WELCOME *To the*

2026 SYMPOSIUM

# The Holland Keynote Lecture: Best Cannulation Practices are Achievable

Deborah Brouwer-Maier RN, CNN

VASA Vascular Access Society of the Americas

Access Excellence.

# No Disclosures

Retired Nephrology Nurse

# Janet Ellen Holland, RN, BSN
# Lost too soon in 2023







# Best Cannulation Practices Are Achievable

- VASA includes the Americas
- Cannulation Practices vary greatly by country
- Leaders in best practices are outside the USA
- Examples include Canada, UK



# Cannulation Training for Dialysis Staff

- Guidelines vary by location or organization
- In the USA, no standardized training curriculum- the last version was the FFBI toolkit in the mid-2000s
- Lack of realistic fake arms or simulators
- Lack of POCUS utilization to support cannulation mapping or real-time cannulation
- Lack of a standardized cannulation skills assessment tool
- In the USA, primary cannulators are the Patient Care Technicians (PCT)
- In the USA, nurses lack cannulation expertise due to the shifting of the task to the PCT's

# Review of 7 Clinical Practice Guidelines

Pinto R, Sousa C, Salgueiro A, Fernandes I. Arteriovenous fistula cannulation in hemodialysis: A vascular access clinical practice guidelines narrative review. J Vasc Access. 2022 Sep;23(5):825-831. doi: 10.1177/11297298211006972. Epub 2021 Apr 30. PMID: 33926285.

Our analysis outlines current CPGs for HD VA cannulation with lack of good evidence support for the majority of the recommendations, showing that, there is an urgent need for international collaboration and coordination to ensure relevant and high-quality evidence.

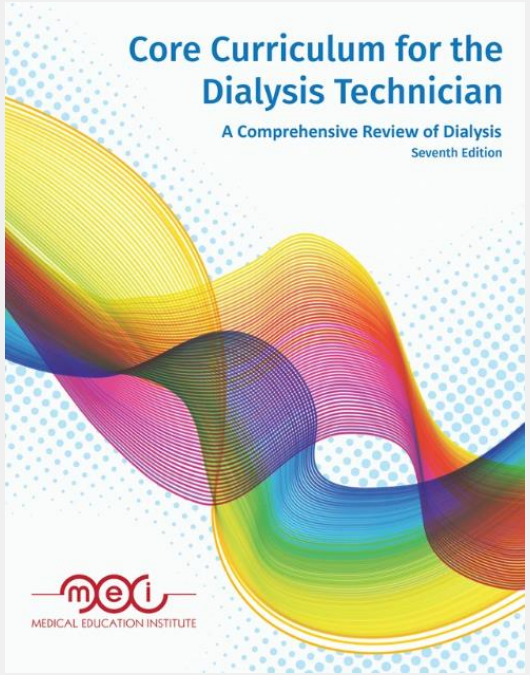
Future CPGs must consider recommendations with better grading of evidence aiming patient-centered care and nurse decision models that can potentially represent better AVF cannulation outcomes.

# Standardized Training Curriculum

The Core Curriculum is used as the source for the current PCT certification exams in the USA

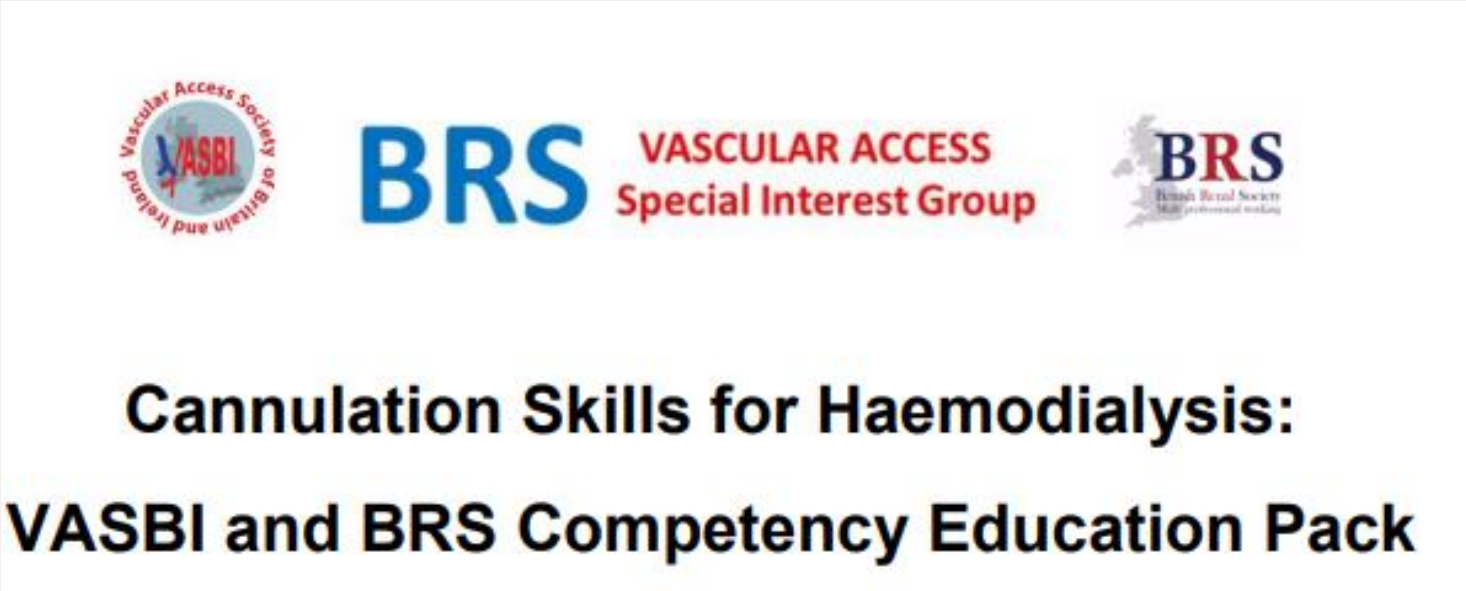
Training for cannulation is provided by the dialysis facility and varies by dialysis organization

https://store.mei.org/core-curriculum-for-the-dialysis-technician-7th-edition



# VASBI & BRS

https://www.vasbi.org.uk/media/resources/Needling_Competency_Document_A.pdf



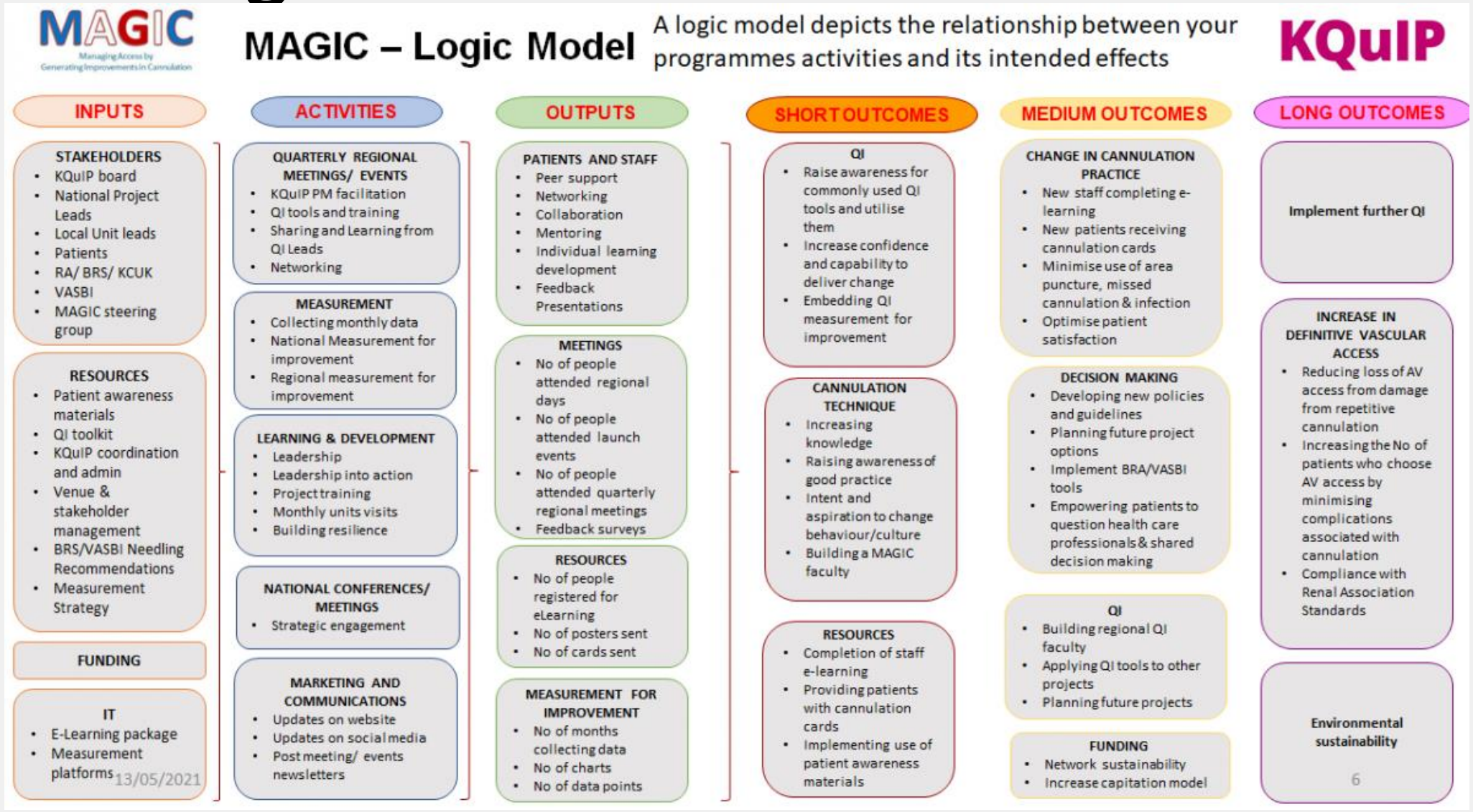
# Managing Access by Generating Improvements in Cannulation (MAGIC)

The 2017 Kidney PREM identified needling/cannulation of AV access as one of three top issues for kidney patients, with a call to improve cannulation experience.

https://www.ukkidney.org/kquip/getting-started-magic

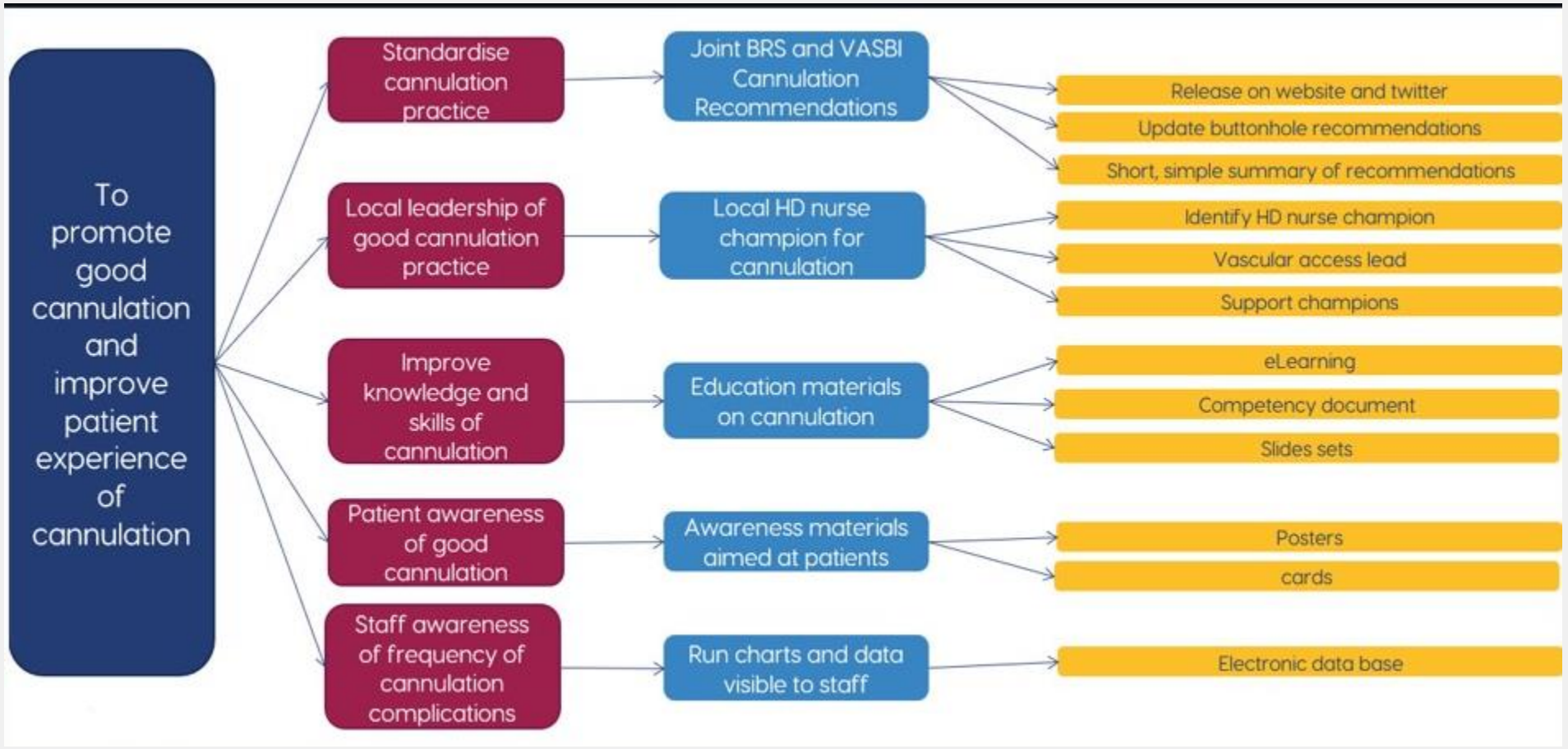


# MAGIC Logic Model



# MAGIC Driver Diagrams

high-level improvement goal/aim into a logical set of high-level factors (primary drivers) that you need to influence in order to achieve your goal.



# MAGIC- Data Collection & Reports

Dialysis Centers report monthly patient data on:

# of Access Types

# of First Cannulation

# of Access Loss

# Access Infections

# of Cannulation Method (Rope Ladder, Area Puncture, Buttonhole)

# of Missed Cannulations

Patient satisfaction scores

# Nursing Recommendations for the Management of Vascular Access in Adult Hemodialysis Patients 2023 Update

https://cdn.ymaws.com/cannt-acitn.ca/resource/resmgr/standards/cannt-va-guidelines-2023-end.pdf

Detailed Guidelines for all aspects of cannulation

# Vascular Access Education Program (VAEP)

The Vascular Access Education Program was created by the Ontario Renal Network, part of Ontario Health, in collaboration with the ORN Cannulation Working Group, to better inform providers about the assessment and care of hemodialysis vascular accesses.

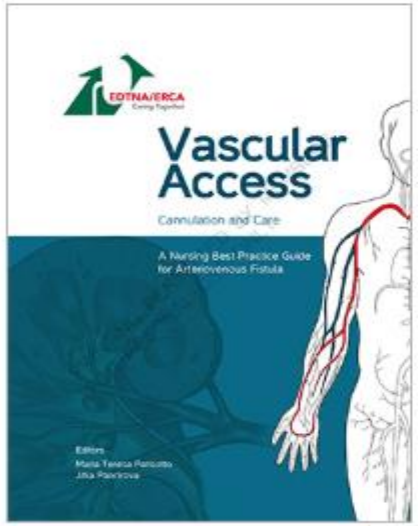
6 Training modules

https://cannt-acitn.ca/page/VAEP-modules

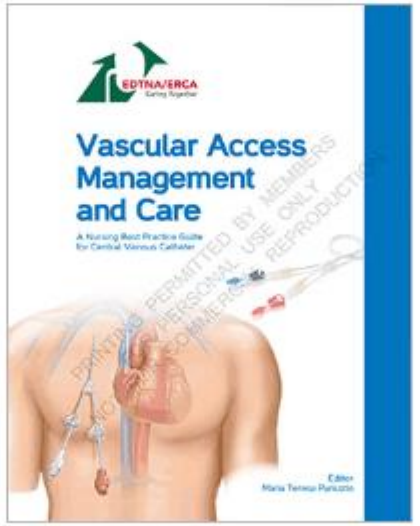
# European Dialysis and Transplant Nurses Association/European Renal Care Association(EDTNA/ERCA)

Free training booklets

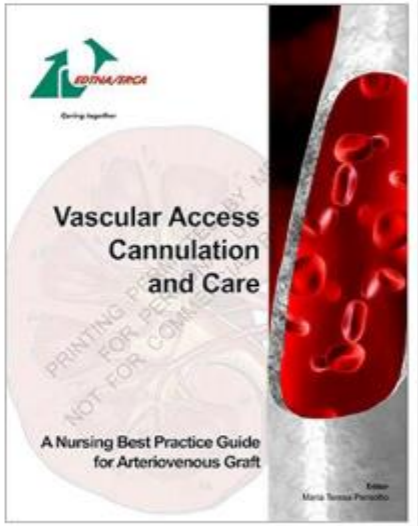
https://edtnaerca.org/education/publications#1585722775175




Vascular Access, Cannulation and Care: A Nursing Best Practice Guide for Arteriovenous Fistula



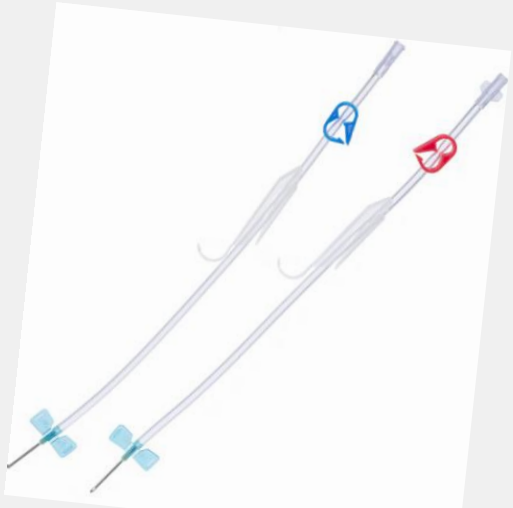

Vascular Access Management and Care - A Nursing Best Practice Guide for Central Venous Catheter




Vascular Access, Cannulation and Care: A Nursing Best Practice Guide for Arteriovenous Graft

# Cannulations Practice Methods

At best, unrealistic fake arms







# Cannulation Simulator: Multiple Publications

Zhang Z, Liu Z, Singapogu R. Extracting Subtask-specific Metrics Toward Objective Assessment of Needle Insertion Skill for Hemodialysis Cannulation. J Med Robot Res. **2019** Sep-Dec;4(3-4):1942006. doi: 10.1142/s2424905x19420066. Epub 2020 Apr 14. PMID: 33681506; PMCID: PMC7932179.

Singapogu R, Chowdhury A, Roy-Chaudhury P, Brouwer-Maier D. Simulator-based hemodialysis cannulation skills training: a new horizon? Clin Kidney J. **2020** Dec 6;14(2):465-470. doi: 10.1093/ckj/sfaa206. PMID: 33623670; PMCID: PMC7886575.

Liu Z, Zhang Z, Kunkel D, Roy-Chaudhury P, Singapogu R. Is Experience in Hemodialysis Cannulation Related to Expertise? A Metrics-based Investigation for Skills Assessment. Ann Biomed Eng. **2021** Jul;49(7):1688-1700. doi: 10.1007/s10439-020-02708-5. Epub 2021 Jan 8. PMID: 33417054; PMCID: PMC8263797.

# Cannulation Simulator: Multiple Publications


Liu Z, Bible J, Petersen L, Roy-Chaudhury P, Geissler J, Brouwer-Maier D, Singapogu R. Measuring Cannulation Skills for Hemodialysis: Objective Versus Subjective Assessment. Front Med (Lausanne). **2021** Nov 30;8:777186. doi: 10.3389/fmed.2021.777186. PMID: 34917637; PMCID: PMC8669158.

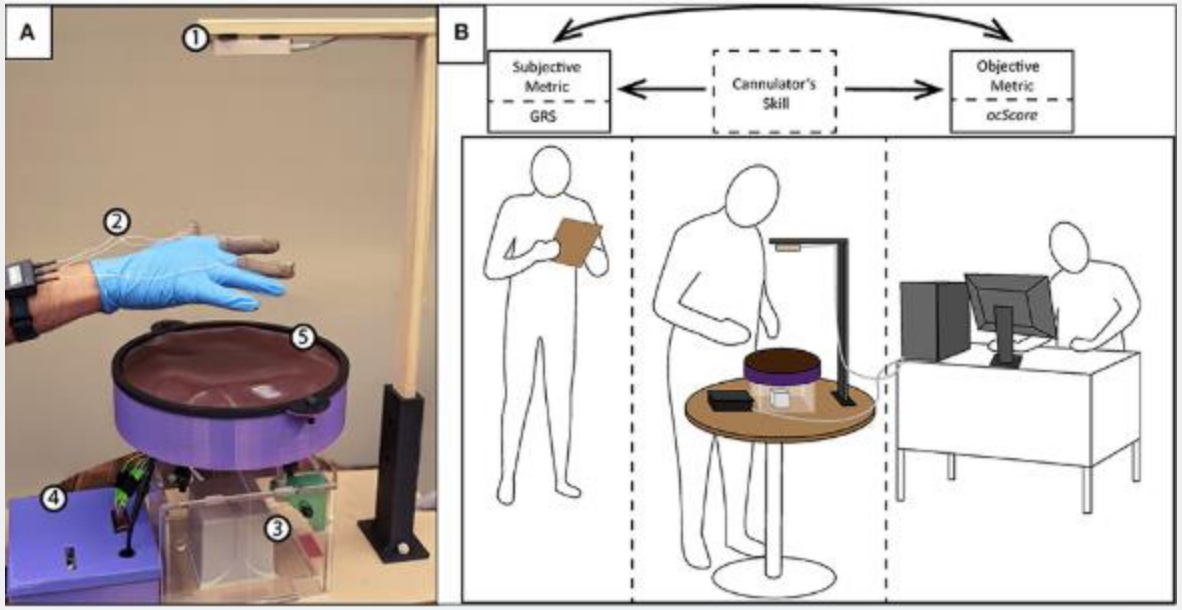
Singh S, Bible J, Liu Z, Zhang Z, Singapogu R. Motion Smoothness Metrics for Cannulation Skill Assessment: What Factors Matter? Front Robot AI. **2021** Apr 16;8:625003. doi: 10.3389/frobt.2021.625003. PMID: 33937348; PMCID: PMC8085519.

Liu Z, Bible J, Petersen L, Zhang Z, Roy-Chaudhury P, Singapogu R. Relating process and outcome metrics for meaningful and interpretable cannulation skill assessment: A machine learning paradigm. Comput Methods Programs Biomed. **2023** Jun;236:107429. doi: 10.1016/j.cmpb.2023.107429. Epub 2023 Apr 18. PMID: 37119772; PMCID: PMC10291517.

Liu Z, Hitchcock DB, Singapogu RB. Cannulation Skill Assessment Using Functional Data Analysis. IEEE J Biomed Health Inform. **2023** Sep;27(9):4512-4523. doi: 10.1109/JBHI.2023.3283188. Epub 2023 Sep 6. PMID: 37310836; PMCID: PMC10519736.

# Simulator Years In Development!

https://www.sojournmedtech.com/about-us






# Pre-Cannulation One Minute Check

Only Takes a Minute!

Not being used before each cannulation






# POCUS for Cannulation

Marticorena RM, Mills L, Sutherland K, McBride N, Kumar L, Bachynski JC, Rivers C, Petershofer EJ, Hunter J, Luscombe R, Donnelly S. Development of competencies for the use of bedside ultrasound for assessment and cannulation of hemodialysis vascular access. CANNT J. 2015 Oct-Dec;25(4):28-32. PMID: 26964424.

Ward F, Faratro R, McQuillan RF. Ultrasound-Guided Cannulation of the Hemodialysis Arteriovenous Access. Semin Dial. 2017 Jul;30(4):319-325. doi: 10.1111/sdi.12603. Epub 2017 May 9. PMID: 28486776.

Ultrasound-guided cannulation aims to improve first-time successful cannulations and minimize cannulation-associated complications such as infiltration and hematoma formation, minimizing delays in access use, and reducing catheter dependency.

In 2026, BLIND Cannulation remains the Standard of Care in the USA!!!!!

# POCUS for Cannulation

Chen S, Liu JS, Chai CC, Si C, Tan SH, Ravindran HR, Martinez MTP, Gao Y, Yeap YR, Liu AYL. Handheld ultrasound-guided cannulation of difficult hemodialysis arteriovenous access: A randomized controlled trial. Hemodial Int. **2023** Jan;27(1):21-27. doi: 10.1111/hdi.13050. Epub 2022 Oct 25. PMID: 36281908.

Renal nurses increased their confidence level after training (pretraining score 26.6 ± 6.9 vs. post training score 36.4 ± 3.0; p = 0.014).

There was a higher success rate (only one cannulation attempt required) for US-guided (96%) versus conventional (72.0%) cannulation (p = 0.049).

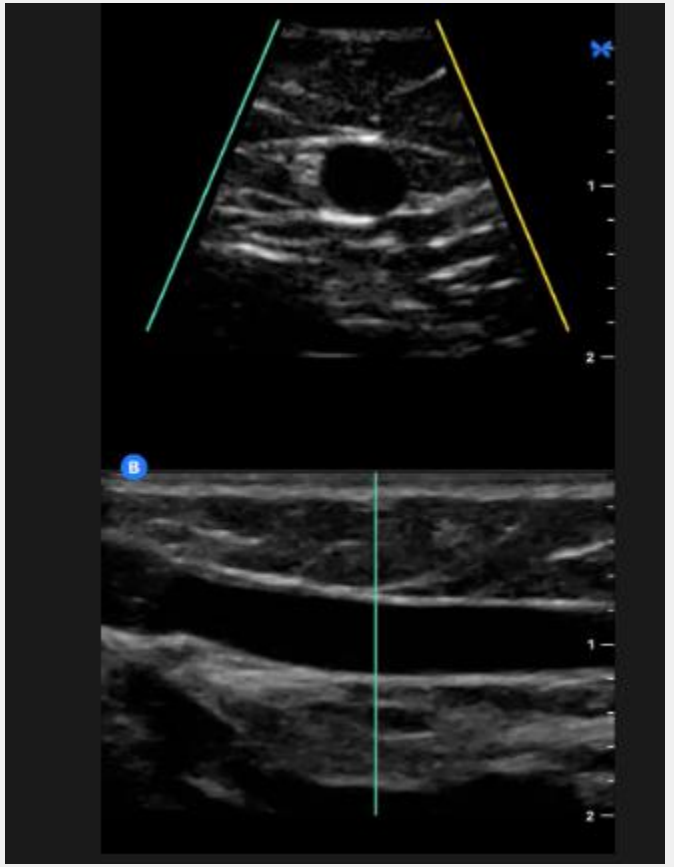
US-guided cannulation had a lower pain score than the conventional method (1.48 ± 0.73 vs. 2.13 ± 0.95, p = 0.012).

The pre-cannulation assessment time and time spent on cannulation were comparable between the two groups.

# POCUS for Cannulation

Widely utilized outside the USA by dialysis nurses





# POCUS for Cannulation- Years to Gain Adoption in the USA





POCUS Standard of Care in other countries

In 2026, BLIND Cannulation remains the Standard of Care in the USA!!!!!

# Lack of a Standardized Cannulation Skills Assessment Tool

Requires Cannulation Data

- ❑ Angle of needle entry used vs. the actual angle required (skin to vessel depth determines angle)
- ❑ Pressure applied to the needle to avoid vessel injury
- ❑ Needle tip placement and advancement to avoid back or sidewalls
- ❑ Needle bevel orientation
- ❑ Blood return and flushing without infiltration
- ❑ Number of needle attempts

A simulator can provide data points to evaluate skill before patient cannulation attempts!

# Cannulation Methods

https://www.kidney.org/sites/default/files/vait-11b_cannulation-how_cannulate_manage_complications.pdf

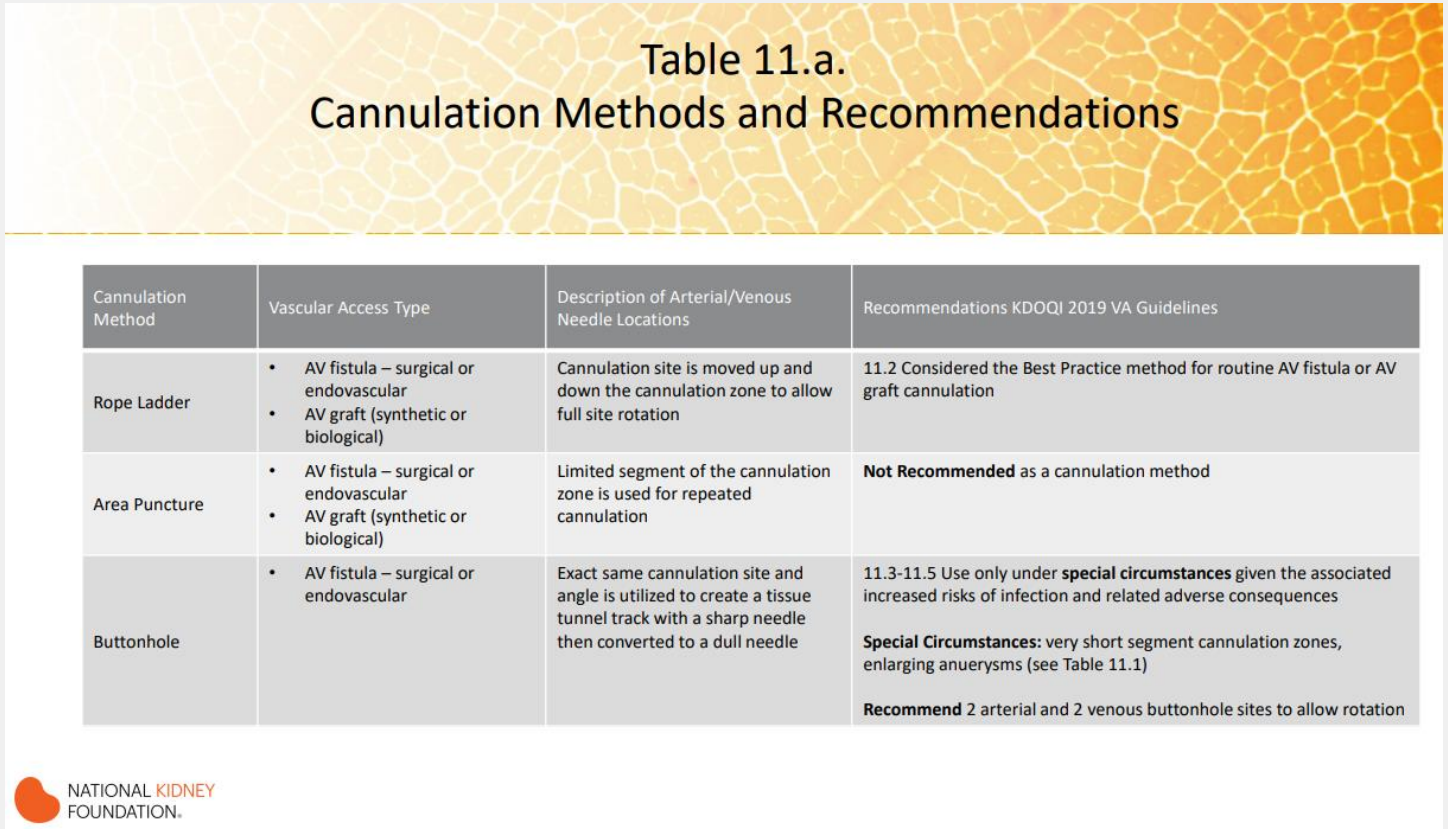


Table 11.a.
Cannulation Methods and Recommendations

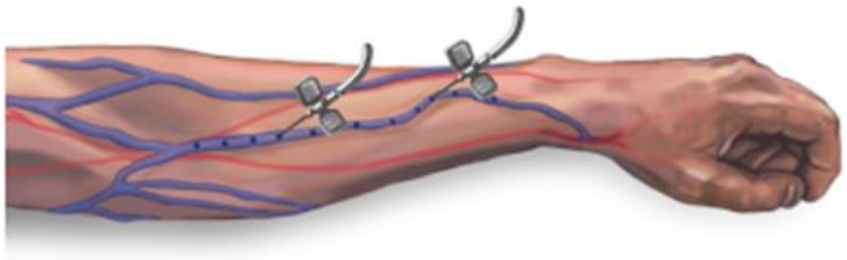
| Cannulation Method | Vascular Access Type | Description of Arterial/Venous Needle Locations | Recommendations KDOQI 2019 VA Guidelines |
|---|---|---|---|
| Rope Ladder | • AV fistula – surgical or endovascular<br>• AV graft (synthetic or biological) | Cannulation site is moved up and down the cannulation zone to allow full site rotation | 11.2 Considered the Best Practice method for routine AV fistula or AV graft cannulation |
| Area Puncture | • AV fistula – surgical or endovascular<br>• AV graft (synthetic or biological) | Limited segment of the cannulation zone is used for repeated cannulation | **Not Recommended** as a cannulation method |
| Buttonhole | • AV fistula – surgical or endovascular | Exact same cannulation site and angle is utilized to create a tissue tunnel track with a sharp needle then converted to a dull needle | 11.3-11.5 Use only under **special circumstances** given the associated increased risks of infection and related adverse consequences<br><br>**Special Circumstances:** very short segment cannulation zones, enlarging anuerysms (see Table 11.1)<br><br>**Recommend** 2 arterial and 2 venous buttonhole sites to allow rotation |

NATIONAL KIDNEY FOUNDATION.

# Cannulation Methods



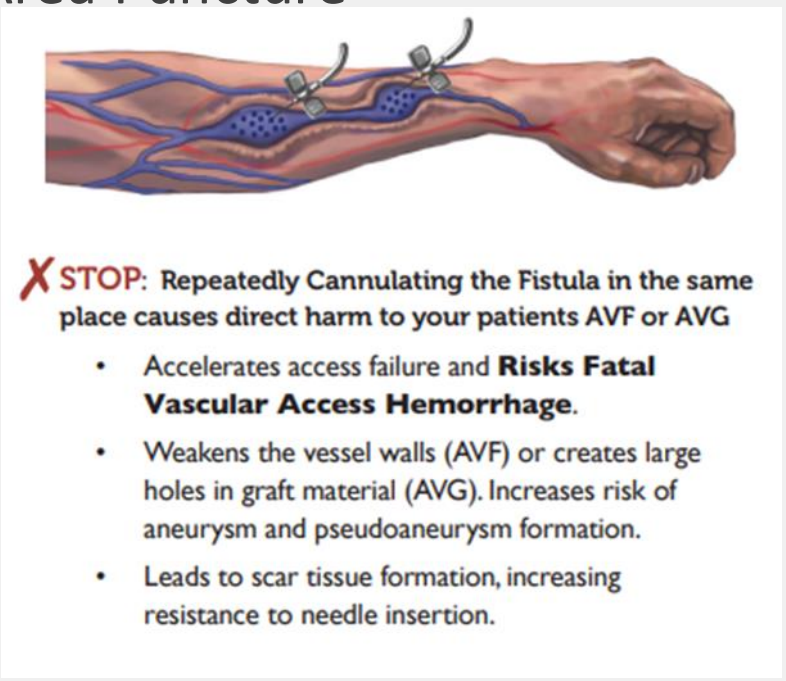

- Rope Ladder



✓GO: **Rope Ladder Cannulation Technique is the recommended best practice for AVF or AVG**

- Help prevent serious complications.
- Preserves access longevity.

- Area Puncture



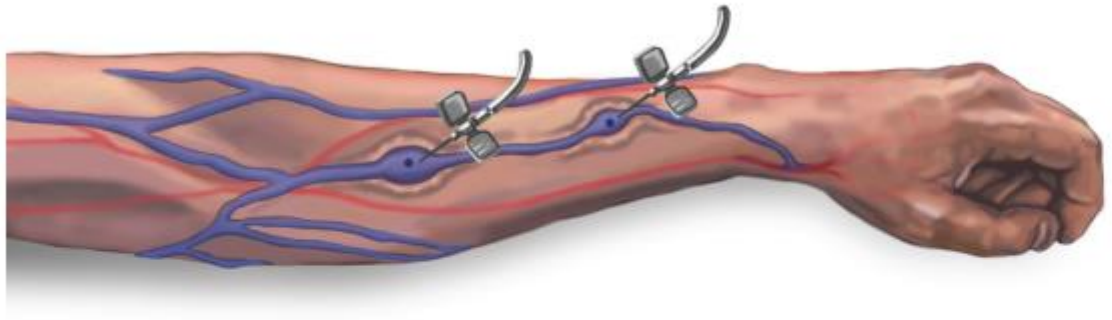
✗STOP: **Repeatedly Cannulating the Fistula in the same place causes direct harm to your patients AVF or AVG**

- Accelerates access failure and **Risks Fatal Vascular Access Hemorrhage**.
- Weakens the vessel walls (AVF) or creates large holes in graft material (AVG). Increases risk of aneurysm and pseudoaneurysm formation.
- Leads to scar tissue formation, increasing resistance to needle insertion.

https://www.vasamd.org/_resources/documents/resources/teams/2025-Practicum-Flyer-Cannulations-Techniques.pdf

# Cannulation Method

## BUTTONHOLE DIALYSIS CANNULATION



✓GO: **Used only for AVFs**

- It involves repeatedly inserting the needle into the same spot at the same angle, which creates a tunnel of scar tissue (called a buttonhole).
- This tunnel lets a blunt buttonhole needle go into the fistula along the same path each time.
- It's best to have two spots for the artery and two for the vein to allow for rotation.
- The buttonhole technique should only be used if the doctor has included it in the patient's care plan.

# Self-Cannulation CMS ESRD Conditions for Coverage V-Tag V456

Patients have the right to know about and participate in their care and treatment to the extent they desire

Self-cannulation may be performed by the patient in ANY facility upon receiving appropriate training and demonstrating competency, should they choose!





https://empoweredkidneycare.org/blog/what-is-self-care-in-center-dialysis/

# Venous Needle Dislodgement and Access-Bloodline Separation

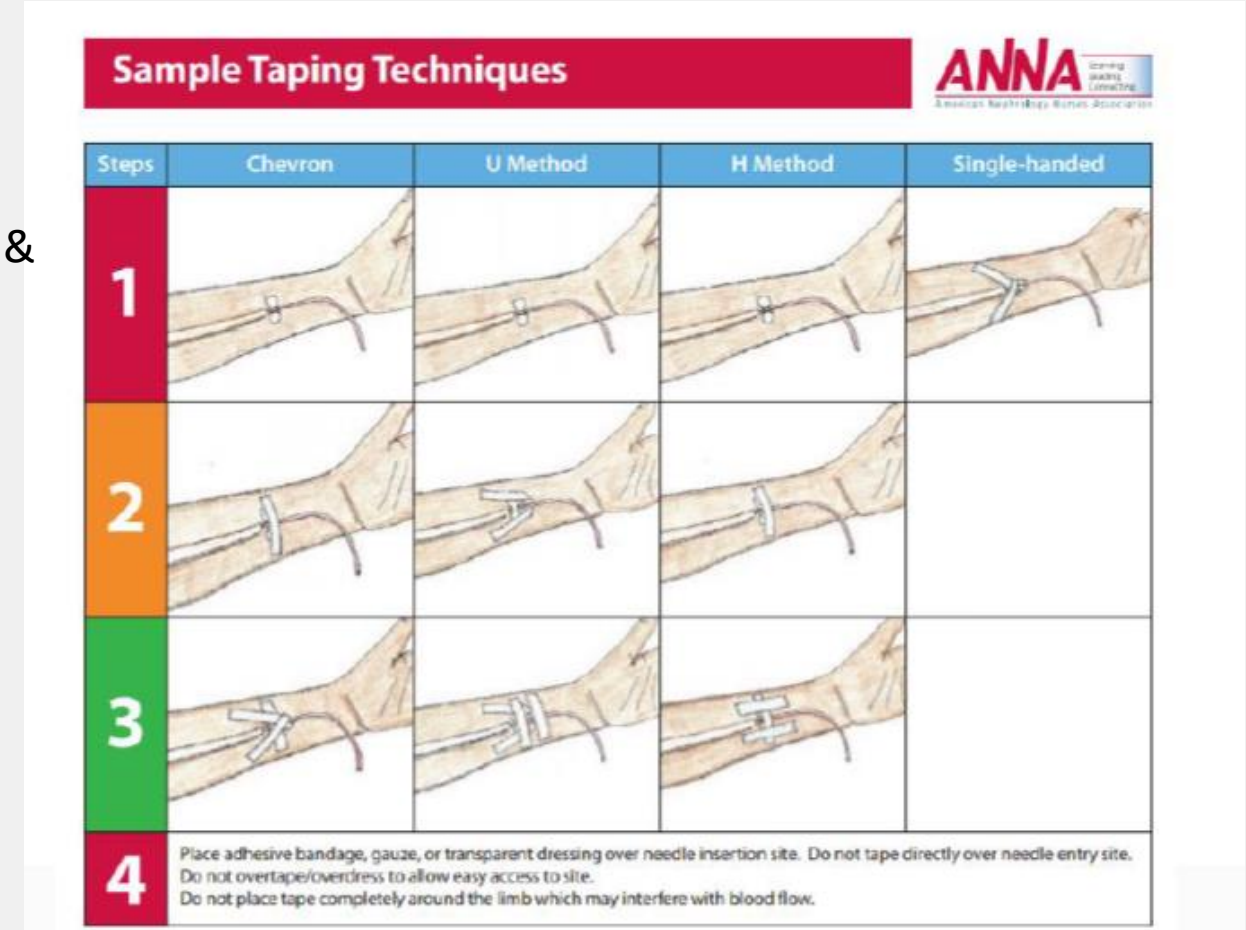
https://www.annanurse.org/wp-content/uploads/2025/04/vndBriefing_3_14_22.pdf

***Venous Needle Dislodgement (VND)***

VND is one of the most challenging safety monitoring problems for hemodialysis patients. Venous pressures typically exhibit minimal changes with disconnection, and life-threatening blood loss can happen fast, often within a few minutes. Research has indicated that three (3) people in the United States die every week due to VND, and an additional three (3) people experience serious bleeding issues every day during dialysis. However, there is no requirement to report VND incidents, thus reliable data is limited.

# Venous Needle Dislodgement and Access-Bloodline Separation

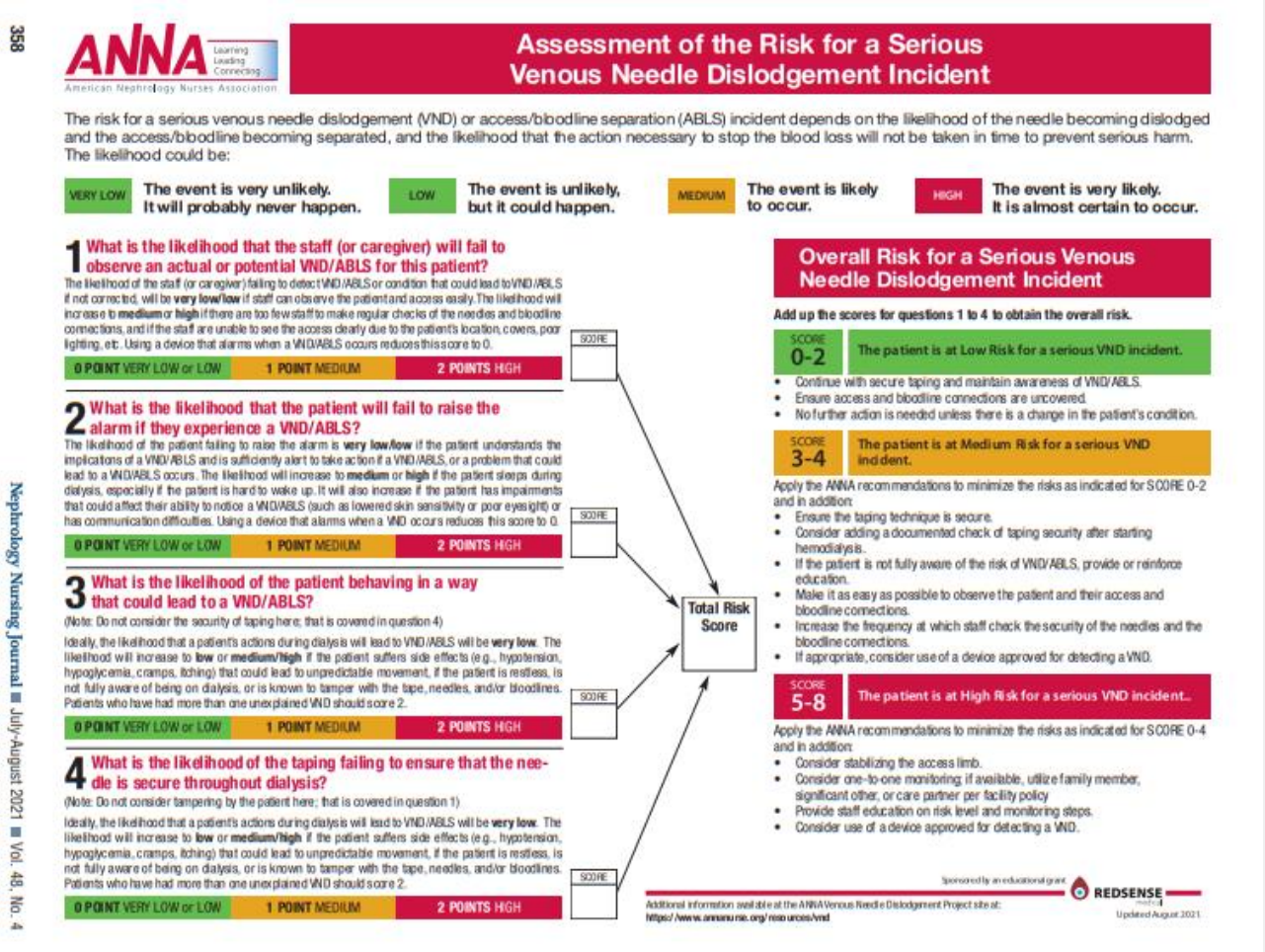
ANNA Toolkit- Taping




Speranza-Reid, J., Brouwer-Maier, D., Cruz, C.M., & Inglese,M. (2021). Venous needle dislodgement and access-bloodline separation. Nephrology Nursing Journal, 48(4),347-365. https://doi.org/10.37526/1526-744X.2021.48.4.347

# Venous Needle Dislodgement and Access-Bloodline Separation

Risk Assessment



358

ANNA Learning Leading Connecting
American Nephrology Nurses Association

## Assessment of the Risk for a Serious Venous Needle Dislodgement Incident

The risk for a serious venous needle dislodgement (VND) or access/bloodline separation (ABLS) incident depends on the likelihood of the needle becoming dislodged and the access/bloodline becoming separated, and the likelihood that the action necessary to stop the blood loss will not be taken in time to prevent serious harm. The likelihood could be:

- VERY LOW — The event is very unlikely. It will probably never happen.
- LOW — The event is unlikely, but it could happen.
- MEDIUM — The event is likely to occur.
- HIGH — The event is very likely. It is almost certain to occur.

**1 What is the likelihood that the staff (or caregiver) will fail to observe an actual or potential VND/ABLS for this patient?**

The likelihood of the staff (or caregiver) failing to detect VND/ABLS or condition that could lead to VND/ABLS if not corrected, will be **very low/low** if staff can observe the patient and access easily. The likelihood will increase to **medium** or **high** if there are too few staff to make regular checks of the needles and bloodline connections, and if the staff are unable to see the access clearly due to the patient's location, covers, poor lighting, etc. Using a device that alarms when a VND/ABLS occurs reduces this score to 0.

0 POINT VERY LOW or LOW | 1 POINT MEDIUM | 2 POINTS HIGH

SCORE

**2 What is the likelihood that the patient will fail to raise the alarm if they experience a VND/ABLS?**

The likelihood of the patient failing to raise the alarm is **very low/low** if the patient understands the implications of a VND/ABLS and is sufficiently alert to take action if a VND/ABLS, or a problem that could lead to a VND/ABLS occurs. The likelihood will increase to **medium** or **high** if the patient sleeps during dialysis, especially if the patient is hard to wake up. It will also increase if the patient has impairments that could affect their ability to notice a VND/ABLS (such as lowered skin sensitivity or poor eyesight) or has communication difficulties. Using a device that alarms when a VND occurs reduces this score to 0.

0 POINT VERY LOW or LOW | 1 POINT MEDIUM | 2 POINTS HIGH

SCORE

**3 What is the likelihood of the patient behaving in a way that could lead to a VND/ABLS?**

(Note: Do not consider the security of taping here; that is covered in question 4)

Ideally, the likelihood that a patient's actions during dialysis will lead to VND/ABLS will be **very low**. The likelihood will increase to **low** or **medium/high** if the patient suffers side effects (e.g., hypotension, hypoglycemia, cramps, itching) that could lead to unpredictable movement, if the patient is restless, is not fully aware of being on dialysis, or is known to tamper with the tape, needles, and/or bloodlines. Patients who have had more than one unexplained VND should score 2.

0 POINT VERY LOW or LOW | 1 POINT MEDIUM | 2 POINTS HIGH

SCORE

**4 What is the likelihood of the taping failing to ensure that the needle is secure throughout dialysis?**

(Note: Do not consider tampering by the patient here; that is covered in question 1)

Ideally, the likelihood that a patient's actions during dialysis will lead to VND/ABLS will be **very low**. The likelihood will increase to **low** or **medium/high** if the patient suffers side effects (e.g., hypotension, hypoglycemia, cramps, itching) that could lead to unpredictable movement, if the patient is restless, is not fully aware of being on dialysis, or is known to tamper with the tape, needles, and/or bloodlines. Patients who have had more than one unexplained VND should score 2.

0 POINT VERY LOW or LOW | 1 POINT MEDIUM | 2 POINTS HIGH

SCORE

Total Risk Score

## Overall Risk for a Serious Venous Needle Dislodgement Incident

**Add up the scores for questions 1 to 4 to obtain the overall risk.**

SCORE 0-2 — The patient is at Low Risk for a serious VND incident.

- Continue with secure taping and maintain awareness of VND/ABLS.
- Ensure access and bloodline connections are uncovered.
- No further action is needed unless there is a change in the patient's condition.

SCORE 3-4 — The patient is at Medium Risk for a serious VND incident.

Apply the ANNA recommendations to minimize the risks as indicated for SCORE 0-2 and in addition:

- Ensure the taping technique is secure.
- Consider adding a documented check of taping security after starting hemodialysis.
- If the patient is not fully aware of the risk of VND/ABLS, provide or reinforce education.
- Make it as easy as possible to observe the patient and their access and bloodline connections.
- Increase the frequency at which staff check the security of the needles and the bloodline connections.
- If appropriate, consider use of a device approved for detecting a VND.

SCORE 5-8 — The patient is at High Risk for a serious VND incident..

Apply the ANNA recommendations to minimize the risks as indicated for SCORE 0-4 and in addition:

- Consider stabilizing the access limb.
- Consider one-to-one monitoring; if available, utilize family member, significant other, or care partner per facility policy
- Provide staff education on risk level and monitoring steps.
- Consider use of a device approved for detecting a VND.

Sponsored by an educational grant REDSENSE medical

Additional information available at the ANNA Venous Needle Dislodgement Project site at: https://www.annanurse.org/resources/vnd

Updated August 2021

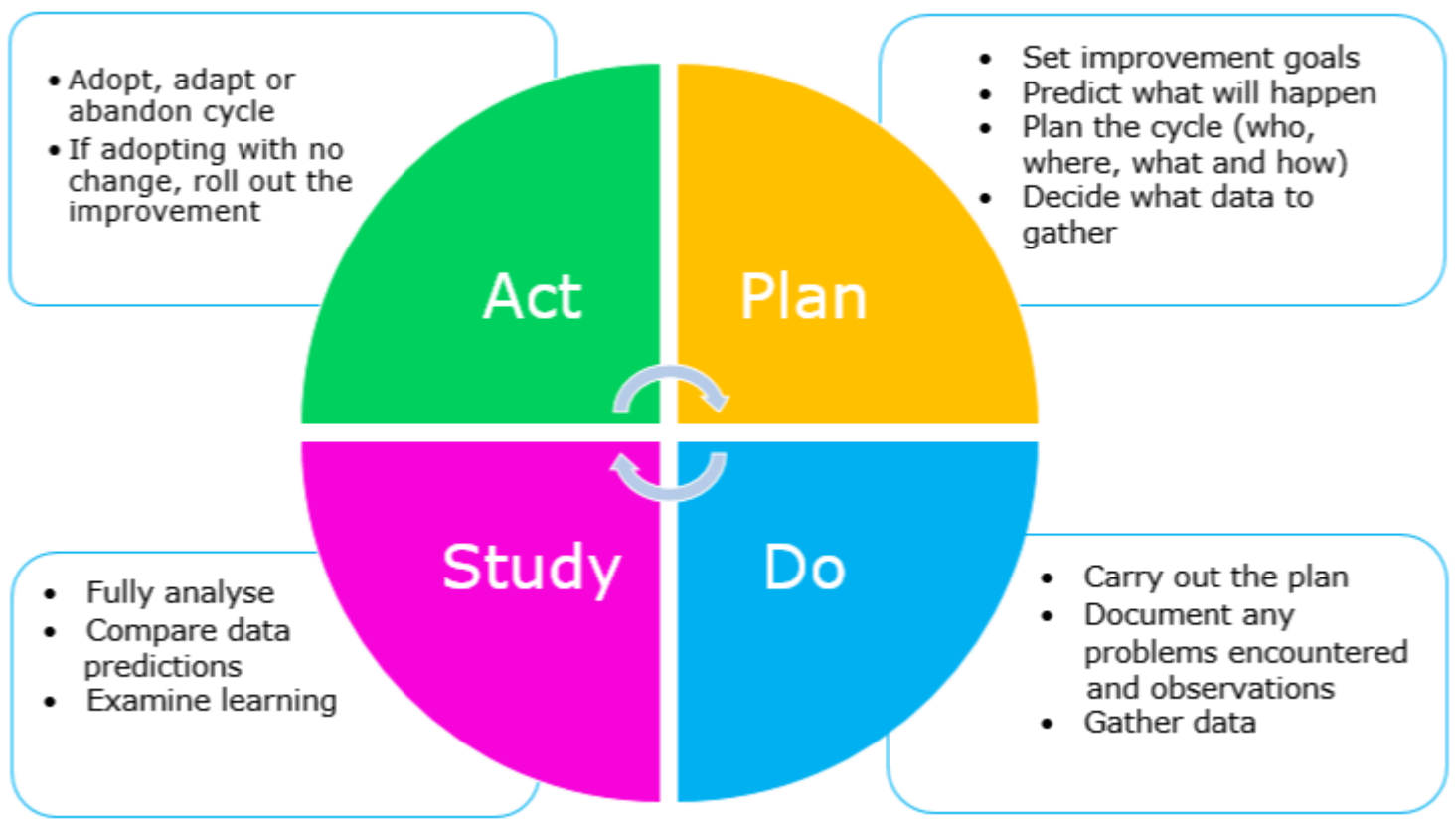
Nephrology Nursing Journal ■ July-August 2021 ■ Vol. 48, No. 4

# Insufficient Cannulation Documentation

- ❑ Cannulation Method used for Arterial & Venous Needle
- ❑ Number of cannulation attempts per site (anything more than 1 needs to be documented)
- ❑ Needle repositioning or adjustments needed to achieve blood return/flush
- ❑ Needle gauge ordered vs. used
- ❑ Arterial needle orientation (Anterograde or Retrograde)
- ❑ Bevel orientation (bevel up or bevel down)
- ❑ More than one cannulator- if so, names of each
- ❑ Patient's pain level, anxiety level, pain control measures used

# PDSA cycle (Plan-Do-Study-Act)

Can’t do without accurate data points!



# VASA Call to Action

- ✓ VASA White Paper on Research Topics- includes cannulation
- ✓ VASA Resources to support proper cannulation https://www.vasamd.org/resources/vascular-access-teams
- ✓ ANNA 2026 National Symposium education session on vascular access by VASA team
- ✓ Continue to support the role of Vascular Access Coordinators with VASA-provided ongoing education
- ❑ Need to determine the data points that should be standardized for each cannulation
- ❑ Need to develop more toolkits for the VASA membership on basic vascular access care and cannulation
- ❑ Need to collaborate with other kidney organizations on vascular access education

# In Memory of Janet Holland

May we continue to:

