

Difficult IV Access (DIVA)

Strategies and Solutions for Insertion Success

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POSITION PAPER

The purpose of this position paper is to articulate the clinical significance of DIVA, examine its implications in inpatient care, and propose a standardized, evidence-based framework for early identification and effective management.



*Protect Patients
Educate Clinicians
Save Lines*

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INTRODUCTION

Peripheral intravenous catheter (PIVC) insertion is among the most commonly performed invasive procedures in hospitalized patients, with global estimates indicating approximately two billion catheters used annually.^{1,2} PIVCs are integral to patient management, serving as essential conduits for the administration of intravenous (IV) fluids, medications, blood products, and diagnostic agents.^{3,4} The successful placement of a PIVC is therefore foundational to the delivery of timely and effective care across a broad spectrum of clinical settings, including emergency and inpatient environments.⁵

In acutely or critically ill patients, rapid IV access is critical for initiating diagnostic and therapeutic interventions.⁶ However, in certain populations, achieving IV access can be particularly challenging, potentially resulting in delays that compromise patient safety and clinical outcomes.^{6,7}

Difficult intravenous access (DIVA) is typically defined as two or more failed attempts to insert a PIVC using traditional techniques, in conjunction with a patient assessment indicating non-visible or non-palpable veins and a previous history of difficult access.⁸ DIVA may present acutely due to sudden illness or may reflect a chronic condition linked to underlying comorbidities.⁹ Risk factors commonly associated with DIVA include non-palpable or non-visible veins, body mass index (BMI) >30, a history of DIVA, and a history of IV drug use (IVDU).⁸ Despite the frequency of DIVA encounters, a standardized and universally accepted assessment tool for identifying DIVA remains absent from routine clinical practice.

Comprehensive PIVC education and training programs, paired with early recognition and management of DIVA are essential to minimizing repeated insertion attempts, preventing complications such as venous depletion, and enhancing the overall patient experience.^{10, 11} Each unsuccessful attempt can compromise future access sites and prolong care. Clinicians must therefore be equipped to identify at-risk patients prior to the initial cannulation attempt.⁸ Evidence supports that early identification of DIVA, combined with vein visualization technology and the use of longer IV catheters can significantly improve first-attempt success rates.¹²

The purpose of this position paper is to articulate the clinical significance of DIVA, examine its implications in inpatient care, and propose a standardized, evidence-based framework for early identification and effective management.

AVA encourages the use of evidence-based guidelines, staff education and competency.



BACKGROUND & PROBLEM

Peripheral intravenous catheters (PIVCs) are required in up to 75% of patients presenting to emergency departments (EDs) and in approximately 90% of hospitalized patients.^{11,13} National hospital data from the United States indicate that patients undergo an average of 9.4 PIVC insertions per admission due to the need for multiple restarts due to failure.¹⁴ In contrast, more focused, institution-level studies reported lower rates, ranging from 1.7 to 2.8 PIVC insertions per admission, however, they did not track comprehensive PIV care throughout admission.^{15,16} Despite the ubiquity of this procedure, first-attempt success rates can be as low as 56.2%, resulting in significant patient discomfort, increased anxiety, and inefficient use of healthcare resources.^{8,17} Repeated failed attempts not only delay care but also contribute to vessel trauma, venous depletion, and higher healthcare costs.^{18,19}

An observational cost-utilization study involving 1,512 patients demonstrated that more than five insertion attempts were associated with a sevenfold increase in costs compared to a single successful attempt.¹⁹ Similarly, a formal cost analysis conducted in an ED with 64,000 annual patient visits estimated the total financial burden of DIVA cases at approximately 890,095.¹¹ These findings underscore the substantial economic and clinical consequences of suboptimal vascular access practices.

Inadequate escalation pathways for managing patients with DIVA further contribute to treatment delays, patient dissatisfaction, and unnecessary consumption of clinical time and supplies.¹⁰ Although DIVA is recognized as a contributing factor to increased central venous access device (CVAD) use and diminished patient outcomes, its broader systemic impacts are frequently underappreciated.² Emerging evidence links DIVA not only to prolonged time to establish IV access but also to downstream delays in laboratory testing, administration of analgesics, and increased length of stay in the ED.¹⁰

PATIENT EXPERIENCE

Patients with DIVA frequently undergo multiple unsuccessful PIVC insertion attempts, often accompanied by procedural pain and heightened anxiety.¹⁴ These repeated failures can erode patient trust in both individual providers and the broader healthcare system.^{9,20} Beyond the immediate clinical consequences, such as treatment delays and increased risk of complications, the psychological impact on patients is significant.⁷ When medical encounters are consistently associated with pain, fear, and failure, patients may develop avoidance behaviors and become reluctant to seek necessary care in the future.

Negative experiences with PIVC insertion are often shaped not only by the outcome of the procedure but also by the clinician's level of technical skill, clinical judgment, and the quality of communication with patients and their families.^{20,21} Evidence indicates that patients who are satisfied with their PIVC experience are more likely to report satisfaction with their overall hospital stay.²⁰ As such, targeted efforts to improve vascular access competency, procedural pain management, and patient-centered communication may lead to improved patient satisfaction and better clinical outcomes.²⁰

For hospital leaders, it is critical to recognize that patient experiences with common procedures like PIVC directly influence hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores, which are publicly reported and incorporated into Center for Medicare and Medicaid Services (CMS) Hospital Value-Based Purchasing (VBP) program.^{22,23} Poor patient experience can negatively affect reimbursement and damage institutional reputation, while sustained improvements may support both financial performance and market competitiveness.^{22,23}

DIVA RISK FACTORS

Although PIVC insertion is commonly regarded as a routine clinical procedure, it can present significant challenges in specific patient populations. Numerous evidence-based risk factors for DIVA have been well established in the literature, highlighting the importance of early identification and tailored intervention strategies.

Risk Factors	Discussion
Vessel Anatomy	Patients with non-visible and/or non-palpable veins due to the challenges in identifying or cannulating a suitable vein. ^{24,25}
Obesity	Patients with a BMI > 30 is associated with increased subcutaneous tissue, which can obscure veins making them difficult to palpate or visualize. ⁸
History of DIVA	A history of previous difficult access is the strongest predictor of future DIVA. ²⁶ Patients with a documented history of DIVA are nearly five times more likely to experience challenges during subsequent PIVC insertions compared to patients without a history of difficult access. ²⁶
History of IVDU	Vessel damage and sclerosis are common in patients with a history of IVDU, significantly limiting the availability of accessible veins for a successful PIVC insertion. ⁴
Chronic conditions	Chronic conditions frequently associated with DIVA include diabetes, sickle cell anemia, obesity, cancer, end stage renal disease and dehydration, all of which can adversely affect vein quality and accessibility. ^{27,28}
Skin Tone	Darker skin pigmentation can reduce vein visibility, increasing the difficulty of PIVC insertion when relying solely on visual assessment. ²⁹
Sex	Females have a threefold higher risk of DIVA compared to males, which may be partially attributed to a higher prevalence of osteoarticular conditions. ³⁰
Age	Elderly patients often experience vascular changes including loss of thickness of the dermal skin layer, thickening of the tunica intima/media and loss of connective tissue which may contribute to fragile, less elastic veins. ³¹
Compromised Skin Integrity	Patients with compromised skin integrity often present challenges for PIVC access because of fewer viable sites and a heightened risk of infection at the IV site. ^{31,32}
Hemodynamic Status	Dehydration, peripheral vasoconstriction, and edema can make PIVC insertions challenging by compromising vein visibility and reducing vessel diameter. ^{4,24}

EVIDENCE-BASED PRACTICES FOR DIVA PATIENTS

Delivering safe, effective, and patient-centered care to individuals with DIVA necessitates the integration of evidence-based knowledge, clinical expertise, and patient values.³¹ This comprehensive approach supports clinical decision-making that is both informed by current research and responsive to the unique needs and preferences of each patient, thereby promoting consistency and quality in vascular access care.³¹ The following evidence-based practices represent core strategies for improving outcomes in patients with DIVA.

Early Identification of Patients at Risk for DIVA

A DIVA risk assessment scale, when used prospectively, enables early identification of patients at increased risk for failed peripheral IV insertion attempts.²⁴ This proactive approach facilitates timely use of vein visualization technology, improving first-attempt success rates, minimizing delays in care, reducing patient discomfort, and preserving venous integrity.^{24,33} Implementing a DIVA risk assessment tool aligns with patient safety goals, enhances clinical efficiency, and reinforces the delivery of evidence-based vascular access care.^{8,24}

Hospitals may choose to develop an internal DIVA risk assessment scale or adopt an evidence-based version to support consistent identification of at-risk patients.^{8,34} Core elements commonly included in such tools are non-visible or non-palpable veins, a history of DIVA, BMI>30, and a history of IVDU.⁸ These four evidence-based criteria are among the most frequently cited in the literature and have been shown to reliably predict insertion difficulty.

Several evidence-based risk assessment models incorporate these factors, including the A-DIVA Scale, C-DIVA Scale, and the A-DICAVE Scale.^{24,35,37} While each tool varies slightly in structure and intended care setting, all share the objective of prospectively identifying high-risk patients to support early clinical intervention and guide appropriate escalation strategies.⁴

Additionally, the acronym SAFE (See, Ask, Feel, and Evaluate BMI) developed by Bahl et al., is a quick assessment tool designed for rapid use in time-sensitive environments.⁸ This tool further supports consistent decision-making under pressure and enhances the likelihood of timely, successful vascular access. The tool below incorporates the SAFE Rule.⁸

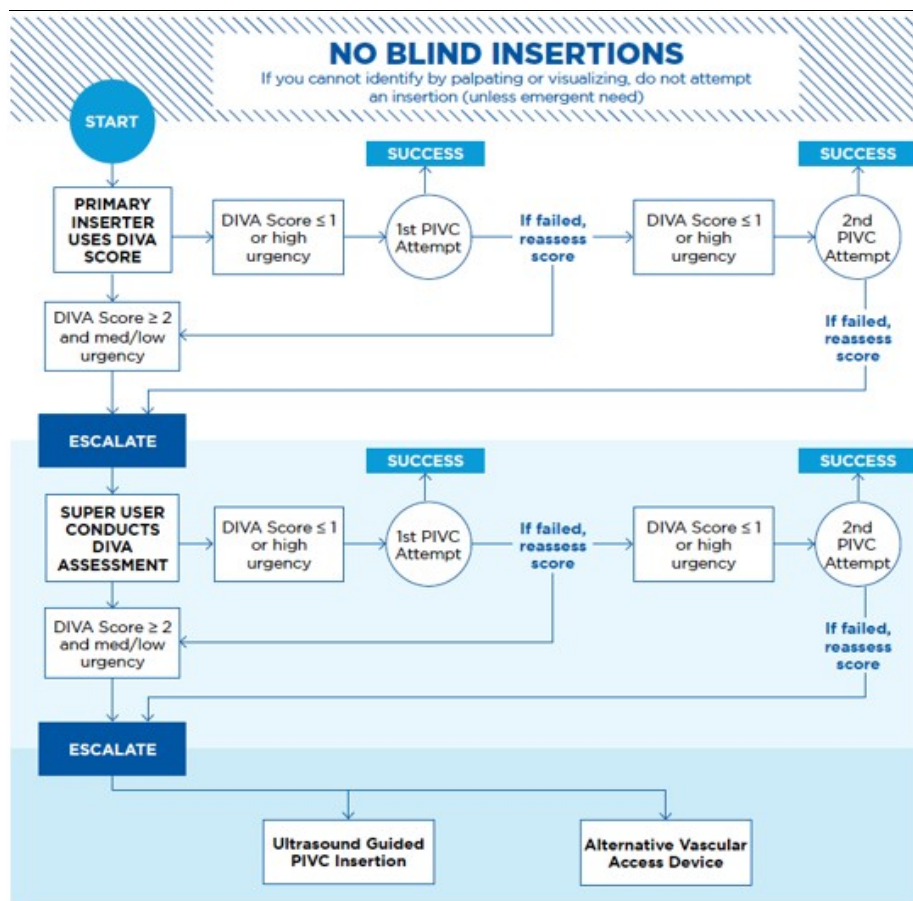
Evidence-Based DIVA Risk Assessment Scale (>1)

Assessment of nonvisible or nonpalpable veins	2
Previous history of DIVA	1
BMI >30	1
Previous history of IVDU	1

Adapted from Bahl A, et al. *J Infus Nurs.* 2024 Mar-Apr 01;47(2):96-107. Point values and scoring criteria developed by the Association for Professionals in Infection Control and Epidemiology (APIC). Used with permission.

An early escalation pathway offers a structured, systematic approach to managing patients with DIVA, promoting timely vascular access and optimizing the use of clinical resources.³⁷ When DIVA is anticipated, based on risk assessment, or following an unsuccessful initial attempt, the pathway should prioritize the use of adjunct technologies such as vein visualization to improve insertion success.³⁷

The escalation pathway outlined below provides a stepwise framework for clinicians, guiding the selection of appropriate interventions based on patient-specific needs and clinical context. This approach supports consistent decision-making, enhances procedural success, and aligns with best practices for evidence-based vascular access management.³⁸



Adapted from Bahl A, et al. *J Infus Nurs.* 2024 Mar-Apr 01;47(2):96-107. Point values and scoring criteria developed by the Association for Professionals in Infection Control and Epidemiology (APIC). Used with permission.

Vein Visualization Tools

Vein visualization technology plays an essential role in the management of patients with DIVA. Devices such as ultrasound and near-infrared imaging enhance clinicians' ability to locate and cannulate veins that are neither visible nor palpable through traditional methods.³¹ Among these, ultrasound is the most widely used modality due to its capacity to provide real-time, dynamic imaging, enabling precise vein identification and significantly improving insertion success rates.^{26,31} Near-infrared technology may enhance first-attempt cannulation success by providing real-time visualization of superficial vein patterns and orientation. It does not reliably provide information on vein depth which is more accurately assessed using ultrasound.³¹

Several additional technologies are emerging to support vascular access in complex cases. These include transillumination using light-emitting diodes, multispectral cameras, electrical stimulation, and robotic systems integrated with artificial intelligence.^{39,40} These innovations aim to improve first-attempt success, minimize patient discomfort, shorten time to access, and reduce the need for escalation to a CVAD.^{39,40}

Each vein visualization device relies on a distinct technological approach to vessel identification. Their efficacy is influenced by factors such as patient anatomy, comorbid conditions, and the experience and technical skill of the operator.³⁹ As no single modality is universally effective, tailoring the device use to individual patient characteristics is essential to overcoming access challenges.⁴⁰

To ensure safe and effective use, clinician training in the operation of vein visualization technologies must be both documented and reviewed on a regular basis. Initial and ongoing competency development is critical for maintaining alignment with current evidence-based practices and institutional policies.³¹ Hospital leadership should assess the clinical benefits, risks, and cost implications of each technology to guide investment decisions and prioritize tools that enhance first-attempt success and meet the specific needs of their patient population.³⁹

Vessel Health and Preservation and Appropriate Vascular Access Device Selection

The Vessel Health and Preservation (VHP) model integrates evidence-based guidelines to support thorough vessel assessment, appropriate device selection, and effective insertion and management of vascular access devices.³³ Preserving vessel integrity is essential to minimize vascular damage and enhance patient safety.⁴¹ The primary objectives of the VHP model are to improve care quality, reduce device-related risks, increase patient satisfaction, and optimize healthcare resource utilization.³³

To accomplish these goals, clinicians must select the most suitable vascular access device based on the patient's prescribed therapy, diagnosis, and overall clinical condition.³¹ Peripheral vascular access devices include short PIVCs, long PIVCs, and midline catheters. Short PIVCs are inserted into superficial veins and are intended for short-term therapies.^{42,43} In contrast, long PIVCs and midline catheters have an extended length and remain fully within the vessel lumen, allowing for longer dwell times.³¹

When long PIVCs and midline catheters are placed into deeper veins, they are associated with extended dwell times and lower complication rates compared to short PIVCs.^{31,42} This approach is especially beneficial for patients with DIVA who often experience multiple failed attempts with short PIVCs. In DIVA patients, early use of ultrasound-guided insertion of a long PIVC or midline catheter improves first-attempt success, supports vessel preservation, reduces delays in treatment, and enhances patient satisfaction.^{31,44}

Patient-Centered Considerations

To advocate for and protect patients with DIVA who often endure multiple PIVC attempts, a standardized approach is essential. This approach should include early identification using an evidence-based risk assessment tool, clearly defined escalation pathways, integration of DIVA alerts within the EMR, ready access to vein visualization technologies, and the involvement of clinicians trained in these advanced vascular access techniques.⁷ Establishing an appropriate infrastructure involves comprehensive education and training, availability of vein visualization tools, and clinical oversight in areas with high PIVC utilization. Evidence demonstrates that IV access is achieved more quickly and efficiently when performed by clinicians with specialized training.¹⁰

Patients with DIVA who receive early intervention using vein visualization technology during PIVC placement may experience reduced pain and anxiety associated with multiple venipuncture attempts.⁸ Furthermore, a team-based approach to managing DIVA has been perceived by patients as improving communication and fostering greater confidence in their clinicians.²⁰ These findings underscore the importance of incorporating patient perspectives, particularly from individuals with prior relevant medical experiences, to enhance PIVC success and promote patient-centered care.

Policies and Procedures Addressing DIVA

Policies and procedures offer a structured framework that guides healthcare organizations in delivering safe and effective patient care.³¹ Developing a policy specific to DIVA establishes standardized processes for identifying and managing IV access challenges.⁴⁵ This policy should be created collaboratively with input from key stakeholders across the organization to ensure comprehensive and practical implementation.⁸

A DIVA policy must include explicit criteria for identifying patients with difficult IV access, which can be achieved through the use of an evidence-based risk assessment scale or through proactive documentation within the EMR.³⁷ The policy should also define an escalation pathway and set limits on the number of insertion attempts, recommending no more than two attempts per clinician.⁴⁶ Additionally, it should outline educational requirements and the demonstration of both initial and ongoing competency among clinicians responsible for vascular access.⁴⁵

Staff Education and Competency

Difficult intravenous access (DIVA) continues to present a significant challenge within hospital settings and necessitates focused educational initiatives to facilitate timely and successful PIVC insertions.

Comprehensive training programs, supported by institutional commitment, have demonstrated that ultrasound-guided peripheral IV insertion can be effectively taught and implemented by clinicians.⁴⁰ Such education and practical training should encompass early identification of patients with DIVA prior to the initial PIVC attempt, thorough understanding of escalation pathways, and the optimal utilization of vein visualization technologies, including but not limited to ultrasound.^{31,47}

To ensure competency and sustain high performance, staff education should be structured around a formalized, evidence-based curriculum that includes both didactic and hands-on components. Simulation-based training has been shown to enhance procedural confidence and skill retention, particularly when managing patients with DIVA.⁴⁸ Competency validation should include supervised insertions, proficiency checklists, and ongoing assessment of outcomes such as first-attempt success rates and complication reduction. Institutions may also consider designating specialized vascular access teams or champions who provide mentorship, reinforce best practices, and serve as resources for real-time support. Embedding these practices into annual competency reviews and onboarding protocols for clinical staff helps to maintain a consistent standard of care and improve patient outcomes in populations with known vascular access challenges.⁴⁹

Documentation and Clinical Decision Support Systems

Accurate documentation of PIVC insertion is essential for ensuring continuity of care and meeting established infusion standards of practice. Standardized documentation should include the clinical indication for insertion, anatomical site, use of vein visualization technology, number of insertion attempts, pain management strategies, dressing type, and securement method.³¹

To support comprehensive documentation and promote high-quality, evidence-based care, clinical decision support systems (CDSS) can be integrated into electronic medical records (EMR) and computerized provider order entry (CPOE) systems.⁵⁰ These technologies enhance clinical decision-making by providing access to relevant patient history, targeted knowledge, and care-specific recommendations.⁵⁰ CDSS tools are typically used at the point of care to deliver real-time, evidence-informed alerts and guidance.⁵¹

Some systems are designed to incorporate artificial intelligence to identify patients at risk for DIVA, using criteria such as a documented history of multiple failed attempts, BMI >30, or prior use of visualization technology.⁵¹ Implementing a DIVA alert within the EMR or CPOE can improve workflow by prompting early escalation to a vascular access specialist or a clinician trained in the use of advanced insertion technologies.

Quality Improvement and Data Collection

Quality improvement initiatives should incorporate systematic data collection focused on the early identification of patients with DIVA, adherence to established escalation pathways, number of insertion attempts, and intended dwell times. This data is essential for evaluating the effectiveness of vascular access programs and identifying areas for improvement.²⁷

Clinical decision support systems can facilitate this process by integrating DIVA alerts and leveraging collected data to monitor trends and enhance clinical decision-making.⁴⁸

Regular audits of documentation are also necessary to detect patient safety risks related to missed identification or inadequate escalation of DIVA cases.³¹ These efforts require a coordinated, organization-wide approach to ensure consistency in practice and improve PIVC outcomes.⁴⁶ To support these objectives, many institutions have established specialized vascular access teams, super-users, or dedicated clinical teams tasked with providing timely and reliable PIVC insertion for patients with difficult access.

Association for Vascular Access (AVA): Practice Recommendations for DIVA Patients

- 1. Early Identification of Patients at Risk for DIVA**

Use an evidence-based DIVA risk assessment scale before first vascular access attempt.

- 2. Escalation Pathway**

Implement an early escalation pathway for patients with DIVA.

- 3. Vein Visualization Tools**

Employ and prioritize the use of vein visualization technologies available within the clinical care setting.

- 4. Vessel Health Preservation and Appropriate Vascular Access Device Selection**

Consider evidence-based guidelines for vessel assessment and choose the most appropriate device.

- 5. Patient-Centered Considerations**

Advocate for patients with DIVA.

- 6. Policies and Procedures Addressing DIVA**

Develop and implement policies and procedures addressing patients with DIVA.

- 7. Staff Education and Competency**

Support and execute comprehensive education and training programs addressing DIVA.

- 8. Documentation and Clinical Decision Support Systems**

Standardize documentation protocols combined with clinical decision support systems integrated within EMRs and computerized provider order entry (CPOE) systems.

- 9. Quality Improvement and Data Collection**

Incorporate quality improvement initiatives and systematic data collection focused on early identification of patients with DIVA, adherence to escalation pathways, number of insertion attempts, and intended dwell times.

CONCLUSION

Difficult intravenous access (DIVA) has become an increasing challenge for patients and clinicians worldwide, negatively impacting patient safety and the quality of care provided.^{37,46} The implementation of adjunctive tools such as DIVA risk assessment scales, escalation pathways, electronic alerts, and vein visualization technologies supports the delivery of patient-centered, high-quality care by enabling early identification and timely intervention. When these tools are effectively integrated into clinical practice, they contribute to improved patient satisfaction, lower rates of failed PIVC attempts, and more efficient utilization of clinical resources and supplies.³⁹

To effectively manage the complexities of DIVA, healthcare organizations should adopt a proactive approach that includes establishing specialized vascular access teams, super-users, or designated clinicians. This strategy fosters a culture aimed at improving clinical outcomes and enhancing the patient experience.⁴⁰

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Disclosures

Darcy Doellman an employee of B. Braun Medical, Inc.

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REFERENCES

1. iData Research. *Global Market Report Suite for Vascular Access Devices: With Impact of COVID19*. <https://www.researchandmarkets.com/reports/5137045/global-vascular-access-devices-market-size>. Published 2023. Accessed July 13, 2025.
2. Marsh N, Larsen EN, Ullman AJ, et al. Peripheral intravenous catheter infection and failure: A systematic review and meta-analysis. *Int J Nurs Stud*. 2024;151:104673.doi:10.1016/j.ijnurstu.2023.104673
3. Kessler R, Hall J, Chipman AK, Hall MK, Amick A. Nurse-focused ultrasound-guided IV program improves core emergency department process measures. *J Vasc Access*. 2025;26(2):578-585. doi:10.1177/11297298241230109
4. Ng M, Mark LKF, Fatimah L. Management of difficult intravenous access: A qualitative review. *World J Emerg Med*. 2022;13(6):467-478. doi:10.5847/wjem.j.1920-8642.2022.104
5. Munoz-Mozas G, Gabriel J. A safe and effective winged peripheral intravenous cannula for use in clinical practice. *Br J Nurs*. 2024;33(2):S12-S19. doi:10.12968/bjon.2024.33.2.S12
6. Whalen M, Maliszewski B, Sheinfeld R, Gardner H, Baptiste D. Outcomes of an innovative evidence-based practice project: Building a difficult-access team in the emergency department. *J Emerg Nurs*. 2018;44(5):478-482. doi:10.1016/j.jen.2018.03.011
7. Schults JA, Calleja P, Slaughter E, et al. Peripheral intravenous catheter insertion and use of ultrasound in patients with difficult intravenous access: Australian patient and practitioner perspectives to inform future implementation strategies. *PLoS One*. 2022;17(6):e0269788. doi:10.1371/journal.pone.0269788
8. Bahl A, Alsbrooks K, Zazyczny KA, Johnson S, Hoerauf K. An improved definition and SAFE rule for predicting difficult intravascular access (DIVA) in hospitalized adults. *J Infus Nurs*. 2024;47(2):96-107.doi:10.1097/NAN.0000000000000535
9. Thompson J, Steinheiser MM, Hotchkiss JB, et al. Standards of care for peripheral intravenous catheters: Evidence-based expert consensus. *Br J Nurs*. 2024;33(21):S32-S46. doi:10.12968/bjon.2024.0422
10. Davis EM, Feinsmith S, Amick AE, et al. Difficult intravenous access in the emergency department: Performance and impact of ultrasound-guided IV insertion performed by nurses. *Am J Emerg Med*. 2021;46:539-544. doi:10.1016/j.ajem.2020.11.013
11. Gala S, Alsbrooks K, Bahl A, Wimmer M. The economic burden of difficult intravenous access in the emergency department from a United States' provider perspective. *J Res Nurs*. 2024;29(1):6-18. doi:10.1177/17449871231213025
12. Godfrey J, Gallipoli L. Introducing an ultrasound-guided longer length peripheral IV catheter for patients with difficult venous access. *Br J Nurs*. 2024;33(7):S4-S8. doi:10.12968/bjon.2024.33.7.S4

13. Kache S, Patel S, Chen NW, Qu L, Bahl A. Doomed peripheral intravenous catheters: Bad outcomes are similar for emergency department and inpatient placed catheters: A retrospective medical record review. *J Vasc Access*. 2022;23(1):50-56. doi:10.1177/1129729820974259
14. Steere L, Ficara C, Davis M, Moureau N. Reaching one peripheral intravenous catheter (PIVC) per patient visit with lean multimodal strategy: The PIV5Rights™ Bundle. *J Vasc Access*. 2019;24(3):31-43. doi:10.2309/j.java.2019.003.004
15. Platt V, Osenkarski S. Improving vascular access outcomes and enhancing practice: Evaluation of a comprehensive PIVC process improvement program at UF Health Jacksonville. *J Infus Nurs*. 2018;41(6):375-382. doi:10.1097/NAN.0000000000000304
16. Zanella MC, Catho G, Jackson H, et al. Dwell time and risk of bloodstream infection with peripheral intravenous catheters: A cohort study. *JAMA Netw Open*. 2025;8(4):e257202. doi:10.1001/jamanetworkopen.2025.7202
17. Vadgaonkar A, Kothale N, Patil P, Kothari AH, Shetty YC. Factors determining success and the cost of materials used in securing intravenous access in an emergency setting: A prospective observational study. *Int Emerg Nurs*. 2023;71:101338. doi:10.1016/j.ienj.2023.101338
18. Paterson RS, Schults JA, Slaughter E, et al. Review article: Peripheral intravenous catheter insertion in adult patients with difficult intravenous access: A systematic review of assessment instruments, clinical practice guidelines and escalation pathways. *Emerg Med Australas*. 2022;34(6):862-870. doi:10.1111/1742-6723.14069
19. van Loon FH, Leggett T, Bouwman AR, Dierick-van Daele AT. Cost-utilization of peripheral intravenous cannulation in hospitalized adults: An observational study. *J Vasc Access*. 2020;21(5):687-693. doi:10.1177/1129729820901653
20. Omkar Prasad R, Chew T, Giri JR, Hoerauf K. Patient experience with vascular access management informs satisfaction with overall hospitalization experience. *J Infus Nurs*. 2022;45(2):95-103. doi:10.1097/NAN.0000000000000460
21. Barksdale AN, Goede M, Madden S, Campos A, High R. Obesity is not associated with increased difficulty placing peripheral IVs in trauma activation patients. *Am J Emerg Med*. 2020;38(9):1875-1878. doi:10.1016/j.ajem.2020.05.028
22. Centers for Medicare & Medicaid Services. Hospital Value-Based Purchasing. <https://www.cms.gov>. Published 2023. Accessed July 18, 2025.
23. Elliott MN, Beckett MK, Hambarsoomian K, et al. Updated adjustment of the HCAHPS survey for new modes of survey administration and patient mix. *Med Care*. 2025;63(5):358-365. doi:10.1097/MLR.0000000000002127

24. van Loon FHJ, van Hooff LWE, de Boer HD, et al. The modified A-DIVA scale as a predictive tool for prospective identification of adult patients at risk of a difficult intravenous access: A multicenter validation study. *J Clin Med*. 2019;8(2):144. doi:10.3390/jcm8020144
25. Stagg PL. The adult difficult intravenous access (DIVA) cognitive aid: An evidence-based cognitive aid prototype for difficult peripheral venous access. *Cureus*. 2023;15(4):e37135. doi:10.7759/cureus.37135
26. Ji Y, Liu C, Cao X, Zhao L. A risk prediction model for adult patients with difficult intravenous access. *J Vasc Access*. Published online January 30, 2025. doi:10.1177/11297298251314909
27. Malik A, Dewald O, Gallien J, et al. Outcomes of ultrasound guided peripheral intravenous catheters placed in the emergency department and factors associated with survival. *Open Access Emerg Med*. 2023;15:177-187. doi:10.2147/OAEM.S405692
28. Petta D, Longobucco Y, Magi CE, et al. Implementation of the enhanced adult DIVA score in an emergency department: A prospective observational study. *J Vasc Access*. Published online January 16, 2025. doi:10.1177/11297298241312457
29. Mielke N, O'Sullivan C, Xing Y, Bahl A. The impact of health disparities on peripheral vascular access outcomes in hospitalized patients: An observational study. *Int J Equity Health*. 2024;23(1):158. doi:10.1186/s12939-024-02213-4
30. Armenteros-Yeguas V, Gárate-Echenique L, Tomás-López MA, et al. Prevalence of difficult venous access and associated risk factors in highly complex hospitalised patients. *J Clin Nurs*. 2017;26(23-24):4267-4275. doi:10.1111/jocn.13750
31. B, Gorski L, Kleidon T, et al. Infusion therapy standards of practice, 9th edition. *J Infus Nurs*. 2024;47(1S):S1-S285. doi:10.1097/NAN.0000000000000532
32. Thayer D. Skin damage associated with vascular access: Understanding common mechanisms of injury and strategies for prevention. *J Radiol Nurs*. 2021;40(1):61-68. doi:10.1016/j.jradnu.2020.05.011
33. Moureau NL. Vessel Health and Preservation: The Right Approach for Vascular Access. Springer Nature; 2024.
34. Peralta-Gámez MS, Gómez de Quero Córdoba M, Reverté-Villarroya S, Cuesta-Martínez R. Comparison of traditional and ultrasound-guided techniques for vascular access in patients with difficult venous access in emergency departments: Randomized clinical trial protocol. *Nurs Rep*. 2025;15(5):177. doi:10.3390/nursrep15050177
35. Civetta G, Cortesi S, Mancardi M, et al. EA-DIVA score (Enhanced Adult DIVA score): A new scale to predict difficult preoperative venous cannulation in adult surgical patients. *J Vasc Access*. 2019;20(3):281-289. doi:10.1177/1129729818804994
36. Salleras-Duran L, Fuentes-Pumarola C, Ballester-Ferrando D, et al. Development, diagnostic sensitivity, and prognostic accuracy of the adult-difficult venous catheterization scale for emergency departments. *J Emerg Nurs*. 2020;46(6):827-837.e2. doi:10.1016/j.jen.2020.06.013

37. Saad AA, Simsekler MCE, Ahmed S, et al. Optimizing strategies for managing difficult intravenous access. *Risk Manag Healthc Policy*. 2025;18:1147-1157.
doi:10.2147/RMHP.S500340
38. Association for Professionals in Infection Control and Epidemiology (APIC). *Guide to Preventing Catheter-Associated Bloodstream Infections in Adults*.
https://apic.org/implementation_guide/new-guide-to-preventing-catheter-associated-bloodstream-infections-in-adults-2025/. Published 2025. Accessed July 18, 2025.
39. Kaganovskaya M, Capitulo KL, Wuerz L. Current and emerging vein identification technology for phlebotomy and peripheral IV cannulation. *Nursing*. 2023;53(2):39-45.
doi:10.1097/01.NURSE.0000905708.30992.e9
40. Roll NP, Raju S, Ownbey M, Jones J, Hopkins C, Cotton J. Health system impact of emergency department-based vascular access program in patients with difficult intravenous access. *POCUS J*. 2025;10(1):78-82. doi:10.24908/pocusj.v10i01.18274
41. Hallam C, Weston V, Denton A, et al. Development of the UK vessel health and preservation (VHP) framework: A multi-organisational collaborative. *J Infect Prev*. 2016;17(2):65-72.
doi:10.1177/1757177415624752
42. Ambrosi E, Longhini J, Marini G, et al. Definitions and occurrence of unused short peripheral intravenous catheters in different care settings: A scoping review. *Nurs Open*. 2025;12(4):e70217. doi:10.1002/nop2.70217
43. Zingg W, Barton A, Bitmead J, et al. Best practice in the use of peripheral venous catheters: A scoping review and expert consensus. *Infect Prev Pract*. 2023;5(2):100271. doi:10.1016/j.infpip.2023.100271
44. Chopra V, Flanders SA, Saint S, et al. The Michigan appropriateness guide for intravenous catheters (MAGIC): Results from a multispecialty panel using the RAND/UCLA appropriateness method. *Ann Intern Med*. 2015;163(6 Suppl):S1-S40. doi:10.7326/M15-0744
45. Laksonen RP Jr, Gasiewicz NK. Implementing a program for ultrasound-guided peripheral venous access: Training, policy and procedure development, protocol use, competency, and skill tracking. *Nurs Clin North Am*. 2015;50(4):771-785.
doi:10.1016/j.cnur.2015.07.010
46. Sou V, McManus C, Mifflin N, et al. A clinical pathway for the management of difficult venous access. *BMC Nurs*. 2017;16:64. doi:10.1186/s12912-017-0261-z

47. Bahl A, Johnson S, Alsbrooks K, et al. Defining difficult intravenous access (DIVA): A systematic review. *J Vasc Access*. Published online November 17, 2021. doi:10.1177/11297298211059648
48. Hoskins MJ, Nolan BC, Evans KL, Phillips B. Educating health professionals in ultrasound-guided peripheral intravenous cannulation: A systematic review of teaching methods, competence assessment, and patient outcomes. *Medicine (Baltimore)*. 2023;102(16):e33624. doi:10.1097/MD.00000000000033624
49. Carr PJ, Higgins NS, Cooke ML, et al. Vascular access specialist teams versus standard practice for catheter insertion and prevention of failure: A systematic review. *BMJ Open*. 2024;12(7):e061234. doi:10.1136/bmjopen-2023-061234
50. Sutton RT, Pincock D, Baumgart DC, et al. An overview of clinical decision support systems: Benefits, risks, and strategies for success. *NPJ Digit Med*. 2020;3:17. doi:10.1038/s41746-020-0221-y
51. Chien SC, Chen YL, Chien CH, et al. Alerts in clinical decision support systems (CDSS): A bibliometric review and content analysis. *Healthcare (Basel)*. 2022;10(4):601. doi:10.3390/healthcare10040601

About AVA

The Association for Vascular Access (AVA) is an organization of healthcare professionals founded in 1985 to promote the specialty of vascular access.

The mission of AVA is to build interprofessional leaders in vascular access to advance knowledge, practice, advocacy, and collaboration to improve outcomes.



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