Clinical Practice Article

Tiny Lines, Big Responsibility: Safe Infusion Care for Our Smallest Patients

Nursing Care of Infusion Lines in Neonatal and Pediatric Intensive Care

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ABSTRACT

Infusion therapy is an essential component of care for critically ill neonates and children. In the NICU, vascular access may be required for intravenous fluids, parenteral nutrition, antibiotics, vasoactive medications, blood products, and other therapies. Common devices include peripheral intravenous catheters (PIVCs), peripherally inserted central catheters (PICCs), and umbilical venous or arterial catheters.[1] For a neonate, however, an infusion line is much more than a route for delivering medication. It is an invasive device connected directly to a fragile vascular system, and inappropriate insertion, handling, or maintenance can result in infiltration, extravasation, occlusion, thrombosis, tissue injury, or bloodstream infection.[1,2] The Centers for Disease Control and Prevention (CDC) recommends that NICU central-line care be approached through standardized insertion and maintenance practices, including care bundles, minimizing unnecessary hub access, and removing central lines as soon as they are no longer required. The 2026 WHO guideline on central venous catheters similarly emphasizes hand hygiene, aseptic technique, education and training, care bundles, maintenance, appropriate access, and timely removal.[3] *For nurses, therefore, safe infusion-line care is a continuous process rather than a single procedure.*

Keywords:
Infusion therapy, Vascular access, Neonatal intensive care unit (NICU); Catheter-associated bloodstream infections; Central line care bundles.

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Introduction: Understanding the Vulnerability of the Neonate

Neonates, particularly preterm infants, have very small veins, immature skin, limited subcutaneous tissue, and a reduced ability to communicate pain or discomfort. A complication that might be recognized easily in an adult can develop silently in a neonate.[1]

The nurse therefore plays a central role in:

- Maintaining line patency
- Preventing infection
- Detecting infiltration and extravasation early
- Monitoring the infusion and prescribed rate
- Maintaining securement
- Assessing the insertion site
- Minimizing unnecessary line manipulation
- Ensuring timely removal when the line is no longer required

Hand Hygiene: The First Line of Protection

Hand hygiene is fundamental to preventing transmission of microorganisms during infusion-line care.[3,4]

The WHO recommends hand hygiene at the five key moments of care, including before touching the patient, before a clean/aseptic procedure, after body-fluid exposure, after touching the patient, and after touching the patient's surroundings.

For NICU nurses, this becomes particularly important before:

- Handling an IV catheter or infusion line
- Accessing a catheter hub
- Changing an infusion
- Administering medication

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- Changing a dressing
- Performing line-related procedures

Gloves should never be considered a substitute for hand hygiene.

Know the Line Before You Handle the Line

Every nurse caring for a neonate should know:

- Type of vascular access
- Insertion site
- Date of insertion
- Indication for the line
- Infusion currently running
- Prescribed rate
- Compatibility of medications/fluids
- Condition of the insertion site
- Securement method
- Whether the line remains clinically necessary

The CDC recommends selecting the type of central line according to the clinical needs of the neonate and considering the fewest number of lumens necessary for care.[1]

A simple question during every shift should be:

"*Does this baby still need this line?"* If the answer is no, timely removal should be considered.[1,2]

Continuous Assessment of the Infusion Site

One of the most important nursing responsibilities is frequent assessment of the vascular access site.[2,5]

For peripheral IV devices, nurses should look for:

- Swelling
- Redness
- Pallor
- Blanching
- Coolness
- Leakage
- Discharge
- Tenderness or signs of discomfort
- Changes in infusion flow
- Resistance during administration
- Skin discoloration

Pediatric guidance recommends particularly frequent assessment in critical-care settings, including NICU, with at least hourly assessment of peripheral IV sites in the referenced guideline.[2]

The frequency should always follow the patient's condition, medication risk, institutional policy, and device type.

Never rely only on the infusion pump. A pump may continue to deliver fluid while the medication is entering tissue rather than the vein.[2]

Early Recognition of Infiltration and Extravasation

Infiltration and extravasation are among the most important complications nurses must recognize early.[2]

Infiltration refers to leakage of a non-vesicant solution into surrounding tissue.

Extravasation refers to leakage of a vesicant or irritant medication into surrounding tissue and can cause significant tissue injury.[2]

In neonates, early recognition is particularly important because tissue damage can progress rapidly and the clinical signs may initially be subtle.[2]

If infiltration or extravasation is suspected, the nurse should:

1. Stop the infusion immediately.
2. Assess the site and the patient's condition.
3. Follow the institution's extravasation protocol.
4. Avoid flushing the affected line unless specifically directed by the applicable protocol.
5. Notify the responsible clinician promptly.
6. Document the event, assessment, medication/solution involved, and interventions.
7. Continue appropriate monitoring of the affected limb/site.

Management should be guided by the specific medication or solution involved and the hospital's approved neonatal/pediatric extravasation protocol.[2,5]

Infection Prevention and Hub Care

Central-line-associated bloodstream infection (CLABSI) is a serious concern in NICU patients.[1]

CDC recommendations emphasize minimizing the number of times central-line hubs are accessed and minimizing blood sampling through central lines when clinically possible.[1]

Therefore, nurses should:

- Perform hand hygiene before line handling.
- Maintain aseptic technique during line access.
- Avoid unnecessary disconnections.
- Minimize unnecessary hub manipulation.
- Use appropriate disinfection procedures according to institutional policy and the device/manufacturer's instructions.
- Maintain a closed infusion system whenever possible.
- Inspect the line and connections regularly.
- Keep the dressing clean, dry, secure, and intact.

A line-access bundle can help standardize these practices across the NICU.[1,3]

Special Consideration for Neonatal Skin

Neonatal skin is immature and particularly vulnerable to injury from adhesives, antiseptics, dressings, and repeated manipulation.[1]

Skin antisepsis must therefore be selected carefully.

The CDC's current NICU recommendations state that alcohol-containing chlorhexidine may be considered when benefits outweigh risks, but gestational age, chronological age, and skin maturity should be considered because chlorhexidine is not appropriate for every neonate.[1]

Similarly, chlorhexidine-impregnated dressings are not recommended for premature neonates because of the risk of serious skin reactions.[6]

Therefore:

"The safest antiseptic or dressing for an adult is not automatically the safest choice for a premature neonate."

NICU protocols should specify age-, gestation-, and skin-maturity-appropriate products.

Securement Without Causing Harm

A well-secured line should remain stable while allowing the nurse to observe the insertion site.

For pediatric peripheral IVs, the catheter should be secured in a way that maintains visibility of the site and avoids excessive pressure or restriction. Pediatric guidance also emphasizes documentation of the device, insertion site, difficulties, maintenance, and removal plan.[5]

Nurses should regularly check for:

- Loose dressing
- Tension on tubing
- Kinking
- Disconnection
- Pressure from fixation devices
- Limb restriction
- Hidden insertion sites

A secure line should never become a hidden line.

Safe Infusion Administration

Before administering any medication or changing an infusion, the nurse should verify:

- Correct patient
- Correct medication/solution
- Correct dose
- Correct concentration
- Correct route
- Correct rate
- Correct line
- Compatibility
- Expiry and integrity of the solution
- Pump settings, where applicable

In neonates, even small errors in volume or rate can have significant consequences because medication doses and fluid requirements are frequently weight-based.

Independent double-checking should be used according to institutional policy for high-alert medications and other designated high-risk infusions.

Central Lines: PICC and Umbilical Catheters

Central lines require meticulous maintenance because they provide direct access to the central circulation.[3,7]

For NICU patients, CDC recommends that umbilical and PICC lines be removed as soon as they are no longer needed. The 2024 CDC NICU guideline also recommends considering removal of umbilical catheters by or before approximately seven days when clinically appropriate, while recognizing that individual clinical needs must guide decisions.[1]

The nurse should therefore participate actively in daily evaluation of line necessity.

Daily question: *"Can this line be safely removed today?"*

If prolonged central access is still required, the team should consider the most appropriate alternative based on the baby's clinical needs.

Documentation: If It Is Not Documented, It Is Difficult to Track

Every infusion-line assessment should be documented according to institutional policy.

Documentation should include, as applicable:

- Type of device
- Site
- Condition of insertion site
- Dressing condition
- Infusion/medication
- Rate
- Patency
- Complications
- Interventions
- Patient response
- Continued need for the line

Pediatric guidance recommends documenting site assessment and complications as well as infusion volume and rate.[2]

Good documentation creates continuity between nurses and helps identify trends before a complication becomes serious.

Family-Centered Care

Parents are an important part of neonatal care.

Where appropriate, nurses should explain:

- Why the baby requires an IV or central line
- Why the line must be protected
- Why parents should not touch or manipulate the line
- Signs of swelling, leakage, redness, or other changes
- When they should immediately inform the nurse

Parents should feel comfortable asking questions and reporting anything they notice.[2]

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A Practical NICU Infusion-Line Safety Checklist

Before touching the line

- ☐ Perform hand hygiene
- ☐ Identify the baby
- ☐ Check the prescribed infusion
- ☐ Assess the line and insertion site

During line care

- ☐ Maintain aseptic technique
- ☐ Minimize unnecessary manipulation
- ☐ Check connections and tubing
- ☐ Verify medication and infusion rate
- ☐ Observe the site continuously when appropriate

After line care

- ☐ Reassess the site
- ☐ Ensure securement
- ☐ Confirm correct infusion rate
- ☐ Document assessment and intervention

At every shift

- ☐ Is the line still required?
- ☐ Is the dressing intact?
- ☐ Is there any sign of infection?
- ☐ Is there infiltration/extravasation?
- ☐ Is the line functioning appropriately?
- ☐ Is there a plan for removal?

Conclusion

Infusion-line care in the NICU requires much more than technical competence. It requires *vigilance, knowledge, consistency, communication, and a strong culture of safety*.

For the smallest and most vulnerable patients, every connection, every dressing, every medication administration, and every assessment matters.

The nurse is often the first person to recognize that something is changing—perhaps a subtle swelling, a change in skin color, an altered infusion rate, or a change in the baby's behavior.

That early recognition can prevent a minor problem from becoming a major complication.

Ultimately, excellent infusion-line care is about protecting the baby while delivering the therapy the baby needs.

"Every line is a lifeline—but only when it is cared for safely."

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