

The Role of Pharmacists and Nurses in Enhancing Safety During Ultrasound-Guided Vascular Access

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Abstract

Ultrasound-guided vascular access (UGVA) has become the preferred technique for peripheral and central venous catheter insertion due to its superior success rates and lower complication rates compared with landmark-guided techniques. While physicians and sonographers are primarily responsible for ultrasound-guided catheter placement, pharmacists and nurses play indispensable roles in ensuring patient safety before, during, and after the procedure. Nurses contribute through patient assessment, preparation, aseptic technique, monitoring, and catheter maintenance, whereas pharmacists optimize medication therapy, evaluate anticoagulation status, recommend appropriate vascular access devices, prevent medication-related complications, and participate in infection prevention initiatives. Interprofessional collaboration among pharmacists, nurses, physicians, and ultrasound professionals significantly reduces catheter-related bloodstream infections (CRBSIs), thrombosis, bleeding complications, and medication errors. This paper reviews the multidisciplinary contributions of pharmacists and nurses in enhancing safety during ultrasound-guided vascular access and highlights evidence-based strategies for improving clinical outcomes.

Keywords: Ultrasound-guided vascular access, Clinical pharmacy, Nursing, Patient safety, Catheter-related bloodstream infection, Medication safety, Interprofessional collaboration

How to cite this article: Asiri MH, Asiri WA, Asiri AA, Al Twaim Z, Almutairi S, Alotaibi A, Alshahrani BYA. The Role of Pharmacists and Nurses in Enhancing Safety During Ultrasound-Guided Vascular Access. *Int J Drug Deliv Technol.* 2026;16(71s): 734-738. DOI: 10.25258/ijddt.16.71s.88

1. Introduction

Vascular access procedures are among the most frequently performed interventions in healthcare. Millions of peripheral intravenous catheters (PIVCs), central venous catheters (CVCs), midline catheters, and peripherally inserted central catheters (PICCs) are inserted annually worldwide for medication administration, fluid therapy, blood sampling, and hemodynamic monitoring. Traditional landmark-guided techniques are associated with complications including:

- Multiple insertion attempts
- Arterial puncture
- Pneumothorax
- Hematoma
- Catheter malposition

- Catheter-related bloodstream infections
- Venous thrombosis

The introduction of real-time ultrasound guidance has transformed vascular access by allowing direct visualization of vessels, surrounding anatomy, and needle advancement. International organizations such as the Infusion Nurses Society (INS), Centers for Disease Control and Prevention (CDC), and Society of Hospital Medicine recommend ultrasound guidance for many vascular access procedures because it significantly improves first-pass success while reducing complications. However, technology alone cannot ensure patient safety. Successful ultrasound-guided vascular access depends on coordinated multidisciplinary care involving physicians,

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nurses, pharmacists, infection prevention teams, and sonographers.

2. Ultrasound-Guided Vascular Access

Ultrasound guidance allows clinicians to visualize:

- Vein diameter
- Vessel depth
- Vessel patency
- Thrombus formation
- Adjacent arteries
- Nerves
- Needle trajectory

Advantages include:

- Higher first-attempt success
- Reduced procedure time
- Fewer insertion attempts
- Lower complication rates
- Reduced patient discomfort
- Improved catheter longevity

These advantages are especially important in critically ill patients, pediatric patients, oncology patients, obese individuals, and patients with difficult intravenous access.

3. Nursing Responsibilities Before Vascular Access

Nurses perform comprehensive patient assessments before catheter insertion.

Assessment includes:

- Previous vascular access history
- Difficult intravenous access assessment
- Allergy history
- Skin integrity evaluation
- Infection screening
- Current medications
- Bleeding risk
- Renal function
- Patient education

Patient education decreases anxiety while improving procedural cooperation.

Nurses also verify:

- Correct patient identification
- Procedure consent
- Appropriate catheter selection
- Sterile equipment availability
- Ultrasound machine preparation

4. Nursing Role During Ultrasound-Guided Procedures

Nurses are central to procedural safety.

Responsibilities include:

Maintaining aseptic technique

Strict sterile precautions include:

- Hand hygiene
- Sterile gloves
- Sterile probe cover

- Sterile ultrasound gel
- Chlorhexidine skin antisepsis
- Maximal sterile barrier precautions for central lines

Monitoring patient status

Continuous monitoring includes:

- Blood pressure
- Heart rate
- Oxygen saturation
- Pain level
- Anxiety
- Vasovagal reactions

Supporting successful cannulation

Nurses assist by:

- Positioning the patient
- Preparing equipment
- Maintaining sterile fields
- Documenting procedure details
- Securing the catheter

5. Nursing Responsibilities After Catheter Placement

Post-procedure nursing care includes:

- Dressing application
- Catheter stabilization
- Flush verification
- Monitoring insertion site
- Infection surveillance
- Patient education
- Documentation

Routine catheter assessment minimizes complications such as infiltration, occlusion, thrombosis, and catheter-related infections.

6. Clinical Pharmacist Contributions

Clinical pharmacists increasingly participate in vascular access teams.

Their responsibilities extend beyond medication dispensing to include comprehensive medication management.

Major responsibilities include:

Medication reconciliation

Pharmacists verify:

- Current medications
- Drug allergies
- Drug interactions
- High-risk medications

Anticoagulation assessment

Before catheter insertion pharmacists evaluate:

- Warfarin
- Direct oral anticoagulants
- Low-molecular-weight heparins
- Antiplatelet agents

Recommendations regarding temporary interruption or continuation of therapy reduce bleeding risk.

Medication compatibility

Pharmacists assess compatibility for:

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- Multiple intravenous drugs
- Total parenteral nutrition
- Vesicants
- Chemotherapy
- Continuous infusions

They recommend the most appropriate vascular access device based on medication characteristics.

7. Prevention of Medication-Related Complications

Pharmacists reduce complications through:

- Appropriate dilution
- Infusion rate optimization
- Extravasation prevention
- Therapeutic drug monitoring
- Identification of vesicants
- Monitoring nephrotoxic medications
- Prevention of catheter occlusion

Examples include:

- Artificial intelligence-assisted vein detection
- Needle tracking systems
- Three-dimensional ultrasound
- Smart infusion pumps
- Electronic vascular access records
- Clinical decision support systems
- Automated catheter selection software

Future integration of artificial intelligence may further enhance multidisciplinary decision-making.

Table 1. Collaborative Roles of Pharmacists and Nurses in Ultrasound-Guided Vascular Access Safety

8. Infection Prevention Through Interprofessional Collaboration Catheter-related bloodstream infections remain among the most preventable hospital-acquired infections. Both pharmacists and nurses contribute to infection prevention. Nurses: • Maintain sterile dressings • Inspect insertion sites • Perform daily catheter care • Remove unnecessary catheters Pharmacists: • Promote antimicrobial stewardship • Optimize antibiotic therapy • Review antimicrobial lock therapy • Participate in infection surveillance • Educate staff regarding antiseptic products Collaborative infection prevention programs have demonstrated substantial reductions in CRBSIs. 9. Team Communication and Safety Culture Safe vascular access requires structured communication. Strategies include: • Daily multidisciplinary rounds • Standardized insertion checklists • Closed-loop communication • Electronic documentation • Shared clinical protocols Effective communication reduces procedural errors while improving patient outcomes. 10. Emerging Technologies Recent innovations continue improving vascular access safety.	Ph a s e	Nursing Respon sibilities	Pharmacis t Responsibi lities	Patie nt Safet y Outco mes
P re - p o c e d u re		Patient assessm ent, educatio n, equipme nt preparat ion, vein assessm ent	Medication reconciliati on, anticoagula nt review, allergy verification , vascular access recommen dations	Reduc ed bleedi ng risk, impro ved patien t readin ess
D u ri n g p r o c e d u re		Sterile techniqu e, patient monitori ng, docume ntation, catheter stabiliza tion	Medication consultatio n, compatibili ty review, emergency medication support	Reduc ed proce dural compl icatio ns and medic ation errors
P o s t - p r o c e d u re		Dressin g care, catheter mainten ance, infectio n	Infusion monitoring, antimicrobi al stewardshi p, adverse drug monitoring	Lower infecti on rates and impro ved cathet er

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P h a s e	Nursing Responsibilities	Pharmacist Responsibilities	Patient Safety Outcomes
duration	patient education		longevity
Long-term outcome	Daily catheter assessment, early complication detection	Therapy optimization, medication safety monitoring	Reduced catheter failure and improved clinical outcomes

8. Encourage continuous quality improvement programs.

13. Conclusion

Ultrasound-guided vascular access has significantly improved the safety and effectiveness of vascular catheter insertion. However, optimal patient outcomes rely not only on ultrasound technology but also on coordinated multidisciplinary care. Nurses ensure procedural excellence through comprehensive assessment, aseptic practice, vigilant monitoring, and catheter maintenance, while pharmacists enhance medication safety by optimizing pharmacotherapy, evaluating anticoagulation, preventing drug-related complications, and supporting infection prevention efforts. Their collaborative approach reduces procedural complications, catheter-related bloodstream infections, medication errors, and healthcare costs while improving patient satisfaction and quality of care. Future advances in artificial intelligence, clinical decision support, and multidisciplinary vascular access programs will further strengthen patient safety and healthcare quality.

11. Challenges

Despite technological advances, several barriers remain:

- Limited pharmacist participation in vascular access teams
- Variable ultrasound competency among clinicians
- Inadequate continuing education
- Time constraints
- Resource limitations
- Lack of standardized protocols
- Inconsistent interdisciplinary communication

Addressing these barriers requires institutional commitment and ongoing professional education.

12. Recommendations

Healthcare organizations should:

1. Establish multidisciplinary vascular access teams.
2. Expand pharmacist participation in vascular access decision-making.
3. Provide competency-based ultrasound training for nurses.
4. Standardize evidence-based insertion and maintenance bundles.
5. Integrate electronic decision support systems.
6. Conduct routine audits of vascular access outcomes.
7. Promote antimicrobial stewardship initiatives.

References

1. Gorski LA, Hadaway L, Hagle ME, et al. *Infusion Therapy Standards of Practice*. Journal of Infusion Nursing. 2024;47(Suppl 1):S1–S285.
2. O’Grady NP, Alexander M, Burns LA, et al. Guidelines for the Prevention of Intravascular Catheter-Related Infections. *Clinical Infectious Diseases*. 2011;52(9):e162–e193.
3. Kornbau C, Lee KC, Hughes GD, Firstenberg MS. Central Line Complications. *International Journal of Critical Illness and Injury Science*. 2015;5(3):170–178.
4. Lamperti M, Bodenham AR, Pittiruti M, et al. International evidence-based recommendations on ultrasound-guided vascular access. *Intensive Care Medicine*. 2020;46(6):1107–1119.
5. Chopra V, Flanders SA, Saint S, et al. The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC). *Annals of Internal Medicine*. 2015;163(6 Suppl):S1–S40.
6. Centers for Disease Control and Prevention (CDC). *Guidelines for the Prevention of Intravascular Catheter-Related Infections*. Updated guidance.
7. Infusion Nurses Society (INS). *Infusion Therapy Standards of Practice*. 2024 Edition.

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8. World Health Organization. *WHO Guidelines on Hand Hygiene in Health Care*. 2009.
9. Marschall J, Mermel LA, Fakih M, et al. Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals. *Infection Control & Hospital Epidemiology*. 2022.
10. Alexandrou E, Ray-Barruel G, Carr PJ, et al. International clinical practice guideline for peripheral intravenous catheter insertion and management. *Journal of Hospital Medicine*. 2023.