being put away/or at bedside	 *Perform seven checks three times before administering medication*  *Transdermal patch* These checks are done before administering the medication to your patient. If taking drug to bedside (e.g., eye drops), do third check at bedside.
4. Before applying a transdermal patch, remove the old patch if it is still in place. Clean area thoroughly. Observe for signs of skin irritation at old patch and document as per agency policy.	Not removing previous patch may result in overdose of the medication. Check between skin folds for old patch.  *Remove previous patch*
5. Dispose of old patch as per agency policy (usually in a biohazard trash bag) by folding in half with sticky sides together and wrapping it in a glove, or cutting it before disposal.	This prevents accidental exposure to the medication.

6. Use a felt tip or soft tip pen to write the date, time, and your initials on the outside of the new patch. DO NOT use a ballpoint pen.	Initialling patch communicates application date and time to other health care providers.  *Write the date, time, and your initials on the transdermal patch* Ballpoint pen can damage patch and thus affect medication delivery.
7. Apply the new patch to a new site that is clear, dry, hairless, and free of skin irritations.	If it is necessary to remove hair, clip the hair instead of shaving to avoid skin irritation. A consistent surface ensures even medication distribution.
NOTE: It is usual to have a "patch-free period" of 10 to 12 hours when the patch is removed, because tolerance to the medication may develop if the patch is worn 24 hours/day. Check doctor's orders to determine if the patch should be removed overnight.	
8. Carefully remove the backing from the patch, taking care to hold it at the edges and not touch the medication with your fingers.	This prevents interference with medication and maintains stickiness of patch.
9. Apply patch by holding one hand firmly over the patch for 10 seconds, then press around the edges to make sure that the patch is securely attached to the skin.	This prevents loss of patch and ensures effectiveness of medication delivery.  *Apply new transdermal patch*

<table>
<tr><td>10. Perform hand hygiene.</td><td>This prevents the transfer of microorganisms.
 
Hand hygiene with ABHR</td></tr>
<tr><td colspan="2">NOTE:
Do not apply new patch to previously used sites for at least one week, so skin irritation is reduced.
Never cut patch in half; a change in dose requires a new transdermal patch.
Never apply a heating pad over the patch as it will affect the rate of absorption, with potentially serious adverse effects.</td></tr>
<tr><td>11. Document as per agency policy, making sure to include site of administration on the MAR.</td><td>Accurate and timely documentation improves patient safety.</td></tr>
<tr><td colspan="2">Data source: BCIT, 2015; Lilley et al., 2011; Perry et al., 2014</td></tr>
</table>

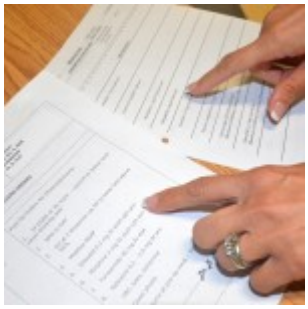
Checklist 54 lists the steps for applying topical medications as creams, lotions, and ointments.

Checklist 54: Applying Topical Creams, Lotions, and Ointments

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Check allergy band for any allergies.
- Complete necessary focused assessments and/or vital signs, and document on MAR.
- Provide patient education as necessary.
- Plan medication administration to avoid disruption:
    - Dispense medication in a quiet area.
    - Avoid conversation with others.
    - Follow agency's no-interruption zone policy.
    - Prepare medications for ONE patient at a time.
    - Follow the SEVEN RIGHTS of medication administration.

STEPS	ADDITIONAL INFORMATION
1. Check MAR against doctor's orders.	Check that MAR and doctor's orders are consistent.  *Compare physician orders and MAR* Night staff usually complete and verify this check as well.

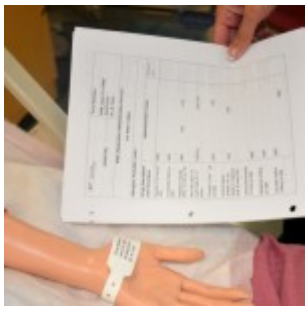
2. Perform the SEVEN RIGHTS x 3 (must be done with each individual medication):

- The right patient
- The right medication (drug)
- The right dose
- The right route
- The right time
- The right reason
- The right documentation

Medication calculation: D/H x S = A

(**D** or desired dosage/**H** or have available x **S** or stock = **A** or amount prepared)

The right patient: check that you have the correct patient using two patient identifiers (e.g., name and date of birth).



Compare MAR with patient wristband

The right medication (drug): check that you have the correct medication and that it is appropriate for the patient in the current context.

The right dose: check that the dose makes sense for the age, size, and condition of the patient. Different dosages may be indicated for different conditions.

The right route: check that the route is appropriate for the patient's current condition.

The right time: adhere to the prescribed dose and schedule.

The right reason: check that the patient is receiving the medication for the appropriate reason.

The right documentation: always verify any unclear or inaccurate documentation prior to administering medications.

Check the right patient, medication, dose, route, time, reason, documentation

NEVER document that you have given a medication until you have actually administered it.

3. The label on the medication must be checked for name, dose, and route, and compared with the MAR at three different times: 1. When the medication is taken out of the drawer 2. When the medication is being poured 3. When the medication is being put away/or at bedside	 *Perform seven checks three times before administering medication* These checks are done before administering the medication to your patient. If taking drug to bedside (e.g., eye drops), do third check at bedside.
4. Apply non-sterile gloves unless skin is broken; then apply sterile gloves.	Using gloves protects health care provider from contact with medication.  *Apply non-sterile gloves* If skin is broken, sterile gloves will prevent the spread of microorganisms.
5. Wash, rinse, and dry the affected area with water and a clean cloth.	This removes previous topical medications.
6. If skin is very dry and flaking, apply topical medication while skin is still damp.	Applying while skin is damp helps to retain moisture within skin layers.

7. Change gloves, performing hand hygiene in between.	Use sterile gloves for open skin lesions to prevent spread of microorganisms.  *Apply sterile gloves if patient has open lesions*
8. Place required amount of medication in palm of hands and soften by rubbing palms together.	Softening makes topical medication easier to spread.  *Rub medication in hands to soften and warm*
9. Let patient know that initial application may feel cold. Apply medication using long even strokes that follow the direction of the hair. Do not rub vigorously.	This prevents irritation of hair follicles.
10. Let patient know that skin may feel greasy after application.	Some topical medications contain oils.
11. Document as per agency policy, making sure to include site of administration on the MAR.	Accurate and timely documentation improves patient safety.
12. Perform hand hygiene.	This step prevents the transfer of microorganisms.  *Hand hygiene with ABHR*
Data source: BCIT, 2015; Lilley et al., 2011; Perry et al., 2014	

Checklist 55 lists the steps for applying medicinal powder topically.

CHECKLIST 55: APPLYING TOPICAL POWDER

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Check allergy band for any allergies.
- Complete necessary focused assessments and/or vital signs, and document on MAR.
- Provide patient education as necessary.
- Plan medication administration to avoid disruption:
  - Dispense medication in a quiet area.
  - Avoid conversation with others.
  - Follow agency's no-interruption zone policy.
  - Prepare medications for ONE patient at a time.
  - Follow the SEVEN RIGHTS of medication administration.

STEPS	ADDITIONAL INFORMATION
1. Check MAR against doctor's orders.	Check that MAR and doctor's orders are consistent.  *Compare physician orders and MAR* Night staff usually complete and verify this check as well.

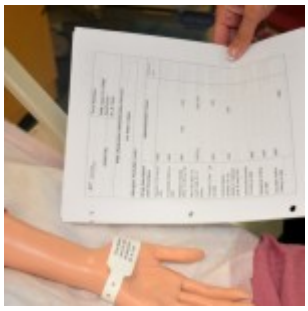
2. Perform the SEVEN RIGHTS x 3 (must be done with each individual medication):

- The right patient
- The right medication (drug)
- The right dose
- The right route
- The right time
- The right reason
- The right documentation

Medication calculation: D/H x S = A

(**D** or desired dosage/**H** or have available x **S** or stock = **A** or amount prepared)

The right patient: check that you have the correct patient using two patient identifiers (e.g., name and date of birth).



Compare MAR with patient wristband

The right medication (drug): check that you have the correct medication and that it is appropriate for the patient in the current context.

The right dose: check that the dose makes sense for the age, size, and condition of the patient. Different dosages may be indicated for different conditions.

The right route: check that the route is appropriate for the patient's current condition.

The right time: adhere to the prescribed dose and schedule.

The right reason: check that the patient is receiving the medication for the appropriate reason.

The right documentation: always verify any unclear or inaccurate documentation prior to administering medications.

Check the right patient, medication, dose, route, time, reason, documentation

NEVER document that you have given a medication until you have actually administered it.

3. The label on the medication must be checked for name, dose, and route, and compared with the MAR at three different times: 1. When the medication is taken out of the drawer 2. When the medication is being poured 3. When the medication is being put away/or at bedside	 *Perform seven checks three times before administering medication* These checks are done before administering the medication to your patient. If taking drug to bedside (e.g., eye drops), do third check at bedside.
4. Ensure that skin is completely dry and clean before application.	This minimizes potential for powder to cake and crust.
5. If application is near patient's face, ask patient to turn away from powder or briefly cover face with a clean towel.	This prevents patient from inhaling powder.
6. Dust skin with a light layer of powder.	Too thick a layer of powder will congeal and crust.
7. If ordered, cover the affected site with the prescribed dressing.	Covering site prevents soiling of patient's clothes and linens.
8. Document as per agency policy, making sure to include site of administration on the MAR.	Accurate and timely documentation improves patient safety.
9. Perform hand hygiene.	Prevents transfer of microorganisms.  *Hand hygiene with ABHR*
Data source: BCIT, 2015; Lilley et al., 2011; Perry et al., 2014	

Critical Thinking Exercises

1. Your patient's MAR states that their Nitro-Patch should be removed at night. Please explain why this is considered safe practice.
2. Discuss the steps you would take to administer a lotion for a patient with a rash that has several open lesions.
3. Discuss why it is necessary to ensure that your patient's skin is clean and dry prior to applying a prescribed topical powder.

6.8 Summary

Nurses play an essential role in medical reconciliation; preparing, administering, monitoring, evaluating, teaching patients; and documenting responses to medications. Medication administration requires good decision-making skills and clinical judgment, and the nurse is responsible for ensuring full understanding of medication administration and its implications for patient safety.

This chapter discusses guidelines to follow for mitigating medication errors and adverse drug events (ADEs). Non-parenteral routes of medication administration are discussed, and the steps for following each of these processes safely is outlined.

Key Takeaways

- Safe and accurate medication administration is a key nursing responsibility.
- Medication administration is a complex process that requires the full attention of the nurse to avoid medication errors and adverse drug events.
- Nurses can reduce errors by following guidelines, knowing the types of medication errors that are most likely to occur and strategies for their prevention, and understanding the implications of the medication being given.
- There are several routes for medication administration. Knowing when it is appropriate to use each route, and knowing the process for medication administration via that route, will help to mitigate medication errors.
- The seven rights and three checks provide a process for safe drug administration and are a collaborative effort of the nurse, the pharmacist, and the physician.
- Accurate and timely documentation of medication administration and the effect of the medication on the patient is an important responsibility of the nurse and promotes patient safety.
- Patient education is an extremely important factor in medication adherence and proper self-administration and is an important nursing responsibility.

SUGGESTED ONLINE RESOURCES

1. Canadian Patient Safety Institute (CPSI): Medication safety. This resource explains how to reduce adverse drug events by following the medication reconciliation process.
2. Centers for Disease Control and Prevention: Medication safety basics. This website outlines medication safety basics and provides several medication safety fact sheets.
3. Institute for Safe Medication Practices Canada (ISMP). This is the website for an independent national not-for-profit organization committed to the advancement of medication

safety in all health care settings.

4. Institute for Safe Medication Practices Canada (ISMP): Medication reconciliation. This website provides a definition of medication reconciliation and resources to complete the medication reconciliation process to ensure safe and effective communication for all health care providers regarding use of all medications.

REFERENCES

Agency for Healthcare Research and Quality. (2014). Checklists. Retrieved on June 11, 2015, from http://psnet.ahrq.gov/primer.aspx?primerID=14

Agrawal, A. (2009). Medication errors: Prevention using information technology systems. *Br J Clin Pharmacol*, 67(6), 681.

British Columbia Institute of Technology (BCIT). (2015). NURS 1020: Clinical techniques. Vancouver: British Columbia Institute of Technology (BCIT).

Butt, A.R. (2010). Medical error in Canada. Issues related to reporting medical error and methods to increase reporting. *McMasters Univserity Medical Journal*, Clinical Review, 7(1). 15 – 8. Retrieved on June 3, 2015 from http://www.mumj.org/Issues/v7_2010/articles/16.pdf

Canadian Patient Safety Institute. (2012). Canadian incident analysis framework. Retrieved on Nov 14, 2015, from http://www.patientsafetyinstitute.ca/en/toolsResources/IncidentAnalysis/Documents/Canadian%20Incident%20Analysis%20Framework.PDF#search=canadian%20analysis%20incident%20framework

Centers for Disease Control. (2013). Infection control. Retrieved on June 11, 2015, from http://www.cdc.gov/oralhealth/infectioncontrol/faq/protective_equipment.htm

Debono, D. S., Greenfield, D., Travaglia, J. F., Long, J. C., Black, D., Johnson, J., & Braithwaite, J. (2013). Nurses' workarounds in acute healthcare settings: A scoping review. *BMC Health Services Research*, 13, 175. doi:10.1186/1472-6963-13-175

Institute for Healthcare Improvement. (2015). High alert medication safety. Retrieved on June 11, 2015, from http://www.ihi.org/topics/highalertmedicationsafety/pages/default.aspx

Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (eds). (2000). *To err is human: Building a safer health system*. Washington, DC: National Academy Press. Retrieved from http://www.iom.edu/~/media/Files/Report%20Files/1999/To-Err-is-Human/To%20Err%20is%20Human%201999%20%20report%20brief.pdf

Lilley, L. L., Harrington, S., Snyder, J. S., & Swart, B. (2011). *Pharmacology for Canadian health care practice* (2nd ed.). Toronto, ON: Elsevier Canada.

Lowry, M. (2016). Rectal drug administration in adults: How, when, why. *Nursing Times*, 112(8), 12-14. Retrieved from https://www.nursingtimes.net/clinical-archive/neurology/rectal-drug-administration-in-adults-how-when-why/7002595.article

Lynn, P. (2011). *Photo atlas of medication administration* (4th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

National Patient Safety Agency. (2009). Safety in doses. Improving the use of medication in NHS. Retrieved on June 11, 2015, from http://www.nrls.npsa.nhs.uk/resources/?entryid45=61625

National Priority Partnership. (2010). Preventing medical errors: A $21 billion opportunity. Retrieved on June 3, 2015, from http://psnet.ahrq.gov/resource.aspx?resourceID=20529

Perry, A., Potter, P., & Ostendorf, W. (2014). *Clinical skills and nursing techniques* (8th ed.). St Louis, MO: Elsevier-Mosby.

Poon, E. G. et al. (2010). Effect of bar-code technology on the safety of medication administration. *N Engl J Med.*, 362, 1698.

Prakash, V., Koczmara, C., Saveage, P., Trip, K., Stewart, J., Mccurdie, T., Cafazzo, J., & Trbovich, P. (2014). Mitigating errors caused by interruptions during medication verification and administration: Interventions in a simulated ambulatory chemotherapy setting. *BMJ Quality and Safety*, 0 (1 – 10). doi:10.1136/bmjqs-2013-002484

The Joint Commission (TJC). (2012). *National patient safety goals.* Oakbrook Terrace, IL: The Commission. Retrieved on June 3, 2015, from http://www.jointcommission.org/standards_information/npsgs.aspx

Vancouver Coastal Health. (2014). Course catalogue registration system. Retrieved from Medication Reconciliation: Top Ten Tips, https://bcpsqc.ca//documents/2012/09/Top-10-Tips-for-Interviewing-Patients.pdf

Chapter 7. Parenteral Medication Administration

7.1 Introduction

Parenteral medications are medications administered directly into body tissue or the circulatory system (according to Merriam-Webster, “parenteral” is a term taken from the Greeks meaning “to avoid the intestines”). They are synonymous with “injectables,” as syringes and needles are used to administer these medications by subcutaneous, intradermal, intramuscular, and intravenous routes. Injections are a direct and reliable way to deliver medication for fast absorption. However, parenteral medications pose a greater risk of harm and adverse reactions than nonparenteral medications. Parenteral medications require special equipment and a specific skill set to ensure that the medication is prepared correctly to have the right therapeutic effect, and to avoid complications (Perry, Potter, & Ostendorf, 2014).

Learning Objectives

- Describe the advantages and disadvantages of injecting medications by each parenteral route
- Explain how to safely administer parenteral medication, prevent needle-stick injuries, prevent infection, and minimize patient discomfort during an injection
- Discuss factors related to equipment and selection of injection site for each parenteral route
- Describe how to correctly administer intradermal, subcutaneous, and intramuscular injections
- Review how to administer an intravenous medication via the direct IV route (bolus) and by a piggyback infusion through a continuous IV line and a saline lock
- Describe how to manage adverse reactions to IV medications
- Explain the complications associated with intravenous medications
- Summarize how to manage and report medication errors in the health care setting

7.2 Parenteral Medications and Preparing Medications from Ampules and Vials

Parenteral refers to the path by which medication comes in contact with the body. **Parenteral medications** enter the body by injection through the tissue and circulatory system. Injection medications are absorbed more quickly and are used with patients who are nauseated, vomiting, restricted from taking oral fluids, or unable to swallow. Parenteral medications can be effective and safe when prepared and administered correctly. However, because they are invasive and absorbed readily and quickly into the body, there are numerous risks associated with administering them (Perry et al., 2014).

There are four routes for parenteral medications (also see Figure 7.1). Each type of injection requires a specific skill set to ensure the medication is prepared properly and administered into the correct location (Perry et al., 2014). The four types of injections are:

1. **Subcutaneous (SC):** This injection places medication/solution the loose connective tissue just under the dermis.
2. **Intradermal (ID):** This injection places the medication into the dermis just under the epidermis.
3. **Intramuscular (IM):** This injection places the medication into the body of a muscle.
4. **Intravenous (IV):** This injection places the medication/solution into a vein through an existing IV line or a short venous access device (saline lock). Medications given by the intravenous route can be given as an IV bolus, as an intermittent (piggyback) medication, or in a large volume continuous infusion.

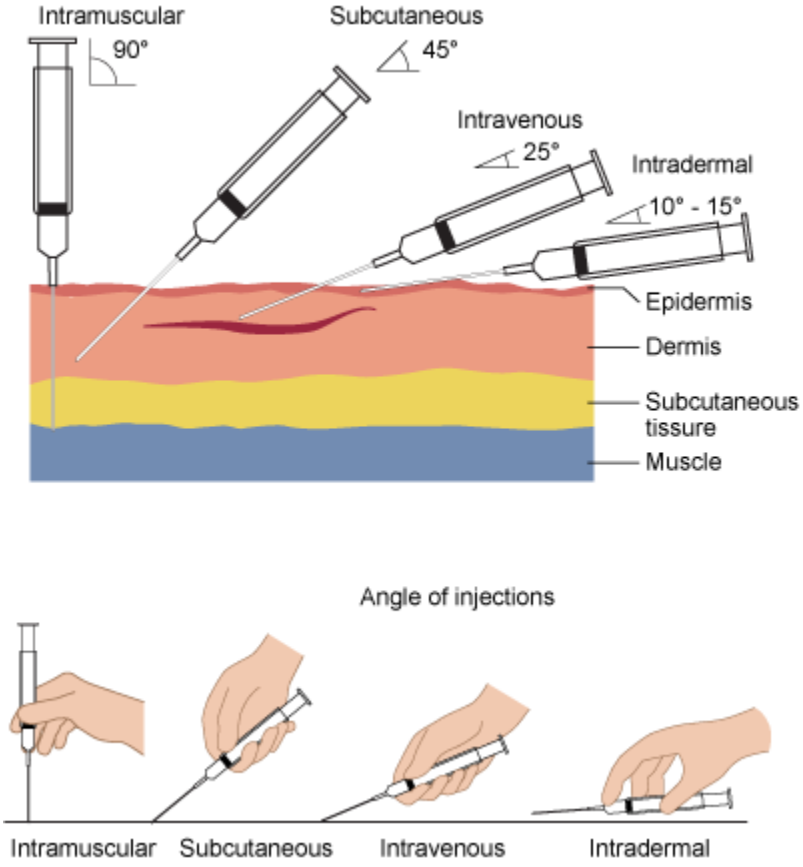


Figure 7.1: Insertion angles

To administer parenteral medications safely, it is imperative to understand how to prevent an infection, prevent medication errors, prevent a needle-stick injury, and prevent discomfort to the patient. Tables 7.1 to 7.4 address specific practices to eliminate safety hazards to patients and health care workers.

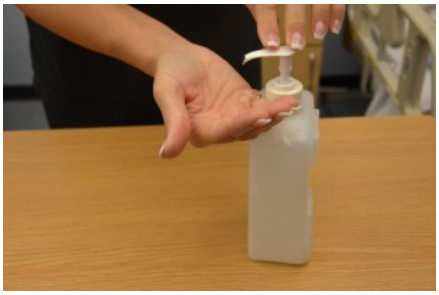
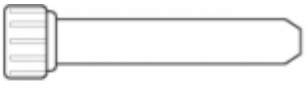
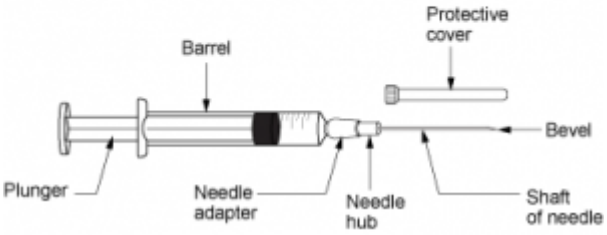
PREVENTING INFECTION DURING AN INJECTION

According to Seigel et al, (2007), research has shown that unsafe injection practices have resulted in patient exposure to infections leading to outbreaks of infectious diseases. These unnecessary exposures were the result of deficient health care practices. Injectable medications must be given in a safe manner to maintain sterility of equipment and prevent the transmission of infectious diseases between patients and health care workers. Table 7.1 summarizes how to prevent an infection during an injection.

Table 7.1 Preventing Infection During an Injection

Safety consideration:

- Always follow the principles of sterile technique when preparing injections.

PRINCIPLE	ADDITIONAL INFORMATION
Perform hand hygiene.	Always perform hand hygiene before administration and after removing gloves. For hand hygiene with ABHR, use 1 to 2 pumps of product; this volume requires a minimum of 15 seconds for hands to dry.  *Hand hygiene with ABHR*
Prevent needle/syringe contamination.	Keep sterile parts of the needle and syringe sterile. Avoid letting the needle touch unsterile surfaces such as the outer edges of the ampule or vial, surface of the needle cap, or counter. Always keep the needle covered with a cap when not in use, and use the scoop-cap method to avoid needle-stick injuries. Avoid touching the length of the plunger. Keep the tip of the syringe sterile by covering with a cap or needle.  Disposable syringe and needle (parts labelled)  *Parts of a syringe and needle*
Prepare patient's skin.	Wash the patient's skin with soap and water when it is soiled with dirt, drainage, or fecal matter/urine. Follow agency policy for skin preparation. When using an alcohol swab, use a circular motion to rub the area for 15 seconds, and then let the area dry for 30 seconds. If cleaning a site, move from the centre of the site outward in a 5 cm (2 in.) radius.
Prevent contamination of solution.	Use single-dose vials/ampules whenever possible. Do not keep multi-dose vials in patient treatment area. Discard if sterility is compromised or questionable. Do not combine and administer medications from single-dose vials or ampules for later use. Ampules should not sit open and should be used immediately, then discarded appropriately.

Use new, sterile sterile equipment with each injection.	Single use syringe and needle must be used with each patient. Always inspect packaging for intactness; inspect for dryness, rips, torn corners and expiry date. If single use equipment is not available, use syringes and needles designed for steam sterilization.
Data source: CDC, 2015; Hutin et al., 2003; Perry et al., 2014; Provincial Infectious Disease Advisory Committee, 2014; Siegel et al., 2007.	

SAFE MEDICATION ADMINISTRATION

Medication errors have a substantial impact on health care in Canada (Butt, 2010). When preparing and administering medication, and assessing patients after receiving medication, always follow agency policy to ensure safe practice. Review Table 7.2 for guidelines for safe medication administration.

Table 7.2 Guidelines for Safe Medication Administration

Safety consideration: • Agency policy on medication administration and on the medication administration record (MAR) may vary. Always receive the required training on the use of each agency's medication system to avoid preventable errors.	
PRINCIPLE	ADDITIONAL INFORMATION
Be vigilant when preparing medications.	Avoid distractions. Some agencies have a no-interruption zone (NIZ), where health care providers can prepare medications without interruptions.
Check for allergies.	Always ask patient about allergies, types of reactions, and severity of reactions.
Use two patient identifiers at all times. Always follow agency policy for patient identification.	Use at least two patient identifiers before administration AND compare against the medication administration record (MAR).
Assessment comes before medication administration.	All medications require an assessment (review of lab values, pain, respiratory or cardiac assessment, etc.) prior to medication administration to ensure the patient is receiving the correct medication for the correct reason.
Be diligent in all medication calculations.	Errors in medication calculations have contributed to dosage errors, especially when adjusting or titrating dosages.
Avoid reliance on memory; use checklists and memory aids.	Slips in memory are caused by lack of attention, fatigue, and distractions. Mistakes are often referred to as attentional behaviours, and they account for most errors in health care. If possible, follow a standard list of steps for every patient.
Communicate with your patient before and after administration.	Provide information to patient about the medication before administering it. Answer questions regarding usage, dose, and special considerations. Give the patient the opportunity to ask questions. Include family members if appropriate.
Avoid workarounds.	A workaround is a process that bypasses a procedure, policy, or problem in a system. For example, nurses may "borrow" a medication from another patient while waiting for an order to be filled by the pharmacy. These workarounds fail to follow agency policies that ensure safe medication practices.
Ensure medication has not expired.	Medication may be inactive if expired.
Always clarify an order or procedure that is unclear.	Always ask for help whenever you are uncertain or unclear about an order. Consult with the pharmacist, charge nurse, or other health care providers and be sure to resolve all questions before proceeding with medication administration.

Use available technology to administer medications.	Bar-code scanning (eMAR) has decreased errors in administration by 51%, and computerized physician orders have decreased errors by 81%. Technology has the potential to help decrease errors. Use technology when administering medications, but be aware of technology-induced errors.
Report all near misses, errors, and adverse reactions.	Reporting allows for analysis and identification of potential errors, which can lead to improvements and sharing of information for safer patient care.
Be alert to error-prone situations and high-alert medications.	High-alert medications are those that are most likely to cause significant harm, even when used as intended. The most common high-alert medications are anticoagulants, narcotics and opiates, insulins, and sedatives. The types of harm most commonly associated with these medications include hypotension, respiratory depression, delirium, bleeding, hypoglycemia, bradycardia, and lethargy.
If a patient questions or expresses concern regarding a medication, stop and do not administer it.	If a patient questions a medication, stop and explore the patient's concerns, review the physician's order, and, if necessary, notify the practitioner in charge of the patient.
Data source: Agency for Healthcare Research and Quality, 2014; Canadian Patient Safety Institute, 2012; Debono et al., 2013; Institute for Healthcare Improvement, 2015; National Patient Safety Agency, 2009; National Priority Partnership, 2010; Prakash, et al., 2014	

PROMOTING SAFETY AND COMFORT OF A PATIENT DURING AN INJECTION

Injections can be given safely and effectively, and harm can be prevented if proper injection technique is used. Most complications related to injections are associated with intramuscular injections, but may occur with any route. Complications can occur when an incorrect site is used, or with an inappropriate depth or rate of injection (Malkin, 2008). To promote patient safety and comfort during an injection, review the guidelines in Table 7.3.

Table 7.3 Promoting Patient Safety and Comfort During an Injection

Principle	Additional Information
Correct needle	For injections, use a sharp, beveled needle and place bevel side up. Change the needle if liquid coats the shaft of the needle. Correct needle length allows for correct delivery of medication into the correct site and can reduce complications such as abscesses, pain, and bruising. Needle selection should be based on size of patient, gender, injection site, and amount of medication injected. Women tend to have more adipose tissue around the buttocks and deltoid fat pad, which means more than half the injections given do not reach the proper IM depths in women. Large bore needles have been found to reduce pain, swelling, and redness after an injection, as less pressure is required to depress the plunger.
Proper angle of insertion and removal (see Figure 7.1)	Inserting the needle at the proper angle (depending on the type of injection) and entering the skin smoothly and quickly can reduce pain during injection. Hold the syringe steady once the needle is in the tissue to prevent tissue damage. Withdraw the needle at the same angle used for insertion. The angle for an IM injection is 90 degrees. With all injections, the needle should be inserted all the way up to the hub. Holding the syringe like a dart prevents the medication from being injected during insertion of needle. Removing residue (medication on the tip of the needle) has been shown to reduce pain and discomfort. To remove residue from the needle, change needles after preparation and before administration.
Patient position	The patient's position may affect their perception of pain. Proper position will also facilitate proper landmarking of the site. For IM injections, for example, the ventrogluteal site has the greatest muscle thickness and is free of nerves and blood vessels, with a small layer of fat.
Relaxation technique and distraction methods	Position the patient's limbs in a relaxed, comfortable position to reduce muscle tension. For example, lying prone may help a patient relax prior to an IM injection. If giving a deltoid IM injection, have the patient relax the arm by placing the hand in the lap. If a patient is receiving an IM injection in the vastus lateralis or ventrogluteal site, encourage the patient to gently point toes outwards to relax the muscle. Relaxation skills of the health care provider will help decrease the patient's anxiety-heightened pain. If possible, divert the patient's attention away from the injection procedure.
Pre-medication, if required	To decrease pain upon insertion, a vapocoolant spray, topical anesthetic, or wrapped ice may be placed on the insertion site for a minute prior to injection. For IM injections, two studies found that applying pressure to the injection site for 10 seconds before the injection reduced pain. This data supports the gate theory of pain control.
Z-track method for IM injections	Some research shows that the Z-track technique results in reduced pain and complications, and fewer injection lesions. However, other research shows that Z-track injections result in more pain and bleeding at the injection site. (See 7.4 Intramuscular Injections for more on the Z-track method.)
Administration rate	Research has found that administrating medications at 10 seconds per ml is an effective rate for IM injections. Increasing the rate to 20 seconds per ml did not show any reduction in pain. Always review drug administration rate as per pharmacy or manufacturer's recommendations.
Gentle touch with insertion sites	Gently apply a dry sterile gauze to the site after the injection. Rotate injection sites to prevent the development of indurations and abscesses.
Aspiration with IM injections	Review the latest research regarding the utility of aspirating IM injections. There is lack of strong evidence to support the technique of aspiration with IM injections.

Data source: Ağac & Günes, 2011; Canadian Agency for Drugs and Technologies in Health, 2014; Cocoman & Murray, 2008; Greenway, 2014; Hunter, 2008; Malkin, 2008; Mitchell & Whitney, 2001; Nisbit, 2006; Ogston-Tuck, 2014a; Perry et al., 2014; Rodgers & King, 2000; Sisson, 2015; Workman, 1999

PREVENTING NEEDLE-STICK INJURIES

Health care providers can be at risk for needle-stick injuries in any health care setting. The most common places for needle-stick injuries to occur are in the operating room and patient rooms. Tasks that place the health care provider at risk include recapping needles and mishandling IV lines. Table 7.4 provides guidelines to prevent needle-stick injuries.

Table 7.4 Recommendations for Prevention of Needle-Stick Injuries

Principle	Additional Information
Avoid recapping needles.	Recapping needles has led to the transmission of infection. If possible, always use devices with safety features — i.e., safety shield.
Dispose of the needle immediately after injection.	Immediately dispose of used needles in a sharps disposal container (puncture-proof and leak-proof) to avoid unsafe disposal of a sharp.
Reduce or eliminate all hazards related to needles.	Avoid using needles if possible. Use a needle only when performing an SC, ID, or IM injection. Use a needleless system and engineered safety devices for prevention of needle-stick injuries.
Plan disposal of sharps before injection.	Plan the safe handling and disposal of needles before beginning a procedure that requires a sharp needle. Bring sharps container close to the bedside prior to injection. Sharps containers should be at eye level and within arm's reach.
Follow all standard policies related to prevention / treatment of injury.	Follow all agency policies regarding infection control, hand hygiene, standard and additional precautions, and blood and body fluid exposure management.
Report all injuries.	Report all needle-stick injuries and sharp-related injuries immediately. Data collected regarding the nature of injuries help guide needle-stick prevention strategies for new practices and devices. Review how to manage needle-stick injuries and follow agency policy regarding exposure to blood-borne pathogens. Policies help decrease the risk of contracting a blood-borne illness.
Participate in required training and education.	Attend training on injury-prevention strategies related to needles and safety devices as per agency policy. Participate in and evaluate the selection of safety devices, and report known needle-stick hazards to managers.
Data source: American Nurses Association, 2002; Centers for Disease Control, 2012; National Institute for Occupational Safety and Health, 1999; Perry et al., 2014; Pratt et al., 2007; Wilburn, 2004; Wilburn & Eijkemans, 2004	

PREPARING MEDICATIONS FROM AMPULES AND VIALS

Specific equipment, such as syringes and needles, is required to prepare and administer parenteral medications. The selection of the syringe and needle is based on the type and location of injection; amount, quality, and type of medication; and the body size of the patient. Many syringes come with needleless systems or needles with safety shields to prevent injuries (Perry et al., 2014). Aseptic technique is paramount to the preparation and administration of these medications.

Parenteral medications are supplied in sterile vials, ampules, 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 (see Figure 7.2). Medication is withdrawn using a syringe and a filter needle. A blunt fill needle with filter (see Figure 7.3) must be used when withdrawing medication to prevent glass particles from being drawn up into the syringe (see Figure 7.4). Never use a filter needle to inject medication (Perry et al., 2014).

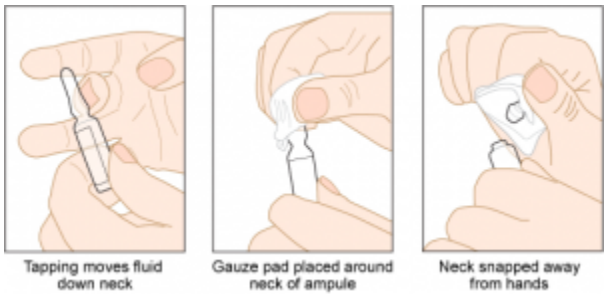


Figure 7.2 Breaking open an ampule

Figure 7.3 Blunt fill needle with filter

Figure 7.4 Using a blunt fill needle with filter with an ampule

Read this information about ampules to review how to prepare medication from an ampule.

VIDEO 7.1

Watch the video *Preparing a Medication from an Ampule* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

A **vial** is a single- or multi-dose plastic container with a rubber seal top, covered by a metal or plastic cap (see Figure 7.5). A single-use vial must be discarded after one use; a multi-dose vial must be labelled with the date it was opened. Check hospital policy to see how long an open vial may be used. The vial is a closed system, and air must be injected into the vial to permit the removal of the solution (Perry et al., 2014) (see Figure 7.6).

Figure 7.5 Preparing medications from a vial

Figure 7.6 Vial with safety needle inserted

Read this information about vials to review how to prepare medication from a vial and reconstitute medication.

VIDEO 7.2

Watch the video *Preparing Medications from a Vial* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

A **syringe** (see Figure 7.7)is a sterile, single-use device that has a Luer lock (see Figure 7.8) or non-Luer lock tip, which influences the name of the syringe. Syringes come in various sizes from 0.5 ml to 60 ml. Syringes may come with or without a sterile needle and will have a safety shield on the needle.

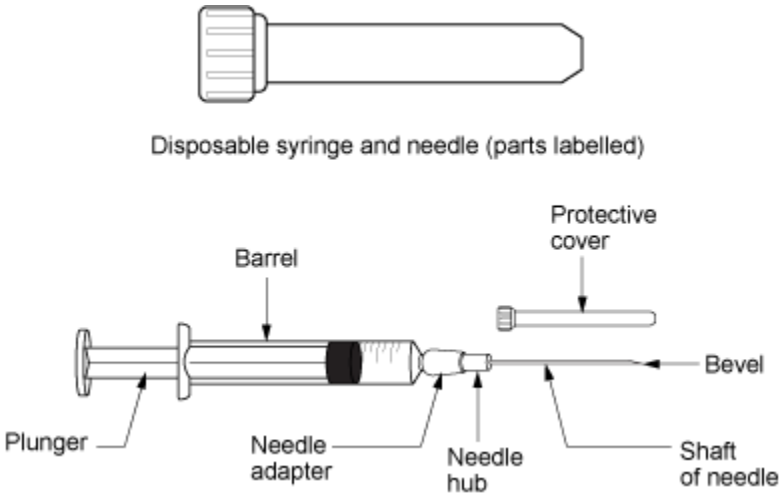


Figure 7.7 Labelled syringe

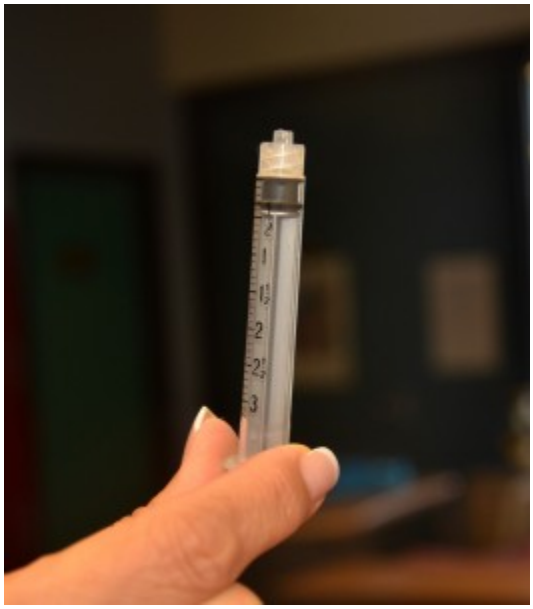


Figure 7.8 Luer lock needle

Insulin is only given using an insulin syringe (see Figure 7.9). Insulin is ordered in units. It is important to use the correct syringe and needle for the specific injection. Always examine the measurement scale on the syringe to determine that you have the correct syringe (Lynn, 2011).

Figure 7.9 Insulin syringe with safety shield

Read this information about syringes to review the different types of syringes.

Needles are made of stainless steel, are sterile and disposable, and come in various lengths and sizes. The needle is made up of the hub, shaft, and bevel. The bevel is the tip of the needle that is slanted to create a slit into the skin. The hub fits onto the tip of the syringe. All three parts must remain sterile at all times. The length of the needle will vary from 1/8 in. to 3 in., depending on the injection. 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). A needle will have its gauge and length marked on the outer packaging; choose the correct gauge and length for the injection ordered (Lynn, 2011) (see Figures 7.10, 7.11, and 7.12).

Read this information about needles to review needles and how to “scoop cap”.

Figure 7.10 Variety of needles with different gauges and lengths

Figure 7.11 Types of needles with safety shields

Figure 7.12 Needle with safety cap

Critical Thinking Exercises

1. What are three strategies that can be implemented to reduce distractions while preparing medication?
2. What are two ways to prevent needle-stick injuries?

7.3 Intradermal and Subcutaneous Injections

Intradermal injections (ID) are injections administered into the dermis, just below the epidermis. The ID injection route has the longest absorption time of all parenteral routes. These types of injections are used for sensitivity tests, such as TB (see Figure 7.13), allergy, and local anesthesia tests. The advantage of these tests is that the body reaction is easy to visualize, and the degree of reaction can be assessed. The most common sites used are the inner surface of the forearm and the upper back, under the scapula. Choose an injection site that is free from lesions, rashes, moles, or scars, which may alter the visual inspection of the test results (Lynn, 2011).

Equipment used for ID injections is a tuberculin syringe calibrated in tenths and hundredths of a millilitre, and a 1/4 to 1/2 in., 26 or 27 gauge needle. The dosage of an ID injection is usually under 0.5 ml. The angle of administration for an ID injection is 5 to 15 degrees. Once the ID injection is completed, a bleb (small blister) should appear under the skin. Checklist 56 outlines the steps to administer an intradermal injection.

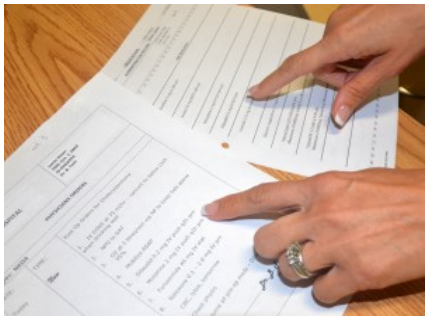
Figure 7.13 TB syringe

Checklist 56: Administering an Intradermal (ID) Injection

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety Considerations:

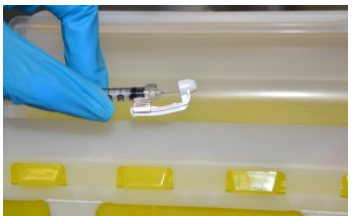
- Do not aspirate. It is not necessary to aspirate because the dermis is relatively without vessels.
- Always take steps to eliminate interruptions and distractions during medication preparation.
- If the patient expresses concerns about the medication or procedure, stop and explore the concerns. Re-verify order with physician if appropriate.

STEPS	ADDITIONAL INFORMATION
1. Prepare medication or solution as per agency policy. Ensure all medication is properly identified. Check physician orders, *Parenteral Drug Therapy Manual* (PDTM), and MAR to validate medication order and guidelines for administration.	Properly identifying medication decreases risk of inadvertently administering the wrong medication. Preparing medications ensures patient safety with medication administration.  *Compare physician orders and MAR*  *Prepare medication from a vial*

2. Perform hand hygiene.	Gather all supplies: medication syringe, non-sterile gloves, alcohol swab and sterile gauze, Band-Aid (if required).  *Required supplies*
3. Enter room and introduce yourself, explain procedure and the medication, and allow patient time to ask questions.	Explaining rationale increases the patient's knowledge and reduces their anxiety.
4. Close the door or pull the bedside curtains.	This provides patient privacy.
5. Compare MAR to patient wristband and verify this is the correct patient using two identifiers.	This ensures accuracy of the medication or solution and prevents errors. Two patient identifiers are patient name and date of birth.  *Compare MAR with patient wristband*
6. Assess patient for any contraindications to the medications.	Assessment is a prerequisite for every medication given.
7. Select appropriate site for administration. Assist the patient to the appropriate position as required.	Site should be free from lesions, rashes, and moles. Selecting the correct site allows for accurate reading of the test site at the appropriate time.  *Assess site for ID injection*

8. Perform hand hygiene and apply non-sterile gloves.	Gloves help prevent exposure to contaminants.  *Apply non-sterile gloves*
9. Clean the site with an alcohol swab or antiseptic swab. Use a firm, circular motion. Allow the site to dry.	Pathogens from the skin can be forced into the tissues by the needle. Allowing the skin to dry prevents introducing alcohol into the tissue, which can be irritating and uncomfortable.  *Clean injection site*
10. Remove needle from cap by pulling it off in a straight motion.	This decreases risk of accidental needle-stick injury.  *Remove needle from cap*
11. Using non-dominant hand, spread the skin taut over the injection site.	Taut skin provides easy entrance for the needle.  *Hold skin taut prior to injection*

12. Hold the syringe in the dominant hand between the thumb and forefinger, with the bevel of the needle up.	This allows for easy handling of the syringe.  *Hold needle with bevel up*
13. Hold syringe at a 5- to 15-degree angle from the site. Place the needle almost flat against the patient's skin, bevel side up, and insert needle into the skin. Insert the needle only about 1/4 in., with the entire bevel under the skin.	Keeping the bevel side up allows for smooth piercing of the skin and induction of the medication into the dermis.  *ID injection*
14. Once syringe is in place, slowly inject the solution while watching for a small weal or bleb to appear.	The presence of the weal or bleb indicates that the medication is in the dermis.  *Presence of a bleb (white raised circle)*

15. Withdraw the needle at the same angle as insertion, engage safety shield or needle guard, and discard in a sharps container. Do not massage area after injection.	Withdrawing at the same angle as insertion minimizes discomfort to the patient and damage to the tissue. Proper needle disposal prevents needle-stick injuries.  *Discard syringe in sharps container* Massaging the area may spread the solution to the underlying subcutaneous tissue. Gently pat with sterile gauze if blood is present.
16. If injection is a TB skin test, circle the area around the injection site to allow for easy identification of site in three days.	 *Draw circle around injection site*
17. Discard remaining supplies, remove gloves, and perform hand hygiene	This prevents the spread of microorganisms.  *Hand hygiene with ABHR*
18. Document the procedure and findings according to agency policy.	Proper documentation helps ensure patient safety. Document time, date, location, and type of medication injected.
19. Evaluate the patient response to injection within appropriate time frame.	The patient will need to be evaluated for therapeutic and adverse effects of the medication or solution.
Data source: ATI, 2015a; Berman & Snyder, 2016; Brookside Associates, 2015a; Clayton, Stock, & Cooper, 2010; Perry et al., 2014	

SUBCUTANEOUS INJECTIONS

Subcutaneous (SC) injections are administered into the adipose tissue layer just below the epidermis and dermis. This tissue has few blood vessels, so drugs administered by this route have a slow, sustained rate of absorption. Sites for SC injections include the outer aspect of the upper arm, the abdomen (from below the costal margin to the iliac crest) within one inch of the belly button, anterior aspects of the thighs, upper back, and upper ventral gluteal area (Lynn, 2011) (see Figure 7.14).

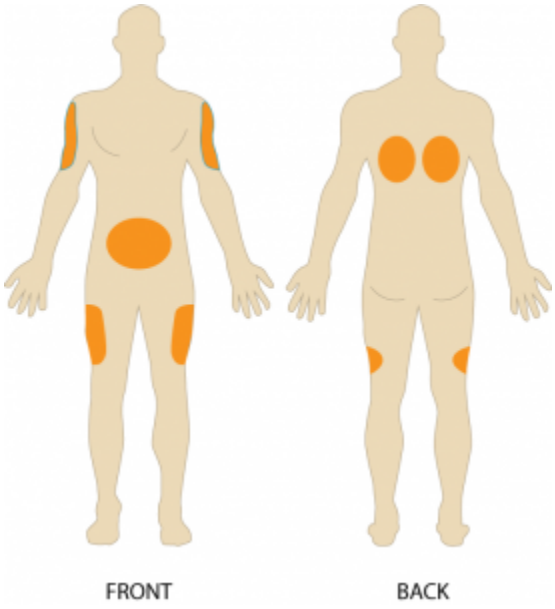


Figure 7.14 SC injection sites

Choose a site that is free of skin lesions and bony prominences. Site rotation prevents the formation of lipohypertrophy or lipoatrophy in the skin. Physical exercise or application of hot or cold compresses influences the rate of drug absorption by altering local blood flow to the tissues. Any condition that impairs that blood flow to the subcutaneous tissue contradicts the use of subcutaneous injections. Examples of subcutaneous medications include insulin, opioids, heparin, epinephrine, and allergy medication (Perry et al., 2014).

To administer an SC injection, a 25 to 30 gauge, 3/8 in. to 5/8 in. needle is used. Some subcutaneous injections come prefilled with the syringe attached. Always confirm that the right-size needle is appropriate for the patient before use. Subcutaneous injections are usually given at a 45- to 90-degree angle. The angle is based on the amount of subcutaneous tissue present. Generally, give shorter needles at a 90-degree angle and longer needles at a 45-degree angle (Lynn, 2011). SC injections do not need to be aspirated as the likelihood of injecting into a blood vessel is small. Usually, no more than 1 ml of medication is given subcutaneously, as larger amounts may cause discomfort to the patient and may not be absorbed appropriately (Lynn, 2011).

There are varying opinions on whether to pinch the skin during administration. Pinching is advised for thinner patients in order to lift the adipose tissue up and away from the underlying muscle and tissue. If pinching is used, release the pinch when the needle is inserted to avoid injecting into compressed tissue. Note, too, that elevating or pinching the skin has been found to increase the risk of injury, as the needle may pierce the opposite side of the skin fold and enter the skin of the health care worker (Black,

2013). The abdomen is the best location for an SC injection if a patient has little peripheral SC tissue. If patient is obese, use a needle that is long enough to insert through the tissue at the base of the skin fold (Perry et al., 2014).

INSULIN SC INJECTIONS

Insulin is considered a high-risk medication, and special care must be taken to ensure the correct amount of medication and type of insulin is administered at the correct time. As well, safety checks related to a patient receiving SC insulin should be carried out (Ellis & Parush, 2012). Table 7.5 lists specific guidelines for administering insulin (and see Figure 7.15).

Table 7.5 Guidelines for Administering SC Insulin

Insulin	Additional Information
Insulin is considered a high-risk medication.	Special care must be taken to ensure the correct amount of medication and type of insulin is administered, at the correct time. It is highly recommended to always get your insulin dosages double-checked by another health care provider. Always follow the standard for medication preparation at your agency.
Insulin is only administered using an insulin syringe.	Insulin is the only drug with its own type of syringe with a needle attached. Insulin is always ordered and administered in units, based on a blood sugar reading and a diabetic insulin protocol (or sliding scale). Some hospitals have preprinted physician orders, and some hospitals have handwritten orders. Insulin syringes can come in 30-, 50-, or 100-unit measurements. Always read the increments (calibration) carefully.
There are different types of insulin.	There are rapid-, short-, intermediate-, and long-acting insulins. For each type of insulin, it is important to know how the insulin works and the onset, peak, and duration of the insulin.
Administering two different types of Insulin.	If a patient is ordered two types of insulin, some insulins may be mixed together in one syringe. Many insulins MAY NOT be mixed together. Do not mix Lantus (Glargine) or Levemir (Determir).If administering cloudy insulin preparations (Humulin – N), gently roll the vial between the palms of your hands to re-suspend the medication. Always draw up the short acting insulin first, to prevent it from being contaminated with the long acting. If too much insulin is drawn up from the second vial, discard syringe and start again. Always check with the PDTM for the most current guidelines regarding insulin administration.Insulin orders may change from day to day. Always ensure the most current physician orders are being followed.
Know about rotating injection sites.	Injection site rotation is no longer necessary as newer insulins have a lower risk for hypertrophy of the skin. Typically, a patient will pick one anatomic area (e.g., upper arm) and rotate the injection sites within that region to maintain consistent insulin absorption from day to day. Insulin absorption rates vary from site to site. The abdomen absorbs the fastest, followed by the arms, thighs, and buttocks.
Know when to administer insulin.	The timing of insulin injections is critical to correct insulin administration based on blood sugar levels and when the patient will eat. Knowing the peak action and duration of insulin is critical to proper insulin medication management. If giving insulin, always ensure the patient is not nauseated, is able to eat, and that food is arriving before the insulin starts working. Typically, short- or rapid-acting insulin is given 15 minutes before meals. Intermediate- or long-acting insulin may be given twice daily, at breakfast and dinner.
Measure blood sugar levels and food intake.	Insulin injections are based on blood sugar values and on when the patient will eat. The timing of an insulin injection is critical to ensure the patient receives insulin correctly.

Use insulin injection pens.	**Injection pens** are a new technology used by patients to self-inject insulin using a syringe, needle, and prefilled cartridge of insulin. It is essential that patients be taught how to use injection pens so they understand the technology. A **mini-infusion pump** is a battery-operated machine that delivers medications in very small amounts to patients with controlled infusion times. The most common types of mini-infusion sets are insulin pumps or subcutaneous infusion devices. For more information on mini-infusion sets and volume-controlled sets, see Suggested Online Resources in section 7.8.
Data source: Canadian Diabetes Association, 2013; Perry et al., 2014	

Figure 7.15 Insulin syringe with needle attached

Special considerations:

- Insulin is stored in the refrigerator. When a vial is in use, it should be at room temperature. Do not administer cold insulin. Check agency policy for how long a vial can be used.
- Patients who take insulin should monitor their blood sugar (glucose) levels as prescribed by their health care provider.
- Vials of insulin should be inspected prior to use. Any change in appearance may indicate a change in potency.
- Use the type of insulin prescribed. Do not change the type unless ordered by a health care provider.
- Allow patient to choose site for injection. A patient may self-administer insulin if it's determined to be safe and in the patient's best interest.
- All health care providers should be aware of the signs and symptoms of hypoglycemia. Signs and symptoms include fruity breath, restlessness, agitation, confusion, slurring of words, clammy skin, inability to concentrate or follow commands, hunger, and nausea. The patient may complain of blurred or double vision. Late signs include unconsciousness. Hypoglycemia is a medical emergency. Always have an emergency diabetic kit available. If a

conscious diabetic patient appears to be hypoglycemic or has a blood sugar (glucose) reading of 4 mmol/L or lower, give glucose, such as sucrose tablets, solution, or juice. Follow agency policy regarding hypoglycemic reactions.

HEPARIN SC INJECTIONS

Heparin is an anticoagulant used to reduce the risk of thrombosis formation by suppressing clot formation (Perry et al., 2014). Heparin is also considered a high-alert medication (ISMP, 2014).

Table 7.6 provides specific guidelines to consider before and after administering heparin.

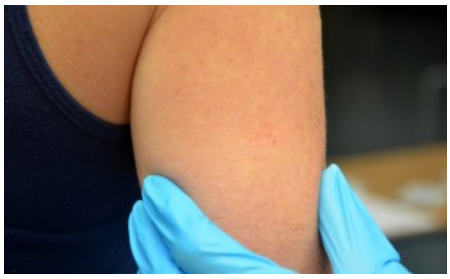
Table 7.6 Guidelines for Administering SC Heparin

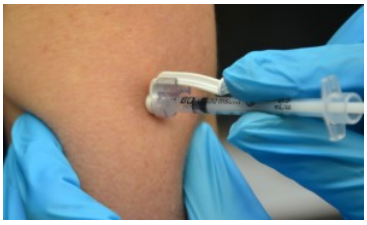
Heparin	Additional Information
Heparin is considered a high-risk medication.	Heparin is available in vials and prefilled syringes in a variety of concentrations. Because of the dangerous adverse effects of the medication, it is considered a high-risk medication. Always follow agency policy regarding the preparation and administration of heparin.
Rotate heparin injection sites.	It is important to rotate heparin sites to avoid bruising in one location. To minimize bruising and pain associated with heparin injections, they can be given in the abdominal area, at least 5 cm away from the belly button.
Know the risks associated with heparin.	There are many risks associated with the administration of heparin, including bleeding, hematuria, hematemesis, bleeding gums, and melena.
Review lab values.	Review lab values (PTT and aPTT) before and after heparin administration.
Use prepackaged heparin syringes.	Many agencies use prepackaged heparin syringes. Always follow the standards for safe medication administration when using prefilled syringes. Low molecular weight heparin (LMWH) is more effective in some patients.
Assess patient conditions prior to administration.	Some conditions increase the risk for hemorrhage (bleeding), such as recent childbirth, severe diabetes, severe kidney and liver disease, severe traumas, cerebral or aortic aneurysm, cerebral vascular accidents (CVA), blood dyscrasias, and severe hypotension.
Assess medications prior to administration.	Over-the-counter (OTC) herbal medications, such as garlic, ginger, and horse chestnut, may interact with heparin. Additional medications that may interact include Aspirin, NSAIDS, cephalosporins, anti-thyroid agents, thrombolytics, and probenecids.
Data source: Clayton et al., 2010; Ogston-Tuck, 2014b; Perry et al., 2014	

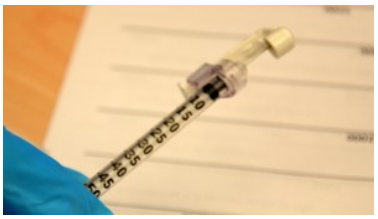
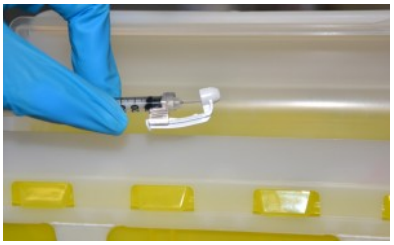
Checklist 57 provides the steps to complete a subcutaneous injection.

Checklist 57: Administering a Subcutaneous Injections

Disclaimer: Always review and follow your hospital policy regarding this specific skill.	
Safety Considerations: • Do not aspirate (pull back on the plunger) after injection. • Review lab values and assessment data prior to injection. • Avoid sites that are bruised, tender, hard, or swollen. • Be vigilant when preparing and administering high-alert medications.	
STEPS	ADDITIONAL INFORMATION
1. Prepare medication or solution as per agency policy. Always compare the physician orders with the MAR.	Preparing medications ensures patient safety with medication administration.  *Prepare medication*
2. Perform hand hygiene; gather supplies.	You will need medication syringe, non-sterile gloves, alcohol swab and sterile gauze, Band-Aid.
3. Enter room and introduce yourself. Identify patient using two acceptable identifiers, explain procedure and the medication, and allow patient time to ask questions.	Explaining rationale increases the patient's knowledge and reduces their anxiety.
4. Close the door or pull the bedside curtains.	This provides patient privacy.
5. Compare MAR to patient wristband and verify this is the correct patient using two identifiers.	This ensures accuracy of the medication or solution and prevents errors.  *Compare MAR with patient wristband*

6. Assess patient for any contraindications for the medications.	Assessment is a prerequisite to the administration of medications.
7. Put on non-sterile gloves.	Gloves help prevent exposure to contaminants.  *Apply non-sterile gloves*
8. Select appropriate site for administration. Assist the patient to the appropriate position as required.	Site should be free from lesions, rashes, and moles. Choosing the correct site allows for accurate reading of the test site at the appropriate time.  *SC site for injection (back of upper arm)*
9. Clean the site with an alcohol swab or antiseptic swab. Use a firm, circular motion. Allow the site to dry.	Pathogens from the skin can be forced into the tissues by the needle. Allowing the skin to dry prevents introducing alcohol into the tissue, which can be irritating and uncomfortable.  *Clean site with alcohol swab*
10. Remove the needle cap with the non-dominant hand, pulling it straight off.	This technique lessens the risk of an accidental needle-stick injury.

11. Grasp or pinch the area surrounding the injection site, or spread the skin taut at the site.	The decision to create a skin fold is based on the nurse's assessment of the patient and the needle length used. Pinching is advised for thinner patients.  *Select SC site (back of upper arm)*
12. Hold the syringe in the dominant hand between the thumb and forefinger. Insert the needle quickly at a 45- to 90-degree angle.	Inserting quickly causes less pain to the patient. Subcutaneous tissue is abundant in well-nourished, well-hydrated people. For patients with little subcutaneous tissue, it is best to insert the needle at a 45-degree angle.
13. After the needle is in place, release the tissue. Move your non-dominant hand to steady and lower the end of the needle. With your dominant hand, inject the medication at a rate of 10 seconds per ml. Avoid moving the syringe.	Keeping the needle steady helps keep the needle in place.  *SC injection*  *Inject medication*
14. Withdraw the needle quickly at the same angle at which it was inserted, while supporting the surrounding tissue with your non-dominant hand.	Withdrawing at the same angle prevents tissue damage and increased pain at the injection site.
15. Using a sterile gauze, apply gentle pressure at the site after the needle is withdrawn. Do not massage the site.	Massage is not necessary and can damage underlying tissue. Massaging after a heparin injection can contribute to the formation of a hematoma.

16. Do not recap the needle. Apply the safety shield or needle guard on needle and dispose in a sharps container.	Safety shields and needle guards help prevent accidental needle-stick injuries.  *SC needle with safety shield*  *Discard syringe in sharps container*
17. Dispose of supplies; remove gloves and perform hand hygiene.	This reduces the risk of infection and the spread of microorganisms.  *Hand hygiene with ABHR*
18. Document procedure and findings according to agency policy.	Timely documentation ensures patient safety.
19. Evaluate patient response to medication.	It is important to evaluate the therapeutic effect of the medication and assess for adverse effects.
Data source: ATI, 2015b; Berman & Snyder, 2016; Brookside Associates, 2015b; Clayton et al., 2010; National Institute of Health Clinical Center, 2015; Ogston-Tuck, 2014b; Perry et al., 2014	

VIDEO 7.3

Watch the video *Administering a Subcutaneous Injection* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

Critical Thinking Exercises

1. Why should a health care provider rotate sites with a heparin SC injection, but only rotate within a site with insulin SC injections?
2. What are three risks associated with administering insulin and heparin subcutaneously?

Additional Videos

VIDEO 7.4

Watch the video *Reconstitution of Powdered IV Medication and administration via a minibag* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

7.4 Intramuscular Injections

Intramuscular (IM) injections deposit medications into the muscle fascia, which has a rich blood supply, allowing medications to be absorbed faster through muscle fibres than they are through the subcutaneous route (Malkin, 2008; Ogston-Tuck, 2014a; Perry et al., 2014). The IM site is used for medications that require a quick absorption rate but also a reasonably prolonged action (Rodgers & King, 2000). Due to their rich blood supply, IM injection sites can absorb larger volumes of solution, which means a range of medications, such as sedatives, anti-emetics, hormonal therapies, analgesics, and immunizations, can be administered intramuscularly in the community and acute care setting (Hunter, 2008; Ogston-Tuck, 2014a). In addition, muscle tissue is less sensitive than subcutaneous tissue to irritating solutions and concentrated and viscous medications (Greenway, 2014; Perry et al., 2014; Rodgers & King, 2000).

The technique of IM injections has changed over the past years due to evidence-based research and changes in equipment available for the procedure. An IM site is chosen based on the age and condition of the patient and the volume and type of medication injected. When choosing a needle size, the weight of the patient, age, amount of adipose tissue, medication viscosity, and injection site all influence the needle selection (Hunter, 2008; Perry et al., 2014; Workman, 1999).

Intramuscular injections must be done carefully to avoid complications. Complications with IM include muscle atrophy, injury to bone, cellulitis, sterile abscesses, pain, and nerve injury (Hunter, 2008; Ogston-Tuck, 2014a). With IMs, there is an increased risk of injecting the medication directly into the patient's bloodstream. In addition, any factors that impair blood flow to the local tissue will affect the rate and extent of drug absorption. Because of the adverse and documented effects of pain associated with IM injections, always use this route of administration as a last alternative; consider other methods first (Perry et al., 2014).

Sites for intramuscular injections include the ventrogluteal, vastus lateralis, and the deltoid site. Literature shows inconsistency in the selection of sites for deep muscular injections: selection may be based on familiarity and confidence rather than on "best practice" (Ogston-Tuck, 2014a). However, there is sufficient evidence that the ventrogluteal IM site is the preferred site whenever possible, and is an acceptable site for oily and irritating medications. The ventrogluteal site is free from blood vessels and nerves, and has the greatest thickness of muscle when compared to other sites (Cocoman & Murray, 2008; Malkin, 2008; Ogston-Tuck, 2014a). A longer needle with a larger gauge is required to penetrate deep muscle tissue. The needle is inserted at a 90-degree angle perpendicular to the patient's body, or at as close to a 90-degree angle as possible. Use a quick, darting motion when inserting the needle.

Aspiration refers to the action of pulling back on the plunger for 5 seconds prior to injecting medication (Ipp, Sam, & Parkin, 2006). Current practice in the acute care setting is to aspirate IM injections to check for blood return in the syringe. Lack of blood in the syringe confirms that the needle is in the muscle and not in a blood vessel. If blood is aspirated, remove the needle, discard it appropriately, and re-prepare and administer the medications (Perry et al., 2014). Recent research has found that there is no evidence to support the practice of aspiration, but despite policy changes, the

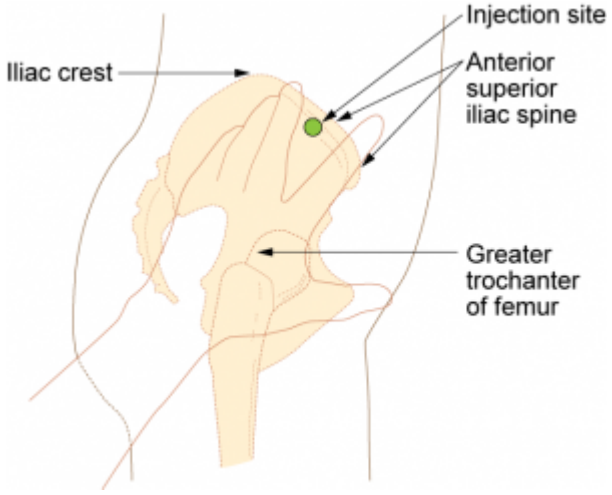
procedure of aspiration continues to be taught and practised (Canadian Agency for Drugs and Technologies in Health, 2014; Greenway, 2014; Sepah, Samad, & Altaf, 2014; Sisson, 2015). Vaccinations and immunizations given by IM injections are never aspirated (Centers for Disease Control, 2015).

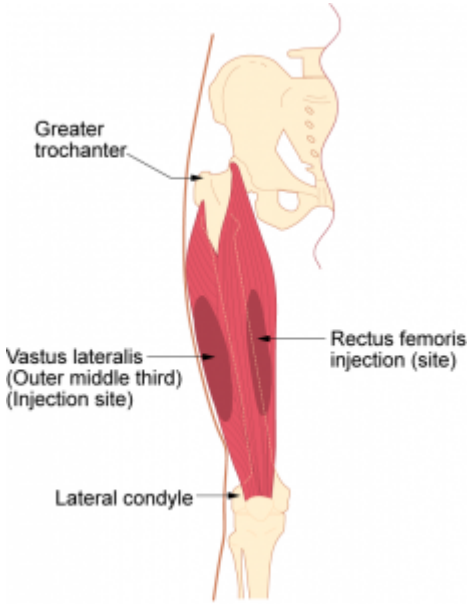
The **Z-track method** is a method of administrating an IM injection that prevents the medication being tracked through the subcutaneous tissue, sealing the medication in the muscle, and minimizing irritation from the medication. Using the Z-track technique, the skin is pulled laterally, away from the injection site, before the injection; then the medication is injected, the needle is withdrawn, and the skin is released. This method can be used if the overlying tissue can be displaced (Lynn, 2011).

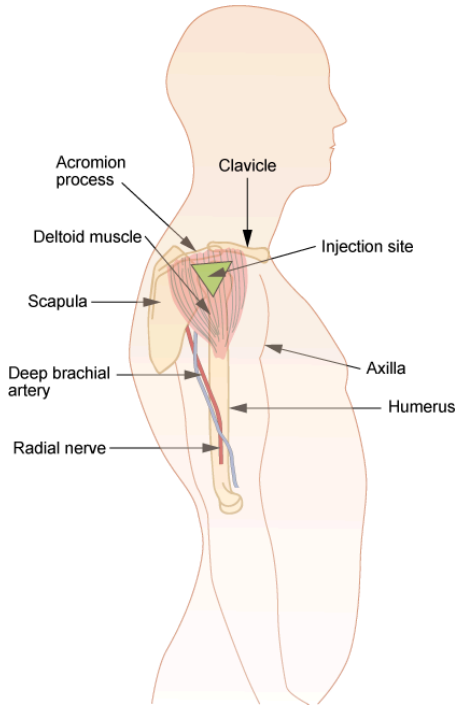
IM INJECTION SITES

Table 7.7 describes the three injection sites for IM injections.

Table 7.7 Intramuscular Injection Sites

Site	Additional Information
Ventrogluteal	The site involves the gluteus medius and minimus muscle and is the safest injection site for adults and children. The site provides the greatest thickness of gluteal muscles, is free from penetrating nerves and blood vessels, and has a thin layer of fat. To locate the ventrogluteal site, place the patient in a supine or lateral position (on their side). The right hand is used for the left hip, and the left hand is used for the right hip. Place the heel or palm of your hand on the greater trochanter, with the thumb pointed toward the belly button. Extend your index finger to the anterior superior iliac spine and spread your middle finger pointing towards the iliac crest. Insert the needle into the *V* formed between your index and middle fingers. This is the preferred site for all oily and irritating solutions for patients of any age. Needle gauge is determined by the solution. An aqueous solution can be given with a 20 to 25 gauge needle. Viscous or oil-based solutions can be given with 18 to 21 gauge needles. The needle length is based on patient weight and body mass index. A thin adult may require a 16 mm to 25 mm (5/8 to 1 inch) needle, while an average adult may require a 25 mm (1 inch) needle, and a larger adult (over 70 kg) may require a 25 mm to 38 mm (1 to 1 1/2 inch) needle. Children and infants will require shorter needles. Refer to the agency policies regarding needle length for infants, children, and adolescents. For the ventrogluteal muscle of an average adult, give up to 3 ml of medication.  *Ventrogluteal intramuscular injection site*

Vastus lateralis	The vastus lateralis is commonly used for immunizations in children from infants through to toddlers. The muscle is thick and well developed. This muscle is located on the anterior lateral aspect of the thigh and extends from one hand's breadth above the knee to one hand's breadth below the greater trochanter. The middle third of the muscle is used for injections. The width of the muscle used extends from the mid-line of the thigh to the mid-line of the outer thigh. To help relax the patient, ask the patient to lie flat with knees slightly bent, or have the patient in a sitting position. The length of the needle is based on the patient's age, weight and body mass index. In general, the recommended needle length for an adult is 25 mm to 38 mm (1 to 1 1/2 inch). The gauge of the needle is determined by the type of medication administered. Aqueous solutions can be given with a 20 to 25 gauge needle; oily or viscous medication should be administered with 18 to 21 gauge needles. A smaller gauge needle (22 to 25 gauge) should be used with children. The length will be shorter for infants and children; see agency guidelines. The maximum amount of medication for a single injection is 3 ml.  *Vastus lateralis intramuscular injection site*

Deltoid muscle	The deltoid muscle has a triangular shape and is easy to locate and access, but is commonly underdeveloped in adults. Begin by having the patient relax the arm. The patient can be standing, sitting, or lying down. To locate the landmark for the deltoid muscle, expose the upper arm and find the acromion process by palpating the bony prominence. The injection site is in the middle of the deltoid muscle, about 2.5 to 5 cm (1 to 2 inches) below the acromion process. To locate this area, lay three fingers across the deltoid muscle and below the acromion process. The injection site is generally three finger widths below, in the middle of the muscle. Select needle length based on age, weight, and body mass. In general, for an adult male weighing 60 to 118 kg (130 to 260 lbs), a 25 mm (1 inch) needle is sufficient. For women under 60 kg (130 lbs), a 16 mm (5/8 inch) needle is sufficient, while for women between 60 and 90 kg (130 to 200 lbs), a 25 mm (1 inch) needle is required. A 38mm (1 1/2 inch) length needle may be required for women over 90 kg (200 lbs) for a deltoid IM injection. Refer to agency policy regarding specifications for infants, children, adolescents, and immunizations. The maximum amount of medication for a single injection is generally 1 ml. For immunizations, a smaller 22 to 25 gauge needle should be used.  *Deltoid intramuscular injection site*

	 *Deltoid IM injection site*
Data source: Berman & Snyder, 2016; Davidson & Rourke, 2014; Ogston-Tuck, 2014a; Perry et al., 2014	

Special Considerations:

- Avoid muscles that are emaciated or atrophied; they will absorb medications poorly.
- IM injection sites should be rotated to decrease the risk of hypertrophy.
- Older adults and thin patients may only tolerate up to 2 ml in a single injection.
- Choose a site that is free from pain, infection, abrasions, or necrosis.
- The dorsogluteal site should be avoided for intramuscular injections. If a needle hits the sciatic nerve, the patient may experience partial or permanent paralysis of the leg.

IM INJECTIONS

Consider the type of medication and the age, condition, and size of the patient when selecting an IM site. Rotate IM sites to avoid complications. Potential complications include lingering pain, tissue necrosis, abscesses, and injury to blood vessels, bones, or nerves. If administering a vaccination, always refer to the vaccination guidelines for site selection. Checklist 58 outlines the steps to perform an IM injection.

Checklist 58: Administering an Intramuscular Injection

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

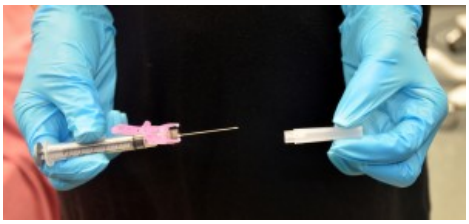
Safety Considerations:

- Ensure the patient's position for injection is not contraindicated by a medical condition (e.g., circulatory shock, surgery).
- Always wear gloves to administer injections. Although policy may vary from place to place, the CDC recommends wearing gloves if there is potential for contact with blood and body fluid.
- If required by agency policy, aspirate for blood prior to administering an IM medication.
- Upon injection, if a patient complains of radiating pain or a burning or a tingling sensation, remove the needle and discard.
- Take all necessary steps to avoid interruptions and distractions when preparing and administering medications.
- If a patient expresses concern or questions the medication, always stop and explore the patient's concerns by verifying the order.
- NEVER recap needles after giving an injection. Apply the safety shield and dispose in the closest sharps container.

STEPS	ADDITIONAL INFORMATION
Assessment	
1. Perform hand hygiene.	Hand hygiene prevents the spread of microorganisms.  *Hand hygiene with ABHR*
2. Compare MAR to patient wristband and use two patient identifiers to confirm patient.	Using two identifiers improves medication safety by ensuring you have selected the correct patient.  *Compare MAR to patient wristband*

3. Assess the patient's symptoms, knowledge of the medication to be received, history of allergies, drug allergies, and types of allergic reactions.	Assess patient data such as vital signs, laboratory values, and allergies before preparing and administering medications by injection.  *Pre-assessment*
4. Assess for any factors that may contraindicate an IM injection.	Factors to look for include circulatory shock, surgery, or muscle atrophy.
Preparation	
5. Verify practitioner's order and MAR.	 *Compare physician orders and MAR*
6. Review medication information, such as purpose, action, side effects, normal dose, rate of administration, time of onset, peak and duration, and nursing implications.	Knowledge of the medication ensures the correct patient receives the correct dose of the correct medication at the correct time via the correct route for the correct reason using the correct documentation.
7. Assemble supplies.	Assemble medication, non-sterile gloves, alcohol swabs, syringes, needles, and sharps container.

8. Prepare medication from an ampule or a vial as per hospital policy. Always compare MAR to the practitioner's original orders to ensure accuracy and completeness.	This prevents medication errors by providing an additional check.  *Prepare medication from a vial*
9. NEVER leave the medication unsupervised once prepared.	Medications left unattended may lead to medication errors.
Procedure	
10. Perform hand hygiene.	Hand hygiene prevents the transmission of microorganisms.  *Hand hygiene with ABHR*
11. Close curtains or door.	This creates privacy for the patient.
12. Verify patient using two unique identifiers and compare to MAR.	This step confirms the correct identity of the patient.  *Compare MAR to patient wristband*
13. Explain the procedure and the medication, and give the patient time to ask questions.	Knowing what is happening helps minimize patient anxiety. Let the patient know there may be mild burning at the injection site.

14. Don non-sterile gloves and prepare the patient in the correct position. Ensure a sharps disposal container is close by for disposal of needle after administration.	This prepares the patient for injection.  *Deltoid IM injection site* Ensuring the sharps container is close by allows for safe disposal of the needle.
15. Locate correct site using landmarks, and clean area with alcohol or antiseptic swab. Allow site to dry completely.	Allowing the site to dry prevents stinging during injection.  *Clean injection site*
16. Place a clean swab or dry gauze between your third and fourth fingers.	This allows for easy access to dry gauze after injection.  *Gauze between fingers 3 and 4*
17. Remove needle cap by pulling it straight off the needle. Hold syringe between thumb and forefinger on dominant hand as if holding a dart.	This prevents needle from touching side of the cap and prevents contamination.  *Pull cap off needle*
18. With non-dominant hand, hold the skin around the injection site.	This secures the area for injection.

19. With the dominant hand, inject the needle quickly into the muscle at a 90-degree angle, using a steady and smooth motion.	Insert the needle with a dart-like motion.  *Insert needle like a dart*
20. After the needle pierces the skin, use the thumb and forefinger of the non-dominant hand to hold the syringe.	Movement of the needle once injected can cause additional discomfort for the patient.  *Insert needle with a dart-like motion*
21. If required by agency policy, aspirate for blood. If no blood appears, inject the medication slowly and steadily. If blood appears, discard syringe and needle, and prepare the medication again.	Because the injection sites recommended for immunizations do not contain large blood vessels, aspiration is not necessary when immunizing.  *Aspirate plunger for blood return*
22. Once medication is completely injected, remove the needle using a smooth, steady motion. Remove the needle at the same angle at which it was inserted.	Using a smooth motion prevents any unnecessary pain to the patient.

23. Cover injection site with sterile gauze, using gentle pressure, and apply Band-Aid as required.	Covering prevents infection at the injection site.  *Cover injection site*
24. Place safety shield on needle and discard syringe in appropriate sharps container.	Placing sharps in appropriate puncture-proof and leak-proof receptacles prevents accidental needle-stick injuries.  *Dispose of syringe in sharps container*
25. Discard supplies, remove gloves, and perform hand hygiene.	This step prevents the spread of microorganisms.  *Hand hygiene with ABHR*
26. Document procedure as per agency policy.	Document the medication, time, route, site, date of administration, and effect of the medication; any adverse effects; unexpected outcomes; and any interventions applied.
27. Assess patient's response to the medication after the appropriate time frame.	Assess for effectiveness of the medication (onset, peak, and duration). Assess injection site for pain, bruising, burning, or tingling.
Data source: CDC, 2013, 2015; Perry et al., 2014	

Checklist 59 outlines the steps to perform a Z-track IM injection.

Checklist 59: Administering a Z -Track Intramuscular Injection

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety Considerations:

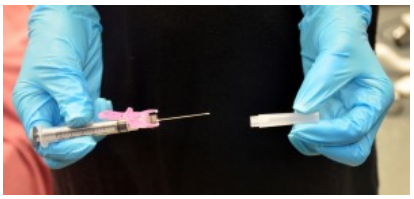
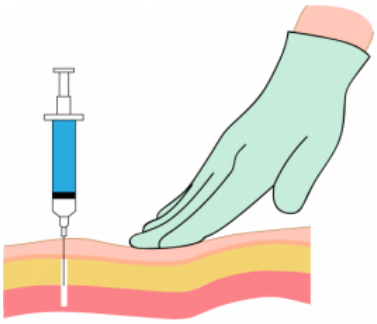
- Ensure the patient's position for injection is not contraindicated by a medical condition (e.g., circulatory shock, surgery).
- Always wear gloves to administer injections. Although policy may vary (for example, if you are in an acute setting compared to a community setting), the CDC recommends wearing gloves if there is potential for contact with blood and body fluids.
- If required by agency policy, aspirate for blood prior to administering an IM medication.
- Upon injection, if a patient complains of radiating pain, burning, or a tingling sensation, remove the needle and discard.
- Take all necessary steps to avoid interruptions and distractions when preparing and administering medications.
- If a patient expresses concern or questions the medication, always stop and explore the patient's concerns by verifying the order.
- NEVER recap needles after giving an injection. Apply the safety shield and dispose in the closest sharps container.

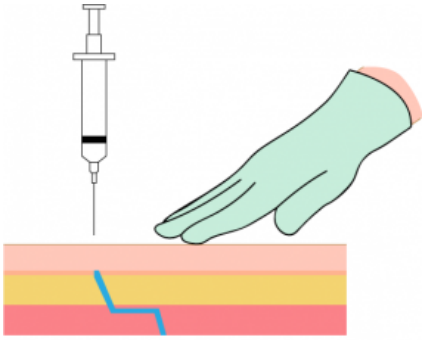
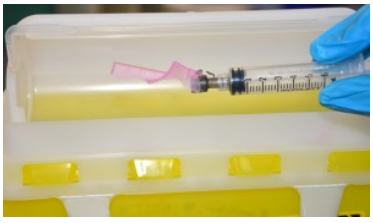
STEPS	ADDITIONAL INFORMATION
Assessment	

1. Perform hand hygiene.	Hand hygiene prevents the spread of microorganisms.  *Hand hygiene with ABHR*
2. Compare Mar to the patient's wristband and use two patient identifiers to confirm patient.	Using two identifiers improves medication safety by ensuring you have selected the correct patient.  *Compare MAR to patient wristband*
3. Assess the patient's symptoms, knowledge of the medication to be received, history of allergies, drug allergies, and types of allergic reactions.	Assess patient data such as vital signs, laboratory values, and allergies before preparing and administering medications by injection.
4. Assess for any factors that may contraindicate an injection.	Factors to look for include circulatory shock, surgery, or muscle atrophy.
Preparation	
5. Verify practitioner's order and MAR.	 *Verify physicians order on MAR*

6. Review medication information such as purpose, action, side effects, normal dose, rate of administration, time of onset, peak and duration, and nursing implications.	Knowledge of the medication ensures the correct patient receives the correct dose of the correct medication at the correct time via the correct route for the correct reason using the correct documentation.
7. Verify expiry date and check for particulates, discoloration, or loss of integrity (sterility).	Discoloured or outdated medication may be harmful. If a medication is discoloured or cloudy, always check manufacturer's specification for the medication.
8. Assemble supplies.	Assemble medication, non-sterile gloves, syringes, needles, and sharps container.
9. Prepare medication from an ampule or a vial as per hospital policy. Always compare MAR to the practitioner's original orders to ensure accuracy and completeness.	This prevents medication errors by providing an additional check.  *Prepare IM injection*
10. NEVER leave the medication unsupervised once prepared.	Unsupervised medication may lead to medication errors
Procedure	
11. Perform hand hygiene.	Hand hygiene prevents transmission of microorganisms

12. Close curtains or door.	This creates privacy for the patient.
13. Verify patient using two unique identifiers and compare to MAR.	This confirms the correct identity of the patient. Follow policy for safe medication administration.  *Compare identification and allergy band with MAR*
14. Explain the procedure and the medication, and give the patient time to ask questions.	Knowing what is happening helps minimize patient anxiety. Let the patient know there may be mild burning at the injection site.
15. Don non-sterile gloves, select the correct site, and prepare the patient in the correct position. Ensure a sharp disposal container is close by for disposal of needle after administration.	This prepares the patient for injection. Ensuring the sharps container is close by allows for safe disposal of the needle.
16. Locate correct site using landmarks, and clean area with alcohol or antiseptic swab. Allow site to dry completely.	Allowing the site to dry prevents stinging during injection.
17. Place a clean swab or dry gauze between your third and fourth fingers.	 *Gauze between fingers 3 and 4* This allows for easy access to dry gauze after injection.

18. Remove needle cap by pulling it straight off the needle. Hold syringe between thumb and forefinger on dominant hand as if holding a dart.	This prevents needle from touching side of the cap and prevents contamination.  *Pull cap off needle*
19. Displace skin in a Z-track manner by pulling the skin down or to one side about 2 cm (1 in.) with your non-dominant hand.	The Z-track method creates a zigzag path to prevent medication from leaking into the subcutaneous tissue. This method may be used for all injections, or may be specified by the medication.  Pull or push the skin 2 to 3 cm away from the injection site with the nondominant hand
20. With skin held to one side, quickly insert needle at a 90-degree angle. After needle pierces skin, continue pulling on skin with non-dominant hand, and at the same time grasp lower end of syringe barrel with fingers of non-dominant hand to stabilize it. Move dominant hand to end of plunger. If required by agency policy, aspirate for blood. If no blood appears, inject the medication slowly.	Insert the needle with a dart-like motion. A quick injection is less painful. Inject medication at 10 seconds/ml. Because the injection sites recommended for immunizations do not contain large blood vessels, aspiration is not necessary when immunizing.  After cleaning the site, inject the needle into the tissue at a 90 degree angle and aspirate for blood return. If no blood return, slowly inject the medication.

21. Once medication is given, leave the needle in place for 10 seconds. Avoid moving the syringe.	Leaving the needle in place allows the medication to be displaced. Movement of the needle can cause additional discomfort for the patient.
22. Once medication is completely injected, remove the needle using a smooth, steady motion. Then release the skin.	Using a smooth motion prevents any unnecessary pain to the patient. 
23. Cover injection site with sterile gauze, using gentle pressure, and apply Band-Aid as required. Do not massage site.	Covering prevents infection at the injection site.  *Cover injection site with gauze*
24. Place safety shield or needle guard on needle and discard syringe in appropriate sharps container.	Placing sharps in appropriate puncture-proof and leak-proof receptacles prevents accidental needle-stick injuries.  *Dispose of syringe in sharps container*

25. Discard supplies, remove gloves, and perform hand hygiene.	This step prevents the spread of microorganisms.  *Hand hygiene with ABHR*
26. Document procedure as per agency policy.	Document the medication, time, route, site, date of administration, and effect of the medication; any adverse effects; unexpected outcomes; and any interventions applied.
27. Assess patient's response to the medication after the appropriate time frame.	Assess for effectiveness of the medication (onset, peak, and duration). Assess injection site for pain, bruising, burning, or tingling.
Data source: Centers for Disease Control, 2013, 2015; Perry et al., 2014	

VIDEO 7.5

Watch a video *Landmarking—Deltoid Administering an IM Injection— Using Z-track* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

VIDEO 7.6

Watch a video *Landmarking—Ventrogluteal Administering an IM Injection—Using Z-track* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

VIDEO 7.7

Watch a video *Landmarking— Vastus Lateralus Administering IM Injection—Using Z-track* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

Critical Thinking Exercises

1. How can you make an injection less painful for a patient? Name four techniques.
2. When giving an IM injection, how can you avoid injury to a patient who is very thin?

Additional Videos

VIDEO 7.8

Watch a video *Insertion of an Indwelling Subcutaneous Device aka 'subcutaneous butterfly'* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

7.5 Intravenous Medications by Direct IV Route

Intravenous (IV) is a method of administering concentrated medications (diluted or undiluted) directly into the vein using a syringe through a needleless port on an existing IV line or a saline lock. The direct IV route usually administers a small volume of fluid/medicine (max 20 ml) that is pushed manually into the patient. Medications given by IV are usually administered intermittently to treat emergent concerns. Medications administered by direct IV route are given very slowly over AT LEAST 1 minute (Perry et al., 2014). Administering a medication intravenously eliminates the process of drug absorption and breakdown by directly depositing it into the blood. This results in the immediate elevation of serum levels and high concentration in vital organs, such as the heart, brain, and kidneys. Both therapeutic and adverse effects can occur quickly with direct intravenous administration (Alberta Health Services, 2009).

In the past, IV medications have been called IV bolus or IV push medications. It is recommended that these terms NOT be used, as they can be mistakenly interpreted as meaning the drugs are to be pushed quickly, in less than a minute (ISMP, 2003). To administer IV medications safely and effectively, all health care agencies have policies in place and the *Parenteral Drug Therapy Manual* (PDTM) that identifies medications that may be given intravenously. (The PDTM may also be referred to as a parenteral drug monograph [Alberta Health Services, 2009].) Only specific medications may be administered via the direct IV route. There are many advantages and disadvantages to administering medications via the intravenous injection method — see Table 7.8.

Table 7.8 Advantages and Disadvantages of Intravenous Medications

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 will occur immediately and may be exacerbated by a rapidly injected medication.
Minimal dilution is required for some medications, which is desirable for patient's own fluid restrictions.	Extravasation of certain medications into surrounding tissues can cause sloughing, nerve damage, and scarring.
There is minimal or no discomfort for the patient in comparison to SC and IM injections.	Not all medications can be given via the direct IV route.
They provide an alternative to the oral route for drugs that may not be absorbed by the GI tract, and they are ideal for patients with GI dysfunction or malabsorption, and patients who are NPO (nothing by mouth) or unconscious.	There is a high risk for infusion reactions, 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 direct route provides a more accurate dose of medication because none is left in the intravenous tubing.	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.
Data source: Albert Health Services, 2009; Lynn, 2011; Perry et al., 2014	

Intravenous medications are always prepared using the SEVEN rights x 3 as per agency policy. Because of the high risk associated with direct intravenous medications, additional guidelines are required. A PDTM or drug monograph provides additional information, which includes the generic name, brand name, classification of the drug, and chart defining which parenteral route may be utilized. Some medications may only be given via a piggyback method or large-volume IV solutions; some

medications may be given diluted over 1 or 2 minutes. In addition, information regarding indications, contraindications, dosage (age dependent), administration/dilution guidelines, adverse effects, clinical indications (e.g., specialized monitoring required, must be on an IV pump), compatibility, and incompatibility in relation to reconstitution and primary IV solution is specified (Alberta Health Services, 2009).

The Institute for Safe Medication Practices (ISMP) (2014) has created a list of high-alert medications that bear the heightened risk of significant harm when they are used in error. Special safeguards for these medications can be found in the PDTM. It is vital to understand which medications are considered high risk prior to administration. A link to the list of high-risk medications can be found under Suggested Online Resources at the end of this chapter. Review the steps shown in Table 7.9 to prepare a medication by direct IV route. The PDTM must be consulted every time an IV medication is given, as memory-based errors are common (World Health Organization, 2012).

Table 7.9 Preparation Questions for Intravenous Medications

Safety Considerations:

- Be diligent and follow all policies related to medication calculations, preparation, and thorough assessment of patient status before and after an injection. Medication errors are the most common preventable errors in health care.
- Use a blunt filter needle or blunt needle when preparing injections. Never use a needle when injecting IV medication. Always use a needleless system.
- After preparing the medication, always label the medication syringe with the patient name, date, time, medication, and dose. Never leave the syringe unattended.
- Always administer the post-saline lock flush at the SAME RATE as the IV medication.
- Always assess the patient's symptoms and need for IV medication prior to administration.
- Always assess the patient's understanding of the medication.

Principle	Additional Information
Verify qualifications for administration.	Are you qualified to give this medication? What supervision is required? What resources must you consult?
Review route of administration and IV site.	Can this medication be given by the IV route? Is the route of administration (needle insertion site) free from redness, swelling, and discomfort?
Review preparation and how to administer the medication.	How is this medication given by the IV route (diluted or undiluted)? Describe the safest way to prepare the medication. Consider the selection of medication. Always use less-concentrated solutions whenever possible. Does the medication require dilution? If diluting the medication, ALWAYS discard (that is, waste) the unused portion before going to the bedside. • Preparation and supplies: is a pre-flush required? • Patient identification: any allergies? • Administration rate: what is the correct rate of administration (over 1 minute, 5 minutes)?
Identify when medication starts to work.	What is the onset, peak, and duration of the medication?
Assess dose and range (e.g., 5 to 10 mg).	Is the ordered dose safe? When did the patient last receive this medication? What was the effect of the medication on the patient?
Understand the therapeutic effect.	What is the expected therapeutic effect of the medication? What preassessment determines if the medication is correct for the patient?
Know adverse effects.	What are the potential adverse effects of the medications? How would you manage these adverse effects? Is there an antidote?

Know potential incompatibilities.	Are there any potential incompatibilities with existing IV solutions? How would you manage these issues? Is a secondary medication currently running? Are there additives to the IV solution?
Know how to complete the procedure.	How do you complete this procedure? Is a post-saline lock flush required?
Document procedure.	How and where do you chart this medication: pain assessment sheet, MAR, etc.?
Data source: BCIT, 2015; Berman & Snyder, 2016; Clayton et al., 2010; WHO, 2012	

Before giving an intravenous medication, always assess the IV needle insertion site for signs of infiltration or phlebitis. Start a new IV site if current site is red, swollen, or painful when flushing. Intravenous medications by direct IV route can be given three ways:

- Through a saline lock (short venous access device)
- Through an existing IV line with compatible IV solution
- Through an existing IV with an incompatible IV solution

Checklist 60 reviews the steps to administer an IV medication through a saline lock. Review the preparation questions for intravenous medication in Table 7.9 prior to administering medication.

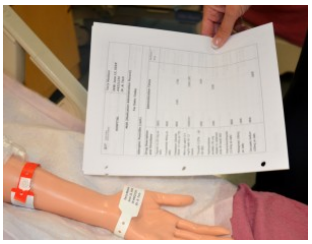
Checklist 60: Administering an IV Medication via a Saline Lock

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

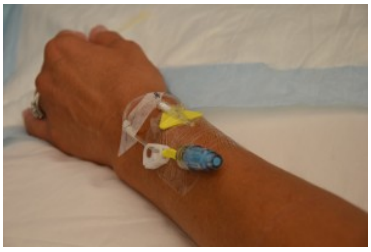
Safety Considerations:

- Review the advantages and disadvantages of IV medications.
- Be able to answer the preparation questions for intravenous medication in Table 7.9 before administering the medication.
- If the medication has been diluted and there is wastage, always discard unused diluted portion of the prepared IV medication before going to the bedside.
- Always label the IV syringe with the patient name, date, time, medication, concentration of the dose, dose, and your initials. Once the medication is prepared, never leave it unattended.
- NEVER administer an IV medication through an IV line that is infusing blood, blood products, heparin IV, insulin IV, cytotoxic medications, or parenteral nutrition solutions.
- Central venous catheters (central lines, PICC lines) may require special pre- and post-flushing procedures and specialized training.
- You will need a watch with a second hand to time the rate of administration.

STEPS	ADDITIONAL INFORMATION
1. Prepare one medication for one patient at the correct time as per agency policy. Review the physician's order, PDTM, and MAR for the correct order and guidelines. Math calculations may be required to determine the correct dose to prepare the medication.	Always apply the SEVEN rights x 3 of medication administration. Review the agency policy if a medication is a stat, given for the first time, a loading dose, or a one-time dose. Some agencies require that high-alert medications be double-checked by a second health care provider. Always follow agency policies. For a list of high-alert medications, see Suggested Online Resources. After preparing the medication, always label the medication syringe with the patient name, date, time, medication, and concentration of the dose (e.g., morphine 2 mg/ml), dose, and your initials. Never leave the medication syringe unattended.
2. Create privacy if possible.	This provides comfort to patient.

3. Confirm patient ID using two patient identifiers (e.g., name and date of birth) AND compare the MAR printout with the patient's wristband to confirm patient ID.	This ensures you have the correct patient and complies with agency standard for patient identification.  *Compare MAR with patient wristband*
4. Check allergy band for any allergies, and ask patient about type and severity of reaction.	This ensures allergy status is correct on the MAR and on patient allergy band.
5. Discuss purpose, action, and possible side effects of the medication. Provide patient an opportunity to ask questions. Encourage patient to report discomfort at the IV site (pain, swelling, or burning).	Keeping patient informed of what is being administered helps decrease anxiety.
6. Perform hand hygiene.	Hand hygiene prevents the transmission of microorganisms.  *Hand hygiene with ABHR*
7. Clean access port in a circular motion with an alcohol swab for 15 seconds. Allow to dry.	This technique prevents introduction of microorganisms by the syringe.  *Clean positive pressure cap (Max Plus) with alcohol swab*

8. Remove air from prefilled syringe. Release clamp on extension tubing and flush the saline lock with 3 to 5 ml of normal saline to ensure patency. Do not force if resistance is felt. Remove syringe.	If swelling, pain, or redness exists, remove IV cannula and restart new IV site. Tenderness is the first sign of phlebitis.  *Release clamp*  *Prepare prefilled normal saline syringe*
9. Attach medication syringe (without needle) to access device.	Using a needleless system prevents needle-stick injuries.  *Attach medication to saline lock*

10. Using a timer with a second hand, inject medication at the correct rate according to agency policy. Use a push-pause method to inject the medication.	Using a timer ensures safe medication administration. Rapid injection of IV medications can be fatal. A slow rate allows medications to be administered correctly.  *Inject medication into saline lock*
11. Remove used medication syringe. Remove air from prefilled NS syringe and attach to the Max Plus device. Flush (3 to 5 ml) at the SAME rate as the medication bolus, according to guidelines found in the PDTM or per IV bolus medication policy. (See Rationale for Flushing with NS after Administering an IV Medication.)	Always check hospital policy on the amount of flush and type of solution when using a saline lock for an IV bolus medication. Flushing the IV line at the same rate as medication delivery ensures that any medication remaining within the IV line is delivered at the correct rate, and avoids giving the patient an accidental bolus of the medication.  *Flush extension tubing with NS at the same rate as medication delivery* Flushing the saline lock clears the medication from the device. Establish positive pressure as per manufacturer's directions.  *When flushing is complete, detach syringe from positive pressure device and then apply clamp on extension tubing* If a patient has a central venous catheter, access and flush as per agency policy.

12. Dispose of all syringes/filter needles into appropriate puncture-proof containers.	This prevents accidental needle-stick injuries.
13. Remove gloves and perform hand hygiene.	This reduces transmission of microorganisms.  *Hand hygiene with ABHR*
14. Document as per agency protocol.	Document the time, reason, drug, dose, effect, and any adverse reactions.
15. Observe for expected therapeutic effect and for adverse effects.	The patient needs to be evaluated and monitored, especially for high-alert medications. IV medications act rapidly.
Data source: Canadian Institute for Health Information, 2009; Clayton et al., 2010; Perry et al., 2014	

Special Considerations:

- Top contributing factors to medication errors include calculation errors, drug preparation errors, human error, and transcription inaccuracy.
- The elderly and the young may be more sensitive to adverse effects.
- With certain medications, creatinine clearance must be assessed prior to administering. Patients with cirrhosis may require a reduction in dosages.
- When a medication dose is given a range (e.g., morphine 2 mg IV q 2-4 hours **p.r.n.**, or as needed), always start with the lowest dose and titrate up. Always assess when the last dose was given and its effectiveness.

RATIONALE FOR FLUSHING WITH NS AFTER ADMINISTERING AN IV MEDICATION

Flushing a Saline Lock after Administering an IV Medication

Flushing after IV medication administration with compatible IV solution is recommended as per the guidelines in Checklists 60, Checklist 61, and Checklist 62 to ensure that medication left in the extension tubing is administered at the appropriate rate. IV medication must be cleared by flushing at the same rate of administration to avoid the risks related to IV push medications. Because 1 ml of medication is left in the extension tubing, due care in flushing is required for the first ml that clears the extension tubing. The remaining saline flush serves to maintain patency of the line.

Here are some examples of clearing IV medication from extension tubing.

1. If morphine (1 mg) is diluted in 1 ml NS and administered over one minute, the subsequent saline flush will be given in this manner: the *first 1 ml* of a 5 ml saline flush syringe will be delivered over one minute, and the remaining 4 ml will be given slowly at the level of patient comfort.
2. If Lasix (40 mg) is given in a 4 ml volume and administered over two minutes, the subsequent saline flush will be given in this manner: the *first 1 ml* of a 5 ml saline flush syringe will be delivered over 30 seconds, and the remaining 4 ml will be given slowly at the level of patient comfort.

Flushing the Primary IV Line after Administering an IV Medication through an IV Port

When flushing an IV line after administering an IV medication, the following applies:

- The volume in the IV tubing from the Max Plus saline lock to the first port is also 1 ml. Take this additional volume into account when flushing after a medication is given via this port.
- It is NOT recommended to speed up the IV solution, because medication in the line would be administered too rapidly and is contrary to the manufacturer's safety recommendation and the PDTM.
- Sudden boluses of some medications may cause mild to severe adverse effects, such as hypotension and toxicity (Clayton et al., 2010).

Checklist 61 lists the steps to administering an IV medication through an existing IV line with compatible IV solution. Review the preparation questions for intravenous medication in Table 7.9 prior to the medication administration.

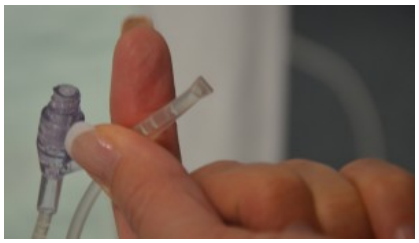
Checklist 61: Administering an IV medication (with Compatible IV Solution)

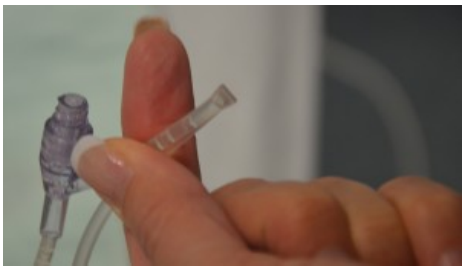
Disclaimer: Always review and follow your hospital policy regarding this specific skill.

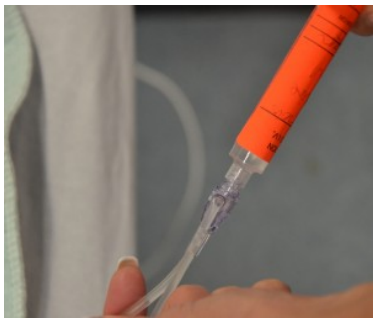
Safety Considerations:

- Review the advantages and disadvantages of IV medications.
- Be able to answer the preparation questions for intravenous medication in Table 7.9 before administering the medication.
- If the medication has been diluted and there is wastage, always discard unused diluted portion of the prepared IV medication before going to the bedside.
- Always label the syringe with the patient name, date, time, medication, concentration of the dose, dose, and your initials. Once the medication is prepared, never leave it unattended.
- NEVER administer an IV medication through an IV line that is infusing blood, blood products, heparin IV, insulin IV, cytotoxic medications, or parenteral nutrition solutions.
- Central venous catheters (central lines, PICC lines) may require special pre- and post-flushing procedures and specialized training.
- You will need a watch with a second hand to time the rate of administration.

STEPS	ADDITIONAL INFORMATION
1. Prepare one medication for one patient at the correct time as per agency policy. Review the physician's order, PDTM, and MAR for the correct order and guidelines. Math calculations may be required to determine the correct dose to prepare the medication.	Always apply the SEVEN rights x 3 of medication administration. Review the agency policy if a medication is a stat, first-time, loading dose, or a one-time dose. Some agencies require that high-alert medications be double-checked by a second health care provider. Always follow agency policies. After preparing the medication, always label the medication syringe with the patient name, date, time, medication and dose concentration (e.g. morphine 2 mg/ml), dose, and your initials. Never leave the syringe unattended.
2. Create privacy if possible.	This provides comfort to patient.
3. Confirm patient ID using two patient identifiers (e.g., name and date of birth) AND compare the MAR printout with the patient's wristband to confirm patient ID.	This ensures you have the correct patient and complies with agency standard for patient identification.  *Compare MAR to patient wristband*

4. Check allergy band for any allergies, and ask patient about type and severity of reaction.	This ensures allergy status is correct on the MAR and on patient allergy band.
5. Discuss purpose, action, and possible side effects of the medication. Provide patient an opportunity to ask questions. Encourage patient to report discomfort at the IV site (pain, swelling, or burning).	Keeping patient informed of what is being administered helps decrease anxiety.
6. Perform hand hygiene and apply non-sterile gloves.	Hand hygiene prevents the transmission of microorganisms.  *Hand hygiene with ABHR*
7. Select IV access port closest to the patient.	 *Select closest port to patient*
8. Clean port in a circular motion with an alcohol swab for 15 seconds. Allow to dry.	This prevents introduction of microorganisms by the syringe.  *Clean port with an alcohol swab*

9. Attach syringe (without needle) to IV line using needleless system. If running primary IV solution is medication (e.g., heparin, morphine, pantaloc, insulin, or blood or blood products), **do not flush**. Start another saline lock on the opposite arm.	Using a needleless system prevents needle-stick injuries.  *Attach medication syringe to the lowest port* Never administer a medication using a filter needle.
10. If IV solution is on an IV pump, pause the device. Pinch IV tubing above the lowest access port or use blue slider clamp.	This prevents the IV medication from travelling up the IV line.  *Pinch IV tubing*  *Blue slider clamp*

11. Inject medication at the recommended rate according to agency policy. Use a timer to monitor time. Use a push-pause method to inject the medication.	This ensures safe medication administration at the correct rate. Rapid injection of IV medications can be fatal.  *Inject IV medication slowly*
12. Remove used medication syringe. Remove air from prefilled NS syringe and attach to the same IV port. Flush (3 to 5 ml) at the SAME rate as the medication bolus, according to guidelines found in the PDTM or per IV bolus medication policy. (See Rationale for Flushing with NS after Administering an IV Medication.)	No needle should be present with a needleless system.  *Remove medication syringe*  *Remove air from prefilled NS syringe*  *Flush IV line*

13. Unpinch/unclamp the IV tubing and ensure the IV is infusing at the correct rate. Restart IV infusion device as required.	 *Regulate IV tubing*
14. Dispose of all syringes/filter needles into appropriate puncture-proof containers if required.	This prevents accidental needle-stick injuries.
15. Remove gloves and perform hand hygiene.	This reduces transmission of microorganisms.  *Hand hygiene with ABHR*
16. Document as per agency protocol.	Document time, reason, drug, dose, therapeutic effect, and any adverse reactions.
17. Evaluate the patient for therapeutic effect and adverse reactions according to appropriate time frame (onset and peak of medication).	Observations provide additional safety measures, especially for high-alert medications. IV medications act rapidly.
Data source: Berman & Snyder, 2016; Canadian Institute for Health Information, 2009; Clayton et al., 2010; Perry et al., 2014; Workers Compensation Act, 2015	

VIDEO 7.9

Watch the video *Administering Medications: Direct IV – Into an IV with an Infusion (PVAD short)* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

Special Considerations:

- Top contributing factors to medication errors include calculation errors, drug preparation errors, human error, and transcription inaccuracy. Be diligent in preparing intravenous medications.
- The elderly and the young may be more sensitive to adverse effects of certain intravenous medications.
- With certain medications, creatinine clearance must be assessed prior to administering. Patients with cirrhosis may require a reduction in dosage.
- When a medication dose is given a range (e.g., morphine 2 mg IV q 2 -4 hours p.r.n.), always start with the lowest dose and titrate up. Always assess when the last medication dose was given.

Checklist 62 reviews the steps to administer an IV medication through an existing IV line with incompatible IV solution. Review the preparation questions for intravenous medication in Table 7.9 prior to the medication administration.

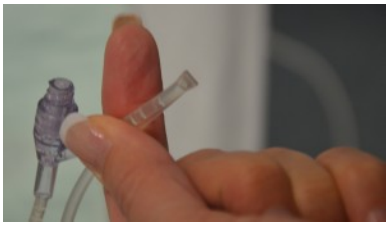
Checklist 62: Administering an IV Medication (with Incompatible IV Solution)

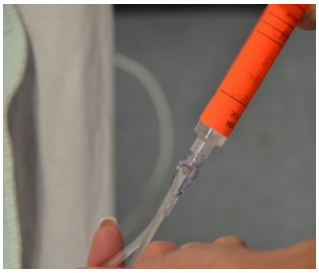
Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety Considerations:

- Review the advantages and disadvantages of IV medications.
- Be able to answer the preparation questions for intravenous medication in Table 7.9 before administering the medication.
- If the medication has been diluted and there is wastage, always discard unused diluted portion of the prepared IV medication before going to the bedside.
- Always label the IV syringe with the patient name, date, time, medication, concentration of the dose, dose, and your initials. Once the medication is prepared, never leave it unattended.
- NEVER administer an IV medication through an IV line that is infusing blood, blood products, heparin IV, insulin IV, cytotoxic medications, or parenteral nutrition solutions.
- Central venous catheters (central lines, PICC lines) may require special pre- and post-flushing procedures and specialized training.
- You will need a timer with a second hand to time the rate of administration.

STEPS	ADDITIONAL INFORMATION
1. Prepare one medication for one patient at the correct time as per agency policy. Review the physician orders, PDTM, and MAR for the correct order and guidelines. Math calculations may be required to determine the correct dose to prepare the medication.	Always apply the SEVEN rights x 3 of medication administration. Review the agency policy if a medication is a stat, first-time, loading dose, or a one-time dose. Some agencies require that high-alert medications be double-checked by a second health care provider. Always follow agency policies. After preparing the medication, always label the medication syringe with the patient name, date, time, medication and dose concentration (e.g. morphine 2 mg/ml), dose, and your initials. Never leave the syringe unattended.
2. Create privacy if possible.	This provides comfort to patient.
3. Confirm patient ID using two patient identifiers (e.g., name and date of birth) AND compare the MAR printout with the patient's wristband to confirm patient ID.	This ensures you have the correct patient and complies with agency standard for patient identification.  *Compare MAR to patient wristband*

4. Check allergy band for any allergies, and ask patient about type and severity of reaction.	This ensures allergy status is correct on the MAR and on patient allergy band.
5. Discuss purpose, action, and possible side effects of the medication. Provide patient an opportunity to ask questions. Encourage patient to report discomfort at the IV site (pain, swelling, or burning).	Keeping patient informed of what is being administered helps decrease anxiety.
6. Perform hand hygiene and apply non-sterile gloves.	Hand hygiene prevents the transmission of microorganisms.  *Hand hygiene with ABHR*
7. Clamp or pinch the IV line, and pause the infusion pump if required.	Always ensure the needle insertion site is patent, free from redness and swelling. Always check agency policy to ensure an IV solution or medication can be stopped temporarily.  *Blue slider clamp*  *Pinch IV tubing* Some IV solutions may not be stopped. If unable to temporarily stop an IV solution or IV medication, start a new IV site.

8. Clean the lowest port on the IV tubing with an alcohol swab in a circular motion for 15 seconds. Allow to dry. Clamp IV tubing above the lowest port on the IV tubing.	This prevents the transmission of microorganisms.  *Clean port with an alcohol swab*
9. Flush the IV line with 10 ml of normal saline or as per agency policy.	This step clears the IV line to prevent any mixing of incompatible medications.  *Flush IV line with NS* If running primary IV solution is medication (e.g., heparin, morphine, pantaloc, or insulin) or blood or blood products, **do not flush**. Start another saline lock on the opposite arm.
10. Inject medication at the recommended rate according to agency policy. Use timer with second hand to time injection. Use a push-pause method to inject the medication.	Medications can be given safely when guidelines are followed. This ensures the medication is delivered at proper intervals according to agency policy.  *Inject IV medication slowly*

11. Remove used medication syringe. Remove air from prefilled NS syringe and attach to the same IV port. Flush (3 to 5 ml) at the SAME rate as the medication bolus, according to guidelines found in the PDTM or per IV bolus medication policy. (See Rationale for Flushing with NS after Administering an IV Medication.)	Flushing at the same rate prevents patient from accidentally receiving a bolus of the medication. Flushing also ensures the line is patent and clears the IV line of all incompatible medications.  *Flush IV line with NS*
12. Unclamp/unpinch IV line and restart IV infusion device as required. Recheck infusion rate if IV solution is running by gravity.	Rechecking infusion rate prevents accidental fluid overload and keeps patient safe.  *Recheck IV rate*
13. Dispose of all syringes/filter needles into appropriate puncture-proof containers.	This prevents accidental needle-stick injuries.
14. Remove gloves and perform hand hygiene.	This reduces the transmission of microorganisms.  *Hand hygiene with ABHR*
15. Document as per agency protocol.	Document time, reason, drug, dose, effect, and any adverse reactions.

16. Evaluate the patient's response to the medication in the appropriate time frame.	Observe patient for expected therapeutic effects and adverse reactions.
Data source: Berman & Snyder, 2016; Canadian Institute for Health Information, 2009; Clayton et al., 2010; Perry et al., 2014	

VIDEO 7.10

Watch the video *Administering Medications: Direct IV – Into a Locked IV (PVAD short)* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

Special considerations:

- Top contributing factors to medication errors include calculation errors, drug preparation errors, human error, and transcription inaccuracy.
- The elderly and the young may be more sensitive to adverse effects.
- With certain medications, creatinine clearance must be assessed prior to administering. Patients with cirrhosis may require a reduction in dosages.
- When a medication dose is given a range (e.g., morphine 2 mg IV q 2 -4 hours p.r.n.), always start with the lowest dose and titrate up. Always assess when the last dose was given.

Critical Thinking Exercises

1. What resource could you consult to determine the onset, peak, and duration of morphine IV?
2. What information should be on the label of an IV medication syringe?

7.6 Administering Intermittent Intravenous Medication (Secondary Medication) and Continuous IV Infusions

Intravenous intermittent infusion is an infusion of a volume of fluid/medication over a set period of time at prescribed intervals and then stopped until the next dose is required. An intermittent IV medication may be called a piggyback medication, a secondary medication, or a mini bag medication (see Figure 7.16). Intravenous medications may be given in small volumes of sterile IV solution (25 to 250 ml) and infused over a desired amount of time (given for 30 minutes every 4 hours) or as a single dose. Many medications must be given slowly to prevent harm to the patient, and this method of administration reduces the risk of rapid infusion. A piggyback medication is given through an established IV line that is kept patent by a continuous IV solution or by flushing a short venous access device (saline lock). Always check the *Parenteral Drug Therapy Manual* PDTM to ensure the correct guidelines are followed for each specific medication given in IV solution. The PDTM provides guidelines on how to mix the IV medication, the amount and type of solution, and the rate of infusion (Perry et al., 2014).

An intermittent medication may be administered by gravity or on an electronic infusion device (EID), also known as an infusion (IV) pump. Many piggyback IV medications must be on an IV pump, which requires programming and specialized training to prevent medication errors. The IV infusion pumps provide hard- and soft-dose limits and safety practice guidelines to aid in safe medication administration (Lynn, 2011). IV medications may also be given by gravity infusion, in which case the health care provider must calculate the infusion rate for drops per minute. The best practice for piggyback infusions is to use an IV infusion pump.

Figure 7.16 Secondary medication (upper IV mini bag) set up with primary infusion set (lower IV bag)

At times, a volume-controlled (intermittent infusion) set may be used to deliver medication for children, older adults, or critically ill patients where fluid volume is a concern. A **volume-controlled intermittent set** is a small device attached below the primary infusion to regulate the mini bag. The medication is added to a small amount of IV solution and administered through an IV line (Lynn, 2011).

Intravenous medications are always prepared using the seven rights x 3 as per agency policy. Because of the many high-risk events associated with intravenous medications, additional guidelines are required. A PDTM or monograph provides this additional information, which includes the generic name, brand name, classification of the drug, and a chart defining which parenteral route may be utilized. Some medications may only be given via a piggyback method or large-volume IV solutions, and some medications may be given diluted over 1 to 2 minutes. In addition, information on indications, contraindications, dosage (age dependent), administration/dilution guidelines, adverse effects, clinical indications (e.g., specialized monitoring required, must be on an IV pump), and compatibility and incompatibility in relation to reconstitution and primary IV solution are specified (Alberta Health Services, 2009).

The Institute for Safe Medication Practices (2014) has created a list of high-alert medications that bear the heightened risk of significant harm when they are used in error. Specific safeguards for these medications can be found in the PDTM. It is vital to understand which medications are considered high risk prior to administration. A link to the list of high-alert medications can be found under Suggested Online Resources at the end of this chapter. In addition to the seven rights x 3 for medication preparation, Table 7.10 summarizes what to review in the PDTM when preparing and administering an intravenous medication. The acronym RED CARS can be used as a reminder.

Table 7.10 The Acronym RED CARS for Intravenous Medications

Mnemonic	Additional Information
R	Rate: What is the rate of injection?
E	Equipment: Equipment may include a syringe, filter needle (vial), or non-filter needle (ampule), label for the syringe, alcohol swab, solution to prepare the medications, PDTM, MAR, non-sterile gloves, normal saline flushes, and a watch with a second hand.
D	Dilution: How much solution is required to dilute the medication, and what type of solution (normal saline or dextrose)? Some intravenous medications must be administered in a piggyback or mini bag, and some may be given diluted directly into the vein through an existing IV line.
C	Compatibility: Is the medication compatible with the primary IV solution and additives? NEVER inject intravenous medications into blood or blood products, or IV continuous infusions such as heparin IV or insulin IV.
A	Allergies: What are the patient's allergies and types of reactions?
R	Reconstitution: If the medication requires reconstitution, follow directions for adding the correct amount of dilution and type of dilution. Use the information to accurately achieve the correct concentration of the medication.
S	Stability: How long is the medication stable at room temperature or when reconstituted?
Data source: BCIT, 2015	

Special considerations when preparing IV intermittent medications:

- Indications and contraindications exist with most IV medications, such as "use cautiously in patients with a penicillin allergy" or "do not administer in patients with a low potassium level" or "monitor for side effects in patients with liver or kidney failure." Clinical indications may include "must be on a cardiac monitor" or "only to be administered in a specialized area such as ICU and CCU."
- Always prepare the medications using the seven rights x 3 when the medication is pulled from storage, poured, and put away.

- Many IV intermittent medications come prepared from the pharmacy and still require a complete check (seven rights x 3) prior to administration.
- The IV solution bag must be labelled at the medication cart with the patient's name, date, time, medication, dose concentration, and your initials.
- Calculate IV rate (gravity or IV pump) before going to the bedside.

Using sterile technique, prepare the intravenous medication as per agency policy, using the PDTM and the seven rights x 3. Many piggyback medications come prepared from the pharmacy and still require a complete check (SEVEN rights x 3) prior to administration. Checklist 63 lists the steps to administering an intermittent IV medication by gravity or an IV infusion pump.

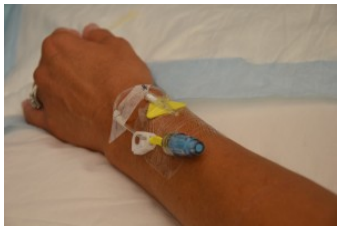
Checklist 63: Administering an Intermittent Intravenous Infusion (First Time)

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety Considerations:

- Review the advantages and disadvantages of IV medications.
- Always label the IV mini bag with the patient name, date, time, medication, concentration of dose, dose, and your initials. Once the medication is prepared, keep in a secure area.
- NEVER administer an IV medication through an IV line that is infusing blood, blood products, heparin IV, insulin IV, cytotoxic medications, or parenteral nutrition solutions.
- Central venous catheters (central lines, PICC lines) require special pre- and post-flushing procedures and specialized training.
- You will need a watch with a second hand to time the rate of administration (if infusing medication by gravity).
- The use of IV infusion pumps requires specialized training to avoid programming errors. Refer to the resources at the end of this chapter for links to reviewing IV infusion devices.

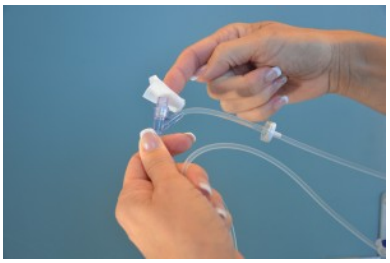
STEPS	ADDITIONAL INFORMATION
1. Prepare one medication for one patient at the correct time as per agency policy. Always check the physician orders, PDTM, and MAR. Mathematical calculations may be required to determine the correct dose to prepare.	Always apply the SEVEN rights of medication administration. Review the agency policy and the PDTM. If a medication is a stat, first-time, loading, or one-time dose, be extra diligent in reviewing the PDTM. Memory slips are a common source of error with medication administration. Complete all assessments (vital signs) and check laboratory values that may influence the medication administration. If piggyback (secondary) medication is made up by the health care provider, ensure the medication label on the mini bag includes the patient name, date, time, medication added, dose and concentration, expiry time, and your initials. Some health agencies require a second independent check with high-alert medications. Always follow agency policy.
2. Perform hand hygiene and bring medication and MAR to bedside. Create privacy if possible.	Additional equipment required includes secondary tubing, a metal or plastic extension hanger, an alcohol swab, and a timer with a second hand. Creating privacy provides comfort to patient.

3. Compare the MAR with the patient's wristband, and use two patient identifiers (name and birth date), according to agency policy, to confirm patient ID.	This ensures you have the correct patient and complies with agency standard for patient identification.  *Compare MAR with patient's wristband*
4. Ask about allergies.	This ensures allergy status is correct on the MAR and patient's allergy band.
5. Discuss purpose, action, and possible side effects of the medication. Provide patient an opportunity to ask questions. Encourage patient to report discomfort at the IV site (pain, swelling, or burning).	Keeping patient informed of what is being administered helps decrease anxiety.
6. Perform hand hygiene.	Hand hygiene prevents the transmission of microorganisms.
7. Assess IV site. Select upper port on the IV tubing.	IV medications may require assessment of vital signs and lab values prior to administration.
8. Complete necessary assessments as required. Assess IV site and flush for patency.	Ensure IV site is free from redness, swelling, and pain prior to administering the medication.  *Assess IV site prior to use*

9. Prime secondary tubing.	Remove secondary tubing from packaging and close the clamp. Hang the medication IV bag on the IV pole and remove the sterile blue protective cap.  *Remove sterile blue cap from IV bag*  *Remove protective cover of spike on IV tubing*  *Fill drip chamber 1/2 to 1/3 full* Slowly open the clamp and prime the tubing.

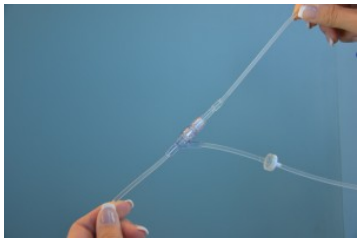
Open clamp and prime tubing

Clean the upper injection port on the primary IV tubing with an alcohol swab for 15 seconds using a circular motion.



Clean upper port on primary IV tubing

Allow to dry. Remove the cap on the distal end of the secondary tubing and carefully insert the upper injection port.



Insert secondary IV tubing into upper port on primary IV tubing

Label the secondary tubing with date and time.

	 *Label IV tubing*
10. Lower the primary IV solution bag using the extension hook.	Ensure piggyback mini bag is hung above the primary IV solution bag. Position of the IV solutions influences the flow of the IV fluid into the patient. The setup is the same if the medication is given by gravity or through an IV infusion pump. Always follow manufacturer's directions for infusion pumps.  *Set up for secondary IV medication*
11. Ensure clamp on secondary tubing is open.	This prevents the patient from missing a dose of medication.  *Open clamp on secondary IV line*

12a. If using gravity infusion, use the roller clamp on the primary set to regulate the rate. The rate will need to be calculated for gtts/mins. 12b. If using an IV infusion pump, set the rate according to the PDTM. Most infusion pumps automatically restart the primary infusion at the previously established rate.	 *Regulate infusion with primary IV line roller clamp* If the medication is administered via gravity, remember to return to the patient and readjust the rate for the primary IV infusion. The primary IV solution will resume infusing at the rate of the secondary infusion, which could lead to rapid infusion of the primary solution. If medication is being given for the first time, stay with the patient for the first 5 minutes to monitor for any potential adverse effects. Encourage patient to notify the health care provider if IV site becomes red, painful, or swollen, or if patient notices any adverse effects from the medication.
13. Leave IV piggyback mini bag and tubing in place for future drug administration. Check agency policy to verify if this practice is acceptable.	Repeated changes in IV tubing increase risk for infection transmission. Secondary IV tubing should be changed as per agency policy.
14. Perform hand hygiene.	Hand hygiene reduces the transmission of microorganisms.  *Hand hygiene with ABHR*
15. Document administration of the IV piggyback on MAR, the I/O sheet, and as per agency policy.	Document time, therapeutic effect, and any adverse reactions. Prompt documentation avoids the possibility of accidentally repeating the administration of the drug. If the drug was omitted or refused, record this appropriately and notify the primary health care provider.

Data source: Berman & Snyder, 2016; Lynn, 2011; Perry et al., 2014; WHO, 2012

Checklist 64 lists the steps to administer an intermittent IV medication using an existing secondary line, by gravity or an IV infusion pump.

Checklist 64: Administering an Intermittent Intravenous Infusion Using Existing Secondary Line

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety Considerations:

- Review the advantages and disadvantages of IV medications.
- Always label the IV mini bag at the medication cart with the patient name, date, time, medication dose (e.g., Gravol 50 mg), concentration, and your initials. Once the medication is prepared, keep in a secure area.
- NEVER administer an IV medication through an IV line that is infusing blood, blood products, heparin IV, insulin IV, cytotoxic medications, or parenteral nutrition solutions.
- Central venous catheters (central lines, PICC lines) require special pre- and post-flushing procedures and specialized training.
- You will need a watch with a second hand to time the rate of administration.
- The use of IV infusion pumps requires specialized training to avoid programming errors. Refer to the resources at the end of this chapter for links to reviewing IV infusion devices.

STEPS	ADDITIONAL INFORMATION
1. Prepare one medication for one patient at the correct time as per agency policy. Always check the physician's order, PDTM, and MAR. Mathematical calculations may be required to determine the correct dose to prepare.	Always apply the SEVEN rights of medication administration. Review the agency policy and the PDTM. If a medication is a stat, first-time, loading, or one-time dose, be extra diligent in reviewing the PDTM. Memory slips are a common source of error with medication administration. Complete all assessments and laboratory values that may influence the medication administration. If piggyback (secondary) medication is made up by the health care provider, ensure the medication label on the mini bag includes the patient name, date, time, medication added, dose and concentration, expiry time, and your initials. Some health agencies require a second independent check with high-alert medications. Always follow agency policy.
2. Bring medication and MAR to bedside. Create privacy if possible.	Additional equipment required includes secondary tubing, a metal or plastic extension hanger, an alcohol swab, and a timer with a second hand. Creating privacy provides comfort to patient.

3. Compare the MAR printout with the patient's wristband, and use two patient identifiers (name and birth date), according to agency policy, to confirm patient ID.	This ensures you have the correct patient and complies with agency standard for patient identification.  *Compare MAR with patient's wristband*
4. Ask about allergies.	This ensures allergy status is correct on the MAR and the patient's allergy band.
5. Discuss purpose, action, and possible side effects of the medication. Provide patient an opportunity to ask questions. Encourage patient to report discomfort at the IV site (pain, swelling, or burning).	Keeping patient informed of what is being administered helps decrease anxiety.
6. Perform hand hygiene.	Hand hygiene prevents the transmission of microorganisms.  *Hand hygiene with ABHR*
7. Complete necessary assessments as required. Assess IV site for patency.	IV medications may require assessment of vital signs and lab values prior to administration. IV site must be patent prior to use.

8. Prime the secondary IV line by “back filling” using the empty IV mini bag attached to the secondary IV line.	Check expiration date on secondary IV tubing. Open the clamp on the secondary IV line and lower the mini bag below the primary IV line. This will cause IV solution from the primary IV bag to enter the old mini bag and clear out the secondary IV line. Allow approximately 25 ml of IV solution to enter the used mini bag.  *Lower secondary IV bag below primary and open clamp to flush out secondary IV line* Once the secondary IV line is cleared, close the clamp on the secondary IV line, and ensure the drip chamber is 1/2 full. Remove the old mini bag from the secondary IV tubing and place on the bedside table. Carefully remove sterile blue cover on new medication bag, and insert the spike of the secondary IV tubing into the new IV bag, being careful to avoid accidental contamination.  *Insert spike into secondary IV bag* Open clamp on the secondary IV tubing.

	 *Open clamp on secondary IV line*
9. Ensure piggyback mini bag is hung above the primary IV solution bag.	Position of the IV solutions influences the flow of the IV fluid into the patient. The setup is the same if the medication is given by gravity or through an IV infusion pump. Always follow manufacturer's directions for infusion pumps.  *Set up for secondary IV infusion*
10. Ensure clamp on secondary tubing is open.	This prevents the patient from missing a dose of medication.  *Open clamp on secondary IV tubing*

11a. If using gravity infusion, use the roller clamp on the primary set to regulate the rate. The rate will be calculated for gtts/mins. 11b. If using an IV infusion pump, set the rate according to the PDTM. Most infusion pumps automatically restart the primary infusion at the previously established rate.	 *Regulate infusion with primary IV line roller clamp* If administering IV medication by gravity, remember to return to the patient and readjust the rate for the primary IV infusion. The primary IV solution will resume infusing at the rate of the secondary infusion, which could lead to rapid infusion of the primary solution. If medication is being given for the first time, stay with the patient for the first 5 minutes to monitor for any potential adverse effects. Encourage patient to notify the health care provider if IV site becomes red, painful, or swollen, or if patient notices any adverse effects from the medication.
12. Leave IV mini bag and tubing in place for future drug administration. Check agency policy to verify if this practice is acceptable.	Repeated changes to IV tubing increase risk for infection transmission. Secondary IV tubing should be changed as per agency policy.
13. Perform hand hygiene.	Hand hygiene reduces the transmission of microorganisms.  *Hand hygiene with ABHR*

14. Document administration of the IV piggyback on MAR, and as per agency policy.	Document time, therapeutic effect, and any adverse reactions Prompt documentation avoids the possibility of accidentally repeating the administration of the drug. If the drug was omitted or refused, record this appropriately and notify the primary health care provider.
Data source: Clayton et al., 2010; Lynn, 2011; Perry et al., 2014; WHO, 2012	

CONTINUOUS INTRAVENOUS (MEDICATION) INFUSION

A **continuous intravenous infusion** is the infusion of a parenteral drug over several hours (continuous drip) to days. It involves adding medication to sterile IV solution (100 to 1,000 ml bag), and then hanging the IV solution as a primary infusion. A continuous drip must be ordered by the physician and listed in the PDTM as a medication to be given by IV continuous infusion. Most IV continuous infusions are given for a short duration. Examples of continuous IV infusion medications include heparin, insulin R, and pantaprazole. Continuous intravenous infusions may come pre-made from the pharmacy, and are labelled with the patient name; IV solution; volume, amount, and concentration of medication; initials of the RN; and date and time prepared (Alberta Health Services, 2009). Always refer to the PDTM for guidelines on how to administer, regulate, and titrate continuous infusions.

An electronic infusion device (EID) must be used to infuse continuous IV medications. Assessments and lab values must be monitored following the PDTM guidelines. A health care provider must assess the continuous medication for the dose, rate, and patency of the IV site, and assess the patient for therapeutic and adverse reactions to the medication. The Institute for Safe Medication Practices (ISMP) (2013) recommends that all high-alert medications be independently double-checked to detect potential harmful errors before they reach the patient. Independent double checks have been shown to detect up to 95% of errors (ISMP Canada, 2013).

Critical Thinking Exercises

1. Can the same secondary IV tubing be used more than once? Explain your answer.
2. What is the purpose of hanging the piggyback IV medication higher than the primary IV solution?

7.7 Complications Related to Parenteral Medications and Management of Complications

Safe medication administration requires special attention to transition points where medication errors are more likely to occur. For example, many errors occur in the ordering and preparing phase. Many parenteral medications are considered high-alert medications because of the potential significant harm when used in error. Therefore, these medications require special safeguards to reduce the risk of error. ISMP (2014) lists IV medications classified as high alert. All parenteral routes of insulin (SC/IV) are considered high alert (ISMP, 2014). Specific safeguards may include:

- Know the safe dosage range for each medication you administer.
- Label all medications that are prepared away from the bedside and not in the original container.
- Refer to the ISMP lists for high-alert medications: do not crush, do not use any error-prone abbreviations or look-/sound-alike drugs and symbols.
- Never assume an ordered medication dose is the correct medication or correct dose. Know your medications.

In addition, complications may occur if medication is injected incorrectly, if incorrect equipment (needle or syringe) is used to prepare the medication, or if an error occurs in preparing (calculation, selection of the med), administration, or post-assessment of the patient receiving the medication. Additional complications may include nerve or tissue damage, medication being absorbed too fast or too slow, wrong location for the medication, pain, bleeding, or a sterile abscess (Perry et al., 2014).

Despite safe medication administration practices, an adverse reaction may happen to a patient for a variety of complex reasons and contributing factors (College of Nurses of Ontario, 2015). An **adverse reaction,** also known as an **adverse event**, is an undesirable effect of any health product such as prescription and non-prescription pharmaceuticals, vaccines, serums, and blood-derived products; cells, tissues, and organs; disinfectants; and radiopharmaceuticals. An adverse reaction may occur under normal use and conditions of the product. Reactions may be evident within minutes or years after exposure to the product and may range from minor reactions, like a skin rash, to serious and life-threatening events such as a heart attack or liver damage (Health Canada, 2012). For example, some IV bolus medications may cause a sudden drop in blood pressure or heart rate, or hives may result.

Table 7.11 lists five steps to manage an adverse reaction.

Table 7.11 Managing Adverse Reactions to IV Medications

Step	Additional Information
1.	Immediately stop the injection (or infusion) of the medication. Keep syringe of medication for further investigation of the reaction.
2.	Assess and monitor vital signs. Alert other members of the health care team and ask for assistance as required. Provide reassurance to the patient about the event.
3.	Notify responsible health care provider.
4.	Perform interventions (CPR, O_2 support) as required. Ensure patient has a patent IV site for any required medications to manage the adverse reaction.
5.	Document and report the event through PSLS or agency-specified reporting system.
Data source: Alberta Health Services, 2009; Clayton et al., 2010; College of Nurses of Ontario, 2015; Health Canada, 2012	

COMPLICATIONS OF INTRAVENOUS MEDICATIONS

Complications may result from direct, continuous, or secondary IV medications. The complications are not specific to one medication. It is important for the health care provider to know which adverse event may occur with each individual medication. For example, the administration of an IV opioid (narcotic) medication could result in respiratory depression. Table 7.12 provides a list of possible complications and related interventions.

Table 7.12 Possible Complications and Related Interventions

Complications	Related Interventions
Speed shock: A systemic reaction caused by the rapid injection of a medication into the circulation, resulting in toxic levels of medication in the plasma. Symptoms can include cardiac arrest, flushed face, headache, irregular pulse, shock, syncope, and tightness in the chest.	Use a peripheral IV site, if possible, to allow for maximum hemodilution before the medication reaches the heart/brain. Stay with the patient and observe for symptoms or changes in vital signs and level of consciousness during and after administration. Stop the injection immediately if the patient develops signs or symptoms of circulatory (drop in BP), respiratory (dyspnea), or neurological (decrease in LOC) deterioration during administration.
IV medication is incompatible with IV fluids: Results in chemical or physical changes in their composition. Precipitates may form, colour may change (e.g., IV fluid becomes cloudy in the IV tubing), or the change may not be visible. Therapeutic effect of the medication may be reduced, obliterated, or potentiated. Toxic substances may be formed.	Always follow the guidelines in the PDTM. Do not mix medications in one syringe and only give one medication at a time. Never add medications to blood, blood products, or total parenteral nutrition. To avoid mixing of medications, ensure IV tubing and injection ports are flushed adequately between medication administrations. Stop the IV medication and flush with normal saline. If unable to give an IV medication due to incompatibles, start a new IV site or a new IV system (prime a new primary and secondary line) to administer the medication. Document changes and notify physician.
IV site shows signs of phlebitis or irritation: Injection of medication into a vein may cause inflammation or roughening of the endothelial lining, which can result in thrombus formation. Medication may also be inadvertently injected into surrounding tissue, resulting in tenderness, pain, tissue necrosis, or nerve damage. Septic thrombophlebitis can result from poor aseptic technique.	Monitor for signs and symptoms, such as redness, swelling, pain, blanching, and streaking. If these signs are present, stop infusion immediately. Discontinue access device and restart in another site. If required, provide extravasation care as per agency policy.
Data source: Alberta Health Services, 2009; Lynn, 2011	

REPORTING MEDICATION ERRORS

Medication errors are the leading cause of preventable errors in Canada (ISMP Canada, 2014). A **medication incident** is “any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer. Medication incidents may be related to professional practice, drug products, procedures, and systems, and include prescribing, order communication, product labelling / packaging / nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use.” (ISMP Canada, 2014, p.8)

Most of the critical incidents reported to the ISMP occurred during administration of a medication, with the wrong quantity of medication. The top five medications were hydromorphone, desmopressin, epinephrine, heparin, and morphine. Opioids continue to be the top medication classes associated with harmful incidents reported. Most of the opioid-related deaths involved overdoses, overlapping drug toxicities, administration of opioids to people who should not have received them, and use of hydromorphone (ISMP Canada, 2014).

Overall, the top three contributing factors were communication, independent check processes, and insufficient knowledge (ISMP Canada, 2014). Table 7.13 lists areas for improvement to prevent IV medication errors.

Table 7.13 Areas for Improvement to Prevent IV Medication Errors

Area	Additional Information
Monitoring of patient after medication administration	Be diligent in post-assessments of all IV medications. However, be particularly aware of high-alert medications, such as insulin, opioids, and anticoagulants. Many incident reports state that timely observation by a health care provider or family member prevents a bad outcome. Many overdoses can be reversed if caught in a timely manner.
IV infusion pump errors	Errors can include: • Lack of available IV pumps • Transcription errors such as: ◦ Decimal point omitted ◦ Decimal point moved ◦ Concentration input • Incorrect drug selection • Multiple line confusion • Pump setup To decrease patient harm, hospitals need additional funding to purchase more IV pumps.
Health care technology	Computer-prescribed order entry (CPOE), automated dispensing cabinets (ADC), and other tools seek to improve patient safety and decrease errors. Protocols and force functioning need to be developed to minimize potential errors and to identify potential gaps in the system process.
Reporting, analysis, and knowledge translation	The collection and analysis of incident reports is the backbone to further improvements. Without a robust system, there cannot be the identification of contributing factors to medication incidents. Always report near misses, adverse reactions, and medication errors to ensure investigation and improvement is initiated. In addition, shared learning and strategies are vital for safer health care.
Data source: Clayton et al., 2010; ISMP Canada, 2014	

Critical Thinking Exercises

1. List three types of complications and preventive measures for each one.
2. Name two strategies to reduce the risk of harm from high-alert medications, and consider a method of sharing your strategies with your colleagues.

7.8 Summary

Parenteral medication administration is an effective method of delivering medication to patients, and can be safely accomplished by utilizing the appropriate guidelines and policies in place to keep patients safe from harm. IV medications have a higher risk of harm than non-parenteral medication. The ever-increasing complexity of the health care environment increases the risk of a medication error with parenteral medications. The key takeaways below provide advice for preventing errors with parenteral medications.

Key Takeaways

- Parenteral medications have a quicker onset of therapeutic effects. Be aware of the onset, peak, and duration of all parenteral medications.
- Know which medications are considered high-alert medications and perform independent double checks to minimize errors.
- Always consider the therapeutic effects and adverse effects when administering parenteral medications.
- Safeguards for medication administration exist in most hospitals. Make use of all safety strategies (such as smart IV pumps, no-interruption zones, two patient identifiers, and checklists) to administer medications safely.
- Quality and safety controls for safe medication administration must be considered along the entire process, not just at the point of administration.
- It is human nature to look for quick and easy ways to perform a task, but doing so may lead to errors. Avoid workarounds: Most hospitals have operational failures that lead to front line health care providers finding ways to manage deficiency in hospital operating systems. Rather than creating workarounds, engage in the additional steps to prevent re-occurrence of issues.
- Stay current with evidence-based research regarding potential system errors in health care. Commit to improving patient safety with medication administration.
- Report all errors, near misses, and adverse reactions to ensure knowledge is shared, and to prevent further errors from occurring.

SUGGESTED ONLINE RESOURCES

1. Agency for Healthcare Research and Quality (AHRQ). This website provides evidence-based research, guidelines, recommendations, and resources on improving patient safety .
2. Canadian Patient Safety Institute (CPSI). This organization’s website provides guidelines, research, and recommendations for improving patient safety in Canada.

3. Drug calculations. This medication calculation website reviews how to calculate the dosages for parenteral and non-parenteral medications, and IV fluids. It also includes metric conversions and IV drop rate calculations.
4. Institute for Healthcare Improvement (IHI). This group's website provides educational resources, webinars, publications, and improvement stories and tools to enhance patient safety.
5. Institute for Safe Medication Practices (ISMP). This organization focuses on improving medication administration. Its website lists high-alert medications, offers newsletters and webinars, and provides a system for reporting medication errors, guidelines, and policies on safe practices.

REFERENCES

Ağac, E., & Günes, U. Y. (2011). Effect on pain of changing the needle prior to administering medication intramuscularly: A randomized controlled trial. *Journal of Advanced Nursing*, 67(3) 563-568. doi: 10.1111/j.1365-2648.2010.05513.x.

Agency for Healthcare Research and Quality. (2014). Checklists. Retrieved on June 11, 2015, from http://psnet.ahrq.gov/primer.aspx?primerID=14

Alberta Health Services. (2009). Direct IV medications. Specialized clinical competency program. Retrieved on June 2, 2015, from http://extcontent.covenanthealth.ca/Policies/iii-45_Learning_Module.pdf

American Nurses Association. (2002). Needlestick prevention guide. Retrieved on Oct 5, 2015, from http://www.who.int/occupational_health/activities/2needguid.pdf

ATI. (2015a). Administering an ID injection. Retrieved on Oct 7, 2015, from http://www.atitesting.com/ati_next_gen/skillsmodules/content/medication-administration-3/equipment/intradermal-injections.html

ATI. (2015b). Administering an SC injection. Retrieved on Oct 7, 2015, from http://www.atitesting.com/ati_next_gen/skillsmodules/content/medication-administration-3/viewing/subcutaneous_injection.html

Berman, A., & Snyder S. J. (2016). *Skills in clinical nursing* (8th ed.). New Jersey, New York: Pearson.

Black, L. (2013). Ditch the pinch: Bilateral exposure injuries during subcutaneous injections. *American Journal of Infection Control*, 41(9), 815-819. doi: 10.1016/j.ajic.2012.10.017

British Columbia Institute of Technology (BCIT). (2015). NURS 3020: Clinical techniques. Week 11, power point notes.

Brookside Associates. (2015a). Procedure for administering an intradermal injection. Retrieved on Oct 8, 2015, from http://brooksidepress.org/intramuscular/lessons/lesson-2-administer-an-intramuscular-injection/2-07-procedure-for-administering-an-intradermal-injection/

Brookside Associates. (2015b). Procedure for administering a subcutaneous injection. Retrieved on Oct 7, 2015, from http://brooksidepress.org/intramuscular/lessons/lesson-2-administer-an-intramuscular-injection/2-05-procedure-for-administering-a-subcutaneous-injection/

Butt, A. R. (2010). Medical error in Canada. Issues related to reporting medical error and methods to increase reporting. *McMaster University Medical Journal*, Clincal Review, 7(1). 15-18.

Canadian Agency for Drugs and Technologies in Health. (2014). Aspirating versus not aspirating prior to injection of medication: Comparative clinical evidence and guidelines. Retrieved on Oct 7, 2015, from https://www.cadth.ca/sites/default/files/pdf/htis/nov-2014/RB0669%20Aspiration%20Prior%20to%20Injection%20Final.pdf

Canadian Diabetes Association. Clinical Practice Guidelines Expert Committee. (2013). Clinical practice guidelines for the prevention and management of diabetes in Canada. *Canadian journal of diabetes*, 37(supp 1), s1-s212.

Canadian Institute for Health Information. (2009). National system for incident reporting: An innovative approach to information management. *CPSI forum, 2009*. Retrieved on June 2, 2015, from http://www.patientsafetyinstitute.ca/English/toolsResources/Presentations/Documents/2009/Canada%27s%20Forum%20-%20Presentation%20A4-b.pdf

Canadian Patient Safety Institute. (2012). Canadian analysis incident framework. Retrieved on June 3, 2015, from http://www.patientsafetyinstitute.ca/english/toolsresources/incidentanalysis/documents/canadian%20incident%20analysis%20framework.pdf

Centers for Disease Control (CDC). (2012). NOISH fast facts (home healthcare workers). How to prevent needlestick and sharp injuries. Retrieved on Oct 7, 2015, from http://www.cdc.gov/niosh/docs/2012-123/pdfs/2012-123.pdf

Centers for Disease Control (CDC). (2013). Infection control. Retrieved on June 11, 2015, from http://www.cdc.gov/oralhealth/infectioncontrol/faq/protective_equipment.htm

Centers for Disease Control (CDC). (2015). Injection safety. Retrieved on June 2, 2015, from http://www.cdc.gov/injectionsafety/

College of Nurses of Ontario. (2015). Medication practice standard. Retrieved on June 1, 2015, from http://www.cno.org/Global/docs/prac/41007_Medication.pdf

Clayton, B. D., Stock, Y. N., & Cooper, S. E. (2010). *Basic pharmacology for nurses*. St Louis, MO: Mosby Elsevier.

Cocoman, A., & Murray, J. (2008). Intramuscular injections: A review of best practice for mental health nurses. *Journal of Psychiatry Mental Health Nursing*, *15*(5), 424-434. doi: 10.1111/j.1365-2850.2007.01236

Davidson, K.M. & Rourke, L. (2014). Teaching best evidence: Deltoid intramuscular injection techniques. Retrieved on Oct 15, 2015, from http://www.sciedu.ca/journal/index.php/jnep/article/view/1888/1291

Debono, D. S., Greenfield, D., Travaglia, J. F., Long, J. C., Black, D., Johnson, J., & Braithwaite, J. (2013). Nurses' workarounds in acute healthcare settings: A scoping review. *BMC Health Services Research, 13*(175). doi:10.1186/1472-6963-13-175

Ellis, J., & Parush, A. (2012). Preventing errors with high alert drugs: Testing a computerized double check. Retrieved on June 5, 2015, from http://www.patientsafetyinstitute.ca/English/research/cpsiResearchCompetitions/2009/Documents/Ellis/Ellis%20Techinical%20Report%20English.pdf

Greenway, K. (2014). Rituals in nursing: Intramuscular injection. *Journal of Clinical Nursing, 23*(23-24), 3583-3588. doi: 10.1111/jocn.12627

Health Canada. (2012). Adverse reaction information. Retrieved on June 1, 2015, from http://www.hc-sc.gc.ca/dhp-mps/medeff/advers-react-neg/index-eng.php

Hunter, J. (2008). Intramuscular injection techniques. *Nursing Standard, 22* (24), 35-40.

Hutin, Y., Hauri, A., Chiarello, L., Caitlin, M., Stillwell, B., Ghebrehiwet, T., Garner, J., and Members of the Safe Injection Practice Group (2003). Best infection control practices for intradermal, subcutaneous and intramuscular injections. Retrieved on Nov. 8, 2015 from http://www.who.int/bulletin/volumes/81/7/Hutin0703.pdf

Institute for Healthcare Improvement. (2015). High alert medication safety. Retrieved on June 11, 2015, from http://www.ihi.org/topics/highalertmedicationsafety/pages/default.aspx

Institute for Safe Medication Practices (ISMP). (2003). How fast is too fast for IV push medications? Retrieved on June 3, 2015, from http://www.ismp.org/newsletters/acutecare/articles/20030515.asp

Institute for Safe Medication Practices (ISMP). (2013). Independent double checks: Undervalued and misused: Selective use of this strategy can play an important role in medication safety. Retrieved on June 5, 2015, from https://www.ismp.org/newsletters/acutecare/showarticle.aspx?id=51

Institute for Safe Medication Practices (ISMP). (2014). ISMP list of high alert medications in acute care settings. Retrieved on June 1, 2015, from https://www.ismp.org/tools/highalertmedications.pdf

Institute for Safe Medication Practices Canada (ISMP Canada). (2013). Ontario hospital critical incident related to medications or IV fluids analysis report. *January-December 2013*. Retrieved on June 4, 2015, from http://www.ismp-canada.org/download/ocil/ON_Critical_Incidents_Analysis_Report_3JUL2014.pdf

Institute for Safe Medication Practices Canada (ISMP Canada). (2014). Opioid-related deaths associated with medication incidents. Findings of multi-incident analysis. Retrieved on June 4, 2015, from http://www.ismp-canada.org/download/OpioidStewardship/Opioid-Related_Deaths_Associated_with_Medication_Incidents_Nov2014.pdf

Ipp, M., Sam, J., & Parkin, P. C. (2006). Needle aspiration and intramuscular vaccination. *Arch Pediatr Adolesc Med, 160*(4), 451-453. doi:10.1001/archpedi.160.4.451-a

Lynn, P. (2011). *Photo atlas of medication administration* (4th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Malkin, B. (2008). Are techniques used for intramuscular injection based on research evidence? *Nursing times*, 104: 50-51, 48–51.

Merriam-Webster. (2015). Definition of parenteral. Retrieved on June 5, 2015, from http://www.merriam-webster.com/medical/parenteral

Mitchell, J. R., & Whitney, F. W. (2001). The effect of injection speed on the perception of intramuscular injection pain. A clinical update. Retrieved on Oct 7, 2015, from http://www.ncbi.nlm.nih.gov/pubmed/11760527

National Institute for Occupational Safety and Health. (1999). Preventing needle stick injuries in the health care setting. Retrieved on Oct 5, 2015, from http://www.cdc.gov/niosh/docs/2000-108/pdfs/2000-108.pdf

National Institute of Health Clinical Center. (2015). NIH Clinical Center patient education material. Giving a subcutaneous injection. Retrieved on Oct 7, 2015, from http://www.cc.nih.gov/ccc/patient_education/pepubs/subq.pdf

National Patient Safety Agency. (2009). Safety in doses. Improving the use of medication in NHS. Retrieved on June 11, 2015, from http://www.nrls.npsa.nhs.uk/resources/?entryid45=61625

National Priority Partnership. (2010). Preventing medical errors: A $21 billion opportunity. Retrieved on June 3, 2015, from http://psnet.ahrq.gov/resource.aspx?resourceID=20529

Nisbet, A. C. (2006). Intramuscular gluteal injections in the increasingly obese population: Retrospective study. *British Medical Journal*, *332*(7542), 637-638. doi: http://dx.doi.org/10.1136/bmj.38706.742731.47

Ogston-Tuck, S. (2014a). Intramuscular injection technique: An evidence-based approach. *Nursing Standard*, *29*(4), 52-59. Retrieved on Oct 7, 2015, from http://journals.rcni.com/doi/pdfplus/10.7748/ns.29.4.52.e9183

Ogston-Tuck, S. (2014b). Subcutaneous injection technique: An evidence-based approach. *Nursing Standard*, *29*(3), 53-58.

Perry, A., Potter, P., & Ostendorf, W. (2014). *Clinical skills and nursing techniques* (8th ed.). St Louis, MO: Elsevier-Mosby.

Prakash, V., Koczmara, C., Saveage, P., Trip, K., Stewart, J., Mccurdie, T., Cafazzo, J., & Trbovich, P. (2014). Mitigating errors caused by interruptions during medication verification and administration: Interventions in a simulated ambulatory chemotherapy setting. *BMJ Quality and Safety, 0* (1-10). doi:10.1136/bmjqs-2013-002484

Pratt, J. R., Pellowe, C. M., Wilson, J. A., Loveday, H. P., Harper, P. J., Jones, S. L. R. J., McDougall, C., & Wilcox, M. J. (2007). Epic2: National evidence based guidelines for preventing health care associated infections in NHS hospitals in England. *J Hosp Infect 65*, Suppl 1, S1 – 64.

Provincial Infectious Disease Advisory Committee. (2014). *Best practices for hand hygiene in all*

health care settings (4th ed.). Retrieved on June 4, 2015, from http://www.publichealthontario.ca/en/eRepository/2010-12%20BP%20Hand%20Hygiene.pdf

Rodgers, M.A., & King, L. (2000). Drawing up and administering intramuscular injections: A review of the literature. *Journal of Advanced Nursing*, *31*(3), 574–582. doi: 10.1046/j.1365-2648.2000.01312.x

Sepah, Y., Samad, L., & Altaf, A. (2014). Aspiration in injections: Should we continue or abandon the practice? *F1000Research*, *3*(157) doi:10.12688/f1000research.1113.1

Siegel, J.D., Rhinehart, E., Jackson, M., Chiarello, L., and the Healthcare Infection Control Practices Advisory Committee (2007). Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. Retrieved on Nov. 8, 2015, from http://www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf

Sisson, H. (2015). Aspirating during the intramuscular injection procedure: A systematic literature review. *Journal of Clinical Nursing*, *Sept 24* (17-18), 2368-2375. doi: 10.1111/jocn.12824

Wilburn, S. Q. (2004). Needlestick sharps injury and prevention. *The Online Journal of Issues in Nursing*. Retrieved on Oct 5, 2015, from http://www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Volume92004/No3Sept04/InjuryPrevention.html

Wilburn, S. Q., & Eijkemans, G. (2004). Preventing needle stick injuries among health care workers. *International Journal of Occupational and Environmental Health*, *10*(4), 451-456.

Workers Compensation Act. (2015). Occupational health and safety regulation. Retrieved on July 20, 2015, from http://www.bclaws.ca/Recon/document/ID/freeside/296_97_04

Workman, B. (1999). Safe injection techniques. *Nursing standard*, 13(39), 47-53.

World Health Organization. (2012). Course: Knowledge is the enemy of unsafe care. Retrieved on June 1, 2015, from http://who.int/patientsafety/education/curriculum/course7_handout.pdf

Chapter 8. Intravenous Therapy

8.1 Introduction

The use of intravenous (IV) therapy is common in the health care setting. IV therapy is a treatment that infuses fluids, nutrients, blood, blood products, or medication directly into a vein. It is a fast, efficient way to infuse fluids and medications into the body.

This chapter will review how to care for a patient with peripheral intravenous therapy and central venous catheters. It will cover how to prepare IV infusions, and how to assess, maintain, and prevent complications related to intravenous therapy.

Learning Objectives

- Define patient conditions
- Discuss how to prevent infections related to IV therapy, general guidelines, and complications associated with IV therapy
- Compare the benefits and complications related to a peripheral IV for administering IV therapy
- Identify common types of central venous catheters and the benefits and complications associated with them
- Demonstrate how to flush a saline lock, start a continuous IV infusion, discontinue a continuous infusion, and discontinue a peripheral IV
- Describe how to change IV solution and IV tubing, and how to calculate IV rates
- Discuss indications for blood and blood product transfusions
- Describe how to prepare, administer, and monitor blood and blood products and manage transfusion reactions according to Canadian standards
- Define total parenteral nutrition (TPN), explain how to care for a patient receiving TPN, and identify potential complications
- Explain how to administer TPN

8.2 Intravenous Fluid Therapy

Intravenous therapy is treatment that infuses intravenous solutions, medications, blood, or blood products directly into a vein (Perry, Potter, & Ostendorf, 2014). Intravenous therapy is an effective and fast-acting way to administer fluid or medication treatment in an emergency situation, and for patients who are unable to take medications orally. Approximately 80% of all patients in the hospital setting will receive intravenous therapy.

The most common reasons for IV therapy (Waitt, Waitt, & Pirmohamed, 2004) include:

1. To replace fluids and electrolytes and maintain fluid and electrolyte balance: The body's fluid balance is regulated through hormones and is affected by fluid volumes, distribution of fluids in the body, and the concentration of solutes in the fluid. If a patient is ill and has fluid loss related to decreased intake, surgery, vomiting, diarrhea, or diaphoresis, the patient may require IV therapy.
2. To administer medications, including chemotherapy, anesthetics, and diagnostic reagants: About 40% of all antibiotics are given intravenously.
3. To administer blood or blood products: The donated blood from another individual can be used in surgery, to treat medical conditions such as shock or trauma, or to treat a failure in the production of red blood cells. The infusion restores circulating volumes, improving the ability to carry oxygen and replace blood components that are deficient in the body.
4. To deliver nutrients and nutritional supplements: IV therapy can deliver some or all of the nutritional requirements for patients unable to obtain adequate amounts orally or by other routes.

GUIDELINES RELATED TO INTRAVENOUS THERAPY

The following are general guidelines for peripheral IV therapy:

- IV fluid therapy is ordered by a physician or nurse practitioner. The order must include the type of solution or medication, rate of infusion, duration, date, and time. IV therapy may be for short or long duration, depending on the needs of the patient (Perry et al, 2014).
- IV therapy is an invasive procedure, and therefore significant complications can occur if the wrong amount of IV fluids or the incorrect medication is given.
- Aseptic technique must be maintained throughout all IV therapy procedures, including initiation of IV therapy, preparing and maintaining equipment, and discontinuing an IV system. Always perform hand hygiene before handling all IV equipment. If an administration set or solution becomes contaminated with a non-sterile surface, it should be replaced with a new one to prevent introducing bacteria or other contaminants into the system (Centers for Disease Control [CDC], 2011).
- Understand the indications and duration for IV therapy for each patient. Practice guidelines

recommend that patients receiving IV therapy for more than six days should be assessed for an intermediate or long-term device (CDC, 2011).

- If a patient has an order to keep a vein open, or "TKVO," the usual rate of infusion is 20 to 50 ml per hour (Fraser Health Authority, 2014).
- Complications may occur with IV therapy, including but not limited to localized infection, catheter-related bloodstream infection (CR-BSI), fluid overload, and complications related to the type and amount of solution or medication given (Perry et al., 2014).
- For an infusing peripheral IV, the site must be assessed every 2 hours and p.r.n.
- A saline lock site must be assessed every 12 hours and p.r.n.

TYPES OF VENOUS ACCESS

Safe and reliable venous access for infusions is a critical component of patient care in the acute and community health setting. There are a variety of options available, and a venous access device must be selected based on the duration of IV therapy, type of medication or solution to be infused, and the needs of the patient. In practice, it is important to understand the options of appropriate devices available. This section will describe two types of venous access: peripheral IV access and central venous catheters.

PERIPHERAL IV

A peripheral IV is a common, preferred method for short-term IV therapy in the hospital setting. A **peripheral IV (PIV)** (see Figure 8.1) is a short intravenous catheter inserted by percutaneous venipuncture into a peripheral vein, held in place with a sterile transparent dressing to keep the site sterile and prevent accidental dislodgement (CDC, 2011). Upper extremities (hands and arms) are the preferred sites for insertion by a specially trained health care provider. If a lower extremity is used, remove the peripheral IV and re-site in the upper extremities as soon as possible (CDC, 2011; McCallum & Higgins, 2012). The hub of a short intravenous catheter is usually attached to IV extension tubing with a positive pressure cap (Fraser Health Authority, 2014).

PIVs are used for infusions under six days and for solutions that are iso-osmotic or near iso-osmotic (CDC, 2011). They are easy to monitor and can be inserted at the bedside. CDC (2011) recommends that PIVs be replaced every 72 to 96 hours to prevent infection and phlebitis in adults. Most agencies require training to initiate IV therapy, but the care and preparation of equipment, and the maintenance of an IV system can be completed each shift by the trained health care provider. For more information on how to initiate IV therapy, see the resources at the end of the chapter.

Figure 8.1 Peripheral intravenous (IV) catheter (PIV)

PIVs are prone to phlebitis and infection, and should be removed (CDC, 2011) as follows:

- Every 72 to 96 hours and p.r.n.
- As soon as the patient is stable and no longer requires IV fluid therapy
- As soon as the patient is stable following insertion of a cannula in an area of flexion
- Immediately if tenderness, swelling, redness, or purulent drainage occurs at the insertion site
- When the administration set is changed (IV tubing)

Several potential complications may arise from peripheral intravenous therapy. It is the responsibility of the health care provider to monitor for signs and symptoms of complications and intervene appropriately. Complications can be categorized as local or systemic. Most complications are avoidable if simple hand hygiene and safe principles are adhered to for each patient at every point of contact (Fraser Health Authority, 2014; McCallum & Higgins, 2012). Table 8.1 lists the potential local and complications and treatment.

Table 8.1 Potential Local Complications of Peripheral IV Therapy

Complication	Signs, Symptoms, and Treatment
Phlebitis	**Phlebitis** is the inflammation of the vein's inner lining, the tunica intima. Clinical indications are localized redness, pain, heat, and swelling, which 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. It is recommended to 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 with a high alkaline, acidic, or hypertonic solutions. To avoid chemical phlebitis, follow the *Parenteral Drug Therapy Manual* (PDTM) guidelines for administering IV medications for the appropriate amount of solution and rate of infusion. Treatment: Immediately remove cannula. May elevate arm or apply a warm compress. Document findings in chart. Initiate a new peripheral IV if necessary.
Infiltration	**Infiltration** occurs when a non-vesicant solution (IV solution) is inadvertently administered into surrounding tissue. Signs and symptoms include pain, swelling, redness, skin surrounding insertion site is cool to touch, change in quality or flow of IV, tight skin around IV site, IV fluid leaking from IV site, and frequent alarms on the IV pump. Treatment: Stop infusion and remove cannula. Follow agency policy related to infiltration. Always secure peripheral catheter with tape or IV stabilization device to avoid accidental dislodgement. Avoid areas of flexion and always assess IV site prior to giving IV fluids or IV medications.
Extravasation	**Extravasation** occurs when vesicant solution (medication) is administered and inadvertently leaks into surrounding tissue, causing damage to surrounding tissue. Characterized by the same signs and symptoms as infiltration but also includes burning, stinging, redness, blistering, or necrosis of the tissue. Treatment: Stop infusion and remove cannula. Follow agency policy for extravasation for specific medications. For example, toxic medications have a specific treatment plan.
Hemorrhage	Hemorrhage is defined as bleeding from the puncture site. Treatment: Apply gauze to the site until the bleeding stops, then apply a sterile transparent dressing.
Local infection at IV site	Local infection is indicated by purulent drainage from site, usually two to three days after an IV site is started. Treatment: Remove cannula and clean site using sterile technique. Monitor for signs and symptoms of systemic infection.
Data source: Fraser Health Authority, 2014; McCallum & Higgins, 2012	

Systemic complications can occur apart from chemical or mechanical complications. To review the systemic complications of IV therapy, see Table 8.2.

Table 8.2 Systemic Complications of Peripheral IV Therapy

Safety considerations: • Cardiac and renal patients have increased risk of systemic complications. • Pediatric patients, neonates, and elderly people have increased risk of systemic complications.	
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 at lung bases, restlessness, breathlessness, dyspnea, and coughing up pinky 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 notify the physician.
Air embolism	**Air embolism** refers to the presence of air in the vascular system and occurs when air is introduced into the venous system and travels to the right ventricle and/or pulmonary circulation. An air embolism is reported to occur more frequently during catheter removal than during insertion, and the administration of up to 10 ml of air has been proven to have serious and fatal effects. 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, lightheadedness, hypotension, wheezing, increased heart rate, altered mental status, and jugular venous distension. Treatment: Occlude source of air entry. Place patient in a Trendelenburg position on the left side (if not contraindicated), apply oxygen at 100%, obtain vital signs, and notify physician promptly. To avoid air embolisms, ensure drip chamber is one-third to one-half filled, ensure all IV connections are tight, ensure clamps are used when IV system is not in use, and remove all air from IV tubing by priming prior to attaching to patient.
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 tip to ensure end is intact.

Catheter-related bloodstream infection	**Catheter-related bloodstream infection (CR-BSI)** is caused by microorganisms that are introduced into the blood through the puncture site, the hub, or contaminated IV tubing or IV solution, leading to bacteremia or sepsis. A CR-BSI is a nosocomial preventable infection and an adverse event. CR-BSI is confirmed in a patient with a vascular device (or a patient who had such a device in the last 48 hours before the infection) and no apparent source for the infection other than the vascular access device with one positive blood culture. Treatment: IV antibiotic therapy To avoid CR-BSI, perform hand hygiene prior to care and maintenance of an IV system, and use strict aseptic technique for care and maintenance of all IV therapy procedures.
Data source: Fraser Health Authority, 2014; Fulcher & Frazier, 2007; McCallum & Higgins, 2012; Perry et al., 2014	

CENTRAL VENOUS CATHETERS

A **central venous catheter** (CVC) (see Figure 8.2), also known as a central line or central venous access device, is an intravenous catheter that is inserted into a large vein in the central circulation system, where the tip of the catheter terminates in the superior vena cava (SVC) that leads to an area just above the right atrium. CVCs have become common in health care settings for patients who require IV medication administration and other IV treatment requirements. CVCs can remain in place for more than one year. Some CVC devices may be inserted at the bedside, while other central lines are inserted surgically. Central lines are inserted by a physician or specially trained health care provider, and the use of ultrasound guided placement is recommended to reduce time of insertion and complications (Safer Healthcare Now, 2012).

A CVC has many advantages over a peripheral IV line, including the ability to deliver fluids or medications that would be overly irritating to peripheral veins, and the ability to access multiple lumens to deliver multiple medications at the same time (Fraser Health Authority, 2014). Central venous catheters can be inserted percutaneously or surgically through the jugular, subclavian, or femoral veins, or via the chest or upper arm peripheral veins (Perry et al., 2014). Femoral veins are not recommended, as the rate of infection is increased in adults (CDC, 2011; Safer Healthcare Now, 2012). To have a CVC inserted or removed, an order by a physician or nurse practitioner must be obtained. Site selection for a CVC may be based on numerous factors, such as the condition of the patient, patient's age, and type and duration of IV therapy.

The majority of patients in an ICU will have a CVC to receive fluids and medications. A chest X-ray is given to determine correct placement before inserting, or to confirm a suspected dislodgement (Fraser Health Authority, 2014). An IV pump must be used with all CVCs to prevent complications.

CVCs are typically inserted for patients requiring more than six days of intravenous therapy or who:

- Require antineoplastic medications
- Are seriously or chronically ill

- Require vesicant or irritant medications
- Require toxic medications or multiple medications
- Require central venous pressure monitoring
- Require long-term venous access or dialysis
- Require total parenteral nutrition
- Require medications with a pH greater than 9 or less than 5, or osmolality of greater than 600mOsm/L
- Have poor vasculature
- Have had multiple PIV insertions/attempts (e.g., two attempts by two different IV therapy practitioners)

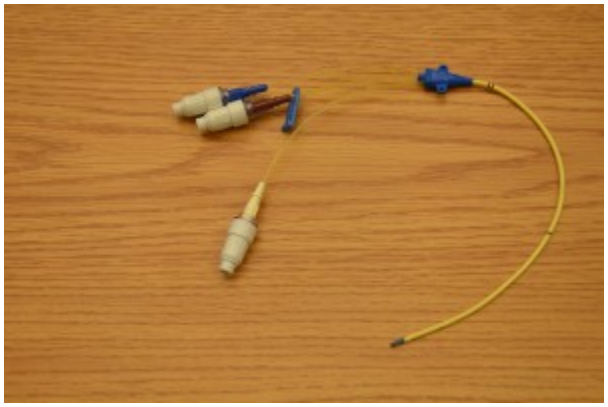


Figure 8.2 Central venous catheter (CVC) with three lumens

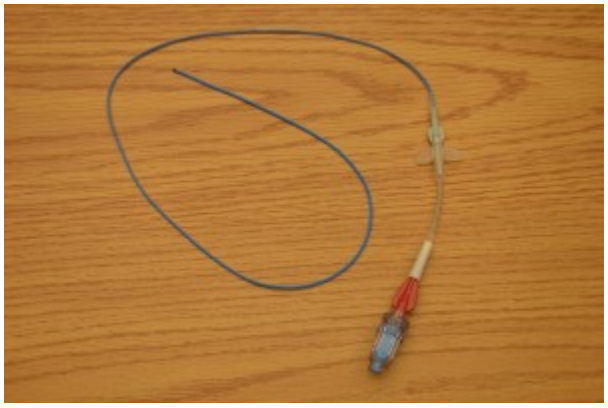


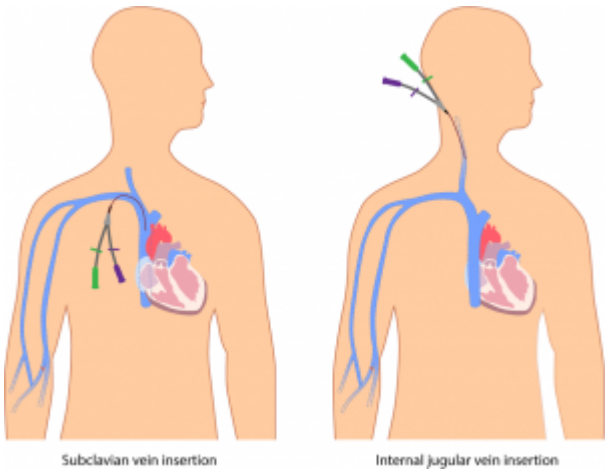
Figure 8.3 Peripherally inserted central catheter (PICC) with one lumen

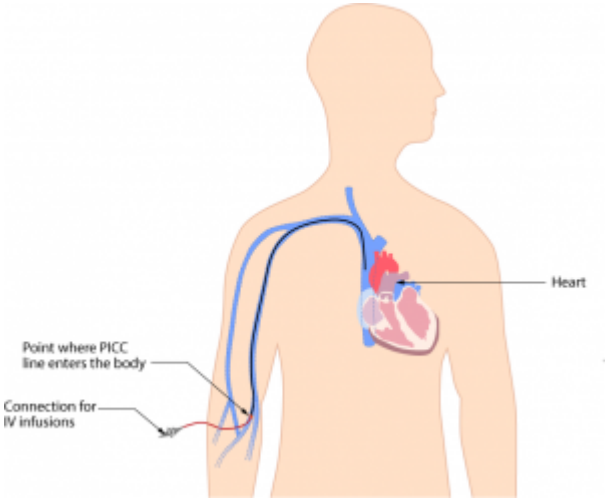
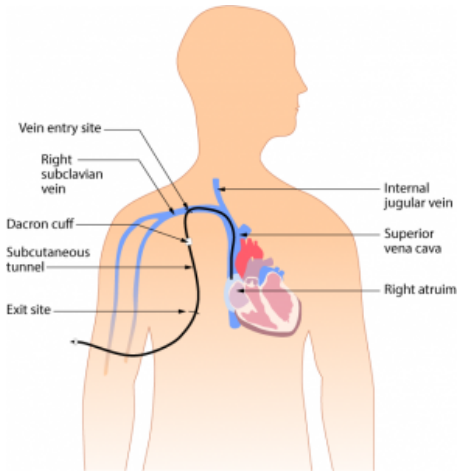
A central line is made up of lumens. A **lumen** is a small hollow channel within the CVC tube. A CVC may have single, double, triple, or quadruple lumens (Perry et al., 2014). Depending on the type of CVC, it may be internally or externally inserted, and may have an open-ended or valved tip. Open-ended devices are those in which the catheter tip is open like a “straw.” These have a higher risk for complications, such as hemorrhage, air embolism, and occlusion from fibrin or clots. Valved devices are those in which the tip is configured with a three-way pressure-activated valve (Perry et al., 2014). It

is important to know what type of central line is being used, as this will impact how to care for and manage the equipment for specific procedures. Table 8.3 lists various types of central lines.

Table 8.3 Types of Central Venous Catheters (CVCs)

Safety considerations: • CVC care and maintenance requires specialized training to prevent complications. • Central lines heighten the risk for patients to develop a nosocomial infection. Strict adherence to aseptic technique is required for all CVC care.	
TYPE	LOCATION AND ADDITIONAL INFORMATION

Percutaneous central venous catheter (CVC)	Tip location: The tip of the catheter is located in the SVC. The entry site is the exit site. Can be inserted at the bedside by specially trained physician or nurse. The **percutaneous CVC** is inserted directly through the skin. The internal or external jugular, subclavian, or femoral vein is used. Most commonly used in critically ill patients. Can be used for days to weeks, and the patient must remain in the hospital. Usually held in place with sutures or a manufactured securement device.  *Central venous catheters*  *Internal jugular venous catheter (upper CVC)*

Peripherally inserted central catheter (PICC)	Tip location: The tip is located in the SVC. A **PICC** (see Figure 8.3) may be inserted at the bedside, in a home or radiology setting. The line is inserted through the antecubital fossa or upper arm (basilic or cephalic vein) and is threaded the full length until the tip reaches the SVC. Can provide venous access for up to one year. The patient may go home with a PICC. PICCs can easily occlude and may not be used with dilantin IV. It is held in place with sutures or a manufactured securement device.  *PICC line inserted in the upper arm (through the basilic vein)*
Subcutaneous or tunnelled central venous catheter	A **tunnelled CVC**, also known as a Hickman, Broviac, or Groshong, is a long-term CVC with a proximal end tunnelled subcutaneously from the insertion site and brought out through the skin at an exit site. Insertion is a surgical procedure, in which the catheter is tunnelled subcutaneously under the skin in the chest area before it enters the SVC. A tunnelled catheter may remain inserted for months to years. These CVCs have a low infection rate due to a **Dacron cuff**, an antimicrobial cuff surrounding the catheter near the entry site, which is coated in antimicrobial solution and holds the catheter in place after two to three weeks of insertion.  *Tunnelled CVC*

Implanted central venous catheter (ICVC, port a cath)	The **implanted central venous catheter (ICVC)** is inserted into a vessel, body cavity, or organ and is attached to a reservoir or "port," located under the skin. The ICVC is also referred to as a **port a catheter** or **port a cath**. A surgical procedure is required to insert the device, which is considered permanent. The device may be placed in the chest, abdomen, or inner aspect of the forearms. It is often better for body image. The ICVC can be accessed using a non-coring needle. A patient may return home with this type of CVC.  *Chest with ICVC inserted*  *ICVC under the skin*

Data source: Fulcher & Frazier, 2011; Perry et al., 2014

CVCs have specific protocols for accessing, flushing, disconnecting, and assessment. All health care providers require specialized training to care for, manage complications related to, and maintain CVCs as per agency policy. Never access or use a central line for IV therapy unless trained as per agency policy. For more information on CVC care and maintenance, see the suggested online reference list at the end of this chapter.

Health care providers should assess a patient with a central line at the beginning and the end of every shift, and as needed. For example, if the central line has been compromised (pulled or kinked), ensure it is functioning correctly. Each assessment should include:

- Type of CVC and insertion date: reason for CVC
- Dressing: is it dry and intact?
- Lines: secure with stat-lock, sutures, or Steri-Strips?
- Review: patient still requires a CVC?
- Insertion site: free from redness, pain, swelling?
- Positive pressure cap: attached securely?
- IV fluids: running through an IV pump?
- Lumens: number of lumens and type of fluids running through each?
- Vital signs: fever?
- Respiratory/cardiovascular check: any signs and symptoms of fluid overload?

See Table 8.4 for a list of complications, signs and symptoms, and interventions.

Table 8.4 Potential Complications with Central Venous Catheters

Complication	Signs and Symptoms	Interventions
Pulmonary edema	Also known as fluid overload (circulatory overload); characterized by decreased oxygen saturation, increased respiratory rate, fine or coarse crackles at lung bases, restlessness, breathlessness, dyspnea, coughing up pinky frothy sputum.	Accurate fluid balance assessments, monitor electrolytes and vital signs, provide chest auscultation, elevate head of bed, administer oxygen and diuretic therapy
Mechanical complications	A mechanical complication that mainly occurs during insertion of the CVC due to failure to correctly place the catheter, which may lead to asystolic cardiac arrest, bleeding, subcutaneous hematoma, hemothorax, catheter mal-position, or pneumothorax. These complications are usually detected at the time of insertion.	Treatment will be specific to the complication.
Catheter-related bloodstream infection	Infection is a common complication of indwelling CVCs in patients with a vascular device and no apparent source for the bloodstream infection other than the device. Confirmed with one positive blood culture in patients who have had a vascular device implanted within the last 48 hours. Catheter-related bloodstream infection (CR-BSI) is caused by microorganisms that are introduced into the blood through the puncture site, the hub, or contaminated IV tubing or IV solution, leading to bacteremia or sepsis. A CR-BSI is a nosocomial preventable infection and an adverse event. Systemic: elevated temperature, flushed, headache, malaise, tachycardia, decreased BP, and additional signs and symptoms of sepsis	Strict hand-washing, aseptic technique for all procedures, close monitoring of vital signs, strict protocols for dressing, tubing and cap changes, blood cultures as required, IV antibiotic therapy, remove/ replace catheter, prevent contamination of hub
Infection at insertion site	Insertion site may become red, tender, swollen, or have purulent drainage. Monitor blood work and temperature.	Notify physician, clean area using strict aseptic technique, send **C & S swab** (swab for bacterial wound culture) as per policy
Catheter-related thrombosis	**Catheter-related thrombosis (CRT)** is the development of a blood clot related to long-term CVC use. It mostly occurs in the upper extremities and can lead to further complications, such as pulmonary embolism, post-thrombotic syndrome, and vascular compromise. Symptoms include pain, tenderness to palpation, swelling, edema, warmth, erythema, and development of collateral vessels in the surrounding area. Most CRTs are asymptomatic, and prior catheter infections increase the risk for developing a CRT.	Routine flushing with positive pressure, vital signs, repositioning, IV bolus, notify physician, venogram/ X-rays likely; will require anticoagulant therapy and possible removal of the CVC

Air embolism	An air embolism is the presence of air in the vascular system and occurs when air is introduced into the venous system and travels to the right ventricle and/or pulmonary circulation. An air embolism can occur during CVC insertion, while catheter is in place, or at time of removal. Administration of up to 10 ml of air has been proven to have serious effects, and is sometimes fatal. Tiny 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, lightheadedness, hypotension, wheezing, increased heart rate, altered mental status, and jugular venous distension. The effects of air embolism depend on the rate and volume of air introduced.	Occlude source of air entry. Place patient in a Trendelenburg position on the left side (if not contraindicated), apply oxygen at 100%, obtain vital signs, and notify physician promptly. To avoid an air embolism, ensure drip chamber is one-third to one-half filled, ensure all IV connections are tight, ensure clamps are used when IV system is not in use, and remove all air from IV tubing by priming prior to attaching to patient.
Occlusions of CVC (mechanical or thrombus)	Occlusions may be mechanical (**pinch-off syndrome**, due to an internal pinching of the central line between the first rib and clavicle), caused by medication (unplanned/accidental precipitation in the IV line), or from parenteral nutrition (may leave a lipid residue inside the catheter). Thrombus formation (fibrin sheath around the tip of the catheter) may occur as soon as 24 hours after CVC is inserted. Thrombotic occlusions are responsible for approximately 58% of all occlusions. In addition to causing catheter dysfunction, thrombotic occlusions can lead to catheter-related thrombosis. Signs include sluggish flow rate, inability to flush or infuse medications, and frequent downstream occlusion alarms on the EID.	Follow agency-specific guidelines for managing various types of occlusions. Thrombolytic therapy may be initiated. Do not flush against resistance, flush well between medications, and always flush using positive pressure through a positive pressure cap.
Damage to CVC line	CVCs may become broken or cracked. Assess for pinholes, cracks, or tears during routine care. Assess for drainage after routine care. Avoid using sharp objects around CVCs, and only use a needleless device when accessing a central line.	Clamp immediately and seal with a sterile, occlusive dressing to prevent an air embolism, bleeding, or a CR-BSI. The CVC may be repaired or replaced. Notify health care provider promptly. Repair should only be completed by a trained CVC specialist.

Catheter migration	Patient may experience dysrhythmias caused by tip of the catheter moving from original position to an unwanted position. Migration may occur due to increased intrathoracic pressure due to coughing, change in body position, or physical movement (of the arms), sneezing, or weightlifting.	Call physician and stop all fluid infusions. You may need to pull back on tubing and X-ray CVC again for placement confirmation. Tape catheter securely using tape and devices. Do not pull on central lines; prevent IV lines from being caught on other equipment.
Data source: Baskin et al., 2009; BCIT, 2015a; Brunce, 2003; Fraser Health Authority, 2014; Perry et al., 2014; Prabaharan & Thomas, 2014		

Critical Thinking Exercises

1. What is the difference between a non-tunnelled (percutaneous) catheter and a tunnelled catheter?
2. Name three advantages and three disadvantages of a central line.

8.3 IV Fluids, IV Tubing, and Assessment of an IV System

Patients are prescribed an IV solution (fluids) based on their electrolyte and fluid volume status. IV fluids are commonly categorized as colloids and crystalloids. **Colloid solutions** contain large molecules that cannot pass through semi-permeable membranes and are used to expand intravascular volume by drawing fluid from extravascular space via high osmotic pressure. Examples of colloid solutions are albumin, dextrans, and hydroxyethyl starches (Crawford & Harris, 2011). **Crystalloid solutions** contain solutes such as electrolytes or dextrose, which are easily mixed and dissolvable in solution. Crystalloids contain small molecules that flow easily across semi-permeable membranes, which allows for transfer from the bloodstream into the cells and tissues (Crawford & Harris, 2011). They may increase fluid volume in interstitial and intravascular space. Examples of crystalloid solutions are isotonic, hypotonic, and hypertonic solutions.

Isotonic solutions have an osomolality of 250 to 375 mOsm/L. Isotonic solutions have the same osmotic pressure as plasma, creating constant pressure inside and outside the cells, which causes the cells to remain the same (they will not shrink or swell) and does not cause any fluid shifts within compartments. Isotonic solutions are useful to increase intravascular volume, and are utilized to treat vomiting, diarrhea, shock, and metabolic acidosis, and for resuscitation purposes and the administration of blood and blood products. Examples of isotonic solutions include normal saline (0.9% sodium chloride), lactated Ringer's solution, 5% dextrose in water (**D5W**), and Ringer's solution. It is important to monitor patients receiving isotonic solutions for fluid volume overload (hypervolemia) (Crawford & Harris, 2011).

Hypotonic solutions have a lower concentration, or tonicity, of solutes and have an osomolality equal to or less than 250 mOsm/L. The infusion of hypotonic solutions lowers the osmolality within the vascular space and causes fluid to shift to the intracellular and interstitial space. Cells will swell but may also delete fluid within the vascular space. Examples of hypotonic solutions include 0.45% sodium chloride, 0.33% sodium chloride, 2.5% dextrose in water, and 0.2% sodium chloride. Monitor for hypovolemia and hypotension related to fluid shifting out of the vascular space, and do not administer to patients with increased intracranial pressure (ICP), as it may exacerbate cerebral edema. Use cautiously in patients with burns, liver failure, and traumas (Crawford & Harris, 2011).

Hypertonic solutions have a higher concentration, or tonicity, of solutes and have an osomolality equal to or greater than 375 mOsm/L. The osmotic pressure gradient draws water out of the intracellular space into the extracellular space. Examples of hypertonic solutions include D5W and 0.45% sodium chloride, D10W, and 3% sodium chloride. Hypertonic solutions may cause intravascular fluid volume overload and pulmonary edema, and they should not be used for an extended period of time. Hypertonic solutions should not be used in patients with heart or renal disease who are dehydrated (Crawford & Harris, 2011).

Read the article *IV fluids: what nurses need to know* for more in-depth information regarding colloid and crystalloid solutions.

Although all IV fluids must be administered carefully, hypertonic solutions are additionally risky.

An order for IV fluids may be continuous or as a bolus, depending on the needs of the patient. IV solutions are available in 25 ml to 1000 ml bags. The frequency, duration, amount, and additives to solution must be ordered by a physician or nurse practitioner; for example, an order may be "give NS at 125 ml/hr."

The most common types of solutions include normal saline (NS) and D5W. Patients may also have medications, such as potassium chloride, thiamine, and multivitamins, added to IV solutions. To discontinue an IV infusion, an order must be obtained from the physician or nurse practitioner (Perry et al., 2014).

IV ADMINISTRATION EQUIPMENT

When a peripheral vein has a cannula inserted, an extension tubing is connected to the hub on the cannula and flushed with normal saline to maintain patency of the cannula. Most peripheral intravenous cannulas will have **extension tubing**, a short, 20 cm tube with a positive fluid displacement/positive pressure cap attached to the hub of the cannula for ease of access and to decrease manipulation of the catheter hub (Vancouver Coastal Health, 2008). The extension tubing must be changed each time the peripheral catheter is changed. When the peripheral cannula is not in use, the extension tubing attached to the cannula is called a *saline lock*.

Intravenous fluids are administered through thin, flexible plastic tubing called an *infusion set* or **primary infusion tubing/administration set** (Perry et al., 2014). The infusion tubing/administration set connects to the bag of IV solution. Primary IV tubing is either a macro-drip solution administration set that delivers 10, 15, or 20 gtts/ml, or a micro-drip set that delivers 60 drops/ml. Macro-drip sets are used for routine primary infusions. Micro-drip IV tubing is used mostly in pediatric or neonatal care, when small amounts of fluids are to be administered over a long period of time (Perry et al., 2014). The drop factor can be located on the packaging of the IV tubing.

Primary IV tubing is used to infuse continuous or intermittent fluids or medication. It consists of the following parts:

- Backcheck valve: Prevents fluid or medication from travelling up the IV
- Access ports: Used to infuse secondary medications and give IV push medications
- Roller clamp: Used to regulate the speed of, or to stop or start, a gravity infusion
- Secondary IV tubing: Shorter in length than primary tubing, with no access ports or backcheck valve; when connected to a primary line via an access port, used to infuse intermittent medications or fluids. A **secondary tubing administration set** is used for

secondary IV medication.

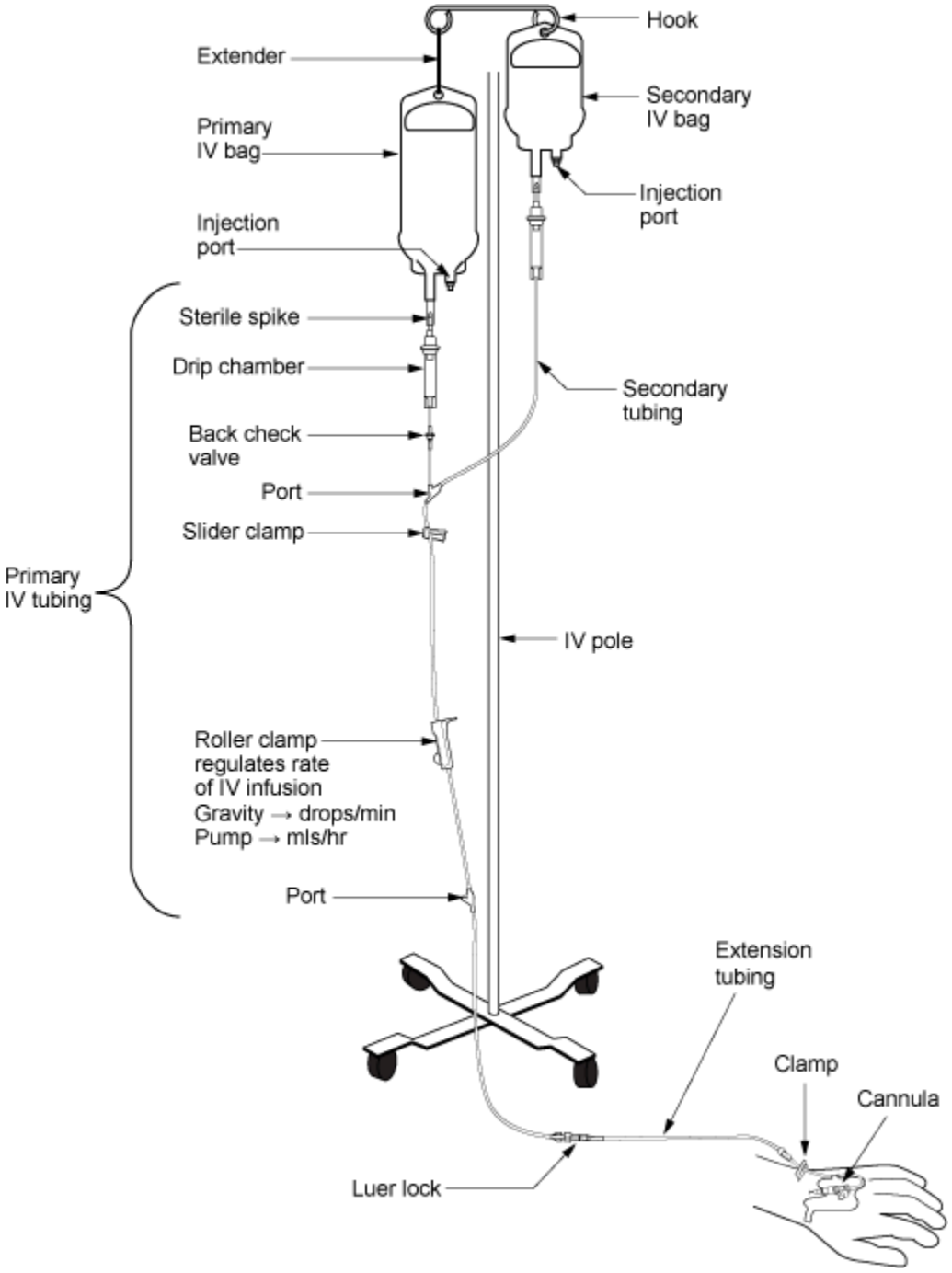


Figure 8.4 IV Primary and secondary tubing set up

IV solution bags should have the date, time, and initials of the health care provider marked on them to be valid. Add-on devices (e.g., extension tubing or dead-enders) should be changed every 96 hours, if contaminated when administration set is replaced, or as per agency policy. Intravenous solution and IV tubing should be changed if:

- IV tubing is disconnected or becomes contaminated by touching a non-sterile surface

- Less than 100 ml is left in the IV solution bag
- Cloudiness or precipitate is found in the IV solution
- Equipment (date and time) is outdated
- IV solution is outdated (24 hours since opened)

Primary and secondary administration sets (see Figure 8.4) should be changed regularly to minimize risk and prevent infection (CDC, 2011; Fraser Health Authority, 2014). Change IV tubing according to agency policy. Table 8.5 lists the frequency of IV tubing change.

Table 8.5 Frequency of IV Tubing Changes

Safety considerations:

- All IV tubing must be changed using sterile technique.
- IV tubing is changed based on the type of tubing, time used, and the type of solution.
- If possible, coordinate IV tubing changes with IV solution changes.

FREQUENCY OF IV TUBING CHANGE	TYPE OF IV TUBING AND SOLUTION
Every 72 -96 hours	Primary tubing with hypotonic, isotonic, or hypertonic continuous solution, when insertion site is changed, or when indicated by the type of solution or medication being administered.
Every 24 hours	Secondary or intermittent IV solution or medication. Rationale: When an intermittent infusion is repeatedly disconnected and reconnected for infusion, there is increased risk of contamination at the catheter hub, needleless connector, and the male Luer end of the administration set, potentially increasing risk for CR-BSI.
Every 24 hours	Infusions containing fat emulsions (IV solutions combined with glucose and amino acids infused separately or in a 3 in 1 admixture). Example: Total parenteral nutrition (TPN).
4 hours or 4 units, whichever comes first, or between products	Blood and blood products

Data source: CDC, 2011

INFUSING IV FLUIDS BY GRAVITY OR AN ELECTRONIC INFUSION PUMP (EID)

To ensure therapeutic effectiveness of IV fluids, a constant, even flow is necessary to prevent complications from too much or too little fluid. A physician must order a rate of infusion for IV fluids or for medications. The rate of infusion for medications (given via a secondary or primary infusion) can be found in the *Parenteral Drug Therapy Manual* (PDTM). If an order for IV fluids is “to keep vein

open" (TKVO), the minimum flow rate is 20 to 50 ml per hour, or according to physician's orders (Fraser Heath Authority, 2014).

A health care provider is responsible for regulating and monitoring the amount of IV fluids being infused. IV fluid rates are regulated in one of two ways:

1. Gravity. The health care provider regulates the infusion rate by using a clamp on the IV tubing, which can either speed up or slow down the flow of IV fluids. An IV flow rate for gravity is calculated in gtts/min.
2. Electronic infusion device (EID) (see Figure 8.5). The infusion rate is regulated by an electronic pump to deliver the fluids at the correct rate and volume. All IV pumps regulate the rate of fluids in ml/hr. An IV pump (EID) is used for many types of patients, solutions, and medications (Vancouver Coastal Health, 2008).

An IV pump must be used for:

- All CVC devices
- All opioid infusions (use a patient-controlled analgesia)
- All pediatric patients
- All medication as described in the PDTM
- Infusion rates below 60 ml/hr

Figure 8.5 Electronic infusion device (EID)

To calculate the drops per minute for an infusion by gravity, follow the steps in Table 8.6.

Table 8.6 Calculating the Drops per Minute (gtts/min) for an Infusion by Gravity

Steps	Additional Information
1. Verify the physician order.	An order may read: Example 1. Give NS IV 125 ml/hr Example 2. Give 1000 ml of NS IV over 8 hours.
2. Determine the drop factor on the IV administration set.	The drop factor is the amount of drops (gtts) per minute. IV tubing is either macro tubing (10, 15, or 20 gtts/min) or micro tubing (60 gtts/min). The drop factor (or calibration of the tubing) is always on the packaging of the IV tubing.
3. Complete the calculation using the formula.	Use the formula: $\frac{\text{Infusion rate (ml/hr)} \times \text{IV drop factor (gtts/min)}}{\text{60 (Administration time is always in minutes)}} = \text{drops per minute}$ To calculate ml/hr, divide 1000 ÷ 8 = 125 ml/hr. Example: Infuse IV NS at 125 ml/hr. IV tubing drop factor is 20 gtts/min $\frac{125 \times 20}{60}$ = 41.6 gtts/min, round up to 42 gtts/min (Round down or up to the nearest whole number)

4. Regulate IV infusion using the roller clamp.	Observe and count the drips in the drip chamber and regulate for 42 gtts/min (one full minute). Alternatively, divide 42 by 4 (rounded down from 10.4 to 10 gtts/min) to count for 15 seconds. The gtts/min should be assessed regularly to ensure the IV is infusing at the correct rate (e.g., every 1 to 2 hours, if the patient accidentally bumps the IV tubing, or if a patient returns from another department).  *Regulate IV tubing by using a roller clamp*
Data source: Fulcher & Frazier, 2007; Perry et al., 2014	

Take the *IV calculations* quiz for more practice with IV fluid dose calculation.

When an infusion is by gravity, there are several factors that may alter the flow/infusion rate (Fulcher & Frazier, 2007). In addition to regulating the flow rate, assess the IV system to ensure these factors are not increasing or decreasing the flow of the IV solution. These factors are listed in Table 8.7.

Table 8.7 Factors Influencing the Flow Rate of Infusions

Factors	Additional Information
Tube occlusion	May occur if the tubing is kinked or bent. Tubing may become kinked if caught under the patient or on equipment, such as beds and bed rails.
Vein spasms	Irritating or chilled fluids (fluids stored in the fridge) may cause a reflex action that causes the vein to go into spasm at or near the intravenous infusion site. If fluids or medications are chilled, bring to room temperature prior to infusion.
Height of the fluid container	The IV tubing drip chamber should be approximately 3 feet above IV insertion site.
Location/position of IV cannula	If the cannula is located in an area of flexion (bend of an arm), the IV flow may be interrupted when the patient moves around. To avoid this issue, replace IV cannula.
Infiltration or extravasation	If the cannula punctures the vein, the fluid will leak into the surrounding tissue and slow or stop the flow, and swelling will develop.
Accidental touching/ bumping of the control clamp or raising arm above heart level	Instruct the patient not to touch the roller clamp and to take care not to bump the clamp, as this may accidentally change the flow rate. Instruct patient to keep hand/ arm below heart level; an elevated hand/arm will slow or stop an infusion running by gravity.
Needle or cannula gauge/ diameter	The smaller the needle or cannula, the slower the fluid will flow.
Data source: Fulcher & Frazier, 2007; Perry et al., 2014	

ASSESSING AN IV SYSTEM

All patients with IV fluid therapy (PIV and CVC) are at risk for developing IV-related complications. The assessment of an IV system (including the IV site, tubing, rate, and solution) (see Figure 8.6) often depends on what is being infused, the patient's age and medical condition, type of IV therapy (PIV or CVC), and agency policy. Generally, an IV system should be assessed as described in Checklist 65.

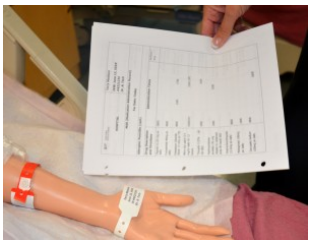
Figure 8.6 Assess IV site prior to use

Checklist 65: Assessing an IV System

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- IV systems must be assessed every 1 to 2 hours or more frequently if required.
- An IV system should be assessed at the beginning of a shift, at the end of a shift, if the electronic infusion device alarms or sounds, or if a patient complains of pain, tenderness, or discomfort at the IV insertion site.
- Review the patient's chart to determine insertion date and type of solution ordered.
- A peripherally inserted catheter is usually replaced every 72 to 96 hours, depending on agency policy.
- If the peripheral catheter or central venous catheter is not in use, or is being used intermittently, flushing is required to keep the site patent. Refer to agency policy for flushing guidelines.
- A not-in-use peripheral IV site is generally flushed every 12 hours with 3 to 5 ml of normal saline.
- Review the in-and-out sheet to determine expected amount in the IV solution bag.
- Patients with cardiac or renal disease, as well as pediatric patients, are at a higher risk for IV-related complications.
- Elderly patients often have fragile veins and may require closer monitoring.

STEPS	ADDITIONAL INFORMATION
1. Perform hand hygiene.	This step reduces the transmission of microorganisms.
2. Introduce yourself and explain the purpose of the assessment.	This builds trust with patient and allows time for the patient to ask questions.
3. Confirm patient ID using two patient identifiers (e.g., name and date of birth), and compare the MAR printout with the patient's wristband.	This step ensures you have the correct patient and complies with agency standard for patient identification.  *Compare MAR with patient wristband*
4. Apply non-sterile gloves (optional).	This reduces the transmission of microorganisms.

5. Assess the IV insertion site and transparent dressing on IV site.	Check IV insertion site for signs and symptoms of phlebitis or infection. Check for fluid leaking, redness, pain, tenderness, and swelling. IV site should be free from pain, tenderness, redness, or swelling. Ensure patient is informed to alert the health care provider if they experience pain or notice swelling or redness at the IV site. If patient is unable to report pain at IV site, more frequent checks are required.
6. Inspect the patient's arm for streaking or venous cords; assess skin temperature.	Assess complications on hand and arm for signs and symptoms of phlebitis and infiltration/extravasation.
7. Assess IV tubing for kinks or bends.	Kinks or bends in tubing may decrease or stop the flow of IV fluids. Ensure tubing is not caught on equipment or side rails on bed. Tubing should be properly labelled with date and time.
8. Check the rate of infusion on the primary and secondary IV tubing. Verify infusion rate in physician orders or medication administration record (MAR).	If IV solution is on gravity, calculate and count the drip rate for one minute. If solution is on an IV pump, ensure the rate is correct and all clamps are open as per agency protocol. If secondary IV medication is infusing, ensure clamp on secondary IV tubing is open. The EID is unable to distinguish if the primary bag or secondary bag is infusing.
9. Assess the type of solution and label it on bag. Check volume of solution in bag.	IV solutions become outdated every 24 hours. Ensure the correct solution is given. If 100 ml of solution or less is left in the bag, change the IV solution and document on in-and-out sheet. If an IV pump is used, ensure it is plugged into an outlet. Ideally, the IV solution should be 90 cm above patient heart level.
10. Assist patient into comfortable position, place call bell in reach, and put up side rails on bed as per agency policy.	These precautions prevent injury to the patient.
11. Perform hand hygiene.	This step prevents the spread of microorganisms.
12. Document procedure and findings as per agency policy.	Timely and accurate documentation promotes patient safety.
Data source: Fulcher & Frazier, 2007; Perry et al., 2014	

Critical Thinking Exercises

1. What are the signs and symptoms of phlebitis?
2. What types of patients should not receive hypotonic IV solutions?

8.4 Priming IV Tubing and Changing IV Fluids and Tubing

Primary and secondary IV tubing and add-on devices (extension tubing) must be primed with IV solution to remove air from the tubing. Priming refers to placing IV fluid in IV tubing to remove all air prior to attaching the IV tube to the patient. IV tubing is primed to prevent air from entering the circulatory system. An air embolism is a potential complication of IV therapy and can enter a patient's blood system through cut tubing, unprimed IV tubing, access ports, and drip chambers with too little fluid (Perry et al., 2014). It is unknown how much air will cause death, but deaths have been reported with as little as 10 ml of air. The best way to avoid air bubbles in IV tubing is to prevent them in the first place (Perry et al., 2014). New IV tubing may also be required if leaking occurs around the tube connecting to the IV solution, if the tubing becomes damaged, or if it becomes contaminated. Checklist 66 outlines the process of priming IV tubing.

Checklist 66: Priming IV Tubing

Disclaimer: Always review and follow your hospital policy regarding this specific skill.	
Safety considerations: • Primary IV tubing can be macro-drip or micro-drip tubing. The drop factor of the IV tubing is required to complete the IV drip rate calculation for a gravity infusion. • Remember to invert all access ports and backcheck valve.	
STEPS	ADDITIONAL INFORMATION
1. Perform hand hygiene.	This step prevents the transmission of microorganisms.
2. Check order to verify solution, rate, and frequency.	This ensures IV solution is correct and helps prevent medication error.
3. Gather supplies.	You will need IV solution, primary IV tubing, time label, change label, alcohol swab, and basin or sink.  *Sterile IV solution*
4. Remove IV solution from outer packaging and gently squeeze.	Tear the perforated corner of the outer packaging; check colour, clarity, and expiration date.  *Remove IV solution from packaging*

5. Remove primary IV tubing from outer packaging.	 *IV tubing*
6. Move the roller clamp about 3 cm below the drip chamber and close the clamp.	 *Move roller clamp*
7. Remove the protective cover on the IV solution port and keep sterile. Remove the protective cover on the IV tubing spike.	Be careful and do not contaminate the spike.  *Remove protective cover from spike on IV tubing*

8. Without contaminating the solution port, carefully insert the IV tubing spike into the port, gently pushing and twisting.	 *Insert IV spike into sterile solution using sterile technique*
9. Hang bag on IV pole.	The IV bag should be approximately one metre above the IV insertion site.
10. Fill the drip chamber one-third to one-half full by gently squeezing the chamber. Remove protective cover on the end of the tubing and keep sterile.	Filling the drip chamber prevents air from entering the IV tubing.  *Fill drip chamber*
11. With distal end of tubing over a basin or sink, slowly open roller clamp to prime the IV tubing. Invert backcheck valve and ports as the fluid passes through the tubing. Tap gently to remove air and to fill with fluid.	Inverting and tapping the access ports and backcheck valve helps displace and remove air when priming the IV tubing.  *Invert IV tubing when priming with solution*
12. Once IV tubing is primed, check the entire length of tubing to ensure no air bubbles are present.	This step confirms that air is out of the IV tubing.

13. Close roller clamp. Cover end with sterile dead-ender or sterile protective cover. Hang tubing on IV pole to prevent from touching the ground.	Keep the distal end sterile prior to connecting IV to patient.
14. Label tubing and IV bag with date, time, and initials.	Label IV solution bag as per agency policy. Do not write directly on the IV bag.  *Labelled IV bag*
15. Perform hand hygiene.	This reduces the transmission of microorganisms.  *Hand hygiene with ABHR*
Data source: Fulcher & Frazier, 2007; Perry et al., 2014.	

VIDEO 8.1

Watch the video *Priming IV Lines* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

IV solutions are considered sterile for 24 hours. An IV solution may be changed if the physician's order changes, if an IV solution infusing at TKVO is expired after 24 hours, or if the IV solution becomes contaminated. To change an IV solution bag, follow Checklist 67.

Checklist 67: Changing an IV Solution Bag

Disclaimer: Always review and follow your hospital policy regarding this specific skill.	
STEPS	ADDITIONAL INFORMATION
1. Verify and select correct IV solution bag and compare to the medication administration record (MAR) or physician orders.	IV solutions are considered a medication and must be checked using the SEVEN RIGHTS x 3, as per agency policy.  *Sterile IV solution*
2. Introduce yourself, identify patient, and explain procedure.	Proper identification of a patient prevents medication errors. Explaining the procedure provides an opportunity for the patient to ask questions.
3. Perform hand hygiene.	Hand hygiene prevents the transmission of microorganisms.
4. Remove outer plastic packaging and squeeze bag to test for leaks and expiration date. Assess for precipitates or cloudiness. Hang new IV solution on IV pole.	This ensures the correct IV solution is used.  *Remove IV solution from packaging*
5. Pause the EID or close the roller clamp on a gravity infusion set.	Stops the infusion to prevent air bubbles from forming in IV tubing.
6. Remove protective plastic cover from the new IV solution tubing port.	Keep IV tubing port sterile at all times. If IV tubing port becomes contaminated, dispose of it immediately and replace.

7. Remove the old IV solution bag from the IV pole. Turn IV bag upside down, grasping the tubing port. With a twisting motion, carefully remove IV tubing spike from old IV solution bag.	Removing old solution from IV pole prevents spilling of solution. Ensure IV tubing spike remains sterile during removal to avoid contaminating IV tubing.
8. Using a gentle twisting motion, firmly insert the spike into the new IV bag.	This ensures that a sterile technique is used during the process.  *Spike new IV solution*
9. Fill the drip chamber by compressing it between your thumb and forefinger. Ensure the drip chamber is one-third to one-half full. Check IV tubing for air bubbles.	Fluid in the drip chamber helps prevent air from being introduced into IV tubing.  *Fill drip chamber*  *IV tubing label*

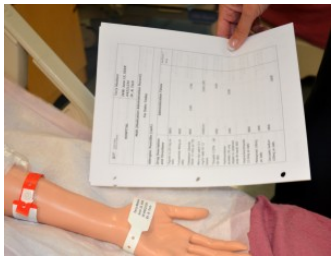
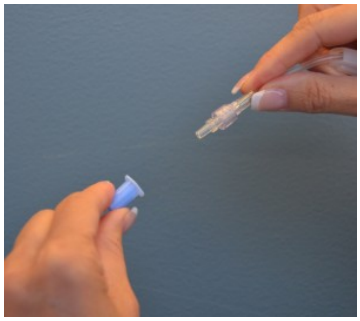
10. Open clamp and regulate IV infusion rate via gravity, or press start on the EID as per physician orders.	Once rate is set, count the drops per minute on the gravity set or ensure the EID is running at the correct rate as per physician orders.  *Regulate IV tubing with a roller clamp*
11. Label new IV solution bag as per agency policy. Time tape gravity IV solutions as per agency policy	Labelling IV solutions provides easy viewing of infusing solutions and additives.  *Labelled IV bag*
12. Dispose of used supplies, perform hand hygiene, and document IV solution bag change according to agency policy.	Document time, date, type of solution, rate, and total volume.
Data source: Fulcher & Frazier, 2007; Perry et al., 2014.	

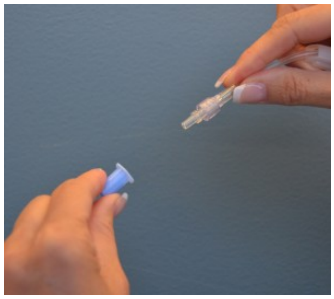
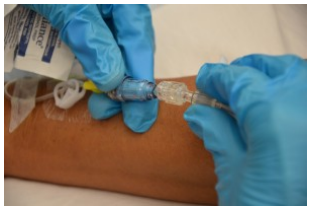
VIDEO 8.2

Watch the video *Changing IV bags* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

Checklist 68 describes how to change the IV tubing administration set and IV solution at the same time.

Checklist 68: IV Tubing Administration Set and IV Solution Change

Disclaimer: Always review and follow your hospital policy regarding this specific skill.	
STEPS	ADDITIONAL INFORMATION
1. Verify physician orders for the type of solution, rate, and duration. Collect necessary supplies.	This step verifies the patient's need for IV fluids/ medications. It also confirms the correct rate and solution for patient safety.
2. Perform hand hygiene.	Hand hygiene prevents the transmission of microorganisms.
3. Identify yourself, identify the patient using two identifiers, and explain the procedure to the patient.	Proper identification of patient prevents errors.  *Compare MAR with patient wristband*
4. Prime new administration set using a new IV solution bag and new IV tubing.	IV solutions are considered a medication. Prime as per Checklist 66. Keep distal protective cap attached to IV tubing to ensure sterility of distal end. Label IV solution and IV tubing as per agency policy.  *Keep distal end sterile with sterile cap*
5. Hang new administration set (primed primary line and IV solution) on IV pole.	This prepares the equipment and adheres to the principles of aseptic technique.
6. Clamp old IV administration set. Remove IV tubing if on an EID.	Stop the flow of infusion during tubing and solution change.

7. Clean the connection between the distal end of old IV tubing and the positive pressure cap. Scrub the area for 15 seconds and let it dry for 30 seconds.	Proper disinfection of equipment decreases bacterial load and prevents infections.  *Scrub the connection between the IV tubing and positive pressure cap*
8. Remove the protective cap on the distal end of the new IV administration set.	 *Remove sterile cap*
9. Carefully disconnect the old tubing from the positive pressure cap and insert the new IV tubing into the positive pressure cap attached to the extension tubing.	 *Disconnect IV tubing from hub*
10. Open the roller clamp on the new tubing to regulate flow rate, or insert new tubing into the EID and restart IV rate.	This step ensures the IV solution is infusing at the correct rate.  *Regulate IV tubing using a roller clamp*

11. Check IV site for patency, and signs and symptoms of phlebitis.	IV site should be free from redness, swelling, and pain. Dressing on IV site should be dry and intact.  *Assess IV site for patency*
12. Discard old supplies and perform hand hygiene.	This step prevents the spread of microorganisms.  *Perform hand hygiene*
13. Document procedure as per agency policy.	Document the date and time of IV tubing and solution change.
Data source: BCIT, 2015b; Fulcher & Frazier, 2007; Perry et al., 2014	

Critical Thinking Exercises

1. How long can IV solution be used?
2. What is the purpose of removing air from IV tubing?

8.5 Flushing a Saline Lock and Converting a Saline Lock to a Continuous IV Infusion

A **saline lock (SL)**, also known as a heparin lock, is a peripheral intravenous cannula connected to extension tubing with a positive pressure cap (see Figure 8.7). This device allows easy access to the peripheral vein for intermittent IV fluids or medications (Perry, et al., 2014). The saline lock is "flushed" or filled with normal saline to prevent clotting when not in use. To use an SL, the cannula is flushed with 3 to 5 ml of normal saline to assess patency. After the saline lock is used, the cannula is flushed again with 3 to 5 ml of normal saline or heparin to "lock" the saline in the cannula in order to keep it patent. Once the saline lock is inserted, it can be left in a vein for up to 72 hours or as per agency policy. Saline locks are usually inserted in the arm or hand. If a saline lock is removed, the extension tubing and positive pressure cap are also changed (Vancouver Coastal Health, 2012).

Figure 8.7 Saline lock with positive pressure cap (Max Plus)

A saline lock can be used for continuous and intermittent short-term IV therapy. Flushing is performed:

- Before and after administering IV fluids or medications to assess placement and patency of PIV
- After blood sampling
- After each infusion to prevent mixing of incompatible medications and solutions
- Every 12 hours when the saline lock is not in use

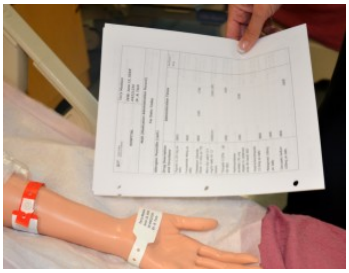
A saline lock must be flushed in a specific manner to prevent blood being drawn into the IV catheter and occluding the device between uses. Checklist 69 describes the process of flushing an SL.

Checklist 69: Flushing a Saline Lock

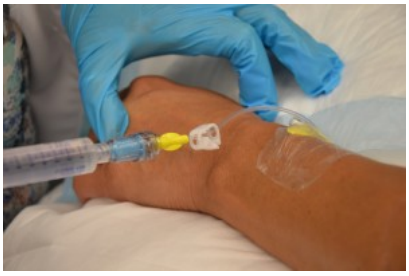
Disclaimer: Always review and follow your hospital policy regarding this specific skill.

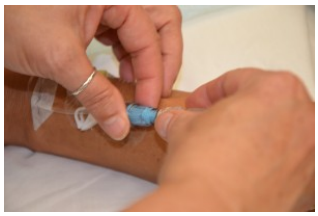
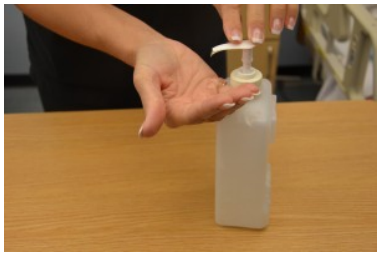
Safety considerations:

- Poor standards of aseptic technique are the primary cause of health care infections. Be diligent with disinfecting and sterile technique. Sterile technique must be used with all IV procedures.
- An alcohol swab (70% isopropyl alcohol) must be used to clean the hub prior to access. The hub is scrubbed for 15 seconds and allowed to dry completely (30 seconds).
- Never attempt to flush a "blocked" saline lock. If unable to flush, remove the SL.
- Never use a needle to access a positive pressure cap. Attach a Luer lock syringe to the positive pressure cap to flush.

STEPS	ADDITIONAL INFORMATION
1. Perform hand hygiene; gather supplies.	You will need alcohol swabs, 3 to 5 ml syringe prefilled with 0.9% normal saline, clean gloves.  *Hand hygiene with ABHR*
2. Compare MAR to patient's wristband, identify patient using two identifiers, and explain procedure to patient.	Follow agency policy for proper patient identification.  *Compare MAR with patient wristband*
3. Clean work surface with CaviWipes and let dry.	This prevents the spread of microorganisms.

4. Perform hand hygiene and apply clean gloves.	This prevents and minimizes the spread of microorganisms.  *Apply non-sterile gloves*
5. Assess IV site for signs and symptoms of phlebitis.	If IV site is red, tender, or swollen, the SL needs to be discontinued; do not flush.  *Assess site for phlebitis*
6. Scrub the top of the positive pressure cap for 15 seconds and let dry for 30 seconds.	Aseptic technique is required for all IV procedures. All access ports must be disinfected to decrease the bacterial load prior to use.  *Clean the positive pressure device (Max Plus) prior to use*
7. Open clamp on extension tubing.	Clamp must be open to flush the saline lock.  *Open clamp on saline lock*

8. If using a prefilled normal saline syringe for flushing, the air must be “purged” from the syringe. To remove air from a syringe, apply gentle pressure to the syringe plunger until a click, snap, or pop sound is heard. Next, remove the sterile dead-ender on the Luer lock end of the syringe, and remove the air by gently pushing the plunger upwards, keeping the syringe vertical.	Purging the air prevents it from being injected into the patient. Air should never be injected into a patient.  *Apply pressure to the plunger until a click, snap, or pop sound is heard*  *Purge a prefilled syringe*
9. Attach NS prefilled Luer lock syringe by twisting the syringe onto the positive pressure cap. Undo clamp on extension tubing. Inject 3 to 5 ml of solution using turbulent stop-start technique. Flush until visibly clear. Do not bottom out syringe (leave 0.2 to 0.5 ml in the syringe).	Turbulent stop-start flush ensures full flushing of the catheter. Bottoming out the saline syringe with the plunger can cause reflux of fluid back into the catheter. If resistance is felt, do not force flush.  *Flush the saline lock*

10. Remove syringe from positive pressure cap; THEN clamp the extension tubing.	Always clamp after removing syringe from the positive pressure cap. Positive displacement occurs when the syringe is disconnected from the positive pressure cap.  *Close clamp on saline lock* Clamp the extension tubing as close to the IV site as possible to prevent negative fluid displacement and accidental aspiration of blood at the catheter tip.
11. Wipe top of the positive pressure cap with an alcohol swab to remove fluid residue.	Moisture promotes the growth of microorganisms.  *Wipe top of pressure cap*
12. Ensure dressing is dry and intact, and the extension tubing is properly secured with tape.	Properly secured extension tubing prevents accidental dislodgement of SL.  *Dry and intact dressing*
13. Remove gloves; discard supplies and perform hand hygiene.	Proper disposal of equipment prevents the spread of microorganisms.  *Hand hygiene with ABHR*

14. Document procedure.	Document IV site assessment, location of PIV, procedure, date, and time.
Data source: Perry et al., 2014; Vancouver Coastal Health, 2008	

VIDEO 8.3

Watch the video *PVAD – short Flush (aka saline lock flush)* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

An SL can be converted to a continuous or intermittent IV to infuse fluids or medications. Prior to converting an SL to a continuous infusion, review the physician's orders for type of solution, infusion rate, additives, and duration. IV solutions are considered a medication. Follow the seven rights × 3 when preparing IV solution. To convert a saline lock to a continuous IV, review Checklist 70.

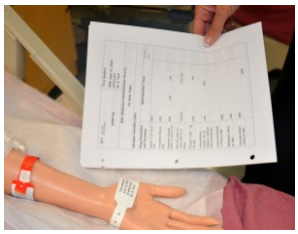
Checklist 70: Converting a Saline Lock to a Continuous IV Infusion

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

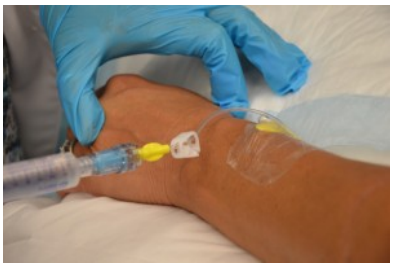
Safety considerations:

- If at any time you think a piece of equipment has been contaminated, dispose of it immediately and obtain a new sterile piece.
- Always assess IV site and flush SL prior to initiating an IV infusion.
- Always follow the safety seven rights x 3 for IV fluids and medications.
- Educate the patient on signs and symptoms of phlebitis and when to call for assistance (unexpected or adverse reactions).
- IV solutions must be recorded on the in-and-out sheet or patient chart.
- Patients on continuous IV solutions are at risk for fluid overload, especially patients with renal or cardiac conditions. Monitor output and input when patients are on a continuous infusion.

STEPS	ADDITIONAL INFORMATION
1. Verify physician orders and collect supplies.	You will need clean gloves, 3 to 5 ml prefilled 0.9% normal saline syringe, IV solution, IV pump if indicated. Verify the rate and duration of solution. Review the rationale/reason for the IV fluids to provide an explanation to the patient.
2. Perform hand hygiene and prime IV tubing with IV solution.	Prime IV tubing with correct IV solution as per Checklist 66. Ensure IV tubing and IV solution bag are labelled.  *Prime IV tubing*

3. Enter room and identify patient using two identifiers.	Identifying patient correctly prevents errors and enhances safe practices.  *Compare MAR with patient wristband*
4. Explain procedure, clean work surface and let dry, and perform hand hygiene.	Educate patient about why IV fluids are being initiated. Hand hygiene prevents the spread of microorganisms.  *Hand hygiene with ABHR*
5. Apply gloves, scrub the top of the positive pressure cap for 15 seconds, and let dry for 30 seconds.	Appropriately disinfecting the positive pressure cap decreases the bacterial count and adheres to the principles of infection control.  *Clean positive pressure cap (Max Plus) with alcohol swab*

6. Open clamp on extension tubing and assess IV site.	 *Open clamp on saline lock* Clamp must be released to flush the extension tubing.
7. If using a prefilled normal saline syringe for flushing, the air must be "purged" from the syringe. To remove air from a syringe, apply gentle pressure to the syringe plunger until a click, snap, or pop sound is heard. Next, remove the sterile dead-ender on the Luer lock end of the syringe, and remove the air by gently pushing the plunger upwards.	Purging the air prevents it from being injected into the patient. Air should never be injected into a patient.  *Push up gently on plunger until a click is heard*  *To purge air, remove the sterile dead-ender and push up gently on the plunger until all air is removed*

8. Attach NS prefilled Luer lock syringe by twisting the syringe to the positive pressure cap. Inject 3 to 5 ml of solution using turbulent stop-start technique. Flush until visibly clear. Do not bottom out syringe (leave 0.2 to 0.5 ml in the syringe).	Turbulent stop-start flush ensures full flushing of the catheter. Bottoming out the saline syringe with the plunger can cause reflux of fluid back into the catheter. If resistance is felt, do not force flush.  *Flush with normal saline*
9. Remove syringe and discard.	Proper disposal of equipment decreases the spread of microorganisms.
10. Scrub the top of the positive pressure cap for 15 seconds and let dry for 30 seconds.	Appropriately disinfecting the positive pressure cap decreases the bacterial count and adheres to the principles of infection control.  *Clean positive pressure cap (Max Plus) with alcohol swab*

11. Without breaking sterile technique, remove the cap on the distal end of the IV tubing. Using a twisting motion, connect Max Plus end to IV tubing.	Do not let the positive pressure cap touch any non-sterile surface prior to attaching the IV tubing. If required, place the positive pressure cap on sterile gauze while preparing tubing.  *Connect IV tubing to saline lock*  *Continuous IV infusion*
12. Initiate IV infusion.	Adjust IV infusion rate by gravity or IV pump as per physician's orders. Monitor for factors that may affect flow rate.  *Adjust IV rate*
13. Secure IV tubing to patient with tape.	Properly secured extension tubing prevents accidental dislodgement of tubing.  *Secure IV tubing with tape*
14. Document procedure and monitor expected response to IV fluids.	Chart type of solution, rate, date, and time of infusion as per agency policy.
Data source: Perry et al., 2014; Vancouver Coastal Health, 2008	

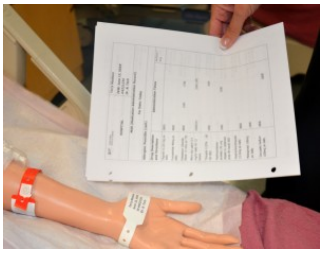
Critical Thinking Exercises

1. A continuous infusion is started on your patient. As you leave the room, your patient complains of pain at the insertion site. What should you do?
2. When flushing a positive pressure cap, when do you clamp the extension tubing?

8.6 Converting an IV Infusion to a Saline Lock and Removal of a Peripheral IV

A peripheral IV may be converted to a saline lock when a prescribed continuous IV therapy is switched to intermittent IV or a saline lock for future use. A physician’s order is required to stop a continuous infusion. Checklist 71 describes how to convert an infusion to a saline lock.

Checklist 71: Converting an IV Infusion to a Saline Lock

Disclaimer: Always review and follow your hospital policy regarding this specific skill.	
STEPS	ADDITIONAL INFORMATION
1. Verify physician orders to convert IV infusion to a saline lock.	Ensures correct order is being implemented.
2. Perform hand hygiene; collect supplies.	This prevents the transmission of microorganisms.  *Hand hygiene with ABHR*
3. Identify yourself; identify the patient using two identifiers and comparing the MAR to the patient's wristband; explain the procedure to the patient.	Proper identification prevents errors. Explaining the procedure educates the patient and allows time for patient to ask questions.  *Compare MAR with patient wristband*
4. Perform hand hygiene.	This step prevents the transmission of microorganisms.
5. Stop IV infusion with clamp or turn off EID. Apply clean gloves.	This prevents fluid from escaping from tubing when disconnecting tubing from positive pressure cap (hub).
6. Scrub the connection area between the hub and IV tubing for 15 seconds and let dry for 30 seconds.	 *Scrub the connection between the IV tubing and positive pressure cap*

7. Disconnect primary tubing from the extension tubing; ensure the positive pressure cap remains on the extension tubing. Place a sterile cap on end of IV tubing if tubing will be reconnected for later infusion.	 *Disconnect IV tubing from saline lock*
8. Scrub the hub for 15 seconds and let dry for 30 seconds.	Aseptic technique is required for all IV procedures. All access ports must be disinfected to decrease the bacterial load prior to use.  *Clean positive pressure cap (Max Plus) with alcohol swab*
9. Attach 10 ml syringe prefilled with 0.9% normal saline and flush saline lock to clear the positive pressure cap. Do not bottom out syringe.	Turbulent stop-start flush ensures full flushing of the catheter. Bottoming out the saline syringe with the plunger can cause reflux of fluid back into the catheter. If resistance is felt, do not force flush. Assess IV site for pain, redness, or swelling.  *Flush saline lock*

10. Remove syringe and discard.	Proper disposal of equipment prevents the spread of microorganisms.  *Discard syringe*
11. Clamp extension tubing.	Clamping the extension tubing as close to the IV site as possible prevents negative fluid displacement and accidental aspiration of blood at the catheter tip.  *Close clamp on saline lock*  *Saline lock*
12. Wipe top of positive pressure cap with alcohol swab to remove fluid residue.	Removal of excess fluid prevents bacterial growth on the hub.
13. Document procedure as per agency policy.	Document date, time, and IV site assessment.
Data source: Perry et al., 2014; Vancouver Coastal Health, 2008	

VIDEO 8.4

Watch a video *Converting an IV to a saline lock – Extension Present* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

VIDEO 8.5

Watch a video *Converting an IV to a saline lock – No Extension Present* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

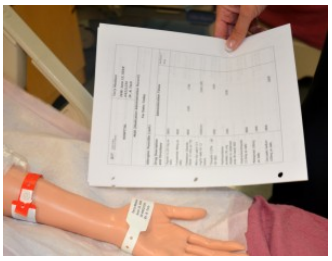
A peripheral IV (saline lock) may be discontinued if ordered by a physician or nurse practitioner; if the patient is discharged from a health care facility; if signs of phlebitis, infiltration, or extravasation occur; or if the saline lock is no longer required for fluids or medication (Fulcher & Fraser, 2007). Peripheral IV's should be removed promptly when no longer needed to avoid a catheter-related bloodstream infection (CR-BSI), as well as unnecessary pain and trauma (Infusion Nurses Society, 2012). In general, saline locks are changed every 72 hours. If a patient has a peripheral IV in an area of flexion, the IV site should be replaced within 24 hours, or when the patient is stable. Other research shows that peripheral IV cannulas should not be routinely changed but replaced based on whether the site is functioning, the saline lock is required, the insertion site is patent, and/or the insertion site is a source of infection (CDC 2011; Infusion Nurses Society, 2011).

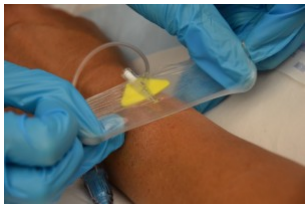
At times, a physician may order IV fluids to be discontinued but request to have the IV converted to saline lock. Be sure to assess the order for discontinuing an IV. Before removing an IV, consider the following:

- Is the patient drinking enough fluids?
- Is the patient voiding, passing gas, and having bowel sounds?
- Is there a need for the IV (IV meds)?
- Are the lab values within normal limits (Hgb, K)?
- Is the patient using an epidural/PCA?
- Do you have a physician order?

Review the steps in Checklist 72 for removing a peripheral IV.

Checklist 72: Removing a Peripheral IV

Disclaimer: Always review and follow your hospital policy regarding this specific skill.	
Safety considerations: • Assess the patient and be sure they are medically stable prior to removing SL. Check the following: lab values, ongoing need for fluids or IV medications, inability to eat or drink, presence of nausea or vomiting. • If patient has ongoing medical concerns requiring an IV, alert the physician.	
STEPS	ADDITIONAL INFORMATION
1. Confirm physician's order or the reason to remove the IV cannula.	This step prevents errors in the health care setting.
2. Perform hand hygiene and collect supplies.	You will need sterile gauze (two 2x2s), clean gloves, tape, alcohol swab as required, C & S swab if purulent drainage present.
3. Identify yourself; identify the patient using two identifiers and comparing the MAR to the patient's wristband; explain the procedure to the patient.	Proper identification prevents errors. Explaining the procedure educates the patient and allows patient to ask questions.  *Compare MAR with patient wristband*
4. Perform hand hygiene and apply clean gloves. Open up sterile gauze for easy access and place close by.	Preparing gauze allows for easy access once cannula is removed.
5. Remove tape on extension tubing.	Tape must be removed prior to removing cannula.

6. Remove transparent dressing: • Stabilize the IV cannula. • Loosen one edge of transparent dressing toward the IV site by stretching the dressing in the direction of loosened edge. • Loosen the other edge of the dressing and repeat previous step.	 *Removing transparent dressing*  *Completely remove dressing from IV site*
7. If purulent drainage is present, perform C & S swab and clean area with alcohol swab.	This provides follow-up data for potential infection.
8. Hold sterile gauze above the insertion site; do not apply pressure. Keeping the cannula parallel to the skin, pull out in a straight, slow, steady motion. Assess catheter tip and discard cannula as per agency policy.	Applying pressure to the IV site upon removal of the catheter is painful for the patient. Remove catheter first, then apply pressure.  *Gauze over cannula*  *Remove saline lock*
9. Place sterile gauze over insertion site and apply gentle pressure until bleeding stops, usually for 2 to 3 minutes.	If patient is on coagulation therapy, extended pressure will be required to stop bleeding at IV site for 5 minutes.

10. Apply new sterile gauze and tape to create occlusive dressing on old IV site.	This prevents bacteria from entering the old IV site.  *Apply sterile gauze over IV insertion site*
11. Discard supplies, remove gloves, and perform hand hygiene.	These steps prevent the spread of microorganisms.  *Hand hygiene with ABHR*
12. Document procedure as per agency policy.	Document date, time, condition of cannula, appearance of IV site, and type of dressing applied.
Data source: ATI, 2015; Perry et al., 2014; Phillips, 2005	

VIDEO 8.6

Watch a video *Removing a PVAD-Short Cannula* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

Critical Thinking Exercises

1. What is the purpose of applying pressure to the site after the cannula has been removed?
2. Name five factors to consider prior to discontinuing an IV.

8.7 Transfusion of Blood and Blood Products

All health care practitioners who administer blood or blood products must complete specific training for safe transfusion practices and be competent in the transfusion administration process. Always refer to your agency policy for guidelines for preparing, initiating, and monitoring blood and blood product transfusions. These guidelines apply to adult patients only.

The transfusion of blood or blood products (see Figure 8.8) is the administration of whole blood, its components, or plasma-derived products. The primary indication for a red blood cell (RBC) transfusion is to improve the oxygen-carrying capacity of the blood (Canadian Blood Services, 2013). A health care provider order is required for the transfusion of blood or blood products. RBC transfusions are indicated in patients with anemia who have evidence of impaired oxygen delivery. For example, individuals with acute blood loss, chronic anemia and cardiopulmonary compromise, or disease or medication effects associated with bone marrow suppression may be candidates for RBC transfusion. In patients with acute blood loss, volume replacement is often more critical than the composition of the replacing fluids (Canadian Blood Services, 2013). Transfusions can restore blood volume, restore oxygen-carrying capacity of blood with red blood cells, and provide platelets and clotting factors. The most common type of blood transfusion is blood that is donated by another person (allogeneic). Autologous transfusion is the transfusion of one's own blood (Perry et al., 2014).

Figure 8.8 Red blood cells and blood IV tubing

Transfusion therapy is considered safe, and stringent precautions are followed in the collection, processing, and administration of blood and blood components. However, transfusions still carry risks such as incompatibility, human error, and disease transmission, and blood transfusion must be taken seriously at all times. Incompatibility can be decreased by using irradiated red blood cells or leukocyte-

reduced blood. The majority of blood transfusion complications are a result of human error (Perry et al., 2014).

Compatibility testing is vital for all recipients of blood or blood products. Recipients must be transfused with an ABO group specific to their own blood type or ABO group-compatible. There are three types of blood typing systems: ABO, Rh, and human leukocyte antigen (HLA). For more information on these, refer to the online resources at the end of this chapter. It is vital to understand what types of blood groups are compatible for transfusions (Canadian Blood Services, 2013).

When administering blood and blood products, it is important to know the patient's values and beliefs regarding blood products. Some groups of individuals, mainly Jehovah Witnesses, will refuse blood transfusions or blood products based on religious beliefs. These individuals will refuse transfusion of whole blood and primary blood components but may accept transfusion of derivatives of primary blood components such as albumins solutions, clotting factors and immunoglobulins. Always assess each individual preference to establish if a blood component is an acceptable treatment to manage their illness or condition (Canadian Blood Services, 2007).

When managing blood transfusions, it is important to prevent complications from occurring and to identify issues promptly to manage reactions effectively. Transfusion reactions (mild to life-threatening) may occur despite all safety measures taken. All transfusion reactions and transfusion errors must be reported to the hospital's transfusion services (blood bank). It is imperative to know what signs and symptoms to look for, and to educate your patient on what to report and when to report potential transfusion reactions. Mild to severe reactions may include (Canadian Blood Services, 2011):

- Temperature ≥ 38.0 C or change of 1°C from pretransfusion value within 15 minutes after initiation of transfusion
- Acute or delayed hemolytic transfusion reaction
- Hypotension/shock
- Rigors
- Anxiety
- Back or chest pain
- Nausea/vomiting
- Shortness of breath (dyspnea)
- Hemoglobinuria
- Bleeding/pain at IV site
- Tachycardia/arrhythmia
- Generalized flushing
- Rash ≥ 25% of body
- Urticaria and other anaphylaxis reactions
- Hemolysis after transfusion
- Cytopenias after transfusion

- Virus, parasite, and prion infections
- Non-immunological reactions including infection
- Circulatory overload
- Hypothermia

For more information on types of reactions, signs and symptoms, and treatments, review the article adverse events related to blood transfusions, or see the online resources at the end of this chapter. If patient has a blood transfusion reaction, always follow agency policy to manage mild to severe blood reactions. In general, if a reaction occurs, follow the steps outlined in Checklist 73.

Checklist 73: Managing a Blood or Blood Product Transfusion Reaction

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Always review your agency's algorithm for managing mild to severe reactions. If a reaction is mild (e.g., fever), and without any other complications, a patient may continue the transfusion if monitored closely. Most other transfusion reactions require the transfusion to be stopped immediately.
- A blood transfusion reaction may occur 24 to 48 hours post-transfusion.
- Each separate unit presents a potential for an adverse reaction.
- Follow emergency transfusion guidelines when dealing with an emergency blood or blood product transfusion.
- Be aware of which types of blood or blood products cause the most types of transfusion reactions.
- Be aware of the types of patients at high risk for blood or blood product transfusion reactions.
- Always have emergency equipment and medications available during a transfusion. For example, epinephrine IV should always be readily available.

STEPS	ADDITIONAL INFORMATION
1. Stop transfusion immediately.	The severity of a blood transfusion reaction is related to the amount of product infused and the amount of time it has been infusing.
2. Keep IV line open with 0.9% saline.	Keeps IV site patent for emergency medications if required.
3. Complete cardiovascular and vital signs assessment.	Assessment monitors the type and severity of reaction. In addition to assessment: • Maintain good urinary output. • Avoid fluid overload. • Manage DIC (disseminated intravascular coagulation) or hemorrhage if clinically indicated. • Provide supportive measures as required (oxygen, etc.).
4. Contact physician for medical assessment and to inform about reaction.	The physician responsible for the patient must be informed of all transfusion reactions.
5. Check vital signs every 15 minutes until stable.	Vital signs must be monitored to identify improving or worsening condition.
6. Obtain blood and urine samples as soon as possible.	Blood and urine samples can help identify the type of blood transfusion reaction.

7. Check all labels, tags, forms, blood order, and patient's identification band to determine if there is a clerical discrepancy.	Clerical errors account for the majority of blood transfusion reactions.
8. Keep all blood and IV tubing for further testing by the blood bank for verification of blood product and patient identification.	All blood products and IV tubing are investigated by the transfusion services and reported to Canadian Blood Services and Public Health Agency of Canada. These professional bodies are responsible for reporting and recording incidents of reactions.
9. Notify blood bank.	Notify blood bank when an adverse reaction occurs, even if transfusion is continued.
10. Document as per agency policy.	Document time, date, signs and symptoms, type of product, notification to the physician and management of reaction, and patient response to management of reaction. Documentation includes, but is not limited to: • Transfusion reaction form • Patient chart • Report for transfusion services (blood bank) • Adverse event form (Patient Safety Learning System or PSLS)
Data source: Alberta Health Services, 2015a; Canadian Blood Services, 2011; Perry et al., 2014; Vancouver Coastal Health, 2008	

In preparation for a blood or blood product transfusion (Alberta Health Services, 2015a, 2015b; Perry et al., 2014; Vancouver Coastal Health, 2008), the steps listed in Checklist 74 must be completed. These steps must be completed *before* obtaining the blood or blood product from the blood bank.

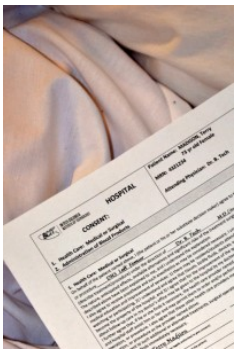
Checklist 74: Preparing for a Blood or Blood Product Transfusion

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- If there is any discrepancy between patient information, group and screen, product ordered, etc., do not proceed. Stop and verify any discrepancies.
- Be diligent when preparing to infuse blood. Distractions may lead to errors when verifying information.

STEPS	ADDITIONAL INFORMATION
1. Verify the physician's order for the specific blood or blood product.	Order must be verified for the type of product; the amount, date, time, and rate and duration of infusion; any modifications to a blood component (e.g., irradiation); specific transfusion requirements; and possible sequence in which multiple components are to be transfused.  *Physician orders for a blood transfusion*
2. Verify the health care provider's orders for any pre- or post-transfusion medications to be administered.	Some patients may require Benadryl IV or Tylenol pretransfusion or Lasix post-transfusion.
3. Obtain the patient's transfusion history, and note any known allergies and previous transfusion reactions.	Past complications may require patient to have pre- and post-transfusion medications to prevent further transfusion reactions.
4. Verify that type and cross-match (also known as a G & S) have been completed within the past 96 hours.	Verification allows for the identification of any newly developed antibodies, and ensures current compatibility between donor red blood cells and recipient's plasma. If G & S is outdated or not available, initiate process for new G & S sample.

5. Verify patency of IV site.	The patient's IV cannula must be patent and without complications, such as infiltration or phlebitis. The size of cannula (#18 to #20) must match the guidelines set by Canadian Blood Services.  *Assess patency of IV site*
6. Ensure appropriate patient identification band is available and legible.	To complete all safety identification checks, proper identification must be on the patient.
7. Assess laboratory values, such as hematocrit, coagulation values, and platelet count.	This ensures the transfusion is appropriate for the patient.
8. Check that the patient has properly completed and signed the transfusion consent form. Assess patient's understanding of the procedure and its rationale. Consent is required for the transfusion of blood and blood components and products.	All blood products must have a consent form signed prior to the transfusion.  *Example of a consent form* Consent is mandatory for all blood and blood product transfusions. Follow agency policy if patient is unable to sign or consent to blood or blood product transfusions.
9. Know the indications for the transfusion.	Know why the patient is receiving the transfusion.

10. Obtain and record the patient's pretransfusion baseline vital signs, including temperature, pulse, respiration, blood pressure, and oxygen saturation level. If the patient is febrile, which means the patient's temperature is higher than 37.8°C (100°F), notify the health care provider before initiating the transfusion.	Pretransfusion vital signs are a mandatory component of blood administration.  *Pre-assessment of vital signs*
11. Have emergency equipment available at the bedside (oxygen, suction, etc.).	Be prepared for potential complications, as prompt intervention may be required to prevent serious complications.  *Emergency equipment check at bedside*
12. Complete all documentation as required per agency policy.	Proper documentation provides evidence that all required procedures have been followed to prepare for a transfusion.
Data source: Alberta Health Services, 2015b; Canadian Blood Services, 2011; Perry et al., 2014; Vancouver Coastal Health, 2008	

Checklist 75 provides steps to administering blood and blood products safely in the acute care setting.

Checklist 75: Transfusion of Blood and Blood Products

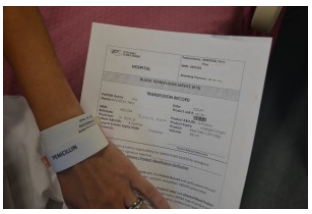
Disclaimer: Always review and follow your hospital policy regarding this specific skill.

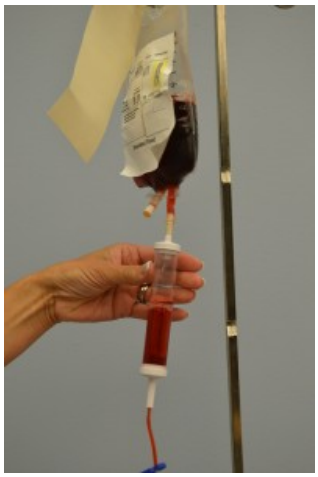
Safety considerations:

- No medications may be added to blood units or through IV tubing.
- Specific blood administration tubing is required for all blood transfusions. Blood tubing is changed every 4 hours or 4 units, whichever comes first.
- See agency policy for using EID for the administration of blood products.
- Intravenous immunoglobulin (IVIG) is only compatible with D5W.
- All blood products taken from the blood bank must be hung within 30 minutes and administered (infused) within 4 hours due to the risk of bacterial proliferation in the blood component at room temperature.

STEPS	ADDITIONAL INFORMATION
1. Verify physician orders and all preparation steps as listed in Checklist 74.	
2. Assess or initiate venous access.	Appropriate needle gauge is based on clinical status of patient, urgency of transfusion, and venous access: • #18 gauge for trauma/surgery • #20 to #22 for elective medical/geriatric Transfusion set must be Luer-locked to a 2.0 ml maximum extension tubing, either directly to cannula or through a Max Plus positive pressure cap.  *Saline lock*

3. Initiate primary infusion at TKVO.	Prime an IV line following Checklist 66. • 0.9% NS for RBC • D5W for IVIG Refer to blood product fact sheets for all other products.  *Normal saline IV solution*
4. Complete and document cardiovascular assessments and initial vital signs.	Document any clinical sign or symptom that may be confused with a transfusion reaction (e.g., existing fever).
5. Obtain products from the transfusion areas within 30 minutes of planned transfusion.	Plan for pickup or delivery of blood and blood products. Do not request blood or blood products if Steps 1 to 4 are not complete.
6. Complete visual inspection of product.	Assess blood bag for any signs of leaks or contamination, such as clumping, clots, gas bubbles, or a purplish discoloration. Return to blood bank if blood bag contains any of the above signs.  *Visual inspection of the blood bag*

7. Initial verification: a. Compare the **transfusion medical services** (TMS) documentation with the patient record to verify: • Patient first and last name and unique identifier number • Physician order • Consent • Patient ABO grouping (G & S) b. Compare the TMS documentation with the product label attached to the product tab and verify: • Patient first and last name and unique identifier number • Type of blood product and ABO blood grouping • 11-digit serial number • Product expiry date and time • Special requirements (e.g., irradiated) • G & S expiry date	All verification numbers/information must match exactly. Must be completed by two trained staff members competent in blood transfusion administration process as set out by the agency. Confirm the patient blood type and Rh are compatible with the donor blood type and Rh. If there are any discrepancies, stop the process and contact the TMS for resolution and direction. Do not proceed. Ensure the blood product matches the physician's orders (red blood cells or platelets).  *TMS record*
8 Administer pre-medications as ordered.	Medications must be administered through an IV infusion set, and the IV site cleared with 0.9% NS.
9. Final verification (must be completed by the same two staff members as noted in Step 7). Compare the patient's first and last name and unique identifier number using all of the following: • Patient identification band or equivalent ID process as approved by the TMS (Ask the patient to spell first and last name and state date of birth.) • TMS documentation • Compatibility tag and label attached to blood product Only after recipient identification and product check is confirmed, invert product 5 to 10 times and insert spike of the blood administration set into the blood product container.	All verification numbers must match exactly. If there are any discrepancies, stop the process and contact the TMS for resolution and direction. Do not proceed.  *Identify patient* Patients who are alert and oriented should be asked to: • Spell first and last name • State their date of birth All identifying information attached to the blood bag must remain attached at least until completion of transfusion.

10. Perform hand hygiene. Prime the blood product administration set: • Close clamp. Completely cover the filter with product. • A straight blood administration set is used for all transfusions. • A Y-type blood administration set should only be considered in clinical situations where additional fluid volume may be required.	Do not remove the product from the presence of the patient; prime at bedside. If product is removed from bedside, the final verification process must be completed again.  *Prime blood tubing*
11. Initiate transfusion: • Obtain vital signs immediately prior to transfusion, then 15 minutes after initiation, then every hour until transfusion is complete. • Maintaining asepsis, disconnect the NS infusion and connect blood administration set and start transfusion. • Advise patient on the signs and symptoms of transfusion reaction and what and when to report.	Adults: Initiate red cells slowly (25 ml in the first 15 minutes). For all other blood transfusions, refer to the blood and product sheet as per your agency policy. Some agencies use an EID to administer blood transfusions. Always check agency policy prior to transfusion. For each and every unit: • Remain with the patient for the first 5 minutes and assess for clinical signs of transfusion reaction. • Complete transfusion within 4 hours of removal from the blood bank. Most transfusion reactions occur within first 15 minutes of a transfusion. Infusing small amounts of blood component initially minimizes volume of blood to which patient is exposed, thereby minimizing severity of reaction.  *Infusion of packed red blood cells*

12. Monitor: • Assess and observe for clinical signs and symptoms of reactions up to 24 hours post-transfusion. • Complete all appropriate clinical documentation.	Vital signs must be monitored: • Immediately prior to infusion • Within 10 to 15 minutes • Every hour until transfusion is complete  *Vital signs*
13. In the event of a transfusion reaction, stop the infusion.	• Manage transfusion reactions as per protocol. • Complete required transfusion reaction form. • Return remaining blood to blood bank for further investigation.
14. For additional units, repeat steps 6 to 12.	Follow the same process to ensure patient safety.
15. Flush administration set with maximum of 50 ml of normal saline and re-establish IV or SL as per physician orders.	Flushing displaces any blood or blood product from the administration set. It is not necessary to flush between units of the same blood product.
16. Discard waste in biohazard waste container.	This prevents the spread of biohazard waste.
17. Complete all documentation as required by agency.	Documentation may include: • Transfusion record form • All vital signs and reactions • Any significant findings, initiation and termination of transfusion • Record of transfusion on the in-and-out sheet
Data source: Alberta Health Services, 2015a, 2015b; Perry et al., 2014; Vancouver Coastal Health, 2008	

Critical Thinking Exercises

1. How many units of blood can be transfused through one blood administration set?
2. What are the steps to managing a blood transfusion reaction?

8.8 Total Parenteral Nutrition (TPN)

Total parenteral nutrition (TPN), also known as parenteral nutrition (PN) is a form of nutritional support given completely via the bloodstream, intravenously with an IV pump. TPN administers proteins, carbohydrates, fats, vitamins, and minerals. It aims to prevent and restore nutritional deficits, allowing bowel rest while supplying adequate caloric intake and essential nutrients, and removing antigenic mucosal stimuli (Perry et al., 2014).

TPN may be short-term or long-term nutritional therapy, and may be administered on acute medical floors as well as in critical care areas. The caloric requirements of each patient are individualized according to the degree of stress, organ failure, and percentage of ideal body weight. TPN is used with patients who cannot orally ingest or digest nutrition (Triantafillidis & Papalois, 2014). TPN may be administered as peripheral parenteral nutrition (PPN) or via a central line, depending on the components and osmolality. Central veins are usually the veins of choice because there is less risk of thrombophlebitis and vessel damage (Chowdary & Reddy, 2010). According to Chowdary & Reddy (2010), candidates for TPN are:

- Patients with paralyzed or nonfunctional GI tract, or conditions that require bowel rest, such as small bowel obstruction, ulcerative colitis, or pancreatitis
- Patients who have had nothing by mouth (NPO) for seven days or longer
- Critically ill patients
- Babies with an immature gastrointestinal system or congenital malformations
- Patients with chronic or extreme malnutrition, or chronic diarrhea or vomiting with a need for surgery or chemotherapy
- Patients in hyperbolic states, such as burns, sepsis, or trauma

TPN is made up of two components: amino acid/dextrose solution and a lipid emulsion solution (see Figure 8.9). It is ordered by a physician, in consultation with a dietitian, depending on the patient's metabolic needs, clinical history, and blood work. The amino acid/dextrose solution is usually in a large volume bag (1,000 to 2,000 ml), and can be standard or custom-made. It is often yellow in colour due to the multivitamins it contains. The ingredients listed on the bag must be confirmed by the health care provider hanging the IV bag. The solution may also include medication, such as insulin and heparin. The amino acid/dextrose solution is reviewed and adjusted each day based on the patient's blood work. Lipid emulsions are prepared in 100 to 250 ml bags or glass bottles and contain the essential fatty acids that are milky in appearance. At times, the lipid emulsion may be added to the amino acid/dextrose solution. It is then called *3 in 1* or *total nutrition admixture* (Perry et al., 2014).

TPN is prepared by a pharmacy, where the calories are calculated using a formula, and is usually mixed for a 24-hour continuous infusion to prevent vascular trauma and metabolic instability (North York Hospital, 2013). TPN orders should be reviewed each day, so that changes in electrolytes or the acid-base balance can be addressed appropriately without wasting costly TPN solutions (Chowdary & Reddy, 2010).

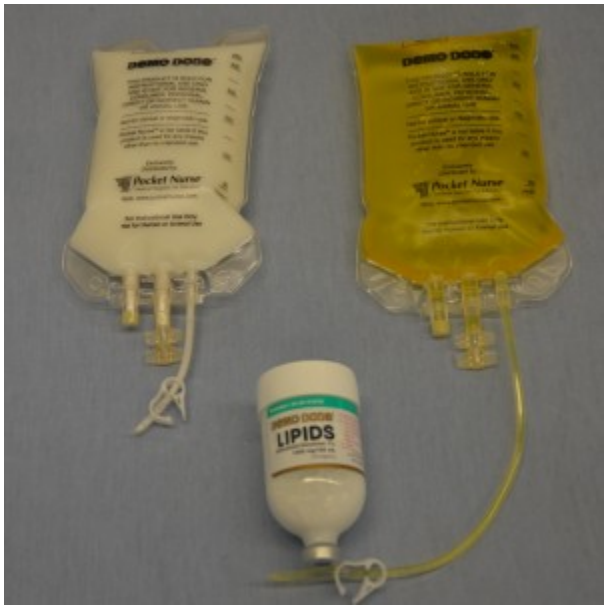


Figure 8.9 Types of TPN (amino acids and lipids)

Figure 8.10 TPN tubing with special filter

TPN is not compatible with any other type of IV solution or medication and must be administered by itself. TPN must be administered using an EID (IV pump), and requires special IV filter tubing (see Figure 8.10) for the amino acids and lipid emulsion to reduce the risk of particles entering the patient. Agency policy may allow amino acids and lipid emulsions to be infused together above the filters. TPN tubing will not have any access ports and must be changed according to agency policy. Always review agency policy on setup and equipment required to infuse TPN.

A physician may order a total fluid intake (TFI) for the amount of fluid to be infused per hour to prevent fluid overload in patients receiving TPN. It is important to keep track of all the fluids infusing (IV fluids, IV medications, and TPN) in order to avoid fluid overload (Perry et al., 2014). Do not abruptly discontinue TPN (especially in patients who are on insulin) because this may lead to hypoglycemia. If for whatever reason the TPN solution runs out while awaiting another bag, hang D5W at the same rate of infusion while waiting for the new TPN bag to arrive (North York Hospital, 2013). Do not obtain blood samples or central venous pressure readings from the same port as TPN infusions. To prevent severe electrolyte and other metabolic abnormalities, the infusion rate of TPN is increased gradually, starting at a rate of no more than 50% of the energy requirements (Mehanna, Nankivell, Moledina, & Travis, 2009).

COMPLICATIONS RELATED TO TPN

There are many complications related to the administration of TPN (Perry et al., 2014). Table 8.8 lists potential complications, rationale, and interventions.

Table 8.8 TPN Complications, Rationale, and Interventions

Complication	Rationale and Interventions
Catheter-related bloodstream infection (CR-BSI), also known as sepsis	CR-BSI, which starts at the hub connection, is the spread of bacteria through the bloodstream. There's an increased risk of CR-BSI with TPN, due to the high dextrose concentration of TPN. Symptoms include tachycardia, hypotension, elevated or decreased temperature, increased breathing, decreased urine output, and disorientation. Interventions: Strict adherence to aseptic technique with insertion, care, and maintenance; avoid hyperglycemia to prevent infection complications; closely monitor vital signs and temperature. IV antibiotic therapy is required. Monitor white blood cell count and patient for malaise. Replace IV tubing frequently as per agency policy (usually every 24 hours).
Localized infection at exit or entry site	Due to poor aseptic technique during insertion, care, or maintenance of central line or peripheral line Interventions: Apply strict aseptic technique during insertion, care, and maintenance. Frequently assess CVC site for redness, tenderness, or drainage. Notify health care provider of any signs and symptoms of infection.
Pneumothorax	A pneumothorax occurs when the tip of the catheter enters the pleural space during insertion, causing the lung to collapse. Symptoms include sudden chest pain, difficulty breathing, decreased breath sounds, cessation of normal chest movement on affected side, and tachycardia. Interventions: Apply oxygen, notify physician. Patient will require removal of central line and possible chest tube insertion.
Air embolism	An air embolism may occur if IV tubing disconnects and is open to air, or if part of catheter system is open or removed without being clamped. Symptoms include sudden respiratory distress, decreased oxygen saturation levels, shortness of breath, coughing, chest pain, and decreased blood pressure. Interventions: Make sure all connections are clamped and closed. Clamp catheter, position patient in left Trendelenburg position, call health care provider, and administer oxygen as needed.
Hyperglycemia	Related to sudden increase in glucose after recent malnourished state. After starvation, glucose intake suppresses gluconeogenesis by leading to the release of insulin and the suppression of glycogen. Excessive glucose may lead to hyperglycemia, with osmotic diuresis, dehydration, metabolic acidosis, and ketoacidosis. Excess glucose also leads to lipogenesis (again caused by insulin stimulation). This may cause fatty liver, increased CO_2 production, hypercapnea, and respiratory failure. Interventions: Monitor blood sugar frequently QID (four times per day), then less frequently when blood sugars are stable. Follow agency policy for glucose monitoring with TPN. Be alert to changes in dextrose levels in amino acids and the addition/removal of insulin to TPN solution.

Refeeding syndrome	**Refeeding syndrome** is caused by rapid refeeding after a period of malnutrition, which leads to metabolic and hormonal changes characterized by electrolyte shifts (decreased phosphate, magnesium, and potassium in serum levels) that may lead to widespread cellular dysfunction. Phosphorus, potassium, magnesium, glucose, vitamin, sodium, nitrogen, and fluid imbalances can be life-threatening. High-risk patients include the chronically undernourished and those with little intake for more than 10 days. Patients with dysphagia are at higher risk. The syndrome usually occurs 24 to 48 hours after refeeding has started. The shift of water, glucose, potassium, phosphate, and magnesium back into the cells may lead to muscle weakness, respiratory failure, paralysis, coma, cranial nerve palsies, and rebound hypoglycemia. Interventions: Rate of TPN should be based on the severity of undernourishment for moderate- to high-risk patients. TPN should be initiated slowly and titrated up for four to seven days. All patients require close monitoring of electrolytes (daily for one week, then usually three times/week). Always follow agency policy. Blood work may be more frequent depending on the severity of the malnourishment.
Fluid excess or pulmonary edema	Signs and symptoms include fine crackles in lower lung fields or throughout lung fields, hypoxia (decreased O_2 sats). Interventions: Notify primary health care provider regarding change in condition. Patient may require IV medication, such as Lasix to remove excess fluids. A decrease or discontinuation of IV fluids may also occur. Raise head of bed to enhance breathing and apply O_2 for oxygen saturation less than 92% or as per agency protocol. Monitor intake and output. Pulmonary edema may be more common in the elderly, young, and patients with renal or cardiac conditions.
Data source: Chowdary & Reddy, 2010; Mehanna et al., 2009; O'Connor, Hanly, Francis, Keane, & McNamara, 2013; Perry et al., 2014	

A patient on TPN must have blood work monitored closely to prevent the complications of refeeding syndrome. Blood work may be ordered as often as every six hours upon initiation of TPN. Most hospitals will have a TPN protocol to follow for blood work. Common blood work includes CBC (complete blood count), electrolytes (with special attention to magnesium, potassium, and phosphate), liver enzymes (total and direct bilirubin, alanine aminotransferase [ALT], aspartate aminotransferase [AST], alkaline phosphatase [ALP], gamma-glutamyl transferase [GGT], total protein, albumin), and renal function tests (creatinine and urea). Compare daily values to baseline values, and investigate and report any rapid changes in any values (Chowdary & Reddy, 2010; Perry et al., 2014). Table 8.9 outlines a plan of care when a patient is receiving TPN.

Table 8.9 Assessment of a Patient with TPN

Assessment	Additional Information
CVC/ peripheral IV line	Intravenous line should remain patent, free from infection. Dextrose in TPN increases risk of infection. Assess for signs and symptoms of infections at site (redness, tenderness, discharge) and systemically (fever, increased WBC, malaise). Dressing should be dry and intact.
Daily or biweekly weights	Monitor for evidence of edema or fluid overload. Over time, measurements will reflect weight loss/gain from caloric intake or fluid retention.
Capillary or serum blood glucose levels	QID (4 times a day) capillary blood glucose initially to monitor glycemic control, then reduce monitoring when blood sugars are stable or as per agency policy. May be done more frequently if glycemic control is difficult. Indicates metabolic tolerance to dextrose in TPN solution and patient's glycemic status.
Monitor intake and output	Monitor and record every eight hours or as per agency policy. Monitor for signs and symptoms of fluid overload (excessive weight gain) by completing a cardiovascular and respiratory assessment. Assess intakes such as IV (intravenous fluids), PO (oral intake), NG (nasogastric tube feeds). Assess outputs: NG (removed gastric content through the nasogastic tube), fistula drainage, BM (liquid bowel movements), colostomy/ileostomy drainage, closed suction drainage devices (Penrose or Jackson-Pratt drainage) and chest tube drainage.
Daily to weekly blood work	Review lab values for increases and decreases out of normal range. Lab values include CBC, electrolytes, calcium, magnesium, phosphorus, potassium, glucose, albumin, BUN (blood urea nitrogen), creatinine, triglycerides, and transferrin.
Mouth care	Most patients will be NPO. Proper oral care is required as per agency policy. Some patients may have a diet order.
Vital signs	Vital signs are more frequently monitored initially in patients with TPN.
Data source: BCIT, 2015a; Perry et al., 2014	

TPN may be administered in the hospital or in a home setting. Generally, patients receiving TPN are quite ill and may require a lengthy stay in the hospital. The administration of TPN must follow strict adherence to aseptic technique, and includes being alert for complications, as many of the patients will have altered defence mechanisms and complex conditions (Perry et al., 2014). To administer TPN, follow the steps in Checklist 76.

Checklist 76: TPN Administration

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Compare the patient's baseline vital signs; electrolyte, glucose, and triglyceride levels; weight; and fluid intake and output with treatment values, and investigate any rapid change in such values.
- To identify signs of infection early, be aware of the patient's recent temperature range.
- Use strict aseptic technique when caring for central venous catheters and PICC lines.
- Do not use TPN solution if it has coalesced, as evidenced by formation of a thick, dense layer of fat droplets on its surface. If the solution appears abnormal in any way, request a replacement from the pharmacy.
- Never try to catch up with a delayed infusion.

STEPS	ADDITIONAL INFORMATION
1. Review physician's orders and compare to MAR and content label on TPN solution bag and for rate of infusion. Each component of the TPN solution must be verified with the physician's orders.	Check date and time of last TPN tubing change, lab values, and expiry date of TPN to prevent medication error. Assess CVC, WBC, and patient for malaise. Medications may be added to the TPN. Ensure the rate of infusion is verified in the doctor's order each time new TPN bag is initiated.
2. Collect supplies, prepare TPN solution, and prime IV tubing with filter as per agency protocol. TPN requires special IV tubing with a filter.	Generally, new TPN tubing is required every 24 hours to prevent catheter-related bacteremia. Follow agency policy. Ensure tubing is primed correctly to prevent air embolism.  *TPN tubing with special filter*

3. <a href="/clinicalskills/chapter/1-6-hand-hygiene/">Perform hand hygiene, identify yourself, and identify patient using two patient identifiers. Compare the MAR to the patient's wristband. Explain the procedure to the patient.	Hand hygiene prevents the spread of microorganisms. Proper identification prevents patient errors.  *Compare MAR to patient wristband*
4. Complete all safety checks for CVC as per agency policy.	This adheres to safety policies related to central line care.
5. If changing TPN solution, pause EID and remove old TPN administration set. Disinfect connections and change IV tubing as per agency policy. If starting TPN for the first time, flush and disinfect CVC lumens as per agency policy.	Change TPN IV tubing as per agency policy. Use strict aseptic technique with IV changes as patients with high dextrose solutions are at greater risk of developing infections.
6. Insert new TPN solution and IV tubing into EID.	EID must be used with all TPN administration.
7. Start TPN infusion rate as per physician orders.	Prevents medication errors.
8. Discard old supplies as per agency protocol, and perform hand hygiene.	These steps prevent the spread of microorganisms.
9. Monitor for signs and symptoms of complications related to TPN.	See Table 8.8 for list of complications related to TPN.
10. Complete daily assessments and monitoring for patient on TPN as per agency policy.	See daily and weekly assessments in Table 8.9. Flow rate may be monitored hourly.
11. Document the procedure in the patient chart as per agency policy.	Note time when TPN bag is hung, number of bags, and rate of infusion, assessment of CVC site and verification of patency, status of dressing, vital signs and weight, client tolerance to TPN, client response to therapy, and understanding of instructions.
Data source: North York Hospital, 2013; Perry et al., 2014	

Critical Thinking Exercises

1. Describe refeeding syndrome and state one method to reduce the risk of refeeding syndrome.
2. A patient receiving TPN for the past 48 hours has developed malaise and hypotension. What potential complication are these signs and symptoms related to?

Additional Videos

VIDEO 8.7

Watch a video *CVAD Care and Maintenance—Lumens with Valves* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

VIDEO 8.8

Watch a video *CVAD Care and Maintenance—Lumens without Valves* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

8.9 Summary

Infusion therapy is a common treatment in the hospital setting, and vital for patient recovery. The safe management of IV equipment and procedures related to IV therapy is an essential skill for safe patient care. This chapter reviewed the skills necessary to care for a patient receiving IV therapy, and the benefits and complications related to peripheral intravenous therapy, central venous catheters, blood and blood products, and TPN.

Key Takeaways

- Use strict aseptic technique when preparing and maintaining all IV solutions and equipment. Most complications related to IV therapy can be prevented.
- Be alert and vigilant, and assess for complications as per agency policy.
- Keep up to date with recommendations for safe care with IV therapy from the Centers for Disease Control and Canadian Patient Safety Institute.
- There are many types of equipment and procedures related to IV therapy. Educate yourself on the various types of equipment and devices to care for your patient safely.
- Receive the appropriate training for initiating IVs, CVC care and maintenance, and blood and blood product transfusions.
- Remember that patients on IV therapy are at an increased risk for fluid overload. These patients include the elderly, young, and those with cardiac and renal disease.
- Follow all transfusion policies to avoid transfusion errors. Be alert to the potential complications of blood and blood product transfusions.
- Complete all daily assessments related to a patient receiving TPN. These patients are generally quite ill and have a diminished ability to tolerate complications.

Additional Videos

VIDEO 8.9

Watch a video *Blood draw through a CVAD* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

VIDEO 8.10

Watch a video *PVAD-Short Dressing Change* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

VIDEO 8.11

Watch a video *PICC Dressing Change* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

Suggested Online Resources

1. ATI Nursing Education: Blood administration. This module provides comprehensive information about blood administration, including practice questions and step-by-step videos.
2. ATI Nursing Education: Intravenous therapy. This American-based online module covers all topics related to IV therapy including definitions, a review of equipment, step-by-step videos, evidence-based research, frequently asked questions, and quizzes.
3. Canadian Blood Services: Clinical guide to transfusion. These educational materials provide guidelines for the care of patients receiving blood or blood products. This information includes blood administration, adverse reactions, blood components, emergency transfusions, pediatric and neonatal transfusions, and more.
4. Drug calculations. This medication calculation website reviews how to calculate the dosages for parenteral and non-parenteral medications, and IV fluids. It also includes metric conversions and IV drop rate calculations.
5. Fraser Health: Central venous catheters in adult patients. This self-learning online module is designed for health care professionals and covers central venous catheter (CVC) care and maintenance.
6. Fraser Health: Peripheral intravenous initiation. This self-study online module covers initiating intravenous (IV) therapy.
7. Intravenous fluid selection. This sample chapter from a textbook describes the selection of IV fluids and solutions, and includes study questions as well.
8. Mosby's Nursing Video Skills – Advanced. These Canadian-based online module with various videos and procedure checklists related to IV therapy, central lines, blood and blood product transfusions, and TPN.
9. Nursing Made Incredibly Easy: The nurse's quick guide to IV drug calculations. This article

provides a simple and concise way to perform accurate IV drug calculations.

References

Alberta Health Services. (2015a). Transfusion of blood and blood components. Retrieved on July 15, 2015, from https://extranet.ahsnet.ca/teams/policydocuments/1/clp-prov-transfusion-blood-product-policy-ps-59.pdf

Alberta Health Services. (2015b). Transfusion of blood and blood components — Acute adult. Retrieved on July 15, 2015, from https://extranet.ahsnet.ca/teams/policydocuments/1/clp-prov-transfusion-blood-product-adult-acute-procedure-ps-59-01.pdf

ATI. (2015). Discontinuing a peripheral intravenous line. ATI Nursing Education. Intravenous Therapy. Retrieved on Oct 10, 2015 from http://atitesting.com/ati_next_gen/skillsmodules/content/iv-therapy/equipment/discontinuing-iv.html

Baskin, J. L., Pui, C. H., Reiss, U., Wilimas, J. A., Metzger, L. M., Ribeiro, R. C., & Howard, S. C. (2009). Management of occlusion and thrombosis associated with long-term indwelling central venous catheters. *Lancet, 374*(9684), 159. doi: 10.1016/S0140-6736(09)60220-8

British Columbia Institute of Technology (BCIT). (2015a). CVC complications worksheet: NURS 3020. BCIT BSN program.

British Columbia Institute of Technology (BCIT). (2015b). Checklist: IV tubing administration set and IV solution change. NURS 2020. BCIT BSN program.

Brunce, M. (2003). Troubleshooting central lines. Retrieved on Aug 28, 2015, from http://www.modernmedicine.com/modern-medicine/content/troubleshooting-central-lines

Canadian Blood Services (2007). Blood Administration. Retrieved on Nov. 6, 2015 from http://www.transfusionmedicine.ca/sites/transfusionmedicine/files/PDF/CBC_CGT_09.pdf

Canadian Blood Services. (2011). Clinical guide to transfusions. Adverse reactions. Retrieved on July 9, 2015, from http://www.transfusionmedicine.ca/sites/transfusionmedicine/files/articles/CGTTChapter10_MAY2011_FINAL.pdf

Canadian Blood Services. (2013). Clinical guide to transfusions. Blood components. Retrieved on July 9, 2015, from http://www.transfusionmedicine.ca/sites/transfusionmedicine/files/articles/CGTTChapter2_MAR2013_FINAL.pdf

Centers for Disease Control. (2011). Guidelines for the prevention of intravascular catheter related infections. Retrieved on July 5, 2015, from http://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf

Chowdary, K. V. R., & Reddy, P. N. (2010). Parenteral nutrition: Revisited. *Indian Journal of Anaethestic*, *54*(2), 95-103. doi: 10.4103/0019-5049.63637

Crawford, A., & Harris, H. (2011). IV fluids: What nurses need to know. *Nursing 2015, 41*(5), 30-38. Retrieved on July 9, 2015, from http://journals.lww.com/nursing/Fulltext/2011/05000/I_V__fluids_What_nurses_need_to_know.10.aspx?WT.mc_id=HPxADx20100319xMP

Fraser Health. (2007). Central venous catheters in adult patients. A self-learning module. Retrieved on Oct 10, 2015, from https://www.fraserhealth.ca/media/CentralVenousCatheters.pdf

Fraser Health Authority. (2014). Clinical practice guidelines: Intravenous therapy. Retrieved on July 2, 2015, from http://physicians.fraserhealth.ca/media/2014%2005%2015%20IV%20Therapy%20CPG%20FINAL.pdf

Fulcher, E. M., & Fraser, M. S. (2007). *Introduction to intravenous therapy for health professionals*. St Louis, MO: Elsevier.

Infusion Nurses Society. (2011). Infusion nursing standards of practice. *Journal of Infusion Nursing, 34*(1). Retrieved on July 2, 2015, from http://www.ins1.org/i4a/ams/amsstore/category.cfm?product_id=192

Infusion Nurses Society. (2012). INS Position paper: Recommendations for frequency of assessment of the short peripheral catheter site. *Journal of infusion nursing,* 35(5), 290 -292.

McCallum L., & Higgins, D. (2012). Care of peripheral venous cannula sites. *Nursing times*, 108(34-35), 12-15.

Mehanna, H., Nankivell, P. C., Moledina, J., & Travis, J. (2009). Refeeding syndrome — awareness, prevention and management. *Head and Neck Oncology, 1*(4). doi: 10.1186/1758-3284-1-4

North York Hospital. (2013). Care of the patient receiving total parenteral nutrition (TPN). Retrieved on July 6, 2015, from http://www.nygh.on.ca/cernercbt/files%5CCONTENT_Day_2%5CTPN%202013%5CTPN%20learning%20pkg%20revised%20July%202013.pdf

O'Connor, A., Hanly, A. M., Francis, E., Keane, N., & McNamara, D. (2013). Catheter associated blood stream infections in patient receiving parenteral nutrition: A prospective study of 850 patients. *Journal of Clinical Medical Research, 5*(1),18-21. doi: 10.4021/jomr1032w

Perry, A. G., Potter, P. A., & Ostendorf, W. R. (2014). *Clinical skills and nursing techniques* (8th ed.). St Louis, MO: Elsevier-Mosby.

Phillips, L. D. (2005). *Manual of IV therapies*. Philadelphia, PA: F.A. Davis Company.

Prabaharan, B., & Thomas, S. (2014). Spontaneous migration of central venous catheter tip following extubation. *Saudi J Anaesth, 8*(1): 131–133. doi: 10.4103/1658-354X.125975

Safer Healthcare Now. (2012). Interventions. Retrieved on July 9, 2015, from: http://www.patientsafetyinstitute.ca/en/toolsResources/pages/interventions-default.aspx

Triantafillidis, J. K., & Papalois, A. E. (2014). The role of total parenteral nutrition in inflammatory

bowel disease: Current aspects. *Scandinavian Journal of Gastroenterology*, *49*(1), 3-14. doi: 10.3109/00365521.2013.860557.

Vancouver Coastal Health. (2008). *Administration of blood components and blood products*. Vancouver, BC: Vancouver Health Authority.

Vancouver Coastal Heath. (2012). *Saline locks: Care and maintenance*. Vancouver, BC: Vancouver Health Authority.

Waitt, C., Waitt, P., & Pirmohamed, M. (2004). Intravenous therapy. *Postgraduate Medicine*, *80*(939), 1-6. doi: 10.1136/pmj.2003.010421

Chapter 9. Blood Glucose Monitoring

9.1 Introduction

Blood glucose monitoring allows people with diabetes to monitor their blood glucose levels and manage their condition accordingly.

TYPES OF DIABETES

Type 1 diabetes usually develops in childhood or adolescence and used to be called juvenile-onset diabetes. It occurs when the beta cells of the pancreas are destroyed by the immune system and no longer produce insulin, or produce very little insulin. People with this form of diabetes need injections of insulin every day in order to control the levels of glucose in their blood. If they do not have access to insulin, they will die. There is no known way to prevent type 1 diabetes.

Type 2 diabetes used to be called non-insulin-dependent diabetes or adult-onset diabetes. It accounts for at least 90% of all cases of diabetes and can occur at any age. With type 2 diabetes, the body does not make enough insulin or does not respond well to the insulin it makes. Either or both of these characteristics — relative insulin deficiency and insulin resistance — may be present at the time diabetes is diagnosed.

Type 2 diabetes may remain undetected for many years, and the diagnosis is often made when a complication appears or a routine blood or urine glucose test is done. It is often, but not always, associated with overweight or obesity, which itself can cause insulin resistance and lead to high blood glucose levels. People with type 2 diabetes can often initially manage their condition through exercise and diet. However, over time most people will require oral drugs and or insulin.

Gestational diabetes is a form of diabetes that develops in women during pregnancy and disappears after delivery. Gestational diabetes affects about 4% of all pregnancies and increases the risk of developing type 2 diabetes.

Other specific types of diabetes also exist, and more information can be found at the Canadian Diabetes Association website.

MANAGING DIABETES

People with diabetes can manage their disease by monitoring their blood glucose levels. To measure blood glucose levels, blood is obtained through a skin puncture using a specified needle system, which is less painful and invasive than venipuncture. The ease of this skin puncture method makes it possible for patients to perform this procedure themselves.

In the hospital setting, a blood glucose machine (glucometer) is used to provide an accurate blood glucose level in less than a minute using a reagent strip with a drop of blood dropped or wicked onto a new, dry, specifically indicated portion of the reagent strip. These machines must be regularly

calibrated according to agency policy, and each machine should be cleaned between use on different patients.

Ensure that you read and understand the manufacturer’s instructions and your agency policy for the blood glucose monitoring machines used in your clinical setting.

Learning Objectives

- State the abnormal and normal ranges for blood glucose levels in Canadian (SI) values
- Demonstrate the safe use of a glucometer machine
- Collect and organize appropriate equipment to perform a blood glucose test
- Describe the steps in performing a capillary blood glucose test
- Demonstrate dexterity and ability to accurately obtain a blood glucose sample
- Identify when a patient is hypoglycemic or hyperglycemic
- Discuss the management of hypoglycemia using a hypoglycemic protocol

9.2 Glucometer Use

People with diabetes require regular monitoring of their blood glucose to help them achieve as close to normal blood glucose levels as possible for as much of the time as possible. The benefits of maintaining a blood glucose level that is consistently within the range of 4-7 mmol/L will reduce the short-term, potentially life-threatening complications of hypoglycemia as well as the occurrence rate and severity of the long-term complications of hyperglycemia.

Patients in the hospital setting are likely to have inconsistent blood glucose levels as they are affected by changes in diet and lifestyle, surgical procedures, and the stress of being in a hospital. The physician will prescribe how regularly the blood glucose should be monitored. In acute situations, a sliding-scale treatment for insulin will be individually prescribed per patient. The medication administration record (MAR) or sliding scale will provide directions for the amount of medication to be given based on the blood glucose reading.

It is usually the responsibility of the nurse to perform blood glucose readings. As with any clinical procedure, ensure that you understand the patient's condition, the reason for the test, and the possible outcomes of the procedure. Prior to performing a blood glucose test, ensure that you have read and understood the manufacturer's instructions and your agency's policy for the blood glucose monitoring machines (see Figure 9.1) used in your clinical setting, as these vary. It is also important that you determine the patient's understanding of the procedure and the purpose for monitoring blood glucose level. Before you begin, you should also determine if there are any conditions present that could affect the reading. For example, is the patient fasting? Has the patient just had a meal? Is the patient on any medications that could affect the reading (e.g., anticoagulants)? In these situations, draw on your knowledge and understanding of diabetes, the medication you are administering, the uniqueness of your patient, and the clinical context. Use your knowledge and critical thinking to make a clinical judgment.

Figure 9.1 A blood glucose monitoring machine with cotton balls, lancets, and reagent strips

Inspect the area of skin that will be used as the puncture site and ask the patient if they are in agreement with the site you have identified to use for the skin puncture. Your patient may have a preference for the puncture site. For example, some patients prefer not to use a specific finger for the skin puncture.

Or a particular site may be contraindicated. For example, you shouldn’t use the hand on the same side as a mastectomy.

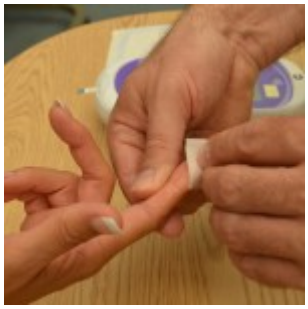
Patients who do their own blood glucose testing at home may prefer to handle the skin-puncturing device themselves and continue self-testing while they are in the hospital.

Checklist 77 outlines the steps for taking a skin-puncture blood sample and using a blood glucose monitor (glucometer) to measure a patient’s blood glucose level.

Checklist 77: Blood Glucose Monitoring

Disclaimer: Always review and follow your hospital policy regarding this specific skill.	
Safety considerations: • Perform hand hygiene. • Check room for additional precautions. • Introduce yourself to patient. • Confirm patient ID using two patient identifiers (e.g., name and date of birth). • Check allergy band for any allergies. • Complete necessary focused assessments and/or vital signs and document on MAR. • Provide patient education as necessary.	
STEPS	ADDITIONAL INFORMATION
1. Review the patient's medical history for diabetes type, medications, and/or anticoagulant therapy.	A thorough knowledge of the patient's medical history is important even when the test performed is a relatively simple procedure. Anticoagulant therapy may result in prolonged bleeding at the skin-puncture site and require pressure to the site.
2. Determine if the test requires special timing; for example, before or after meals. Blood glucose monitoring is usually done prior to meals and the administration of antidiabetic medications.	Blood glucose levels are affected by diet, and the test may be scheduled at very specific intervals. Diet and medication orders are based on the assumption that the test results are accurate.

3. Gather equipment needed: • Disposable latex-free gloves • Alcohol swab • Lancet or automatic lancing device • 2 x 2 gauze • Reagent strips • Blood glucose meter	Having equipment prepared and available promotes organization, safety, and timeliness.  *Gloves, alcohol swab, lancet, gauze, reagent strips, glucometer*
4. Determine if blood glucose meter needs to be calibrated.	Calibration should be done regularly according to agency policy to ensure accuracy of readings.
5. Assess patient's sites for skin puncture.	Skin integrity at the puncture site minimizes the risk of infection and promotes healing.
6. Perform hand hygiene.	Hand hygiene prevents the transfer of microorganisms.  *Hand hygiene with ABHR*

7. Have patient wash hands with soap and warm water, and position the patient comfortably in a semi-upright position in bed or upright in a chair. Encourage patient to keep hands warm. Hospital policy may require use of an alcohol swab only, not water, to clean the puncture site. Ensure that puncture site is completely dry prior to skin puncture.	Washing reduces transmission of microorganisms and increases blood flow to the puncture site.  *Have patient wash hands with warm water*  *Or clean with an alcohol swab if that is agency policy*
8. Remove a reagent strip from the container and reseal the container cap. Do not touch the test pad portion of the reagent strip.	Tight closure of the container keeps strips from damage due to environmental factors.  *Remove reagent strip from container and close container tightly*

9. Follow the manufacturer's instructions to prepare the meter for measurement.	This prepares meter for accurate readings.  *Prepare the glucometer*
10. Place the unused reagent strip in the glucometer or on a clean, dry surface (e.g., paper towel) with the test pad facing up. This step is dependent on the manufacturer's instructions.	 *Prepare the reagent strip according to the manufacturer's instructions* Moisture may alter the test results.
11. Apply non-sterile gloves.	 *Apply non-sterile gloves* Gloves protect health care provider from contamination by blood.
12. Keep area to be punctured in a dependent position. Do not milk or massage finger site.	Dependent position will increase blood flow to the area. Milking or massaging the finger may introduce excess tissue fluid and hemolyze the specimen. Avoid having the patient stand during the procedure to reduce the risk of fainting.

13. Select appropriate puncture site and perform skin puncture.	Your patient may have a preference of site used. For example, the patient may prefer not to use a specific finger for the skin puncture. Or the site may be contraindicated. For example, do not use the hand on the same side as a mastectomy. Avoid fingertip pads; use sides of finger.  *Perform skin puncture using a lancet*
14. Gently squeeze above the site to produce a large droplet of blood.	Do not contaminate the site by touching it. The droplet of blood needs to be large enough to cover the test pad on the reagent strip.  *Gently squeeze site to produce a large droplet of blood*

15. Transfer the first drop of blood (or second drop if indicated by agency policy or manufacturer's instructions) to the reagent strip and apply following the manufacturer's instructions.	The test pad must absorb the droplet of blood for accurate results. Smearing the blood will alter results.  *The test pad must absorb the droplet of blood for accurate results* The timing and specific instructions for measurement will vary between blood glucose meters. Be sure to read the instructions carefully to ensure accurate readings.
16. Immediately press the timer on the meter (unless it starts automatically with insertion of reagent strip).	Timing is critical to produce accurate results. Always check the manufacturer's instructions because the technique varies between meters.
17. Apply pressure, or ask patient to apply pressure, to the puncture site using a 2 x 2 gauze pad or clean tissue.	 *Apply pressure to the puncture site* This will stop the bleeding at the site.

18. Read the results on the unit display.	Each meter has a specified time for the reading to occur.  *Read the blood glucose results on the glucometer*
19. Turn off the meter and dispose of the test strip, 2 x 2 gauze, and lancet according to agency policy.	This reduces contamination by blood to other individuals.
20. Remove non-sterile gloves and place them in the appropriate receptacle.	This reduces transmission of microorganisms.  *Remove non-sterile gloves*

21. Perform hand hygiene.	This reduces the transmission of microorganisms.  *Hand hygiene with ABHR*
22. Review test results with the patient.	This promotes patient participation in health care.
23. Document results according to agency policy.	Results will be used to determine the patient's treatment plan.
Data source: BCIT, 2015; Hortensius et al., 2011; Pagana & Pagana, 2011; Perry, Potter, & Ostendorf, 2014; VCH & PHC Professional Practice, 2013; Weiss Behrend, Kelley, & Randoloph, 2004	

CONVERTING TO CANADIAN (SI) MEASUREMENTS

Many nursing resources are from the United States, where glucose values are reported as mg/dl. Canadian laboratories use the international system of units (SI), which are mmol/L. Therefore, it is important to convert your patient's laboratory values to SI units. For glucose, divide the mg/dl by 18 to find the comparable SI unit (e.g., 65 mg/dl = 3.61 mmol/L). This conversion chart shows specific conversions.

BLOOD GLUCOSE READINGS THAT REQUIRE FOLLOW-UP

The concerns listed in Table 9.1 *must* be attended to and reported immediately to the relevant health care provider. Please consult hospital/unit-specific recommendations for exact values. The concerns and actions in Table 9.1 are guidelines only.

Table 9.1 Blood Glucose Readings that Require Follow-up

Concern	Action
Blood sugar outside “acceptable range” (<2.2 mmol/L or >20 mmol/L)	Repeat capillary test to confirm, and report if reading remains out of range.
Blood sugar <2.2 mmol/L or >20 mmol/L	Order a stat blood glucose (venous sample) by laboratory staff and initiate hypoglycemia or hyperglycemia protocol according to agency policy.
Blood sugar <4 mmol/L	Initiate hypoglycemia protocol according to agency policy.
Preoperative blood sugar <4 mmol/L or >20 mmol/L	Call physician.
Post-operative blood sugar >13.5 mmol/L (acceptable post-operative range = 8-13 mmol/L)	Test urine for ketones. If positive, monitor urine ketones every 4 hours.
Data source: BCIT, 2015	

Critical Thinking Exercises

1. Describe two methods for increasing blood flow to a patient’s finger prior to lancing the finger.
2. What is one thing that you must wait for before administering rapid-acting insulin to a patient on your ward?

9.3 Hypoglycemia and Hyperglycemia

The overlapping symptoms of hypo- and hyperglycemia (e.g., hunger, sweating, trembling, confusion, irritability, dizziness, blurred vision) make the two conditions difficult to distinguish from one another (Paradalis, 2005). Since the treatment is different for each condition, it is critical to test the patient's blood glucose when symptoms occur. The risk factors that may have led to the condition, and the recent medical history of the patient also help to determine the cause of symptoms.

HYPOGLYCEMIA

Hypoglycemia is a condition occurring in diabetic patients with a blood glucose of less than 4 mmol/L. If glucose continues to remain low and is not rectified through treatment, a change in the patient's mental status will result. Patients with hypoglycemia become confused and experience headache. Left untreated, they will progress into semi-consciousness and unconsciousness, leading rapidly to brain damage. Seizures may also occur.

Common initial symptoms of hypoglycemia include:

- Cold, clammy skin
- Weakness, faintness, tremors
- Headache, irritability, dullness
- Hunger, nausea
- Tachycardia, palpitations

These symptoms will progress to mood or behaviour changes, vision changes, slurred speech, and unsteady gait if the hypoglycemia is not properly managed.

The hospitalized patient with type 1 or type 2 diabetes is at an increased risk for developing hypoglycemia. Potential causes of hypoglycemia in a hospitalized diabetic patient include:

- Receiving insulin and some oral antidiabetic medications (e.g., glyburide)
- Fasting for tests and surgery
- Not following prescribed diabetic diet
- New medications or dose adjustments
- Missed snacks

Hypoglycemia is a medical emergency that must be treated immediately. An initial blood glucose reading may confirm suspicion of hypoglycemia. If you suspect that your patient is hypoglycemic, obtain a blood glucose level through skin puncture. A 15 g oral dose of glucose should be given to produce an increase in blood glucose of approximately 2.1 mmol/L in 20 minutes (Canadian Diabetes

Association, 2013). Table 9.2 outlines an example of a protocol that may be used in the treatment of hypoglycemia.

Table 9.2 Hypoglycemia Treatment

Disclaimer: This is an example only of a hypoglycemia protocol. Always follow the protocol of your agency.			
Capillary Blood Gas (CBG)	**Able to Swallow**	**Nil per Mouth with IV Access**	**Nil per Mouth with No IV Access**
≥ 4 mmol/L	No treatment necessary	No treatment necessary	No treatment necessary
2.2-3.9 mmol/L	Give 15 g of glucose in the form of: • 3-5 dextrose/glucose tabs (check the label) (best choice), OR • 175 ml of juice or soft drink (containing sugar), OR • 1 tablespoon of honey, OR • 3 tablespoons of table sugar dissolved in water **Note:** Milk, orange juice, and glucose gels increase blood glucose (BG) levels more slowly and are not the best choice unless the above alternatives are not available. Repeat CBG every 15 to 20 minutes and repeat above if BG remains below 4 mmol/L. Once BG reaches 4 mmol/L, give patient 6 crackers and 2 tablespoons of peanut butter. If meal is less than 30 minutes away, omit snack and give patient meal when it is available.	Notify physician. Give 10-25 g (20-50 ml of **D50W** — dextrose 50% in water) of glucose intravenously over 1 to 3 minutes, OR as per agency policy. Repeat CBG every 15 to 20 minutes until 4 mmol/L. Continue with BG readings every 30 minutes for 2 hours.	Notify physician. Give glucagon 1 mg subcutaneously (SC) or intramuscularly (IM). Position patient on side. Repeat CBG every 15 to 20 minutes. Give second dose of glucagon 1 mg SC or IM if BG remains below 4 mmol/L.
≤ 2.2 mmol/L	Call lab for STAT BG level. Continue as above.	Call lab for STAT BG level. Continue as above.	Call lab for STAT BG level. Continue as above.
Data source: Canadian Diabetes Association, 2013; Paradalis, 2005; Rowe et al., 2015; VCH 2009			

HYPERGLYCEMIA

Hyperglycemia occurs when blood glucose values are greater than 7 mmol/L in a fasting state or greater than 10 mmol/L two hours after eating a meal (Pardalis, 2005). Hyperglycemia is a serious complication of diabetes that can result from eating too much food or simple sugar; insufficient insulin

dosages; infection, illness, or surgery; and emotional stress. Surgical patients are particularly at risk for developing hyperglycemia due to the surgical stress response (Dagogo-Jack & Alberti, 2002; Mertin, Sawatzky, Diehl-Jones, & Lee, 2007). Classic symptoms of hyperglycemia include the three Ps: polydipsia, polyuria, and polyphagia.

The common symptoms of hyperglycemia are:

- Increased urination/output (polyuria)
- Excessive thirst (polydipsia)
- Increased appetite (polyphagia), followed by lack of appetite
- Weakness, fatigue
- Headache

Other symptoms include glycosuria, nausea and vomiting, abdominal cramps, and progression to diabetic ketoacidosis (DKA).

Potential causes of hyperglycemia in a hospitalized patient include:

- Infection
- Stress
- Increased intake of calories (IV or diet)
- Decreased exercise
- New medications or dose adjustments

Note that testing blood glucose levels too soon after eating will result in higher blood glucose readings. Blood glucose levels should be taken one to two hours after eating.

If hyperglycemia is not treated, the patient is at risk for developing DKA. This is a life-threatening condition in which the body produces acids, called ketones, as a result of breaking down fat for energy. DKA occurs when insulin is extremely low and blood sugar is extremely high.

DKA presents clinically with symptoms of hyperglycemia as above, **Kussmaul respiration** (deep, rapid, and laboured breathing that is the result of the body attempting to blow off excess carbon dioxide to compensate for the metabolic acidosis), acetone-odoured breath, nausea, vomiting, and abdominal pain (Canadian Diabetes Association, 2013). Patients in DKA also undergo osmotic diuresis. They pass large amounts of urine because of the high solute concentration of the blood and the body’s attempts to get rid of excess sugar.

DKA is treated with the administration of fluids and electrolytes such as sodium, potassium, and chloride, as well as insulin. Be alert for vomiting and monitor cardiac rhythm. Untreated DKA can be fatal.

Patients with hyperglycemia may also exhibit a non-ketotic hyperosmolar state, also known as hyperglycemic hyperosmolar syndrome (HHS). This is a serious diabetic emergency that carries a

mortality rate of 10% to 50%. Hyperosmolarity is a condition in which the blood has a high sodium and glucose concentration, causing water to move out of the cells into the bloodstream.

Further information on the treatment of DKA and HHS can be found on the Canadian Diabetes Association clinical guidelines website.

Critical Thinking Exercises

1. At 0930 hours, your diabetic patient complains of feeling faint. You check his blood sugar and get a reading of 2.8 mmol/L. What actions will you take?
2. What blood glucose level range do you expect immediately post-operatively from your patient who has type 2 diabetes? Why?

9.4 Summary

Blood glucose monitoring is an important procedure that allows people with diabetes to monitor their blood glucose level and manage their condition. Each blood glucose monitor is slightly different, and it is essential that you read and follow the manufacturer's instructions for each monitor you are using.

When working with patients with diabetes, it is also important to be able to recognize and manage patients with hypoglycemia and hyperglycemia.

Key Takeaways

- Understand the condition of diabetes and how it affects blood glucose levels.
- Always read the manufacturer's instructions for using specific blood glucose machines.
- Know how to recognize and manage patients with hypoglycemia and hyperglycemia.

SUGGESTED ONLINE RESOURCES

1. Canadian Diabetes Association: Antihyperglycemic agents for use in type 2 diabetes. This guideline is laid out in a handy reference table. Information covered includes: drug brand names, drug class and mechanism of action, therapeutic considerations, and more.
2. Canadian Diabetes Association: Clinical practice guidelines. Organization of diabetes care. This resource covers the prevention and management of diabetes in Canada. It was developed under the auspices of the Clinical and Scientific Section of the Canadian Diabetes Association in 2013.
3. Canadian Diabetes Association: Diabetes. This fact sheet outlines the risk factors, symptoms, treatments, and other important information for patients.
4. Canadian Diabetes Association: Diabetes charter for Canada. This is the companion document for the *Clinical practice guidelines. Organization of diabetes care*.
5. Canadian Diabetes Association: Diabetes: Canada at the tipping point. This document reports results from a 2011 national survey conducted online with over 2,000 adults, both with and without diabetes.
6. Canadian Nurses Association: Diabetes toolkit. This website provides evidence-based practice resources for registered nurses and nurse practitioners. Scroll down the page to "Diabetes" to access these PDF files.
7. Canadian Diabetes Association: Standards for diabetes education in Canada 2014. This document describes the standards of diabetes education for diabetes educators.

8. Canadian Diabetes Association: Types of insulin. This reference table lists the insulin types used in Canada, along with the onset, peak times, and duration of each type of insulin.
9. Fraser Health: Glucose monitoring: By point of care (beside testing). This document reviews the Accu-check glucose monitoring system, as well as the quality control procedure and patient test procedure.
10. Registered Nurses Association of Ontaio (RNAO): Reducing foot complications for people with diabetes. This clinical guideline focuses on best practices to help practitioners reduce foot complications for patients with diabetes. The information included in this resource: how to conduct a risk assessment of foot ulcers, basic education for patients, and appropriate interventions.
11. Roche: Accu Chek Inform II: Operator training.These Powerpoint slides, from a presentation by the BC Provincial Health Services Authority, covers the Accu Chek blood glucose monitoring machine.

REFERENCES

British Columbia Institute of Technology (BCIT). (2015). NURS 2020: Clinical techniques. Vancouver: BCIT.

Canadian Diabetes Association. (2013). Canadian diabetes association clinical practice guidelines expert committee. Clinical practice guidelines for the prevention and management of diabetes in Canada. *Can J diabetes*, 37(suppl 1):S1-S212.

Dagogo-Jack, S., & Alberti, K. G. (2002). Management of diabetes mellitus in surgical patients. *Diabetes spectrum*, 15(1), 44-48.

Hortensius, J., Slingerland, R. J., Kleefstra, N., Logtenberg, S. J. J., Groenier, K. H., Houweling, S. T., & Bilo, H. J. G. (2011). Self-monitoring of blood glucose: The use of the first or the second drop of blood. *Diabetes care*, 34(3), 556–560.

Mertin, S., Sawatzky, J., Diehl-Jones, W., & Lee, T. (2007). Roadblock to recovery: The surgical stress response. *Dynamics*, 18(1), 14-22.

Pagana, K., & Pagana, T. (2011). *Mosby's diagnostic and laboratory test reference* (10th ed.). St Louis, MO: Mosby.

Pardalis, D. (2005). Diabetes: Treatment of hyper- and hypoglycemia. Retrieved on Nov 14, 2015, from Tech Talk: The national continuing education program for pharmacy technicians, http://www.canadianhealthcarenetwork.ca/files/2009/10/TTCE_Sept05_Eng.pdf

Perry, A., Potter, P., & Ostendorf, W. (2014). *Clinical skills and nursing techniques* (8th ed.). St Louis, MO: Elsevier-Mosby.

Rowe, B. H., Singh, M., Villa-Roel, C., Leiter, L. A., Hramiak, I., Edmonds, M. L., & … Campbell, S. (2015). Acute management and outcomes of patients with diabetes mellitus presenting to Canadian

emergency departments with hypoglycemia. *Canadian Journal Of Diabetes, 39*(1), 55-64. doi:10.1016/j.jcjd.2014.04.001

Vancouver Coastal Health (VCH). (2009). *Hypoglycemia algorithm.* Vancouver: Vancouver Coastal Health.

VCH & PHC Professional Practice. (2013). *Capillary blood glucose monitoring using the Accu-Chek blood glucose meter.* Vancouver: Vancouver Coastal Health & Providence Health Care.

Weiss Behrend, S., Kelley, K., & Randoloph, S. (2004). Measuring blood-glucose levels. In Gaylene, A. (2004). *Delmar's fundamental and advanced nursing skills* (2nd ed.). Clifton Park, NY: Thomson Delmar Learning.

Chapter 10. Tubes and Attachments

10.1 Introduction

Patients in acute care and community settings often have various tubes and attachments to assist their recovery from surgeries, medical conditions, or procedures. Health care providers must understand how these devices work — their purpose, function, insertion, or removal — and how to prevent complications from these various tubes and attachments.

Learning Objectives

- Describe principles related to the function of tubes and drainage systems
- Identify factors that affect the flow of fluid through tubes
- Describe guidelines for working with patients with drainage systems
- Discuss the purposes, types, special precautions, potential complications, and interventions for
    - Nasogastric tubes
    - Indwelling catheters
    - Closed chest drainage systems
    - Ostomies/urostomies
    - Tracheostomy tubes

10.2 Caring for Patients with Tubes and Attachments

The following five principles apply to the care of drainage tubes. It is important that you remember these principles when you are working with patients who have drainage tubes.

1. *Closed cavities of the body are sterile cavities.* Insertion of any tube must be performed with adherence to the principles of sterile asepsis.

2. *A portal of entry that comes into contact with a non-sterile surface immediately renders an otherwise sterile field non-sterile.* When disconnecting drainage tubes, such as a urinary catheter or a T-tube, the ends must be kept sterile.

3. *Gravity promotes the flow of drainage from a cavity.* Keep drainage tubes and collection bags at a lower level than the cavity being drained. Position the tube so the drainage will not have to run upward.

4. *Drainage will flow out of the tubing if the lumen is not occluded.* Avoid kinks and coils in the tubing and watch that the person does not lie on the tubing. Do not clamp tubes without a doctor's order.

5. *Properly cleanse the site before accessing any tubing to reduce possible introduction of microorganisms into a cavity.* Sometimes contrast media and radiopharmaceuticals are injected via the tubing. An alcohol swab may be used to clean the entry point prior to accessing the tubing.

The following four factors affect the flow of fluid through tubes.

1. Pressure difference

- A fluid will flow through a tube only when a pressure difference occurs between the two ends, with fluids moving from the region of higher pressure to the region of lower pressure. The larger the pressure difference, the more flow there will be.
- A liquid in an enclosed container produces pressure by virtue of its weight. Weight, in turn, is determined by the density of the liquid and by the height of the liquid column from its surface to its outlet.
- When liquid flows out of a container, the liquid column becomes shorter and, therefore, has less weight, producing a drop in pressure and a slower flow rate. However, raising the height of the liquid column increases the pressure and speeds up the flow rate.

2. Diameter

- The diameter of a tube is the width of its lumen or inside opening. This diameter has a significant effect on the resistance to fluid flow. Increasing a tube's diameter increases the flow rate and vice versa.

3. Length

- The length of a tube affects the rate of fluid flow. Fluid is slowed down by the friction of its molecules against the walls of the tube. The longer the tube, the more surface area there is for the fluid to rub against. As well, the friction is greater in narrow tubes because the fluid is near the walls. Tubes should be as short as possible, but long enough to achieve their purpose without unduly restricting the person's movement.

4. Viscosity

- Viscosity refers to the tendency of a fluid to resist flow because of the friction of its molecules rubbing against each other. This lack of slipperiness causes the fluid to flow slowly. The rate of a slowly flowing fluid can be increased by raising the height of the container to increase the pressure difference; opening the clamp more or using a larger tube so there is a wider diameter; or diluting the fluid to make it less viscous.

Caring for patients with multiple tubes and attachments can be challenging. Follow the guidelines in Table 10.1 to help you care for patients with tubes and attachments.

Table 10.1 Guidelines for Caring for Patients with Tubes and Attachments

Guideline	Rationale
Secure tubes to the skin with tape (non-allergenic or waterproof). A good method of taping is to loop the tape around the tubing, make a "neck" of tape, and secure the tape to the skin (except for nasogastric tubes). This allows some gentle moving of the tube without kinking and protects it from the danger of being pulled out.	When tension is applied to the tube, the stress will be taken by the tape rather than by the tube.
Drainage bags should be secured to stretchers, patient gowns, etc., as appropriate.	This prevents undue stress on the drainage tube and/or accidental removal from the wound or body cavity.
Connect tube to sterile tubing and drainage receptacle. Do *not* clamp tubing unless ordered.	This helps keep wound or body cavity sterile and promotes flow of drainage.
To ensure continuous drainage, be sure tubing is not kinked, not caught in the bed rails, not underneath the patient, and free from tension when turning, etc.	Any kinks in tubing can stop drainage from the patient and cause further complications.
Dressing around tube, if any, should be clean and dry. Sterile technique is used if it is necessary to change the dressing.	This avoids irritation from tube rubbing the skin or from excessive drainage.
Record and report patency of tube and amount, colour, character, and odour of drainage. If an unusual situation occurs in your department (i.e., if the bag is full and must be emptied), call for help. If the contents of a drainage tube are spilled, the approximate amount must be reported.	This will help inform ward staff of an unusual situation that happened in your department.
If you are unsure how to empty the container or how to close it after a spill, seek help.	Most drainage tubes must have the ends kept sterile. Always follow agency regulations on how to clean up a blood or body fluid spill.
Data source: BCIT, 2015a	

Critical Thinking Exercises

1. A patient arrives in your department holding her urinary catheter drainage bag in her hand. What should you do?
2. When settling a patient into bed, what factors must be considered to ensure drainage devices are able to flow and drain continuously?

10.3 Nasogastric Tubes

USING A NASOGASTRIC TUBE

A **nasogastric (NG) tube** is a flexible plastic tube inserted through the nostrils, down the nasopharynx, and into the stomach or the upper portion of the small intestine. Placement of NG tubes is always confirmed with an X-ray prior to use (Perry, Potter, & Ostendorf, 2014).

NG tubes are used to:

- Deliver nutrients to the patient via a feeding pump
- Remove gastric contents

An NG tube used for feeding should be labelled. The tube is used to feed patients who may have swallowing difficulties or require additional nutritional supplements. These tubes are narrower and smaller bored than a Salem sump or Levine tube.

An NG tube can also remove gastric content, either draining the stomach by gravity or by being connected to a suction pump. In these situations, the NG tube is used to prevent nausea, vomiting, or gastric distension, or to wash the stomach of toxins.

The NG tube is fastened to the patient using a nose clip, and is taped and pinned to the patient's gown to prevent accidental removal of the tube and to prevent the tube from slipping from the stomach area into the lungs.

When working with people who have nasogastric tubes, remember the following care measures:

- Maintain and promote comfort. The tube constantly irritates the nasal mucosa, causing a great deal of discomfort. Ensure that the tube is securely anchored to the patient's nose to prevent excess tube movement, and is pinned to the gown to avoid excessive pulling or dragging.
- Because one nostril is blocked, patients tend to mouth breathe. This causes dehydration of the nasal and oral mucosa, and patients will complain of thirst, but they are usually NPO (*nil per os* or nothing by mouth). Mouth care will help to relieve the dryness. This can include rinsing the mouth with cold water or mouthwash as long as the patient does not swallow. Some patients may be allowed to suck on ice chips.
- If the patient complains of abdominal pain, discomfort, or nausea, or begins to vomit, report it immediately. The drainage flow is probably obstructed and the tube will need to be irrigated.
- These patients should *never* be allowed to lie completely flat. Lying flat increases the patient's risk of aspirating stomach contents. Patients with an NG tube are at risk for aspiration. The head of bed should always be raised 30 degrees or higher.

Checklist 78 outlines the steps for inserting a nasogastric tube.

Checklist 78: Inserting a Nasogastric tube

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

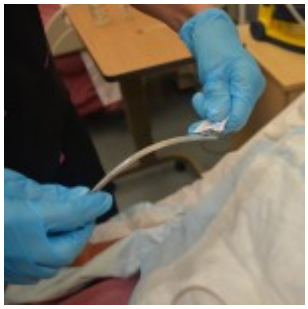
Safety considerations:

- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Explain process to patient; offer analgesia, bathroom, etc.
- Listen and attend to patient cues.
- Ensure patient's privacy and dignity.
- Assess ABCCS/suction/oxygen/safety.
- Apply principles of asepsis and safety.
- Check vital signs.
- Complete necessary focused assessments.

STEPS	ADDITIONAL INFORMATION
1. Perform hand hygiene and gather supplies.	This prevents the transmission of microorganisms.  *Gather supplies*

2. Visually inspect condition of patient's nasal and oral cavities.	Check for signs of infection or skin breakdown.
3. Assess for the best nostril before you begin. Do this by occluding one side and asking the patient to sniff. Ask the patient about previous injuries or history of a deviated septum.	If either nostril is equally suitable, select the nostril closest to the suction.  *Assess for most patent nostril*
4. Palpate patient's abdomen for distension, pain, and/or rigidity. Auscultate for bowel sounds.	Document assessment findings and determine appropriateness of NG tube insertion related to reason for insertion and patient's physical assessment.
5. Assess patient's level of consciousness and understanding of procedure.	Patient must be able to follow instructions related to NG insertion to allow for passage of tube through nasal and gastrointestinal tracts.
6. Check doctor's orders for type of NG tube to be placed and reason for placement.	Check appropriate orders relevant to patient safety.

7. Check doctor’s orders to determine whether the NG tube is to be attached to suction or a drainage bag.	This should be commensurate with the reason for the NG tube.
8. Position patient sitting up at 45 to 90 degrees (unless contraindicated by the patient’s condition), with a pillow under the head and shoulders.	This allows the NG tube to pass more easily through the nasopharynx and into the stomach.
9. Raise bed to a comfortable working height.	This helps prevent biomechanical injury to the health care provider.
10. Agree on a signal the patient can use if they wish you to pause during the procedure.	This procedure can be anxiety-provoking and uncomfortable for many patients. Providing a means for the patient to communicate discomfort and a desire to pause during the procedure helps alleviate anxiety.
11. Place a towel on the patient’s chest and provide facial tissues and an emesis basin.	Nasal and oral secretions may be evident during the procedure.
12. Provide patient with drinking water and a straw if the patient is not fluid restricted.	Sipping water through a straw helps to initiate the swallowing reflex and facilitate passing of NG tube.

13. Stand on patient's right side if you are right-handed and the left side if you are left-handed.	You will use your dominant hand to insert the tube.
14. Measure distance of the tube from • The tip of the nose, to… • The earlobe, to… • The xiphoid process and then mark the tube at this point.	This determines the appropriate length of NG tube to be inserted.  *Measure from tip of nose to earlobe*  *Measure from earlobe to xiphoid process*
15. Lubricate NG tube tip according to your agency policy.	Tube may be lubricated internally using tap water or externally using water-soluble lubricating jelly. Agency policy varies and should be checked.  *Lubricate tip of tube as per agency policy* Never use non-water-soluble lubricant (e.g., Vaseline), as it will not dissolve and may cause respiratory complications if it enters the lungs.

16. Apply clean non-sterile gloves.	Using gloves decreases the transfer of microorganisms.  *Apply clean non-sterile gloves*
17. Curve 10 to 15 cm of the end of the NG tube around your gloved finger, and then release it.	Curling the NG tube around your finger helps it conform to the normal curve of the nasopharynx.  *Curl the NG tube around your finger*
18. Have patient drop head forward and breathe through the mouth.	Dropping the head forward closes the trachea and opens the esophagus, which allows the NG tube to pass more easily through the nasopharynx and into the stomach.
19. Insert NG tube tip slowly into the patient's nostril and advance it steadily, in a downward direction, along the bottom of the nasal passage, with the curved end pointing downward in the direction of the ear on the same side as the nostril.	This follows the natural anatomical alignment of the nasopharynx.  *Insert nasogastric tube slowly into patient's nostril*

20. You may feel slight resistance as you advance along the nasal passage. Twist the tube slightly, apply downward pressure, and continue trying to advance the tube. If significant resistance is felt, remove the tube and allow the patient to rest before trying again in the other nostril.	It is common for the patient to feel discomfort, and this may be expressed with light coughing and gagging. More aggressive coughing and gagging may indicate that the tube has entered the airways, in which case you should withdraw the NG tube.  *Advance the tube gently*
21. If there is difficulty in passing the NG tube, you may ask the patient to sip water slowly through a straw unless oral fluids are contraindicated. If oral fluids are not allowed, ask the patient to try dry swallowing while you advance the tube.	If patient continues to gag or cough, check that the tube is not coiled in the back of the mouth, using a tongue blade and a flashlight to check the back of the mouth. If tube is coiled, withdraw the tube until only the tip of the tube is seen in the back of the mouth. Then try advancing the tube again while patient tries to swallow.  *Patient may sip water slowly through a straw*
22. Continue to advance NG tube until you reach the mark/tape you had placed for measurement.	This ensures accurate placement.

23. Temporarily anchor the tube to patient's cheek with a piece of tape until you can check for correct placement.	This prevents displacement of the NG tube while checking placement.  *Anchor tube*
24. Verify tube placement according to agency policy. Colour-coded pH paper is usually used, as an initial and interim check, to confirm that acidic contents are present. Then an X-ray is taken to confirm placement prior to using NG tube for feeding.	The contents aspirated from the tube should be acidic with a pH <5. If the pH is more than 6, it may indicate the presence of respiratory fluids or small bowel content, and the tube should be removed.  *Verify tube placement using pH paper*
25. Once the tube placement has been confirmed, mark (with a permanent marker) and record the length of tubing extending from the nose to the outer end of the tube.	This aids in timely recognition and identification of tube displacement or migration.
26. Secure the tube to the patient's gown with a safety pin, allowing enough tube length for comfortable head movement.	This keeps the NG tube in place.  *Secure the tube to the patient's gown with a safety pin*

27. Document the procedure according to agency policy, and report any unexpected findings to the appropriate health care provider.	Timely and accurate documentation promotes patient safety.
Data source: ATI, 2015a; BCIT, 2015c; Berman & Snyder, 2016	

Special considerations with NG tubes:

- Always assess correct placement of the NG tube prior to infusing any fluids or tube feeds as per agency policy. Check location of external markings on the tube and colour of the PH of fluid aspirated from the tube. Routine evaluation will ensure the correct placement of the tube and reduce the risk of aspiration. Do not instill air to test location of tube.
- Do not give the patient anything to eat or drink without knowing that the patient has passed a swallowing assessment.
- If changing the gown or repositioning the patient, take care not to pull on the NG tube. Remember to unpin the tube from the gown and repin the tube.
- If the NG tube falls out of the patient, it is not an emergency. *But* be sure to assess your patient. How are the ABCCS? Notify the RN in charge of the patient.
- A patient who appears to be in respiratory distress should be considered an emergency, and emergency procedures should be followed. Respiratory distress may present as coughing, choking, or reduced oxygen saturation.

VIDEO 10.1

Watch the video *Nasogastric tube insertion* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

REMOVING AN NG TUBE

An NG tube should be removed if it is no longer required. The process of removal is usually very quick. Prior to removing an NG tube, verify physician orders. If the NG tube was ordered to remove gastric content, the physician's order may state to "trial" clamping the tube for a number of hours to see

if the patient tolerates its removal. During the trial, the patient should not experience any nausea, vomiting, or abdominal distension.

To review how to remove an NG tube, refer to Checklist 79.

Checklist 79: Removal of an NG Tube

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Explain process to patient; offer analgesia, bathroom, etc.
- Listen and attend to patient cues.
- Ensure patient's privacy and dignity.
- Assess ABCCS/suction/oxygen/safety.
- Apply principles of asepsis and safety.
- Check vital signs.
- Complete necessary focused assessments.

STEPS	ADDITIONAL INFORMATION
1. Verify health care provider's orders to remove NG tube.	An order is required to remove an NG tube.
2. Collect supplies.	Supplies include waterproof pads, 20 ml syringe, tissues, non-sterile gloves, and garbage bag.
3. Verify patient using two identifiers. Explain procedure to patient and place patient in high Fowler's position.	Follow agency policy for proper patient identification.

4. Perform hand hygiene. Place waterproof pad on patient's chest.	This reduces the transmission of microorganisms.  *Perform hand hygiene*
5. Disconnect tube from feed if present.	This prevents risk of aspiration of tube feed.  *Disconnect tube from feed or suction*
6. Remove tape or securement device from nose.	This allows for the tube to be easily removed.  *Remove tape or securement device from nose*

7. Unclip NG tube from patient's gown.	This allows for tube to be easily removed.  *Unclip NG tube from patient's gown*
8. Clear NG tube by inserting 10 to 20 ml of air into tube.	This prevents aspiration of tube feed falling out of tube.  *Insert 10 to 20 ml of air into NG tube*
9. Instruct patient to take a deep breath and hold it.	This prevents aspiration; holding the breath closes the glottis.

10. Kink the NG tube near the naris and gently pull out tube in a swift, steady motion, wrapping it in your hand as it is being pulled out. Dispose of tube in garbage bag.	This prevents any residual feed from flowing out of tube upon removal.  *Pull out tube in a swift, steady motion*  *Wrap tube in glove and dispose as per agency policy*
11. Offer tissue or clean the nares for the patient and offer mouth care as required.	This clears the nares/nasal passages of any remaining secretions.  *Offer tissue or clean the nares for the patient*

12. Remove gloves and place patient in a comfortable position. Assess patient's level of comfort. Perform hand hygiene.	This promotes patient comfort and reduces the transmission of microorganisms.  *Hand hygiene with ABHR*
13. Document procedure according to agency policy	Document removal of NG tube and patient response to the removal.
Data source: ATI, 2015a; BCIT, 2015b; Perry et al., 2014	

Critical Thinking Exercises

1. You are inserting a nasogastric tube and the tube is not advancing. Explain your next steps, with rationale.
2. Your patient has a nasogastric tube and is requesting water because her throat feels dry. Describe your next actions.

10.4 Urinary Catheters

Urinary elimination is a basic human function that can be compromised by illness, surgery, and other conditions. Urinary catheterization may be used to support urinary elimination in patients who are unable to void naturally. Urinary catheterization may be required:

- In cases of acute urinary retention
- When intake and output are being monitored
- For preoperative management
- To enhance healing in incontinent patients with open sacral and perineal wounds
- For patients on prolonged bedrest
- For patients needing end-of-life care

CATHETER-ASSOCIATED URINARY TRACT INFECTIONS

Catheter-associated urinary tract infections (CAUTI) are a common complication of indwelling urinary catheters and have been associated with increased morbidity, mortality, hospital cost, and length of stay (Gould et al., 2009). Urinary drainage systems are often reservoirs for multidrug-resistant organisms (MDROs) and a source of the transmission of microorganisms to other patients (Gould et al., 2009). The most important risk factor for developing a CAUTI, a health care associated infection (HAI), is the prolonged use of a urinary catheter (Centers for Disease Control and Prevention [CDC], 2015). Urinary tract infections (UTIs) are the most commonly reported HAIs in acute care hospitals and account for more than 30% of all reported infections (Gould et al., 2009). Catheters in place for more than a few days place the patient at risk for a CAUTI. A health care provider must assess patients for signs and symptoms of CAUTIs and report immediately to the primary health care provider. Signs and symptoms of a CAUTI include:

- Fever, chills
- Lethargy
- Lower abdominal pain
- Back or flank pain
- Urgency, frequency of urination
- Painful urination
- Hematuria
- Change in mental status (confusion, delirium, or agitation), most commonly seen in older adults

The following are practices for preventing CAUTIs (Perry et al., 2014):

- Insert urinary catheters using sterile technique.
- Only insert indwelling catheters when essential, and remove as soon as possible.
- Use the narrowest tube size (gauge) possible.
- Provide daily cleansing of the urethral meatus with soap and water or perineal cleanser, following agency policy.
- Ensure a closed drainage system.
- Ensure that no kinks or blockages occur in the tubing.
- Secure the catheter tube to prevent urethral damage.
- Avoid use of antiseptic solutions on the urethral meatus and/or in the urinary bag.

URINARY CATHETERIZATION

Urinary catheterization refers to the insertion of a catheter tube through the urethra and into the bladder to drain urine. Although not a particularly complex skill, urethral catheterization can be difficult to master. Both male and female catheterizations present unique challenges.

Having adequate lighting and visualization is helpful, but does not ensure entrance of the catheter into the female urethra. It is not uncommon for the catheter to enter the vagina. Leaving the catheter in the vagina can assist in the correct insertion of a new catheter into the urethra, but you must remember to remove the one in the vagina.

For some women, the supine lithotomy position can be very uncomfortable or even dangerous. For example, patients in the last trimester of pregnancy may faint with decreased blood supply to the fetus in this position. Patients with arthritis of the knees and hips may also find this position extremely uncomfortable. Catheterization may also be accomplished with the patient in the lateral to Sims position (three-quarters prone).

The male urinary sphincter may also be difficult to pass, particularly for older men with prostatic hypertrophy.

There are two types of urethral catheterization: intermittent and indwelling.

Intermittent catheterization (single-lumen catheter) is used for:

- Immediate relief of urinary retention
- Long-term management of incompetent bladder
- Obtaining a sterile urine specimen
- Assessing residual urine in the bladder after voiding (if a bladder scanner is not available)

Indwelling catheterization (double- or triple-lumen catheter) is used for:

- Promoting urinary elimination
- Measuring accurate urine output

- Preventing skin breakdown
- Facilitating wound management
- Allowing surgical repair of urethra, bladder, or surrounding structures
- Instilling irrigation fluids or medications
- Assessing abdominal/pelvic pain
- Investigating conditions of the genitourinary system

The steps for inserting an intermittent or an indwelling catheter are the same, except that the indwelling catheter requires a closed drainage system and inflation of a balloon to keep the catheter in place. Indwelling catheters may have two or three lumens (double or triple lumens). Double-lumen catheters comprise one lumen for draining the urine and a second lumen for inflating a balloon that keeps the catheter in place. Triple-lumen catheters are used for continuous bladder irrigation and for instilling medications into the bladder; the additional lumen delivers the irrigation fluid into the bladder.

Indwelling urinary catheters are made of latex or silicone. Intermittent catheters may be made of rubber or polyvinyl chloride (PVC), making them softer and more flexible than indwelling catheters (Perry et al., 2014). The size of a urinary catheter is based on the French (Fr) scale, which reflects the internal diameter of the tube. Recommended catheter size is 12 to 16 Fr for females, and 14 to 16 Fr for males. Smaller sizes are used for infants and children. The balloon size also varies with catheters: smaller for children (3 ml) and larger for continuous bladder irrigation (30 ml). The size of the catheter is usually printed on the side of the catheter port.

An indwelling catheter is attached to a drainage bag to allow for unrestricted flow of urine. Make sure that the urinary bag hangs below the level of the patient’s bladder so that urine flows out of the bladder. The bag should not touch the floor, and the patient should carry the bag below the level of the bladder when ambulating. To review how to insert an indwelling catheter, see Checklist 80.

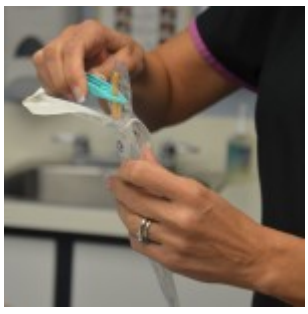
Checklist 80: Insertion of an Intermittent or Indwelling Urinary Catheter

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

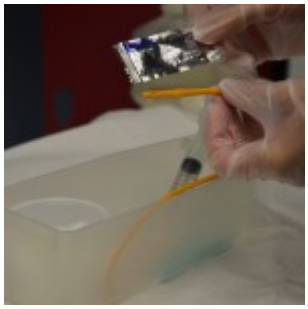
- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Explain process to patient; offer analgesia, bathroom, etc.
- Listen and attend to patient cues.
- Ensure patient's privacy and dignity.
- Assess ABCCS/suction/oxygen/safety.
- Apply principles of asepsis and safety.
- Check vital signs.
- Complete necessaryfocused assessments.

STEPS	ADDITIONAL INFORMATION
1. Verify physician order for catheter insertion. Assess for bladder fullness and pain by palpation or by using a bladder scanner.	Palpation of a full bladder will cause an urge to void and/or pain.
2. Position patient prone to semi-upright with knees raised; apply gloves; and inspect perineal region for erythema, drainage, and odour. Also assess perineal anatomy.	Assessment of perineal area allows for determination of perineal condition and position of anatomical landmarks to assist with insertion.  *Apply non-sterile gloves*

3. Remove gloves and perform hand hygiene.	This prevents transmission of microorganisms.  *Remove non-sterile gloves*  *Perform hand hygiene*
4. Gather supplies: • Sterile gloves • Catheterization kit • Cleaning solution • Lubricant (if not in kit) • Prefilled syringe for balloon inflation as per catheter size • Urinary bag • Foley catheter	Preparation ahead of time enhances patient comfort and safety.  *Prepare sterile field*
5. Check for size and type of catheter, and use smallest size of catheter possible.	Larger catheter size increases the risk of urethral trauma.  *Choose smallest catheter size possible*

6. Place waterproof pad under patient.	This step prevents soiling of bed linens.  *Place waterproof pad under patient*
7. Positioning of patient depends on gender. *Female patient:* On back with knees flexed and thighs relaxed so that hips rotate to expose perineal area. Alternatively, if patient cannot abduct leg at the hip, patient can be side-lying with upper leg flexed at knee and hip, supported by pillows. *Male patient:* Supine with legs extended and slightly apart.	Patient should be comfortable, with perineum or penis exposed, for ease and safety in completing procedure.
8. Place a blanket or sheet to cover patient and expose only required anatomical areas.	This step helps protect patient dignity.
9. Apply clean gloves and wash perineal area with warm water and soap or perineal cleanser according to agency policy.	Cleaning removes any secretions, urine, and feces, and reduces risk of CAUTI.
10. Ensure adequate lighting.	Adequate lighting helps with accuracy and speed of catheter insertion.
11. Perform hand hygiene.	This reduces the transmission of microorganisms.  *Perform hand hygiene*

12. Add supplies and cleaning solution to catheterization kit, and according to agency policy.	This step ensures preparation and organization for procedure.  *Add supplies as necessary*
13. If using indwelling catheter and closed drainage system, attach urinary bag to the bed and ensure that the clamp is closed.	Urinary bag should be closed to prevent urine drainage leaving bag.  *Urinary bag*
14. Apply sterile gloves using sterile technique.	This reduces the transmission of microorganisms.  *Apply sterile gloves*

15. Drape patient with drape found in catheterization kit, either using sterile gloves or using ungloved hands and only touching the outer edges of the drape. Ensure that any sterile supplies touch only the middle of the sterile drape (not the edges), and that sterile gloves do not touch non-sterile surfaces. Drape patient to expose perineum or penis.	The outer 2.5 cm is considered non-sterile on a sterile drape.  *Cover patient with sterile drape*
16. Lubricate tip of catheter using sterile lubricant included in tray, or add lubricant using sterile technique.	Lubrication minimizes urethral trauma and discomfort during procedure.  *Lubricate tip of catheter*
17. Check balloon inflation using a sterile syringe.	This maintains sterility of catheter.  *Check balloon inflation using a sterile syringe*
18. Place sterile tray with catheter between patient's legs.	Sterile tray will collect urine once catheter tip is inserted into bladder.

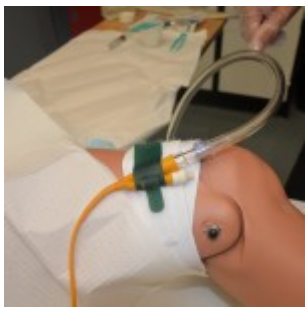
<table>
<tr><td>19. Clean perineal area as follows.

Female patient: Separate labia with fingers of non-dominant hand (now contaminated and no longer sterile). Using sterile technique and dominant hand, clean labia and urethral meatus from clitoris to anus, and from outside labia to inner labial folds and urethral meatus. Use sterile forceps and a new cotton swab with each cleansing stroke.

Male patient: Gently grasp penis at shaft and hold it at right angle to the body throughout procedure with non-dominant hand (now contaminated and no longer sterile). Using sterile technique and dominant hand, clean urethral meatus in a circular motion working outward from meatus. Use sterile forceps and a new cotton swab with each cleansing stroke.</td><td>This reduces the transmission of microorganisms.
 
Cleanse perineal area</td></tr>
<tr><td>20. Pick up catheter with sterile dominant hand 7.5 to 10 cm below the tip of the catheter.</td><td>Holding catheter closer to the tip will help to control and manipulate catheter during insertion.</td></tr>
<tr><td>21. Insert catheter as follows.

Female patient:
• Ask patient to bear down gently (as if to void) to help expose urethral meatus.
• Advance catheter 5 to 7.5 cm until urine flows from catheter, then advance an additional 5 cm.

Male patient:
• Hold penis perpendicular to body and pull up slightly on shaft.
• Ask patient to bear down gently (as if to void) and slowly insert catheter through urethral meatus.
• Advance catheter 17 to 22.5 cm or until urine flows from catheter.</td><td>This process helps visualize urethral meatus and relax external urinary sphincter.
 
Insert catheter gently</td></tr>
<tr><td colspan="2">Note: If urine does not appear in a female patient, the catheter may be in the patient’s vagina. You may leave catheter in vagina as a landmark, and insert another sterile catheter.</td></tr>
<tr><td colspan="2">Note: If catheter does not advance in a male patient, do not use force. Ask patient to take deep breaths and try again. If catheter still does not advance, stop procedure and inform physician. Patient may have an enlarged prostate or urethral obstruction.</td></tr>
<tr><td>22. Place catheter in sterile tray and collect urine specimen if required.</td><td>Urine specimen may be required for analysis. Collect as per agency policy.</td></tr>
</table>

23. Slowly inflate balloon for indwelling catheters according to catheter size, using prefilled syringe.	The size of balloon is marked on the catheter port.  *Slowly inflate balloon*
Note: If patient experiences pain on balloon inflation, deflate balloon, allow urine to drain, advance catheter slightly, and reinflate balloon.	
24. After balloon is inflated, pull gently on catheter until resistance is felt and then advance the catheter again.	Moving catheter back into bladder will avoid placing pressure on bladder neck.
25. Connect urinary bag to catheter using sterile technique.	Keep urinary bag below level of patient's bladder.  *Connect urinary bag to catheter using sterile technique*
26. Secure catheter to patient's leg using securement device at tubing just above catheter bifurcation. *Female patient*: Secure catheter to inner thigh, allowing enough slack to prevent tension. *Male patient*: Secure catheter to upper thigh (with penis directed downward) or abdomen (with penis directed toward chest), allowing enough slack to prevent tension. Ensure foreskin is not retracted.	Securing catheter reduces risk of CAUTI, urethral erosion, and accidental catheter removal.  *Secure catheter to patient's leg* For male patients, leaving the foreskin retracted can cause pain and edema.
27. Dispose of supplies following agency policy.	This reduces the transmission of microorganisms.

28. Remove gloves and <a href="/clinicalskills/chapter/1-6-hand-hygiene/">perform hand hygiene.	This reduces the transmission of microorganisms.  *Hand hygiene with ABHR*
29. Document procedure according to agency policy, including patient tolerance of procedure, any unexpected outcomes, and urine output.	Timely and accurate documentation promotes patient safety.
Data source: BCIT, 2015c; Perry et al., 2014	

VIDEO 10.2

Watch the video *Urinary Catheterization (Male)* by Renée Anderson and Wendy McKenzie, Thompson Rivers University.

VIDEO 10.3

Watch the video *Urinary Catheterization (Female)* by Renée Anderson and Wendy McKenzie, Thompson Rivers University.

REMOVING A URINARY CATHETER

Patients require an order to have an indwelling catheter removed. Although an order is required, it remains the responsibility of the health care provider to evaluate if the indwelling catheter is necessary for the patient's recovery.

A urinary catheter should be removed as soon as possible when it is no longer needed. For post-operative patients who require an indwelling catheter, the catheter should be removed preferably within 24 hours. The following are appropriate uses of an indwelling catheter (Gould et al., 2009):

- Improved comfort for end-of-life care
- Assisting in the healing process of an open sacral or perineal pressure ulcer

- Patients requiring prolonged immobilization (unstable thoracic or lumbar fractures, multiple traumatic injuries)
- Select surgical procedures (prolonged procedures, urological surgeries, etc.)
- Intra-operative monitoring of urinary output
- Patients receiving large-volume infusions or diuretic intra-operatively

When a urinary catheter is removed, the health care provider must assess if normal bladder function has returned. The health care provider should report any hematuria, inability or difficulty voiding, or any new incontinence after catheter removal. Prior to removing a urinary catheter, the patient requires education on the process of removal, and on expected and unexpected outcomes (e.g., a mild burning sensation with the first void) (VCH Professional Practice, 2014). The health care provider should instruct patients to

- Increase or maintain fluid intake (unless contraindicated)
- Void when able and within six to eight hours after removal of the catheter
- Inform the health care provider when he or she has voided, and measure the amount, colour, and any abnormal findings; ensure first void (urine output) is measured as per agency policy
- Report any burning, pain, discomfort, or small amount of urine volume
- Report an inability to void, bladder tenderness, or distension
- Report any signs of a CAUTI

Review the steps in Checklist 81 on how to remove an indwelling catheter.

Checklist 81: Removing an Indwelling Catheter

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Explain process to patient; offer analgesia, bathroom, etc.
- Listen and attend to patient cues.
- Ensure patient's privacy and dignity.
- Assess ABCCS/suction/oxygen/safety.
- Apply principles of asepsis and safety.
- Check vital signs.
- Complete necessary focused assessments.

STEPS	ADDITIONAL INFORMATION
1. Verify physician orders, perform hand hygiene, and gather supplies.	Supplies include non-sterile gloves, sterile syringe (verify size of balloon on Foley catheter), waterproof pad, garbage bag, and cleaning supplies for perineal care.
2. Identify patient using two identifiers. Create privacy and explain procedure for catheter removal.	This ensures you have the correct patient and follows agency policy on proper patient identification.
3. Educate patient on catheter removal and post-urinary catheter care.	Patient must be informed of what to expect after catheter is removed and how to measure urine output, etc.
4. Perform hand hygiene and set up supplies.	 *Perform hand hygiene* Raise bed to working height. Organize supplies. Position patient supine for easy access.

5. Apply non-sterile gloves.	This reduces the transfer of microorganisms.  *Apply non-sterile gloves*
6. Measure, empty, and record contents of catheter bag. Remove gloves, perform hand hygiene, and apply new non-sterile gloves. Remove catheter securement/anchor device.	Record drainage amount, colour, and consistency according to agency policy. Always change gloves after handling a urinary catheter bag. Removing catheter securement device provides easy access to catheter for cleaning and removing.  *Remove catheter securement device*
7. Perform catheter care with warm water and soap or according to agency protocol.	This reduces the transfer of microorganisms into the urethra.
8. Insert syringe in balloon port and drain fluid from balloon. Verify balloon size on catheter to ensure all fluid is removed from balloon.	A partially deflated balloon will cause trauma to the urethra wall and pain.  *Insert syringe in balloon port and drain fluid from balloon*

9. Pull catheter out slowly and smoothly. Catheter should slide out slowly and smoothly.	If resistance is felt, stop removal and reattempt to remove the fluid from the balloon. Attempt removal again. If unable to remove the catheter, stop and notify physician.  *Pull catheter out slowly and smoothly*
10. Wrap used catheter in waterproof pad or gloves. Unhook catheter tube from urinary bag. Discard equipment and supplies according to agency policy.	This prevents accidental spilling of urine from the catheter.  *Wrap used catheter in waterproof pad or gloves*
11. Provide perineal care as required and reposition patient to a comfortable position.	This promotes patient comfort.
12. Review post-catheter care, fluid intake, and expected and unexpected outcomes with patient.	Ensure patient has access to toilet, commode, bedpan, or urinal. Place call bell within reach. Ensure first void (urine output) is measured as per agency policy. Encourage patient to maintain or increase fluid intake to maintain normal urine output (unless contraindicated).

13. Lower bed to safe position, remove gloves, and perform hand hygiene.	Lowering the bed helps prevent falls. Hand hygiene prevents the transmission of microorganisms from patient to health care provider.  *Hand hygiene with ABHR*
14. Document procedure according to agency policy.	Document time of catheter removal, condition of urethra, and any teaching related to post-catheter care and fluid intake. Document time, amount, and characteristics of first void after catheter removal.
Data source: ATI, 2015d; BCIT, 2015b; Perry et al., 2014; VCH Professional Practice, 2014	

If a patient is unable to void after six to eight hours of removing a urinary catheter, or has the sensation of not emptying the bladder, or is experiencing small voiding amounts with increased frequency, a bladder scan may be performed. A bladder scan can assess if excessive urine is being retained. Notify the health care provider if patient is unable to void within six to eight hours of removal of a urinary catheter. If a patient is found to have retained urine in the bladder and is unable to void, an intermittent/straight catheterization should be performed (Perry et al., 2014).

VIDEO 10.4

Watch the video *Foley Catheter Removal* by Renée Anderson and Wendy McKenzie, Thompson Rivers University.

Read the *To Scan or Not To Scan* journal article for more information on bladder scanning.

Critical Thinking Exercises

1. Describe the different techniques for cleansing a female and a male patient prior to catheterization.
2. Your male patient complains of pain while you are inserting a urinary catheter. Describe your next steps.

10.5 Tracheostomies

A tracheostoma is an artificial opening made in the trachea just below the larynx. A tracheostomy tube is a tube that is inserted through the opening, or stoma, to create an artificial airway. Patients who need long-term airway support (long-term patients who are intubated) or who have a need to bypass the upper airway may receive a tracheostomy. A tracheostomy (see Figure 10.1) can be very traumatic for a patient, and many find it difficult to adjust to having one.

The tracheostomy may be permanent or temporary. It is created surgically through the trachea (upper airway remains intact), larynx (upper airway is not patent), or cricothyroid (usually for temporary emergency access to airway). Tracheostomy tubes are inserted for airway maintenance, ventilation, removal of secretions, or as an alternate airway (e.g., following laryngectomy).

Figure 10.1 Cross-section view of a tracheostomy (on a model) inserted in the trachea anterior to the esophagus

TRACHEOSTOMY TUBES

Tracheostomy tubes can be soft plastic, hard plastic, or, at times, metal. All tracheostomy devices are made up of an outer cannula, inner cannula, and an **obturator** used to insert the tube (see Figure 10.2). They come in different sizes and may have a cuff. A cuff tracheostomy produces a tight seal between the tube and the trachea. This seal prevents aspiration of oropharyngeal secretions and air leakages between the tube and the trachea. Tracheostomies are firmly tied and secured around the patient's neck. The ties prevent accidental de-cannulation of the trachea. Sterile gauze and cleaning supplies are used daily to clean the trachea stoma and prevent infection to the site.

Figure 10.2 Left to right: obturator, cuffed tracheostomy tube, non-cuffed tracheostomy tube, tracheal dilators

HUMIDIFICATION

When a patient has a tracheostomy, air is no longer filtered and humidified as it is when passing through the upper airways. Most patients will have humidification and oxygen support. The following is a list of the special considerations of patients with a tracheostomy tube (BCIT, 2015c).

- Patients need to lie at a 30-degree, or greater, angle to facilitate breathing and lung expansion.
- All tracheostomy patients must have suction equipment and emergency supplies at the bedside. Emergency equipment is usually in a clear bag on an IV pole attached to the patient's bed. A tracheostomy patient must be assessed every two hours to determine if suctioning is required.
- Tracheostomy patients are often not permitted anything to drink or eat. Consult with the RN in charge.
- A patient with a tracheostomy tube cannot speak; because the vocal cords are above the level of the tracheostomy tube, air cannot pass over the vocal cords. Speech is not possible without a speaking device.
- Tracheostomy patients always have the tracheostomy tied securely around the neck using ties, according to agency policy.
- Patients with a tracheostomy produce more secretions than usual and may not be able to clear secretions from the tracheostomy with coughing. If secretions in the tracheostomy decrease air entry and cause respiratory distress, the patient should be suctioned immediately.

POTENTIAL COMPLICATIONS

Early potential complications may include hemorrhage, pneumothorax, subcutaneous emphysema, cuff leak, tube dislodgement, and respiratory/cardiovascular arrest. Late potential complications may include airway obstruction, fistulae, infection, aspiration, and tracheal damage/erosion.

Emergency supplies at the bedside must include the following:

1. Suction equipment

2. Oxygen equipment with humidification

3. An emergency bag containing (see Figure 10.3):

- Two replacement tracheostomy tubes (one of the same size, and one a smaller size than the current tube)
- Obturator and spare inner cannula
- 10 ml syringe
- Tracheal tube exchanger
- Tracheal dilators
- Sterile gloves
- Water-soluble lubricant
- If the open stoma is below the sternal notch, an endotracheal tube as per the ENT physician

Figure 10.3 Equipment for emergency bag for tracheostomy patients. Clockwise from top left: sterile gloves, spare tracheostomy tube, scissors, lubricant, cotton-tip applicators, ties, 10ml syringe, tracheal dilators, inner cannula, obturator, sterile gauze

The emergency bag must accompany patients when they are transported off the unit. Table 10.2 outlines methods to prevent possible complications that may arise from tracheostomies, and how to intervene if they do occur.

Table 10.2 Prevention and Interventions for Complications

Complication	Prevention	Interventions
Hemorrhage	• Assess stoma for bleeding (excessive suctioning may also result in blood-streaked secretions). • Report neck swelling. • Report vigorous pulsation around the trachea.	• Inflate cuff. • Suction. • Notify physician immediately if you suspect bleeding. • CODE BLUE if pulsating frank blood. • Monitor vital signs. • Apply pressure to bleed if possible.

Stomal/ pulmonary infection	• Perform dressing changes and tracheostomy care every 8 hours and as needed. • Use sterile technique for tracheostomy suctioning. • Use clean technique for tracheostomy care. • Use humidified oxygen or air. • Follow respiratory assessment as per agency policy. • Have patient do deep breathing and coughing (DB&C) exercises every 2 to 4 hours and as needed. • Instill small amounts of normal saline when suctioning to help loosen secretions as needed. • Suction as necessary. • Maintain hydration. • Take vital signs every four hours.	Report potential signs of infection: • Redness • Sweeping • Purulent drainage • Fever • Abnormal breath sounds • Increased secretions • Decreased oxygen sats

Tube occlusion	• Keep inner cannula of dual tracheostomy tube in situ at all times. • Check patency of single-lumen tracheostomy tube regularly. • Clean inner cannula every 8 hours at a minimum, and as needed. • Maintain humidification. • Maintain hydration (secretions should be loose and thin). • Do DB&C exercises every 2 to 4 hours and as needed. • Suction and instill normal saline to loosen secretions as needed.	If tube occludes: • Place patient supine to expose neck and check for tube dislodgement. • Try ventilation using ambu-bag but do not force air entry. • If unable to ventilate, try suction and instillation of normal saline to clear cannula. • Remove inner cannula if suction catheter still does not pass; check patency and replace with new inner cannula. • If still unable to ventilate, deflate cuff or cuffed tube and notify physician and/or respiratory therapist. • If patient is still unable to ventilate, call CODE BLUE and cut tie tapes, remove tracheostomy tube, insert dilators, and hold stoma open with tracheal dilators until trained health care professional is able to reinsert a tracheostomy tube.

Aspiration	• All tracheostomy patients require a swallow assessment (usually requires a physician order) prior to oral feeding. • No swallow assessment or feeding occurs when cuff is inflated. • Consult speech and language therapist. • Patient should be placed in a semi- to high-upright sitting position. • Ensure cuff is inflated and check cuff pressure once per shift and as needed. • Always suction above cuff prior to cuff deflation.	Report any signs of aspiration: • Excessive coughing and gagging (particularly with eating and drinking) • Increased or changed secretions • Presence of food in secretions • Drop in O_2 sats If patient vomits: • Inflate cuff if present. • Suction immediately. • Raise head of bed; sit patient upright.

Accidental decannulation	• Tracheostomy ties must be secure. • Secure new ties *before* removing old ties. • Assess patient for restlessness/ confusion.	If partial decannulation occurs (air movement is felt from tube): • Deflate cuff if inflated. • Remove inner cannula and insert obturator. • Gently reinsert tube while holding obturator in place. • Remove obturator and replace inner cannula. • Check correct placement. ◦ Feel for air movement from tube. ◦ Check patient's O_2 sats. ◦ Ensure patient's breathing returns to baseline. • Ensure tie tapes are secure and cuff is inflated if ordered. If complete decanulation occurs, call for trained health care professional to reinsert tracheostomy tube. In the meantime: • Maintain tracheal airway and ventilation with bag tracheostomy mask as best as possible. • Protect airway from foreign-body aspiration. • If stoma is less than 7 days old, use tracheal dilators to maintain stoma potency if necessary. • If patient is not ventilating adequately, close stoma and ventilate with bag and face mask with 100% O_2 until CODE team arrives. If patient has known upper-airway obstruction, or a laryngectomy, ventilate via stoma with a tracheostomy or pediatric mask.
Note: Do not hyperextend neck if patient has a known or suspected neck injury.		

Data source: BCIT, 2015c; Vancouver Coastal Health, 2012a

VIDEO 10.5

Watch the video *Trach Tubes – inflated versus deflated cuffs* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

TRACHEAL SUCTIONING

The purpose of suctioning is to maintain a patent airway, to remove secretions from the trachea and bronchi, and to stimulate the cough reflex (Vancouver Coastal Health, 2006). Patients with tracheostomies often have more secretions than normal and will require suctioning to remove secretions from the airway to prevent airway obstruction. Tracheostomy patients should be assessed every two hours and as required to see if suctioning is required. Sterile suction equipment is used each time tracheal suctioning is performed. Secretions can be aspirated using a suction catheter connected to a suction source.

Tracheal suctioning is indicated with noisy respirations, decreased O_2 sats, anxiousness, restlessness, increased respirations or work of breathing, change in skin colour, or wheezing or gurgling sounds. These are signs and symptoms of respiratory distress, and the patient should be suctioned immediately. Checklist 82 outlines the steps for tracheal suctioning.

Checklist 82: Tracheal Suctioning

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Perform hand hygiene.
- Check room for additional precautions.
- Introduce yourself to patient.
- Confirm patient ID using two patient identifiers (e.g., name and date of birth).
- Explain process to patient; offer analgesia, bathroom, etc.
- Listen and attend to patient cues.
- Ensure patient's privacy and dignity.
- Assess ABCCS/suction/oxygen/safety.
- Apply principles of asepsis and safety.
- Check vital signs.
- Complete necessary focused assessments.
- Pre-hyperoxygenate patient if required and as per agency policy.

STEPS	ADDITIONAL INFORMATION
1. Connect one end of connecting tubing to suction machine and place other end in convenient location near patient.	Preparing equipment ahead of time promotes safety, organization, and timeliness.
2. Turn suction device on and set suction pressure to as low a level as possible that is still able to effectively clear secretions (between 80 and 120 mmHg in adults).	 *Set suction pressure between 80 and 120mmHg for adults* Excessive negative pressure damages mucosa and induces greater possibility for hypoxia.
3. Occlude end of suction tubing to check suction pressure between 80 and 20 mmHg.	This step ensures that equipment is functioning safely.

4. Using aseptic technique, open suction kit or catheter. Do not allow suction catheter to touch any non-sterile surfaces. Keep open suction package at bedside as a sterile surface on which to lay catheter between passes.	This prepares catheter, maintains asepsis, and reduces transmission of microorganisms. This provides sterile surface on which to lay catheter between passes.
5. Unwrap or open sterile container and place on bedside table. Be careful not to touch inside of container. Fill with about 100 ml sterile normal saline solution or water.	 *Fill sterile container with about 100 ml sterile normal saline solution or water* Saline or water is used to clean tubing after each suction pass.
6. Apply PPE as per agency policy (e.g., goggles and mask).	This prevents transmission of microorganisms to health care provider.
7. Apply sterile glove to each hand or apply non-sterile glove to non-dominant hand and sterile glove to dominant hand.	This reduces the transmission of microorganisms and maintains sterility of suction catheter.  *Apply sterile glove to each hand or apply non-sterile glove to non-dominant hand and sterile glove to dominant hand*

8. Pick up suction catheter with dominant hand without touching non-sterile surfaces. Pick up connecting tubing with non-dominant hand and secure catheter to tubing.	This maintains catheter sterility and connects catheter to suction.  *Use aseptic technique to attach suction catheter to suction tubing*
9. Check that equipment is functioning properly by suctioning small amount of sterile normal saline or water from sterile container. Suction is initiated by covering the hole on the suctioning tube with your thumb.	This ensures equipment is functioning and lubricates internal catheter and tubing. Too high suction may increase tracheal damage.  *Check that equipment is functioning properly by suctioning small amount of sterile normal saline or water from sterile container*  *Suction is initiated by covering the hole on the suctioning tube with your thumb*

10. Insert suction catheter into tracheostomy until resistance is felt, then pull back about 1/2 inch. Do *not* apply suction when inserting suction catheter.	Resistance is felt at the level of the patient's carina.  *Insert suction catheter into tracheostomy until resistance is felt, then pull back about 1/2 inch*
11. Suction intermittently while simultaneously rotating and withdrawing catheter for a maximum of 10 seconds. Immediately reapply oxygen in between suctions to reoxygenate the patient. *Instill sterile normal saline into tracheostomy prior to suction *only* if prescribed to induce coughing.	This reduces risk of tracheal damage and optimizes suction of secretions.  *Suction intermittently while simultaneously rotating and withdrawing catheter for a maximum of 10 seconds* Suctioning decreases patient's supply of oxygen. Oxgyen supports patient's return to adequate oxygenation. *Evidence-based practice indicates that normal saline is not effective in loosening or mobilizing secretions. Normal saline may occasionally be prescribed to induce coughing in patient.

12. Clear secretions from suction catheter by suctioning sterile normal saline or water from sterile container.	 *Clear secretions from suction catheter by suctioning sterile normal saline or water from sterile container* This clears catheter of secretions and avoids reintroducing pathogens into the airway.
13. Allow periods of rest between suction. The length of time between suctioning depends on patient tolerance. Patient may be suctioned up to three times with the same suction catheter. Do not pass (insert) suction catheter more than three times.	 *Release suction to allow patient time to rest* This reduces the risk of tracheal damage.
14. Reassess respiratory status and O_2 saturation for improvements. Call for help if any abnormal signs and symptoms appear, or if respiratory status does not improve.	This identifies positive response to suctioning procedure and provides objective measure of effectiveness.
15. When suctioning is complete, wrap catheter around gloved hand, pull glove over catheter, and disconnect from suction. Discard supplies in appropriate garbage bags. Turn off suction. Ensure all supplies are readily available at the bedside for next suction procedure.	Wrapping catheter in glove prevents secretions from being spilled from the catheter.  *Wrap suction catheter in glove and dispose* Supplies are essential in case of an emergency or respiratory distress.

16. Return patient to a safe and comfortable position and ensure that call bell is within patient's reach.	This promotes patient safety. 
17. Clean up and dispose of suction supplies according to agency policy.	This reduces the transmission of microorganisms.
18. Perform hand hygiene.	Hand hygiene reduces the transmission of microorganisms.  *Hand hygiene with ABHR*
19. Document procedure according to agency policy.	Documentation may include the suction procedure; patient reaction; amount, thickness, and colour of secretions; if normal saline was instilled; and if sputum samples were sent to the lab. Documentation provides accurate details of response to suctioning and clear communication among the health care team.
Data source: BCIT, 2015c; Halm & Krisko-Hagel, 2008; Perry et al., 2014; Vancouver Coastal Health, 2006	

Special considerations:

- Suctioning can cause nosocomial infections, hypoxia, injury to the airway, and cardiac dysrhythmias. Follow agency policy on suction to prevent these complications.
- Hyperoxygenate patient according to agency policy.
- If a sterile sputum sample is required, follow agency policy for specific directions related to type of equipment in the agency.

VIDEO 10.6

Watch a video *Tracheostomy Suctioning – Closed in line Method* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

TRACHEOSTOMY CARE

Tracheostomy care is performed routinely and as required. Tracheostomy care is essential to avoid potential complications such as obstruction and infection. In addition to suctioning, tracheostomy care includes the following tasks:

- Changing and replacing the inner cannula
- Changing the outer dressing
- Replacing the tracheostomy ties

If possible, these three tasks of tracheostomy care should be performed at the same time to minimize handling of the tracheal device. Collect all supplies at once and complete the procedure in the order listed above. However, there may be times when each task may be performed separately. Ongoing assessment is essential when caring for a patient with a tracheostomy.

Additional care includes:

- Doing more frequent respiratory assessments and checking patency of tracheostomy tube to assess if suction is required (every two hours and as needed) according to agency policy
- Keeping patient well hydrated (helps keep secretions thin)
- Encouraging deep breathing and coughing (as required)
- Reporting potential problems such as swelling, elevated temperature, change in sputum production, decreasing or increasing O_2 requirements

REPLACING AND CLEANING AN INNER CANNULA

The primary purpose of the inner cannula is to prevent tracheostomy tube obstruction. Many sources of obstruction can be prevented if the inner cannula is regularly cleaned and replaced. The inner cannula can be cleansed with half-strength hydrogen peroxide or sterile normal saline. Always check the manufacturer's recommendations for tube cleaning. Some inner cannulas are designed to be disposable, while others are reusable for a number of days. Inner tube cleaning should be done as often as two or three times per day, depending on the type of equipment, the amount and thickness of secretions, and the patient's ability to cough up the secretions.

Changing the inner cannula may encourage the patient to cough, bringing mucous out of the tracheostomy. For this reason, the inner cannula should be replaced prior to changing the

tracheostomy dressing to prevent secretions from soiling the new dressing. If the inner cannula is disposable, no cleaning is required. Checklist 83 describes how to clean and replace an inner tracheal cannula.

Checklist 83: Cleaning an Inner Tracheal Cannula

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Reassess your patient's tolerance for tracheostomy care and watch for signs of respiratory distress.
- Pre-hyperoxygenate patient if required and according to agency policy.
- If removing oxygen while performing tracheostomy care, remember to replace it often to reoxygenate the patient.
- Disposable inner cannulae should be inspected/cleaned every 8 hours or as needed.
- Disposable inner cannulae should be inspected every 8 hours (during tracheostomy care) and replaced every 24 hours and as needed.

STEPS	ADDITIONAL INFORMATION
1. Perform hand hygiene, collect supplies, and verify whether inner cannula needs to be cleaned as per policy.	Supplies include cotton-tip applicator, sterile pipe cleaner, sterile dressing tray, NS, hydrogen peroxide, non-sterile gloves, waterproof pad, and PPE if required.
2. Perform hand hygiene, ID patient using two identifiers, explain procedure to patient, and create privacy if required. Ensure patient has a method to communicate with you during the procedure.	Hand hygiene reduces the transmission of microorganisms.  *Hand hygiene with ABHR* Tracheal patients always require a method to communicate with the health care provider.
3. Apply gloves and PPE (if required), and cover chest with waterproof pad.	This prevents contact with secretions and prevents gown from becoming soiled.

4. Set up sterile tray field; add cleaning solution and supplies.	Organization ensures the process is efficient and fast for the patient.  *Set up sterile tray and add cleaning solution and supplies*
5. Remove oxygen mask to clean dressing but replace frequently as required by patient.	 *Remove oxygen mask to clean dressing* Replace the tracheal oxygen mask frequently to prevent hypoxia.
6. Remove inner cannula by stabilizing neck plate and gently grasping the outer white area. Rotate inner cannula counter-clockwise to unlock it. Pull cannula out in a downward motion. Some inner cannulae will “click” on, some twist on/off. Do not touch the inner cannula; only handle the white outer area unless you are wearing sterile gloves.	Review policy for cleaning frequency and cleaning solution.  *Remove inner cannula by stabilizing neck plate and gently grasping the outer white area*

7. Soak in appropriate solution and, if necessary, use a sterile pipe cleaner to remove exudate from the inner cannula.	Soaking the cannula helps loosen the secretions.  *Soak in appropriate solution and, if necessary, use a sterile pipe cleaner to remove exudate from the inner cannula*
8. Once clean, rinse off inner cannula and ensure all solution is removed. The inner portion may be dried off with a sterile pipe cleaner prior to reinsertion.	Ensure all cleaning solution is removed to prevent tracheal damage from the hydrogen peroxide (if used).
9. Reinsert inner cannula by stabilizing neck plate, holding the white part with the end upright, and twisting into the shape of the tracheostomy.	This prevents trauma to the tracheal stoma.
10. Ensure the inner cannula has “clicked” on by aligning the two dots, or ensure the clamp is secure.	 *Ensure that inner cannula is “clicked” securely into place*
11. Perform hand hygiene.	Hand hygiene reduces the transmission of microorganisms.  *Hand hygiene with ABHR*

Data source: ATI, 2015b; BCIT, 2015c; Morris, Whitmer & McIntosh, 2013; Perry et al., 2014; Vancouver Coastal Health, 2012b

VIDEO 10.7

Watch the video *Replacing and Cleaning an Inner Tracheal Cannula* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

CLEANING STOMA AND CHANGING THE STERILE DRESSING

The stoma should be cleaned and the dressing changed every 6 to 12 hours or as needed, and the peristomal skin should be inspected for skin breakdown, redness, irritation, ulceration, pain, infection, or dried secretions. Patients with copious amounts of secretions often require frequent dressing changes to prevent maceration of the tissue and skin breakdown. Cotton-tip applicators can be used to get under the tracheostomy device, where cleaning can be done using a semi-circular motion, inward to outward. Always use aseptic technique. Checklist 84 provides a safe method to clean the tracheal stoma and replace the sterile dressing.

Checklist 84: Cleaning Stoma and Changing a Sterile Dressing

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Reassess your patient's tolerance for tracheostomy care and watch for signs of respiratory distress.
- Pre-hyperoxygenate patient if required and according to agency policy.
- If removing oxygen while preforming tracheostomy care, remember to replace it often to reoxygenate the patient.

STEPS	ADDITIONAL INFORMATION
1. Perform hand hygiene, verify physician orders for tracheostomy care, and collect supplies.	Supplies include sterile dressing change, pre-cut 4 x 4 gauze, normal saline, cotton-tip applicators, non-sterile gloves, and garbage bag.
2. Perform hand hygiene, ID patient using two identifiers, explain procedure to patient, and create privacy if required. Ensure patient has a method to communicate with you during the procedure.	This reduces the transmission of microorganisms.  *Hand hygiene with ABHR* Tracheal patients always require a method to communicate with the health care provider.
3. Apply non-sterile gloves and cover chest with waterproof pad.	This prevents gown from becoming soiled.

4. Organize all supplies and set up sterile tray field; add cleaning solution to sterile tray.	Organization ensures the process of cleaning is efficient and fast.  *Set up sterile tray and add cleaning solution and supplies*
5. Remove oxygen mask to clean dressing but replace frequently as required by patient.	This prevents hypoxia.  *Remove oxygen mask to clean dressing*
6. Using forceps, remove the soiled dressing around the tube and discard in garbage bag.	All soiled dressings should be removed, as they may excoriate the surrounding peristomal skin.  *Use forceps to remove the soiled dressing*

7. Assess the stoma site for bleeding, appearance of stoma edges, and peristomal skin for evidence of infection or redness (assess for increase in pain, odour, or abscess formation).	Assessment is important to identify and prevent further complications.  *Assess stoma site*
8. Clean the stoma site with a gauze or cotton-tip applicator soaked in normal saline. Be careful not to disturb the tracheostomy tube. Dry surrounding area if required.	Cleaning around the stoma removes any debris or exudate from the stoma. A tracheal stoma should be cleaned with normal saline.  *Clean the stoma site with a gauze or cotton-tip applicator soaked in normal saline*
9. Assess the site to determine if barrier film is required.	Follow agency policy.

10. Apply new manufactured pre-cut tracheostomy dressing to tube using sterile forceps.	Avoid cutting gauze for tracheostomy care. Use non-fraying material. The small fibres from the cut gauze may become loose and accidentally travel into the inner cannula. Always use manufactured pre-cut gauze.  *Apply new manufactured pre-cut tracheostomy dressing to tube using sterile forceps*
Data source: BCIT 2015c; Morris et al., 2013; Perry et al., 2014; Vancouver Coastal Health, 2012	

VIDEO 10.8

Watch this video *Changing a Trachestomy Site Dressing* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

REPLACING TRACHEOSTOMY TIES (VELCRO OR TWILL TAPE)

Tracheal ties will become dirty and require replacing. Ties should be replaced as required, according to agency policy. Ideally, one person should hold the tracheostomy tube in place while the tracheostomy ties are replaced by another person. Alternatively, secure the new tracheostomy ties prior to removing the old tracheostomy ties to avoid accidental dislodgement of the tracheostomy tube if the patient coughs or the tracheostomy is accidentally bumped out. Once the new tracheostomy ties are on, only one finger should fit between the tracheostomy ties and the neck. Ensure twill ties are knotted using a square knot.

Watch this *Securing an Endotracheal Tube with Twill Tape and a Rolling Hitch* video to learn how to tie a square knot.

Checklist 85 lists the steps for replacing tracheostomy ties.

Checklist 85: Replacing Tracheostomy Ties (Velcro or Twill Tape)

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Reassess your patient's tolerance for tracheostomy care and watch for signs of respiratory distress.
- Pre-hyperoxygenate patient if required and according to agency policy
- If removing oxygen while preforming tracheostomy care, remember to replace it often to reoxygenate the patient.

STEPS	ADDITIONAL INFORMATION
1. Perform hand hygiene, verify physician orders for tracheostomy care, and collect supplies.	Use twill ties or Velcro ties.  *Wash hands*
2. Have an additional health care provider assist with the tracheal tie change as required.	If tracheostomy is less than 24 hours old, or patient is confused, agitated, or unpredictable, always have an additional helper at the bedside to prevent accidental dislodgement.

3. Perform hand hygiene, ID patient using two identifiers, explain procedure to patient, and create privacy if required. Ensure patient has a method to communicate with you during the procedure.	This reduces the transmission of microorganisms.  *Hand hygiene with ABHR* Tracheal patients always require a method to communicate with the health care provider.
4. Apply non-sterile gloves.	This reduces the transmission of microorganisms.  *Apply non-sterile gloves*

5. To secure the tracheostomy tube with Velcro ties:

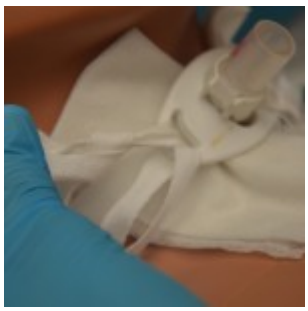
- If patient is at risk of tracheostomy dislodgement due to confusion or agitation, replace Velcro with ribbon tapes.
- If possible, one health care worker can keep the tracheostomy tube in place by holding the flange with gloved hands, while the other can replace the tapes. This avoids potential dislodgement of the tube as this procedure can make the patient cough.
- Thread the narrow Velcro tab through the slit in the flange of the tracheostomy tube and fold it back to adhere to the main tube holder; repeat on other side. Overlap the shorter length of collar with the longer length of collar and secure with the wider Velcro tab. Trim any excess length of collar to fit the size of the patient's neck.
- Check how secure the collar feels. Ensure you can fit one little finger between the collar and the patient. The tape should be tight enough to keep the tracheostomy tube securely in place but loose enough to allow the little finger to fit between the tapes and the neck.

To secure the tracheostomy tube with ribbon/twill tape:

- Cut two pieces of cotton tape, each approximately 50 cm in length (depending on neck size).
- Divide the tape into thirds and fold the first third over the remaining two-thirds of the ribbon.
- Thread the folded edge through one flange hole, forming a loop.
- Thread the loose tape ends through this loop and pull until tight and secure.
- Repeat the process for the other side, securing the tapes with square knots on each side of the neck.

Tracheostomy ties are used to promote patient comfort and keep the tracheostomy secured and in situ.

Velcro ties



Cotton twill ties

6. Perform hand hygiene.	Hand hygiene reduces the transmission of microorganisms.  *Hand hygiene with ABHR*
Data source: BCIT, 2015c; Morris et al., 2013; Perry et al., 2014	

VIDEO 10.9

Watch a video *Changing Tracheostomy Ties* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

Critical Thinking Exercises

1. When suctioning your patient, you notice thick, tenacious secretions. What interventions should be implemented?
2. What methods of communication can you use for your patient with a tracheostomy tube who is unable to speak?

10.6 Chest Tube Drainage Systems

A **chest tube**, also known as a thoracic catheter, is a sterile tube with a number of drainage holes that is inserted into the pleural space. The pleural space is the space between the parietal and visceral pleura, and is also known as the pleural cavity. A patient may require a chest drainage system any time the negative pressure in the pleural cavity is disrupted, resulting in respiratory distress. Negative pressure is disrupted when air, or fluid and air, enters the pleural space and separates the visceral pleura from the parietal pleura, preventing the lung from collapsing and compressing at the end of exhalation. A small amount of fluid or air may be absorbed by the body without a chest tube. A large amount of fluid or air cannot be absorbed by the body and will require a drainage system (Bauman & Handley, 2011; Perry et al., 2014).

The chest tube is connected to a closed chest drainage system, which allows for air or fluid to be drained, and prevents air or fluid from entering the pleural space. The system is airtight to prevent the inflow of atmospheric pressure. Because the pleural cavity normally has negative pressure, which allows for lung expansion, any tube connected to it must be sealed so that air or liquid cannot enter the space where the tube is inserted (Bauman & Handley, 2011; Rajan, 2013).

The location of the chest tube depends on what is being drained from the pleural cavity. If air is in the pleural space, the chest tube will be inserted above the second intercostal space at the mid-clavical line. If there is fluid in the pleural space, the chest tube is inserted at the fourth to fifth intercostal space, at the mid-axillary line. A chest tube may also be inserted to drain the pericardial sac after open heart surgery, and may be placed directly under the sternum (Perry et al., 2014).

The following are some of the conditions that may require a chest tube drainage system (Bauman & Handley, 2011; Perry et al., 2014):

- Pleural effusion
- Pneumothorax
- Hemothorax
- Spontaneous pneumothorax
- Tension pneumothorax
- Traumatic pneumothorax (stab or gunshot wound)
- Cardiac tamponade (accumulation of blood surrounding the heart after open heart surgery or chest surgery)

A chest tube drainage system must always be placed below the drainage site and secured in an upright position (attached to the floor or an IV pole, as in Figure 10.4) to prevent it from being knocked over.

Figure 10.4 Chest tube drainage system secured to IV pole

Figure 10.5 Chest tube drainage system

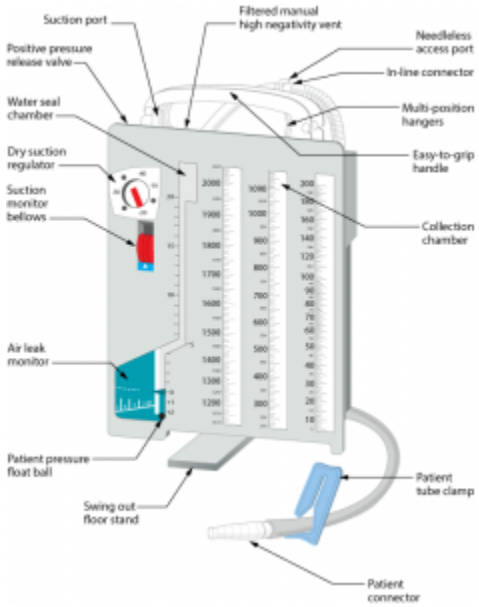


Figure 10.6 Chest tube drainage system with labelled parts

A **chest tube drainage system** is a sterile, disposable system that consists of a compartment system that has a one-way valve, with one or multiple chambers, to remove air or fluid and prevent return of

the air or fluid back into the patient (see Figures 10.5 and 10.6). The traditional chest drainage system typically has three chambers (Bauman & Handley, 2011; Rajan, 2013). Always review what type of system is used in your agency, and follow the agency's and the manufacturer's directions for setup, monitoring, and use. In general, a traditional chest tube drainage system will have these three chambers:

1. Collection chamber: The chest tube connects directly to the collection chamber, which collects drainage from the pleural cavity. The chamber is calibrated to measure the drainage. The outer surface of the chamber has a "write-on" surface to document the date, time, and amount of fluid. This chamber is typically on the far right side of the system (Teleflex Medical Incorporated, 2009).
2. Water-seal chamber: This chamber has a one-way valve that allows air to exit the pleural cavity during exhalation but does not allow it to re-enter during inhalation due to the pressure in the chamber. The water-seal chamber must be filled with sterile water and maintained at the 2 cm mark to ensure proper operation, and should be checked regularly. Fill with additional sterile water as required. The water in the water-seal chamber should rise with inhalation and fall with exhalation (this is called *tidaling*), which demonstrates that the chest tube is patent. Continuous bubbling may indicate an air leak, and newer systems have a measurement system for leaks — the higher the number, the greater the air leak. The water-seal chamber can also monitor intrathoracic pressure (Teleflex Medical Incorporated, 2009).
3. Wet or dry suction control chamber: Not all patients require suction. If a patient is ordered suction, a wet suction system is typically controlled by the level of water in the suction control chamber and is typically set at -20 cm on the suction control chamber for adults. If there is less water, there is less suction. The amount of suction may vary depending on the patient and is controlled by the chest drainage system, not the suction source. Monitor the fluid level to ensure there is gentle bubbling in the chamber. A dry suction system uses a self-controlled regulator that adjusts the amount of suction and responds to air leaks to deliver consistent suction for the patient. If suction is discontinued, the suction port on the chest drainage system must remain unobstructed and open to air to allow air to exit and minimize the development of a tension pneumothorax (Teleflex Medical Incorporated, 2009).

In addition to the three chambers, the drainage system has many safety features to ensure that high negative pressures can be monitored and relieved quickly. To review these safety features and additional information regarding the chambers of a closed chest tube drainage system, visit the Teleflex Medical Incorporated website.

When a patient has a closed chest tube drainage system, it is the health care provider's responsibility to assess the patient and the equipment frequently to ensure the equipment is patent and working effectively. The health care provider should:

- Assess the patient
- Assess the chest tube drainage system for patency and troubleshoot any concerns
- Ensure the safety/emergency equipment is attached to the bed
- Promote lung expansion (deep breathing and coughing exercises, position changes, and ambulation as required)

Checklist 86 reviews the management of a patient with a chest tube drainage system.

Checklist 86: Management of a Chest Tube Drainage System (Pleur-evac)

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

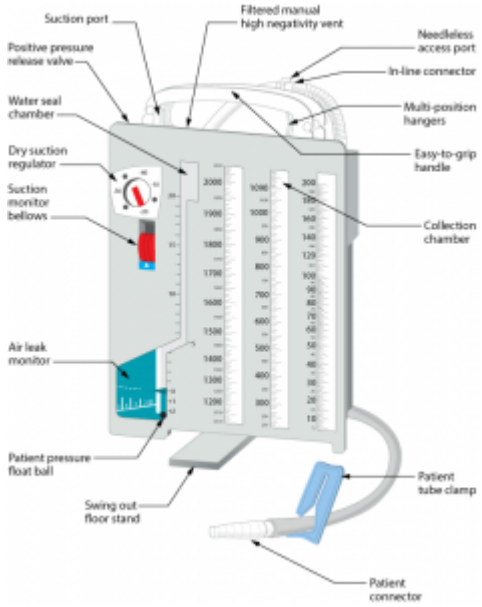
Safety considerations:

- A chest tube may be inserted at the bedside, in procedure room, or in the surgical suite. Health care providers often assist physicians in the insertion and removal of a closed chest tube drainage system.
- After initial insertion of a chest tube drainage system, assess the patient every 15 minutes to 1 hour. Once the patient is stable, and depending on the condition of the patient and the amount of drainage, monitoring may be less frequent. If the patient is stable (vital signs within normal limits; drainage amount, colour, or consistency is within normal limits; the patient is not experiencing any respiratory distress or pain), assessment may be completed every 4 hours. Always follow hospital policy for frequency of monitoring a patient with a chest tube.
- Prior to managing a patient with a chest tube, review reason for the chest tube, the location of the chest tube, normal volume of drainage, characteristics of the drainage, date of last dressing change, and any previously recorded air leaks measurements.
- Safety/emergency equipment must always be at the patient's bedside and with the patient at all times during transportation to other departments. Safety equipment includes:
    - Two guarded clamps
    - Sterile water
    - Vaseline gauze (Jelonet)
    - 4 x 4 sterile dressing
    - Waterproof tape
- *Never* clamp a chest tube without a doctor's order or valid reason. The tube must remain unobscured and unclamped to drain air or fluid from the pleural space. There are a few exceptions where a chest tube may be clamped; see special considerations below.
- Chest tube drainage systems are replaced only when the collection chamber is full or the system is contaminated.

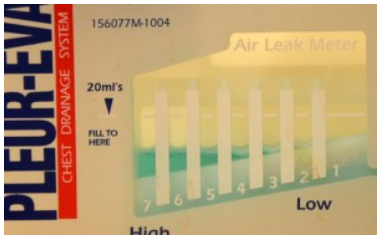
STEPS	ADDITIONAL INFORMATION
1. Review the patient chart for the reason for the chest tube and location and insertion date.	Knowing the reason for the chest tube and location informs the health care provider on the type of expected drainage.
2. Perform hand hygiene. identify patient using two identifiers and explain assessment process to patient. Create privacy to assess the patient and drainage system.	Hand hygiene reduces the transmission of microorganisms. Proper identification provides patient safety measures for safe care.

3. Complete respiratory assessment, ensure patient has minimal pain, and measure vital signs. Place patient in semi-Fowler's position for easier breathing.	Patient should be in a semi-Fowler's position, have minimal pain, have *no* respiratory distress, and have *no* evidence of an air leak around the insertion site, and *no* drainage from the insertion site or chest tube equipment. Frequent assessment of the respiratory status is important if the patient's condition is stable, resolving, or worsening, and ensures that the chest tube is functioning correctly. Assessment should be every 15 minutes to 1 hour until patient is stable. Increase monitoring if patient's condition worsens. Chest tubes are painful, as the parietal pleura are very sensitive. Ensure patient has adequate pain relief, especially prior to repositioning, sitting, or ambulation.
4. Assess chest tube insertion site to ensure sterile dressing is dry and intact. Check insertion site for subcutaneous emphysema.	Dressing should remain dry and intact; no drainage holes should be visible in the chest tube. Dressing is generally changed 24 hours post-insertion, then every 48 hours. Chest tubes are generally sutured in place. There should be no fluid leaking from around the site or sounds of air leaks from insertion site.  *Chest tube insertion site*
5. Maintain a closed system. Ensure all connections are taped and secured according to agency policy.	These measures are important to keep the system intact and prevent accidental tube removal or disruption of the drainage system.

6. Ensure tubing is not kinked or bent under the patient or in the bed rails, or compressed by the bed.	Kinked or bent tubing could interfere with the drainage of the pleural fluid. Dependent loops may collect fluid and impede drainage. The long tube may be coiled and secured to a draw sheet with a safety pin (allowing enough tubing so that the patient can move in bed comfortably) to prevent dependent loops.  *Tubing free from kinks and dependent loops*
7. Collection chamber (drainage system) is below the level of the chest and secured to prevent it from being accidentally knocked over.	The drainage system must remain upright for the water-seal chamber to function correctly. The chest drainage system must be lower than the chest to facilitate drainage and prevent back flow.  *Chest drainage system lower than insertion site*
8. Periodically check water-seal chamber to ensure water level is to the dotted line (2 cm) — at least once every shift. Add water as necessary.	Adequate water in the water-seal chamber prevents excess suction being placed on the delicate tissue. Water levels should be checked each shift as the water may evaporate.

9. Check water-seal chamber for tidaling (water moving up and down) with respirations. Gentle bubbling is normal as the lungs expand.	If the water in the water seal does not move up and down with respirations, the system might not be intact or patent. Periodic bubbling in the water-seal chamber is normal and indicates that air that is trapped is being removed. Frequent assessment of the system is required to ensure proper functioning.  *Chest tube drainage system with labelled parts* Excessive bubbling may cause unnecessary noise and faster evaporation. If there is no tidaling, consider 1) an occlusion somewhere between the pleural cavity and the water seal, or 2) a full expansion of the lung, where suction has drawn the lung up against the holes in the chest tubes. If patient is on positive pressure ventilation, the tidaling will be the opposite: the water will move down with inspiration and up with expiration.
10. Ensure suction control dial is set to ordered level (usually 20 cm).	The amount of suction in the chamber is regulated by the suction control dial, not the suction source.

11. If suction is ordered, a “float” (or equivalent) must be visible clearly in the window.	In wet suction control, gentle bubbling is normal. If there is no bubbling, ensure the connections are tight and turn the suction higher.  *Suction pressure set at – 20 cm*
12. If suction is *not* ordered, ensure the suction port is left open to air. Suction window will appear blank if suction is not in use or not working.	The suction port must be left open to the air and free of obstruction to prevent a tension pneumonthorax.  *Suction port on the top of a chest tube drainage system*  *Suction control window (white rectangle)*
13. In wet suction systems, expect gentle bubbling in the chamber.	Gentle bubbling is normal. Vigorous bubbling is noisy and can be disturbing to the patient. Periodically check the air vent to ensure it is not blocked or occluded.

14. Assess air leak meter to determine progress of patient's internal air level, measured as level 1 to 7. On every shift, document the level of air leak, and if the air leak occurs at rest or with coughing.	Bubbling in the air leak meter indicates an air leak. Measure and monitor. The source of the leak may be identified by: • Checking and tightening connections. • Testing the tube for leaks (see special considerations below). If leak is in the tubing, replace the unit. • If the leak may be at the insertion site, remove the chest tube dressing and inspect. Has the chest tube been pulled out beyond the chest wall? If you cannot see or hear any obvious leaks at the site, the leak is from the lung. • Check patient history. Would you expect a patient air leak? Notify doctor of any new, increased, or unexpected air leaks that are not corrected by the above actions. To document the air leak, note the numbered column through which the bubbling occurs. If bubbling is present in first three columns of the air leak meter, document "air leak 3."  *Air leak meter*
15. Check that the clamp is open.	The chest tube should *not* be clamped unless for specific reasons. See special considerations below.  *Blue clamp is open*

16. Measure date and time, and the amount of drainage, and mark on the outside of the chamber. Record amount and characteristics of the drainage on the fluid balance sheet and patient chart.	Drainage that is red and free-flowing indicates a hemorrhage. A large amount of drainage, or drainage that changes in colour, should be recorded and reported to the primary health care provider. Drainage that suddenly decreases may indicate a blood clot or obstruction in the chest tube drainage system.  *Drainage in collection chamber*
17. Encourage frequent position changes as well as deep-breathing and coughing exercises.	Deep-breathing and coughing exercises promote lung expansion and promote fluid drainage.
18. The following should be documented and assessed according to agency policy: • Presence of air leaks • Fluctuation of water in water-seal chamber • Amount of suction • Amount of drainage and type • Presence of crepitus (subcutaneous emphysema) • Breath sounds • Patient comfort level or pain level • Appearance of insertion site and/or dressing	Proper documentation is required to manage a chest tube drainage system to ensure it is functioning effectively.
Data source: Bauman & Handley, 2011; BCIT, 2015c; Durai, Hoque, & Davies, 2010; Rajan, 2013; Teleflex Medical Incorporated, 2009	

Special considerations:

- Do not strip or milk the chest tube: In practice, stripping is used to describe compressing the chest tube with the thumb or forefinger and, with the other hand, using a pulling motion

down the remainder of the tube away from the insertion site. *Milking* refers to techniques such as squeezing, kneading, or twisting the tube to create bursts of suction to move clots. Any aggressive manipulation (compressing the tube to dislodge blood clots) can generate extreme pressures in the chest tube. There is no evidence showing the benefit of stripping or milking a chest tube (Bauman & Handley, 2011; Durai et al., 2010; Halm, 2007).

- The *only* exceptions to clamping a chest tube are 1) if the drainage system is being changed, 2) if assessing the system for an air leak, 3) if the chest tube becomes disconnected from the chest drainage system — the chest tube should not be clamped for more than a few minutes (Salmon, Lynch, & Muck, 2013), or 4) if the condition of the patient is resolved and the chest tube is ready for removal (as per physician orders).

VIDEO 10.10

Watch the video *Chest tube care & maintenance* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

VIDEO 10.11

Watch the video *Dry suction chest drainage system* by Renée Anderson & Wendy McKenzie, Thompson Rivers University.

Table 10.3 provides a list of potential complications and interventions related to chest tube drainage systems.

Table 10.3 Complications and Interventions Related to Chest Tube Drainage Systems

Complications	Interventions
Potential pneumothorax/ respiratory distress	This is the primary concern for a patient with a chest tube drainage system. • Signs and symptoms include decreased SaO_2, increased work of breathing (WOB), diminished breath sounds, decreased chest movement, complaints of chest pain, tachycardia or bradycardia, hypotension. • Notify health care provider. • Request urgent chest X-ray. • Ensure drain system is intact with no leaks or blockages such as kinks or clamps. • Apply oxygen and take a set of vital signs.
Air leak	An air leak may occur from the chest tube insertion site or the drainage system. Do the following to test the system for the site of an air leak: • Using a booted (or padded) clamp, begin at the dressing and clamp the drainage tubing momentarily. • Look at the water-seal/air leak meter chamber. Keep moving the clamp down the drainage tubing toward the chest drainage system, placing it at 20 to 30 cm intervals. Each time you clamp, check the water-seal/air leak meter chamber. • When you place the clamp between the source of the air leak and the water-seal/air leak meter chamber, the bubbling will stop. If bubbling stops the first time you clamp, the air leak must be at the chest tube insertion site or the lung.
Accidental chest tube removal or chest tube falls out	A chest tube falling out is an emergency. Immediately apply pressure to chest tube insertion site and apply sterile gauze or place a sterile Jelonet gauze and dry dressing over insertion site and ensure tight seal. Apply dressing when patient exhales. If patient goes into respiratory distress, call a code. Notify primary health care provider to reinsert new chest tube drainage system.
Accidental disconnection of the drainage system	A chest tube drainage system disconnecting from the chest tube inside the patient is an emergency. Immediately clamp the tube and place the end of chest tube in sterile water or NS. The two ends will need to be swabbed with alcohol and reconnected.
Bleeding at the insertion site	Bleeding may occur after insertion of the chest tube. Apply pressure to site and monitor.
Subcutaneous emphysema	Subcutaneous emphysema is painless tracking of air underneath the subcutaneous tissue. It may be seen in the chest wall, down limbs, around drain sites, or around the head or neck. When the skin is palpated, it feels similar to having tissue paper trapped beneath the skin. Monitor and report to primary health care provider.
Drainage suddenly stops and respiratory distress increases	The chest tube may be clogged by a blood clot or by fluid in a dependent loop. Assess the drainage system and the patient and notify primary health care provider if required.

Sudden increase in bright red drainage	This may indicate an active bleed. Monitor amount of drainage and vital signs, and notify the primary health care provider.
Data source: ATI, 2015c; BCIT, 2015c; Perry et al., 2014; Teleflex Medical Incorporated, 2009	

HEIMLICH VALVE

A Heimlich valve (see Figures 10.7 and 10.8) is a small, specially designed flutter valve that is portable and mobile, allowing the patient to ambulate with ease. It attaches to the chest tube at one end and a drainage bag at the other. The drainage bag allows air and fluid to escape but prevents their re-entering the pleural space. The valve can be worn under clothing. The valve functions in any position, never needs to be clamped, and can be hooked up to suction if required (Gogakos et al., 2015).

Figure 10.7 Heimlich valve

Figure 10.8 Blue end connects to chest tube; other end may be left open to air or attach to a small drainage bag

Critical Thinking Exercises

1. What should you do if your patient's chest tube becomes disconnected from the chest tube drainage system?
2. When a patient has a chest tube, what emergency supplies must be at the patient's bedside at all

times?

10.7 Ostomy Care

An **ostomy** is a surgically created opening from the urinary tract or intestines, where effluent (fecal matter, urine, or mucous) is rerouted to the outside of the body using an artificially created opening called a **stoma**. A stoma typically protrudes above the skin, is pink to red in colour, moist, and round, with no nerve sensations. Ostomy surgeries are performed when part of the bowel or urinary system is diseased and therefore removed. The output from the stoma (urine, feces, or mucous) is called **effluent**.

An ostomy is named according to the part of intestine used to construct it. A **colostomy** is the creation of a stoma from part of the colon (large bowel), where the intestine is brought through the abdominal wall and attached to the skin, diverting normal intestinal fecal matter through the stoma instead of the anus. An **ileostomy** is created from the ileum (small bowel), which is brought through the abdominal wall and used to create a stoma. A **urostomy** or **ileal conduit** is a stoma created using a piece of the intestine to divert urine to the outside of the body. The ureters are sewn to a piece of the intestine, brought through the abdominal wall, and sutured to create the stoma. These surgeries are performed on patients with diseases such as cancer of the bowel or bladder, inflammatory bowel diseases (such as colitis or Crohn's), or perforation of the colon. Emergencies that may require an ostomy include diverticulitis, trauma, necrotic bowel, or radiation complications. An ostomy may be permanent or temporary, depending on the reason for the surgery. Other types of ostomies are called jejunostomy, double-barrel ostomy, and loop ostomy (Perry et al., 2014).

POUCHING SYSTEMS (OSTOMY APPLIANCES)

Individuals with colostomies, ileostomies, or urostomies have no control or sensation of frequency or output of the stoma. Patients with ostomies must wear a pouching system to collect the effluent from the stoma and protect the skin from irritation. The pouching system must be completely sealed to prevent leaking of the effluent and to protect the surrounding peristomal skin. The disposable pouching systems can be either a one-piece or a two-piece flexible system consisting of a plastic bag and a flange (skin barrier) that sit against the patient's skin. The flange may be flat or convex. The ostomy pouch and flange come together to form one integrated, leakproof unit. The pouch has an open end to allow effluent to be drained, and may be closed using a plastic clip or Velcro strip. There are many different types of pouching systems to meet different needs. Step 2 in Checklist 87 shows ostomy supplies including a flange, an ostomy bag, and a one-piece system (Perry et al., 2104; United Ostomy Association of America, 2011).

The flange is cut to fit around the stoma without impinging on it. Ostomy pouching systems vary and are based on type of stoma, stoma characteristics, stoma location, patient abilities, skin folds, and patient preference. Depending on the type of pouching system, the system can last from four to seven days. The pouch must be changed if it is leaking, odour is present, there is excessive skin exposure, or the patient complains of itching or burning under the skin barrier. Patients with pouches can swim and take showers with the pouching system on. All patients are expected to participate in all aspects of the care of their ostomy; if they cannot, a caregiver may be taught to care for the ostomy (Perry et al., 2014).

Depending on the patient, a surgical procedure may be performed to create an internal pouch to collect feces or urine, which eliminates the need for an external pouch. The **continent ileostomy** is made from part of the ileum and is flushed a number of times each day to clean out the effluent. An **ileoanal ostomy** is a pouch created above the anal sphincter and is also created from a portion of the ileum. Two types of internal urinary diversions may be created from part of the intestine. The first is an orthotopic neobladder, where a bladder is created and placed in the body at a normal bladder position; over time, with continent training, the patient can learn to void normally. The second type is a **continent urinary reservoir**, where a pouch is created from part of the intestine, and a catheter is inserted a number of times during the day to remove the urine (Perry et al., 2014; United Ostomy Association of America, 2011).

PHYSICAL AND EMOTIONAL ASSESSMENT

Patients may have co-morbidities that affect their ability to manage their ostomy care. Conditions such as arthritis, vision changes, Parkinson's disease, or post-stroke complications may hinder a patient's coordination and function to manage the ostomy. In addition, the emotional burden of coping with an ostomy may be devastating for some patients and may affect their self-esteem, body image, quality of life, and ability to be intimate. It is common for ostomy patients to struggle with body image and an altered pattern of elimination. Ensure the patient has the appropriate referrals to the wound and ostomy nurse and social workers, as well as access to support groups or online support groups. As a health care provider, be very aware of non-verbal cues: take care not to show disgust at the ostomy or at odour that may be present when changing an appliance or pouching system (Perry et al., 2014).

Checklist 87 reviews the steps to change an ostomy pouching system (ostomy appliance).

Checklist 87: Changing a Pouching System/Ostomy Appliance (Ileostomy or Colostomy)

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

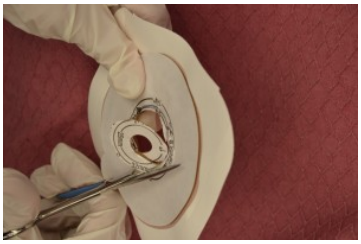
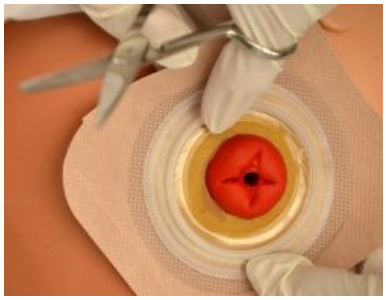
Safety considerations:

- Pouching system should be changed every 4 to 7 days, depending on the patient and type of pouch.
- Always consult a wound care specialist or equivalent if there is skin breakdown, if the pouch leaks, or if there are other concerns related to the pouching system.
- Patients should participate in the care of their ostomy, and health care providers should promote patient and family involvement.
- Encourage the patient to empty the pouch when it is one-quarter to one-half full of urine, gas, or feces.
- Ostomy product choices are based on the patient's needs and preference.
- Follow all post-operative assessments for new ostomies according to agency policy.
- Medications and diet may need adjusting for new ileostomies/ colostomies.
- An ostomy belt may be used to help hold the ostomy pouch in place.
- Factors that affect the pouching system include sweating, high heat, moist or oily skin, and physical exercise.
- Always treat minor skin irritations right away. Skin that is sore, wet, or red is difficult to seal with a flange for a proper leakproof fit.

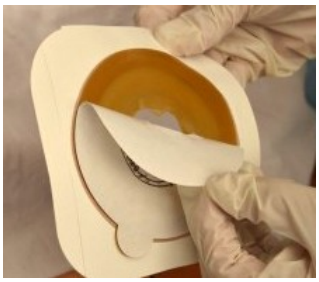
STEPS	ADDITIONAL INFORMATION
1. Perform hand hygiene.	This prevents the spread of microorganisms.  *Hand hygiene with ABHR*

2. Gather supplies.	Supplies include flange, ostomy bag and clip, scissors, stoma measuring guide, waterproof pad, pencil, adhesive remover for skin, skin prep, stomahesive paste or powder, wet cloth, non-sterile gloves, and additional cloths.  *Ostomy supplies*
3. Identify the patient and review the procedure. Encourage the patient to participate as much as possible or observe/assist patient as they complete the procedure.	Proper identification complies with agency policy. Encouraging patients to participate helps them adjust to having an ostomy.
4. Create privacy. Place waterproof pad under pouch.	The pad prevents the spilling of effluent on patient and bedsheets.
5. Apply gloves. Remove ostomy bag, and measure and empty contents. Place old pouching system in garbage bag.	 *Remove ostomy bag from flange*

6. Remove flange by gently pulling it toward the stoma. Support the skin with your other hand. An adhesive remover may be used. If a rod is in situ, do not remove.	Gentle removal helps prevent skin tears. An adhesive remover may be used to decrease skin and hair stripping.  *Remove flange* A rod may be used during the formation of a stoma. It can only be removed by a physician or wound care nurse. If a rod is in place, it can be slid to allow the pouch to be removed.
7. Clean stoma gently by wiping with warm water. Do not use soap.	Aggressive cleaning can cause bleeding. If removing stoma adhesive paste from skin, use a dry cloth first.  *Clean stoma and peristomal skin*
8. Assess stoma and peristomal skin.	A stoma should be pink to red in colour, raised above skin level, and moist.  *Assess stoma* Skin surrounding the stoma should be intact and free from wounds, rashes, or skin breakdown. Notify wound care nurse if you are concerned about peristomal skin.

9. Measure the stoma diameter using the measuring guide (tracing template) and cut out stoma hole. Trace diameter of the measuring guide onto the flange, and cut on the outside of the pen marking.	The opening should be 2 mm larger than the stoma size. Keep the measurement guide with patient supplies for future use.  *Trace template*  *Once size is traced onto back of flange, cut out size to fit stoma*  *Assess flange for proper fit to stoma*

10. Prepare skin and apply accessory products as required or according to agency policy.	Accessory products may include stomahesive paste, stomahesive powder, or products used to create a skin sealant to adhere pouching system to skin to prevent leaking. Wet skin will prevent the flange from adhering to the skin.  *Peristomal skin prep*  *Stomahesive paste*

11. Remove inner backing on flange and apply flange over stoma. Leave the border tape on. Apply pressure. Hold in place for 1 minute to warm the flange to meld to patient's body. Then remove outer border backing and press gently to create seal. If rod is in situ, carefully move rod back and forth but do not pull up on rod.	The warmth of the hand can help the appliance adhere to the skin and prevent leakage.  *Remove backing from flange*  *Apply flange around stoma*  *Press gently to create seal*

12. Apply the ostomy bag. Attach the clip to the bottom of the bag.	This step prevents the effluent from soiling the patient or bed.  *Apply ostomy pouch*  *Attach clip to bottom of bag*
13. Hold palm of hand over ostomy pouch for 2 minutes to assist with appliance adhering to skin.	The flange is heat activated.
14. Clean up supplies, and place patient in a comfortable position. Remove garbage from patient's room.	Removing garbage helps decrease odour.
15. Perform hand hygiene.	This minimizes the transmission of microorganisms.
16. Document procedure.	Follow agency policy for documentation. Document appearance of stoma and peristomal skin, products used, and patient's ability to tolerate procedure and assistance with procedure.
Data source: BCIT, 2015b; Berman & Snyder, 2016; Perry et al., 2014.	

Special Considerations

- When patients are discharged from an acute care facility, ensure they have referrals to a community nurse, are able to empty their pouch system independently or with assistance from a caregiver, have spare supplies, and know the signs and symptoms of complications and where to seek help.
- Patients should be seen by the wound care or ET nurse and have a dietitian referral for new dietary needs related to the ileostomy or colostomy (Registered Nurses Association of Ontario, 2009).

- The ostomy bag may become filled with gas from the intestine and may let out a “farting” sound that is usually quiet, but uncontrollable. Patients may “burp” the bag through the opening at the top in a two-piece system by opening a corner of the ostomy pouch from the flange to let the air out. Dietary restrictions may also help decrease the amount of gas produced by the intestines (Ostomy Canada Society, n.d.).

UROSTOMY CARE

A urostomy is similar to a fecal ostomy, but it is an artificial opening for the urinary system and the passing of urine to the outside of the abdominal wall through an artificially created hole called a stoma. A urostomy is created for the following reasons:

- Bladder cancer
- Cystectomy
- Trauma/surgery
- Incontinence
- Painful bladder/overactive bladder
- Congenital abnormalities
- Conversion of continent urinary diversion to incontinent stoma
- Neurological conditions and diseases
- Spinal cord injury
- Chronic inflammation of bladder
- Interstitial cystitis
- Radiation damage
- Inability to manage a continent urinary diversion or a neobladder

A urostomy patient has no voluntary control of urine, and a pouching system must be used and emptied regularly. Many patients empty their urostomy bag every two to four hours, or as often as they regularly used the bathroom prior to their surgery. Urostomy pouches (see Figure 10.9) have a drain at the end, and the pouch should be emptied when one-third full. The pouch may also be attached to a drainage bag for overnight drainage. Patients with a urostomy are more at risk for urinary tract infections (UTIs) and should be educated on the signs and symptoms of such infections (Perry et al., 2014).

Figure 10.9 Urostomy pouch

Checklist 88 describes how to change a urostomy pouch.

Checklist 88: Changing a Urostomy Pouch/Appliance

Disclaimer: Always review and follow your hospital policy regarding this specific skill.

Safety considerations:

- Urine flows continually from a urostomy; thus, applying a pouch is more challenging than applying a regular ostomy.
- A stent is usually placed in the stoma post-operatively to prevent stenosis of the ureters. The stents are usually removed in the hospital or at the first physician visit.
- Sterile technique must be used when changing a urostomy pouch on a new urostomy. Always follow agency policy.
- Since bacteria grow readily in urine, it is important to empty the pouch regularly and use a pouch with an anti-reflux valve to prevent backup of urine into the urostomy.
- An ostomy belt may be used to hold the pouch in place.
- A urostomy pouch should be changed every three to seven days, depending on the supplies used. It is best to change it before it leaks.
- It is best to wait one or two hours after drinking fluids to change a urostomy appliance.
- Sterile supplies are used in acute care with a fresh post-surgical urostomy. A patient in the community may not use sterile supplies, but strict adherence to proper hand hygiene is required to prevent infections of the bladder, kidney, or urinary tract.
- Never place anything inside the stoma.
- Bacteria can rapidly replicate and cause an infection. Educate the patient on the importance of proper hand hygiene and keeping supplies clean.
- Factors that affect the pouching system include sweating, high heat, moist or oily skin, and physical exercise.
- Always treat minor skin irritations right away. Skin that is sore, wet, or red is difficult to seal with a flange for a proper leakproof fit.

STEPS	ADDITIONAL INFORMATION
1. Perform hand hygiene and collect supplies.	Hand hygiene reduces the transmission of microorganisms. Supplies include urostomy bag (one- or two-piece system), measuring guide, urinary collection bag, non-sterile gloves, scissors, pencil, adhesive remover, skin barrier pad, wick made from sterile gauze (rolled 2 x 2 gauze), waterproof garbage bag, waterproof pad, cleaning cloth, and drying cloth.
2. Identify the patient and review the procedure. Encourage patient to participate as much as possible or observe/assist as they complete the procedure.	Proper identification complies with agency policy. Encouraging patients to participate helps them adjust to having an ostomy.
3. Create privacy and place waterproof pad under pouch.	This maintains patient dignity and the pad protects the patient's bed.

4. Apply non-sterile gloves. Empty and measure urostomy contents. Discard old urostomy pouch.	A full urostomy bag may spill on the patient or bed.
5. Remove flange by gently pulling it toward the stoma. Support the skin with your other hand. An adhesive remover may be used. If stent is in place, do not remove it.	Gentle removal helps prevent skin tears. An adhesive remover may be used to decrease skin and hair stripping.
6. Place rolled gauze at stoma opening. Maintain gauze at the stoma opening continuously during pouch measurement and change.	This prevents urine from spilling on cleaned skin and new pouching system.
7. While keeping rolled gauze in contact with the stoma, cleanse peristomal skin gently with warm tap water using washcloth; do not scrub skin. If you touch stoma, minor bleeding is normal. Pat skin dry.	Aggressive cleaning can cause bleeding. If removing stomahesive paste from skin, use a dry cloth first.
8. Assess stoma and peristomal skin.	A stoma should be pink to red in colour, raised above skin level, and moist. Skin surrounding the stoma should be intact and free from wounds, rashes, or skin breakdown. Notify wound care nurse if concerned about peristomal skin.
9. Measure the stoma diameter using the measuring guide (tracing template) and cut out stoma hole. Trace diameter of the measuring guide onto the flange and cut on the outside of the pen marking.	Customizing the opening of the flange is important to ensure proper fit and prevent leakage.The opening should be 2 mm larger than the stoma. Keep the measurement guide with patient supplies for future use.
10. Prepare the skin and apply accessory products as required or according to agency policy.	Accessory products may include stomahesive paste, stomahesive powder, or products used to create a skin sealant to adhere pouching system to skin to prevent leaking. Wet skin will not allow for proper adhesion of flange.
11. Remove inner backing on flange.	Prepare flange to be placed on stoma.
12. Remove wick from stoma and apply flange around stoma. Leave the border tape on. Apply pressure. Hold in place for 1 minute to warm the flange to meld to patient’s body. Then remove border backing and attach to patient.	The flange is heat activated.
13. Apply the urostomy bag by ensuring the drain is turned to the “off” position, or connect the urostomy bag to a drainage bag at the bedside.	This prevents effluent from soiling the patient or bed. If drainage bag is used, ensure the bag is hanging below the urostomy to prevent backflow of urine into the stoma.
14. Hold palm of hand over pouch for 2 minutes to assist with appliance adhering to skin.	Pouches are heat activated and adhere more effectively when heat is applied.

15. Remove waterproof pad, clean up supplies, place patient in a comfortable position, and perform hand hygiene.	This step prevents contamination from equipment and reduces the transmission of microorganisms.
Data source: BCIT, 2015b; Perry et al., 2014; Vancouver Coastal Health, 2014b	

Special Considerations:

- Teach patients how to change a urostomy bag even if they appear disinterested. Do not insist that they look at the ostomy; allow them time to adjust.
- Educate patients on the importance of drinking adequate fluids each day (unless contraindicated) to prevent a UTI. Patients should drink at least 2 litres of fluid per day (unless contraindicated).
- Some mucous in the urine is normal, but blood is not a normal or expected finding.
- Educate patients on the signs and symptoms of a UTI, which include fever, flank (back) pain, cloudy or smelly urine, and feeling of malaise.
- Educate patients on where to buy supplies and which supplies to have on hand in case the flange leaks and needs replacing (Perry et al., 2014).

Critical Thinking Exercises

1. What dietary or medication changes might be considered for a patient who has a new ileostomy and no longer has a small bowel?
2. A patient with a new colostomy refuses to look at his stoma or participate in changing the pouching system. What are some suggestions to help your patient adjust to the stoma?

10.8 Summary

When patients have tubes and attachments to aid in their recovery, health care providers are required to understand the type, purpose, precautions, complications, and interventions to ensure treatment is effective and to prevent patient harm. Each tube and attachment is unique, and the function of the tube, care of the patient, and safety precautions must be understood. This chapter reviewed many common types of tubes and attachments found in the acute and community setting, and reviewed the care and maintenance of nasogastric tubes, indwelling catheters, ostomies, urostomies, chest tube drainage systems, and tracheostomies.

Key Takeaways

- Specific guidelines and procedures must be followed when working with tubes and attachments to prevent complications from the device.
- Patients with tubes and attachments are more at risk for infection. Take care to maintain sterility of all tubes and ensure device insertion sites stay dry and intact, and all connection points stay intact.
- Be aware of potential complications of each tube and attachment, and prevention strategies. Regularly assess the patient and the device for complications.
- If unfamiliar with a specific device, review all policies and procedures prior to using the device to prevent harm to the patient.
- Know the purpose, type, and special precautions for all tubes and devices that are used in your agency. Complete all training as required.

SUGGESTED ONLINE RESOURCES

1. ATI Nursing Education: Airway management. This resource provides information and videos on the types of airway management devices, suctioning (open and inline), and endotracheal and tracheostomy care.
2. ATI Nursing Education: Closed chest tube drainage systems. This resource provides information and videos on the types of chest tube drainage systems, how to manage a chest tube, how to manage complications, how to replace a closed chest tube drainage system, and how to change a dressing on a chest tube insertion site.
3. ATI Nursing Education: Nasogastric intubation. This resource provides information and videos on the insertion, care, gastric compression, and removal of an NG tube.
4. ATI Nursing Education: Ostomy care. This resource provides information on caring for an ostomy and urostomy, draining an ostomy, changing a pouching system, and colostomy

irrigation.

5. ATI Nursing Education: Urinary catheter care. This resource provides information and videos on the insertion of indwelling and straight catheters, applying a condom catheter, and removing an indwelling catheter.
6. Ostomy Canada Society: Library of ostomy information. This is a resource for individuals and their families living with ostomies. The website contains up-to-date information on ostomy care, research, new items, blogs, events, information about ostomy supplies, support and advocacy groups, healthy living tips, and personal journeys and stories about individuals living with ostomies.

REFERENCES

ATI. (2015a). *Inserting a nasogastic tube.* Retrieved from ATI Nursing Education: Nasogastric intubation. http://www.atitesting.com/ati_next_gen/skillsmodules/content/nasogastric-intubation/viewing/insert-naso-tube.html?id=undefined

ATI. (2015b). *Tracheostomy care*. Retrieved from ATI Nursing Education: Airway management. Retrieved on Aug 24, 2015, from http://www.atitesting.com/ati_next_gen/skillsmodules/content/airway-management/viewing/trach_care.html

ATI. (2015c). *Managing complications*. Retrieved from ATI Nursing Education. Closed chest drainage. Retrieved on Aug 24, 2015, from http://www.atitesting.com/ati_next_gen/skillsmodules/content/closed-chest-drainage/equipment/managing.html

Bauman, M., & Handley, C. (2011). Chest tube care: The more you know, the easier it gets. Retrieved on Aug 26, 2015, from http://www.americannursetoday.com/assets/0/434/436/440/8172/8174/8176/8256/1d298438-82c6-439d-8b2e-77ffaf165fca.pdf

Berman, A., & Snyder S. J. (2016). *Skills in clinical nursing* (8th ed.). New Jersey, New York: Pearson.

British Columbia Institute of Technology (BCIT). (2015a). NURS 1186: Patient care for sonography. Vancouver: BCIT.

British Columbia Institute of Technology (BCIT). (2015b). NURS 2020: Clinical techniques. Vancouver: BCIT.

British Columbia Institute of Technology (BCIT). (2015c). NURS 3020: Clinical techniques. Vancouver: BCIT.

Centers for Disease Control and Prevention. (2015). *Healthcare associated infections*. Retrieved on Aug 26, 2015, from http://www.cdc.gov/HAI/ca_uti/uti.html

Durai, R., Hoque, H., & Davies, T. W. (2010). Managing a chest tube and drainage system. Retrieved on Aug 26, 2015, from http://www.ncbi.nlm.nih.gov/pubmed/20152201

Gogakos, A. et al. (2015). Heimlich valve and pneumothorax. Retrieved on Aug 26, 2015, from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4381465/

Gould, C. V., Umscheid, C. A., Agarwal, R. K., Kuntz, G., Pegues, D. A., & Healthcare Infection Control Practice Advisory Committee. (2009). *Guidelines for Prevention of Catheter Associated Urinary Tract Infections 2009*. Center for Disease Control. Retrieved on Aug 26, 2015 from www.cdc.gov/hicpac/pdf/CAUTI/CAUTIguideline2009final.pdf

Halm, M. A. (2007). To strip or not to strip? Physiological effects of chest tube manipulation. Retrieved on Aug 26, 2015, from http://ajcc.aacnjournals.org/content/16/6/609.full

Halm, M., & Krisko-Hagel, K. (2008). Instilling normal saline with suctioning: Beneficial technique or potentially harmful sacred cow? *American journal of critical care*, 17(5), 469-472.

Morris, L. L., Whitmer, A., & McIntosh, E. (2013). Tracheostomy care and complications in the intensive care unit. Retrieved on Aug 26, 2015, from http://www.aacn.org/wd/Cetests/media/C135.pdf

Ostomy Canada Society. (n.d.). Passing gas with an ostomy. Retrieved on Aug 24, 2015, from http://stolencolon.com/passing-gas-farting-ostomy/

Perry, A. G., Potter, P. A., & Ostendorf, W. R. (2014). *Clinical skills and nursing techniques* (8th ed.). St Louis, MO: Elsevier-Mosby.

Rajan, C. S. (2013). Tube thoracostomy management. Retrieved on Aug 26, 2015, from http://emedicine.medscape.com/article/1503275-overview#a7

Registered Nurses Association of Ontario. (2009). Ostomy care and management. Toronto: Registered Nurses Association of Ontario.

Salmon, N., Lynch, S., & Muck, K. (2013). Chest tube management. Retrieved on Aug 26, 2015, from http://ajcc.aacnjournals.org/content/16/6/609.full

Teleflex Medical Incorporated. (2009). Chest drainage systems. Retrieved on Aug 26, 2015, from http://www.teleflex.com/en/usa/ucd/chest_drainage_systems.php

United Ostomy Association of America. (2011). Ileostomy guide. Retrieved on Aug 24, 2015, from http://www.ostomy.org/uploaded/files/ostomy_info/IleostomyGuide.pdf?direct=1

Vancouver Coastal Health. (2006). *Tracheostomy and endotracheal tubes – suctioning*. Vancouver: Vancouver Coastal Health.

Vancouver Coastal Health. (2012a). *Tracheostomy: Care and management of a patient with a tracheostoma*. Vancouver: Vancouver Coastal Health.

Vancouver Coastal Health. (2012b). *Tracheostomy tubes: Dressing changes and inner cannula cleaning*. Vancouver: Vancouver Coastal Health.

VCH Professional Practice. (2014). *Indwelling urinary catheter: Procedure for insertion and removal (adult)*. Vancouver: Vancouver Coastal Health.

Appendix 1: Glossary

Glossary

- **2 x 2**: Small, commonly used gauze pad measuring 2 inches by 2 inches, or approximately 5 cm x 5 cm.
- **4 x 4**: Medium size, commonly used gauze pad measuring 4 inches by 4 inches, or approximately 10 cm x 10 cm.
- **Absorption atelectasis**: A form of lung collapse that occurs when high concentrations of oxygen displace nitrogen in the alveoli and, as a result, reduce alveolar volume.
- **Additional precautions**: Practices in addition to routine practices for certain pathogens or clinical presentations. These precautions are based on the type of transmission, such as contact, droplet, or airborne.
- **Adverse reaction (**also known as **adverse event**): An undesirable effect of any health product such as prescription and non-prescription pharmaceuticals, vaccines, serums, and blood-derived products, cells, tissues, and organs; disinfectants; and radiopharmaceuticals. An adverse reaction may occur under normal use and conditions of the product.
- **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.
- **Airborne precautions**: Precautions used in addition to routine practices for patients with known or suspected illness that is transmitted by the airborne route.
- **Alcohol-based hand rub (ABHR)**: A liquid, foam, or gel formation of an alcohol-based solution used to reduce the number of microorganisms on the hands when the hands are not visibly soiled. A form of hand hygiene.
- **Ambulation**: Moving from one place to another.
- **Ampule**: A glass container that holds a single dose of medication in liquid form in 1 ml to 10 ml sizes.
- **Antibiotic-resistant organisms (ARO)**: Microorganisms that have developed resistance to the action of various antibiotic agents. Common AROs are MRSA and VRE.
- **Arterial blood gas (ABG)**: Analysis of an arterial blood sample to evaluate the adequacy of ventilation, oxygen delivery to the tissues, and acid-base balance status.
- **Asepsis**: The absence of infectious material (microorganisms) or infection.
- **Aspiration**: The action of pulling back on the plunger of a syringe for 5 to 10 seconds prior to injecting medication.
- **Assistive device**: An object or piece of equipment designed to help a patient with activities of daily living, such as a walker, cane, gait belt, or mechanical lifts.
- **Base of support**: The space between the feet that bears the weight of the body, and the centre of

gravity that falls within the base of support.

- **Blood or body fluid (BBF) exposure**: A splash or puncture exposing you to another person's blood, urine, feces, vomit, or secretions.
- **Body alignment**: The optimal placement of the body parts, working with the pull of gravity to contribute to body balance. Without this balance, the risk of falls and injuries increases.
- **Body balance**: A state of equilibrium achieved by creating a wide **base of support**, the space between the feet that bears the weight of the body, and the centre of gravity that falls within the base of support.
- **Body mechanics**: The coordinated effort of muscles, bones, and the nervous system to maintain balance, posture, and alignment during moving, transferring, and positioning patients.
- **British Columbia Patient Safety and Learning System (BCPSLS)**: A web-based tool used to report and learn about safety events, near misses, and hazards in health care settings.
- **C & S swab**: Swab for culture and sensitivity blood test to determine if a bacterial infection is present in the blood.
- **Capillary refill**: The process whereby blood returns to a portion of the capillary system after its blood supply has been interrupted briefly. For example, depress the nail edge to cause blanching and then release. Colour should return to the nail instantly or in less than three seconds. If it takes longer than three seconds, this suggests decreased peripheral perfusion and may indicate cardiovascular or respiratory dysfunction.
- **Catheter embolism**: Occurs when a small part of the cannula breaks off and flows into the vascular system.
- **Catheter-related blood stream infection (CR-BSI)**: An infection caused by microorganisms that are introduced into the blood through the puncture site, the hub of the needle, or contaminated IV tubing or IV solution, leading to bacteremia or sepsis.
- **Catheter-related thrombosis (CRT)**: The development of a blood clot related to long-term use of CVCs. Mostly occurs in the upper extremities and can lead to further complications such as pulmonary embolism, post thrombotic syndrome, and vascular compromise.
- **Central venous catheter (CVC)** (also known as **central line** or **central venous access device)**: An intravenous catheter that is inserted into a large vein in the central circulation system, where the tip of the catheter terminates in the superior vena cava (SVC).
- **Centre of gravity**: The point at which the mass of a body or object is centred when weight on all sides is equal.
- **Cerebral vascular accident (CVA)**: Also known as a stroke, a CVA is the interruption of blood flow to the brain (i.e., an ischemic stroke) or the rupture of a blood vessel (i.e., a hemorrhagic stroke) causing brain cells in the affected area to die. This event usually results in the loss of some brain function.
- **Chain of infection**: The transmission of microorganisms and subsequent infections is often referred to as the chain of infection. This infectious process can be thought of as a circular chain with six links that represent the specific circumstances needed for the infectious process to occur.
- **Chest tube**: A sterile tube with a number of drainage holes that is inserted into the pleural space. Also known as a thoracic catheter.
- **Chest tube drainage system**: A sterile, disposable system that consists of a compartment system

that has a one-way valve, with one or multiple chambers, to remove air or fluid and prevent return of the air or fluid back into the patient.

- **Clean technique**: *See* medical asepsis.
- ***Clostridium difficile* infection (CDI)**: Infection caused by a bacterium that causes mild to severe intestinal problems and diarrhea. It is the most frequent cause of diarrhea in the hospital setting.
- **Clubbing**: A description of nails, usually presenting in the early stages as being straightened out to 180 degrees, with the nail base feeling spongy. Clubbing occurs with heart disease, emphysema, and chronic bronchitis.
- **Cohorting**: Placing patients with the same infections in the same room if a private room is not available.
- **Colloid solutions**: Solutions made up of large molecules that cannot pass through semi-permeable membranes and are used to expand intravascular volume by drawing fluid from extravascular space via high osmotic pressure. Examples include albumin, dextrans, and hydroxyethyl starches.
- **Colostomy**: The creation of a stoma from part of the colon (large bowel), where the intestine is brought through the abdominal wall and attached to the skin, diverting normal intestinal fecal matter through the stoma instead of the anus.
- **Contact precautions**: Precautions used in addition to routine practice for patients who are known or suspected to be infected with microorganisms that can be transferred by the direct or indirect contact route.
- **Continent ileostomy**: Made from part of the ileum and is flushed a number of times each day to clean out the effluent.
- **Continent urinary reservoir**: Where a pouch is created from part of the intestine, and a catheter is inserted a number of times during the day to remove the urine.
- **Continuous intravenous infusion**: The infusion of a parenteral drug over several hours (continuous drip) to days. It involves adding medication to sterile IV solution (100-1,000 ml bag) and hanging the IV solution as a primary infusion.
- **Crystalloids solutions**: Solutions made up of solutes such as electrolytes or dextrose that are easily mixed and dissolvable in solution. Crystalloids contain small molecules that flow easily across semi-permeable membranes, which allows for transfer from the bloodstream into the cells and tissues.
- **CWMS**: An initialism used to remember "colour, warmth, movement, sensation of extremities."
- **Cyanosis**: A bluish, mottled discoloration that signifies decreased perfusion and indicates that the tissues are not being adequately oxygenated.
- **D50W**: Fifty-percent dextrose in water.
- **D5W**: Five-percent dextrose in water.
- **Dacron cuff**: An antimicrobial cuff surrounding a tunnelled CVC near the entry site, which is coated in antimicrobial solution to help prevent infection and holds the CVC in place.
- **Deep venous thrombosis (DVT)**: The formation of a blood clot within a deep vein, predominantly in the legs.
- **Droplet precautions**: Precautions used in addition to routine practices for patients who are

known or suspected to be infected with microorganisms that are spread by large droplets.

- **Effluent**: The output from the stoma (urine, feces, or mucous).
- **Extension tubing**: Short, 20 cm, flexible sterile tube with a positive fluid displacement/positive pressure cap attached to the hub of the peripheral cannula.
- **Extravasation**: When vesicant solutions (medication) are administered and inadvertently leaked into surrounding tissue, causing damage to surrounding tissue.
- **Fowler's position**: The patient's head of bed is placed at a 45-degree angle. Hips may or may not be flexed. Common position to provide patient comfort and care.
- **Fraction of inspired oxygen (FiO_2)**: Fraction or percentage of oxygen being measured. Natural air includes 20.9% **oxygen**, which is equivalent to FiO2 of 0.21.
- **Gait belt or Transfer belt**: A two-inch-wide (5 mm) belt, with or without handles, that is placed around a patient's waist and fastened with Velcro. A transfer belt can be used with patients who are a one-person pivot transfer, a two-person pivot transfer, or a transfer with a slider board.
- **Gauge of a needle**: The diameter of the needle.
- **Gestational diabetes**: A form of diabetes that develops in women during pregnancy and disappears after delivery. Gestational diabetes affects about 4% of all pregnancies and increases the risk of developing Type 2 diabetes.
- **Hand hygiene**: A general term used to describe any action of hand cleaning. It refers to the removal of soil and oil, and the killing or removal of transient microorganisms from the hands. Hand hygiene may be accomplished using an alcohol-based hand rub or soap and water. Surgical hand scrub is also a method of hand hygiene.
- **Hand hygiene with soap and water**: Hand hygiene using friction, soap, and water to remove microorganisms from hands.
- **Health care associated infection (HAI)**: An infection that develops as a result of contact with a pathogen in the health care setting or from a health care worker, that was not present at the time of admission. Also known as a nosocomial infection.
- **High alert medications**: Medications that are most likely to cause significant harm, even when used as intended. Mistakes may or may not be more common with high alert medications, but the harm to patients is more serious.
- **Hypertonic solution**: An IV solution that has a higher osmolality than plasma (serum), with an osmolality greater than 375 mOsm/L.
- **Hypotonic solution**: A solution that has an osmolality of less than 25 mOsm/L, a lower osmolality than intravascular space.
- **Hypoxemia**: A condition where arterial oxygen tension or partial pressure of oxygen (PaO_2) is below normal (<80 mmHg).
- **Hypoxia**: The reduction of oxygen supply at the tissue level, which is not measured directly by a laboratory value but by pulse oximetry and SpO_2.
- **Hypoxic drive**: A condition found in some patients with a chronically high level of $PaCO_2$, such as those with chronic obstructive pulmonary disease (COPD), where the stimulus and drive to breathe is caused by a decrease in PaO_2, not by an increase of CO_2.
- **Ileal conduit**: See *urostomy*.

- **Ileoanal ostomy**: A pouch created above the anal sphincter and is also created from a portion of the ileum.
- **Ileostomy**: Created from the ileum (small bowel), which is brought through the abdominal wall and used to create a stoma.
- **Implanted central venous catheter (ICVC)**: A CVC inserted into a vessel, body cavity, or organ and attached to a reservoir or "port" located under the skin. The device may be placed in the chest, abdomen, or inner aspect of the forearms. Also known as an implanted venous access device (IVAD), port a catheter, or port a cath.
- **Infection prevention and control (IPAC) practices**: Evidence-based procedures and practices that, when used consistently in a health care setting, can prevent and reduce disease transmission, eliminate sources of potential infections, and prevent the transfer of pathogens from one person to another.
- **Infiltration**: When non-vesicant solutions (IV solutions) are inadvertently administered into surrounding tissue.
- **Injection pens**: A new technology used by patients to self-inject insulin using a syringe, needle, and pre-filled cartridge of insulin.
- **Intradermal (ID) injection**: An injection that places the medication into the dermis, just under the epidermis.
- **Intramuscular (IM) injection**: An injection that places the medication into the body of a muscle.
- **Intravenous (IV) injection**: An injection that places the medication/solution into a vein through an existing IV line or a short venous access device (saline lock). Medications given by the intravenous route can be given as an IV bolus, as an intermittent (piggyback) medication, or in a large-volume continuous infusion.
- **Intravenous therapy**: Treatment that infuses intravenous solutions, medications, blood, or blood products directly into a vein.
- **Isotonic solution**: A solution in which the concentration of the dissolved particles is similar to that of plasma, with an osmolality of 250 to 375 mOsm/L.
- **Keloid formation**: A firm scar-like mass of tissue that occurs at the wound site. The scarring tends to extend past the wound and is darker in appearance.
- **Kussmaul respiration**: Deep, rapid, and laboured breathing that is characteristic of patients with acidosis (excess acidity of tissues).
- **Lateral position**: The patient lies on the side of the body with the top leg over the bottom leg. This position helps relieve pressure on the coccyx.
- **Latex allergy**: A reaction to latex products made from natural rubber in which people become allergic (or sensitive) to the proteins found in natural rubber.
- **Line of gravity**: The vertical line extending from the centre of gravity to the base of support, down the centre of the body. If the line of gravity moves outside the base of support, the amount of energy required to maintain equilibrium is increased.
- **Lumen**: A small, hollow channel within the CVC tube.
- **Mechanical lift**: A hydraulic lift, usually attached to a ceiling, used to move patients who cannot bear weight, who are unpredictable or unreliable, or who have a medical condition that does not allow them to stand or assist with moving.

- **Medical asepsis** (also known as **clean technique**): Includes procedures used for reducing the number of microorganisms and preventing their spread.
- **Medication incident**: Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer.
- **Methicillin-resistant *Staphylococcus aureus* (MRSA)**: A strain of *Staphylococcus aureus* that is resistant to beta-lactam classes of antibiotics such as penicillin, cloxacillin, and cephalosporin.
- **Musculoskeletal injury (MSI)**: An injury or disorder of the muscles, tendons, ligaments, joints or nerves, blood vessels, or related soft tissue including a sprain, strain, or inflammation related to a work injury.
- **Nasogastric (NG) tube**: A flexible plastic tube inserted through the nostrils, down the nasopharynx, and into the stomach or the upper portion of the small intestine.
- **Needles**: Hollow cylindrical objects, made of stainless steel, with a sharp point used to inject medications into or draw fluids from the body. Needles are made up of the hub, shaft, and bevel.
- **No-Interruption Zone (NIZ)**: A place where health care providers can prepare medications without interruptions.
- **Nosocomial infection**: *See* health care associated infection (HAI).
- **Obturator**: A small plastic device used as a guide during tracheostomy tube insertion.
- **Oral suctioning**: The use of a rigid, plastic suction catheter, known as a yankauer, to remove pharyngeal secretions through the mouth.
- **Orthopneic or tripod position**: The patient sits at the side of the bed with head resting on an over-bed table on top of several pillows. This position is used for patients with breathing difficulties.
- **Orthostatic hypotension**: A form of low blood pressure that occurs when changing position from lying down to sitting, making the patient feel dizzy, faint, or lightheaded.
- **Ostomy:** A surgically created opening from the urinary tract or intestines, where effluent (fecal matter, urine, or mucous) is rerouted to the outside of the body using an artificially created opening called a **stoma**.
- **Oxygen therapy**: Treatment to provide oxygen according to target saturation rates (as per physician orders or hospital protocol) in order to achieve normal or near normal oxygenation saturation levels for acute and chronically ill patients.
- **Oxygen toxicity**: A condition caused by excessive or inappropriate supplemental oxygen, which can lead to severe damage to the lungs — ranging from mild tracheobronchitis to diffuse alveolar damage — and other organ systems.
- **Parenteral medications**: Refers to the path by which the medication comes in contact with the body. Medications that enter the body by the parenteral route enter the tissue and circulatory system by injection.
- **$PaCO_2$**: The partial pressure of carbon dioxide in the arterial blood, which is measured by using a $PaCO_2$ analyzer.
- **Percutaneous central venous catheter**: A CVC inserted directly through the skin into the internal or external jugular, subclavian, or femoral vein. The tip of the catheter is located in the superior vena cava (SVC).

- **Peripheral IV (PIV)**: A short intravenous catheter inserted by percutaneous venipuncture into a peripheral vein.
- **Peripherally inserted central catheter (PICC)**: A central line inserted through the antecubital fossa or upper arm (basilic or cephalic vein) and threaded the full length until the tip reaches the superior vena cava (SVC).
- **Personal protective equipment (PPE)**: Clothing or equipment worn to protect against hazards.
- **Phlebitis**: The inflammation of the vein's inner lining, the tunica intima.
- **Pinch-off syndrome**: An internal pinching of a central line between the first rib and clavicle; can contribute to a mechanical occlusion of a CVC.
- **Port a catheter/port a cath**: *See* implanted central venous catheter (ICVC).
- **Primary infusion tubing/administration set**: A thin, flexible plastic sterile tubing used to infuse IV therapy.
- **Primary intention**: A type of wound healing where the wound edges are sutured or stapled closed, and the wound heals quickly with minimal tissue loss. Examples of wounds healing by primary intention are simple surgical wounds that heal without complications.
- **p.r.n.**: From the Latin *pro re nata* and means "as needed."
- **Prone position**: When the patient lies on the stomach with the head turned to the side.
- **Pulmonary edema** (also known as **circulatory overload** or **fluid overload**): A condition caused by excess fluid accumulation in the lungs, due to excessive fluid in the circulatory system.
- **Refeeding syndrome**: Caused by rapid refeeding after a period of under-nutrition, leads to metabolic and hormonal changes characterized by electrolyte shifts (decreased phosphate, magnesium, and potassium in serum levels), which may lead to widespread cellular dysfunction.
- **Routine practices**: A system of prevention and control practices recommended by the Public Agency of Canada to be used for all patients/residents/clients during all care to prevent and control all transmission of microorganisms in all health care settings.
- **Saline lock** (also known as **heparin lock**): A peripheral intravenous cannula with extension tubing attached to the hub, usually inserted in the arm or hand.
- **Secondary intention**: A type of wound healing where the wound is left open to heal by scar formation. Healing is slow, which places the patient at risk for infection, there is a loss of skin, and granulation tissue fills the area left open. Examples of wounds healing by secondary intention include severe lacerations or massive surgical interventions.
- **Secondary tubing administration set**: Flexible, sterile tubing used to hang a secondary IV medication, which connects to an access port on the primary IV tubing.
- **Semi-Fowler's position**: The patient's head of bed is placed at a 30-degree angle. This position is used for patients who have cardiac or respiratory conditions, and for patients with a nasogastric tube.
- **Sims position**: Patient lies between supine and prone with legs flexed in front of the patient. Arms should be comfortably placed beside the patient, not underneath.
- **Slider board or Transfer board**: Board used to transfer immobile patients from one surface to another surface while the patient lies supine. The board allows health care providers to move immobile, bariatric, or complex patients in a safe manner.

- **Speed shock**: A systemic reaction caused by the rapid injection of a medication into the circulatory system, resulting in toxic levels of medication in the plasma.
- **Sterile asepsis**: *See* sterile technique.
- **Sterile field**: A sterile surface on which to place sterile equipment that is considered free from microorganisms.
- **Sterile gloves**: Gloves that are free from all microorganisms; required for contact with any invasive procedure and when contact with any sterile site, tissue, or body cavity is expected.
- **Sterile technique** (also known as **sterile asepsis**): A set of specific practices and procedures performed to make equipment and areas free from all microorganisms and to maintain that sterility.
- **Stoma:** See *ostomy*.
- **Subcutaneous (SC) injection**: An injection that places medication/solution into the loose connective tissues just under the dermis.
- **Supine position**: In this position, patients lie flat on their back. Additional supportive devices may be added for comfort.
- **Surgical asepsis**: The absence of all microorganisms within any type of invasive procedure.
- **Surgical hand scrub**: An antiseptic surgical scrub or antiseptic hand rub performed prior to donning surgical attire.
- **Surgical site infection (SSI)**: An infection that occurs after surgery in the area of surgery.
- **Syringe**: A sterile, single-use device with a Luer lock or non-Luer lock tip, which influences the name of the syringe. Syringes come in various sizes from 0.5 ml to 60 ml.
- **Tertiary intention**: A type of wound healing where the wound closing is intentionally delayed. On occasion, wounds are left open (covered by a sterile dressing) to allow an infection or inflammation to subside. Once the wound is closed with staples or sutures, the scarring is minimal.
- **Total parenteral nutrition (TPN)**: The infusion of nutrients, including amino acids, vitamins, electrolytes, dextrose, fat, and trace elements. It is most commonly administered through a central venous catheter.
- **Transfers**: Moving a patient from one flat surface to another, such as from a bed to a stretcher.
- **Transfusion medical services (TMS)**: Blood bank.
- **Trendelenburg position**: A position that places the head of the bed lower than the feet. Used in situations such as hypotension and medical emergencies. Helps promote venous return to major organs such as the head and heart.
- **Tunnelled central venous catheter**: A long-term CVC with a proximal end tunnelled subcutaneously from the insertion site and brought out through the skin at an exit site. It is a surgical procedure, where the catheter is tunnelled subcutaneously under the skin in the chest area before it enters the superior vena cava (SVC).
- **Type 1 diabetes**: A condition that usually develops in childhood or adolescence, and used to be called juvenile-onset diabetes. It occurs when the beta cells of the pancreas are destroyed by the immune system and no longer produce insulin, or produce very little insulin.
- **Type 2 diabetes**: A condition that used to be called non-insulin-dependent diabetes or adult-onset

diabetes. With Type 2 diabetes, the body does not make enough insulin or does not respond well to the insulin it makes.

- **Urostomy** or **ileal conduit**: A stoma created using a piece of the intestine to divert urine to the outside of the body.
- **Vancomycin-resistant *Enterococci* (VRE)**: Strains of *Enterococcus faecium* or *Enterococcus faecalis* that are resistant to antibiotics. A type of ARO.
- **Vertigo**: A sensation of dizziness.
- **Vial**: A single- or multi-dose plastic container with a rubber seal top, covered by a metal or plastic cap.
- **Volume-controlled intermittent set**: A small device attached below the primary infusion to regulate the mini bag. The medication is added to a small amount of IV solution and administered through an IV line.
- **Workaround**: A process that bypasses a procedure, policy, or problem in a system. For example, nurses may "borrow" a medication from another patient while waiting for an order to be filled by the pharmacy.
- **Wound dehiscence**: A mechanical failure of wound healing; remains a problem and can be affected by multiple factors.
- **Z-Track method**: A method of administrating an intramuscular injection that prevents the tracking of the medication through the subcutaneous tissue and seals the medication in the muscle, minimizing irritation from the medication.

Appendix 2: Checklists Summary

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

Chapter 8

Chapter 9

Chapter 10

Appendix 3: Videos Summary

Chapter 1

- Video 1.1: Donning and Doffing PPE
- Video 1.2: Principles of Asepsis
- Video 1.3: Applying Sterile Gloves

Chapter 2

- Video 2.1: Assessing Range of Motion and Strength
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Chapter 3

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Chapter 4

- Video 4.1: Simple Sterile Dressing Change
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- Video 7.7: Landmarking— Vastus Lateralus Administering IM Injection—Using Z-track
- Video 7.8: Insertion of an Indwelling Subcutaneous Device aka ‘subcutaneous butterfly’
- Video 7.9: Administering Medications: Direct IV – Into an IV with an Infusion (PVAD short)
- Video 7.10: Administering Medications: Direct IV – Into a Locked IV (PVAD short)

Chapter 8

- Video 8.1: Priming IV Lines
- Video 8.2: Changing IV bags
- Video 8.3: PVAD – short Flush (aka saline lock flush)
- Video 8.4: Converting an IV to a saline lock – Extension Present
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- Video 8.6: Removing a PVAD-Short Cannula
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- Video 8.8: CVAD Care and Maintenance—Lumens without Valves
- Video 8.9: Blood draw through a CVAD
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Chapter 10

- Video 10.1: Nasogastric tube insertion
- Video 10.2: Urinary Catheterization (Male)
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- Video 10.6: Tracheostomy Suctioning – Closed in line Method
- Video 10.7: Replacing and Cleaning an Inner Tracheal Cannula
- Video 10.8: Changing a Trachestomy Site Dressing
- Video 10.9: Changing Tracheostomy Ties
- Video 10.10: Chest tube care & maintenance
- Video 10.11: Dry suction chest drainage system

About the Authors

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Glynda Rees Doyle teaches at the British Columbia Institute of Technology (BCIT) in Vancouver, British Columbia. She completed her MSN at the University of British Columbia with a focus on education and health informatics, and her BSN at the University of Cape Town in South Africa. Glynda has many years of national and international clinical experience in critical care units in South Africa, the UK, and the USA. Her teaching background has focused on clinical education, problem-based learning, clinical techniques, and pharmacology.

Glynda is involved in several interprofessional research projects within BCIT and also in collaboration with other Canadian nursing schools, studying the impact of mobile devices laden with clinical resources, social networks, and e-portfolios on nursing students and their education. Her interests include the integration of health informatics in undergraduate education, and the impact of educational technologies on nursing students' clinical judgment and decision making at the point of care to improve patient safety and quality of care.

Glynda currently sits on the Research Ethics Board at BCIT, is a digital health peer leader for the Canadian Association of Schools of Nursing and Canada Health Infoway, the communications director for the Canadian Nursing Informatics Association, and a member of the American Medical Informatics Association's Education and Nursing Informatics Working Groups.

JODIE ANITA MCCUTCHEON

Jodie McCutcheon teaches in the undergraduate BSN program at the British Columbia Institute of Technology (BCIT). She is currently the nursing lab coordinator for the BSN program. She completed her BSN at the University of Victoria and came to BCIT to teach with experience in medical, geriatric, and cardiac nursing, as well as leadership experience as a nurse educator and clinical coordinator at VGH. She completed her MSN at the University of British Columbia with a focus on clinical education and online learning.

Jodie chose to become an educator because she wanted to impact the future of nursing by preparing individuals to practise safely and effectively in a complex health care environment. Jodie has many years of teaching experience in problem-based learning, skill acquisition, and course development for the nursing program and allied health care programs at BCIT. Her interests include lab education and simulation as effective teaching strategies to promote learning. Jodie is involved in many Interprofessional Education (IPE) projects at BCIT. Her primary passion in nursing education is the promotion of patient safety and quality initiatives and teaching strategies in the School of Health Sciences at BCIT. She is the co-chair of the patient safety and quality committee in the BSN program and has brought various safety initiatives to BCIT, including Change Day and Canadian Patient Safety Week. Jodie is a member of the BC Lab Educators committee, Western and Northern Region Canadian Association of Schools of Nursing, and the International Nursing Association for Clinical Simulation and Learning.

Versioning History

This page provides a record of edits and changes made to this book since its initial publication. Whenever edits or updates are made in the text, we provide a record and description of those changes here. If the change is minor, the version number increases by 0.01. If the edits involve substantial updates, the version number increases to the next full number

The files posted by this book always reflect the most recent version. If you find an error in this book, please fill out the Report an Error form.

Version	Date	Change	Details
1.00	November 24, 2015	Book published.	
1.01	May 16, 2018	Several broken video links were removed and replaced with text suggesting the student watch a video or demonstration for the cited skill.	
1.02	November 16, 2018	Made correction to section 7.4.	Replaced “NEVER give an IM injection in the dorsogluteal muscle. If a needle hits the sciatic nerve, the patient may experience partial or permanent paralysis of the leg.” with “The dorsogluteal site should be avoided for intramuscular injections. If a needle hits the sciatic nerve, the patient may experience partial or permanent paralysis of the leg.”

Version	Date	Change	Details
1.03	December 14, 2018	Made correction to section 6.4 and set table widths to 100%.	Replaced “The rectal route (see Figure 6.1) is not as reliable in absorption and distribution as oral and parenteral routes. The rectal route is, however, relatively safe because there is less potential for adverse effects (Perry et al., 2014).” with “Drugs administered PR have a faster action than via the oral route and a higher bio-availability – that is, the amount of effective drug that is available is greater as it has not been influenced by upper gastrointestinal tract digestive processes. Rectal absorption results in more of the drug reaching the systemic circulation with less alteration on route. As well as being a more effective route for delivering medication, rectal administration also reduces side-effects of some drugs, such as gastric irritation, nausea and vomiting” (Lowry, 2016, para 2).” Pages numbers in PDF will change.
1.04	June 5, 2019	Updated the book’s theme	The styles of this book have been updated, which may affect the page numbers of the PDF and print copy.

Version	Date	Change	Details
1.05	October 9, 2020	Added replacement videos to body and appendix of book.	Links to openly licensed videos created by TRU were added throughout this book. A summary of these videos are listed in the newly created Appendix 3.
1.06	April 16 and May 5, 2021	Added remaining TRU videos body and appendix of book.	A summary of these videos are listed in the newly created Appendix 3.
1.07	May 20, 2021	Updated metadata and front/back matter. Updated theme and styles.	• Added ISBNs • Changed theme to “Clarke” • Changed “About this Book” to “About BCcampus Open Education” and replaced content
1.08	October 15, 2021	Error correction.	Corrected mislabeling of dorsiflexion and plantarflexion images in 2.5 Head-to-Toe Assessment and 2.7 Focused Assessments.
1.09	September 23, 2022	Wording change.	Replaced “health care provider” with “health care team member” in 4.4 Suture Removal to better indicate the range of people who are able to remove sutures.