Transonic HD03 On-the-Spot Vascular Access Assessment

Confirm Delivered Flow
Detect Recirculation
Measure Access Flow

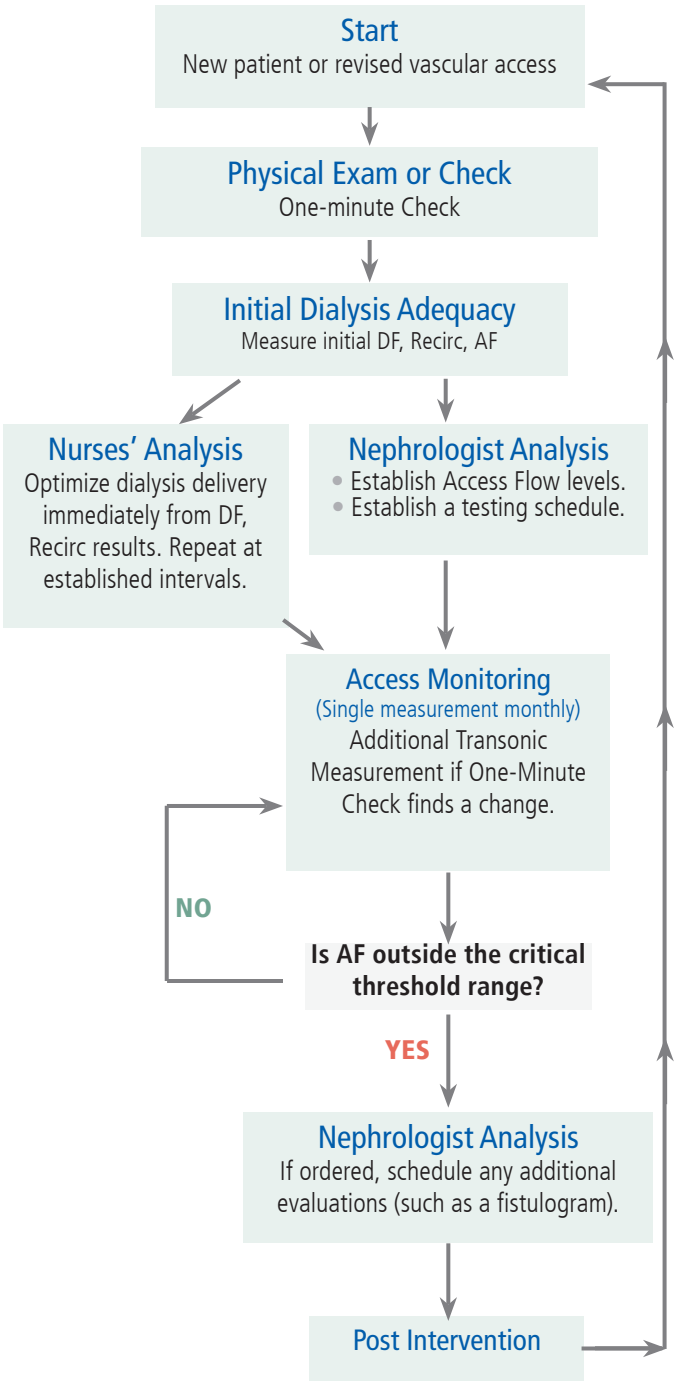
- **Delivered Flow:** Delivered flow can differ from the dialysis pump setting. It is important to compare the pump setting to the actual circuit flow so you can optimize your dialysis patient's treatment on the spot.

- **Recirculation:** The HD03 separates vascular access recirculation from cardiopulmonary recirculation (CPR). The HD03 measures the actual percentage of recirculation.

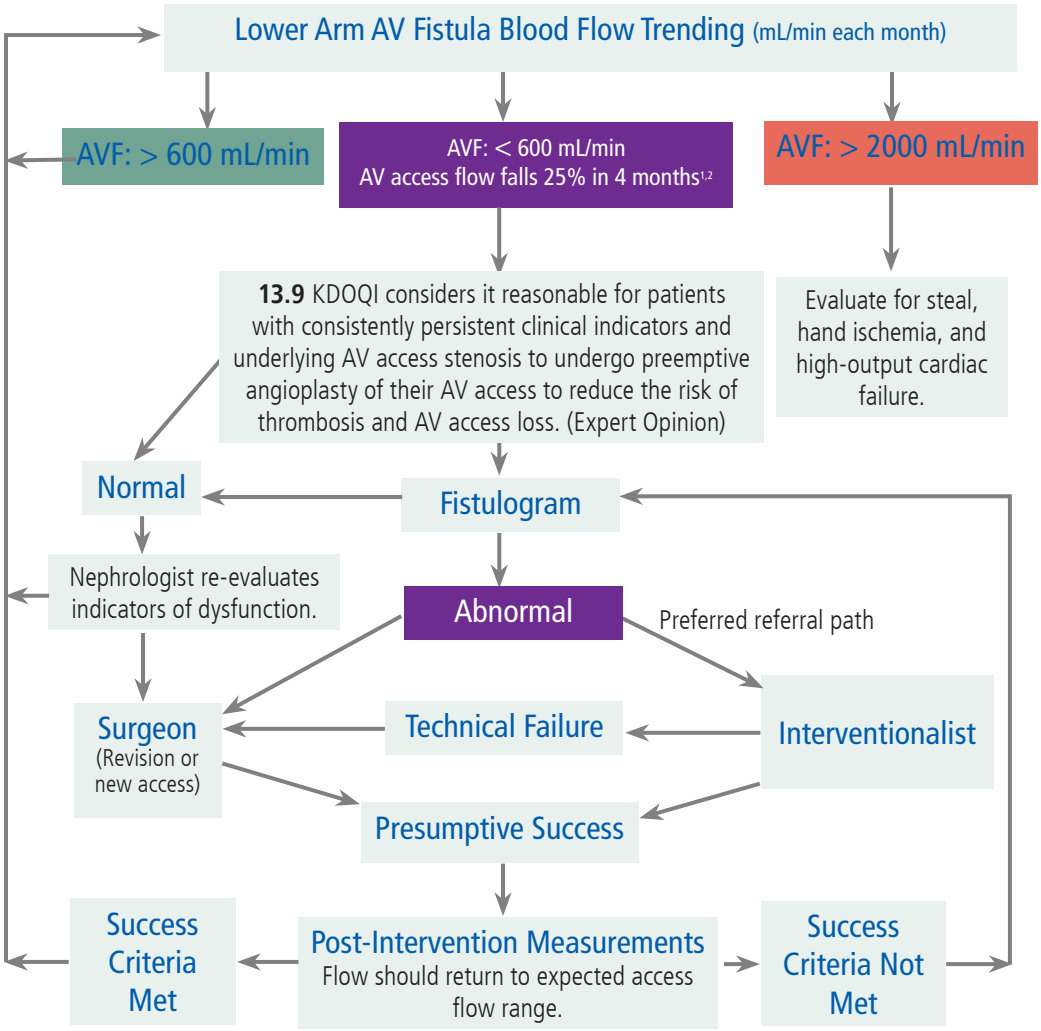
- **Vascular Access Blood Flow:** The HD03 measures Access Flow up to 4000ml/min. Changes in the Access Flow can indicate access dysfunction, including inflow stenosis and outflow stenosis. High Access Flow can identify risk of steal, hand ischemia, and high output cardiac failure. Access Flow measurement are used to trend changes over time and to confirm other clinical indicators including physical exam indications of dysfunction.

transonic
THE MEASURE OF BETTER RESULTS.

Overview of AV Fistula or AV Graft Protocols



Lower Arm Arteriovenous (AV) Fistula



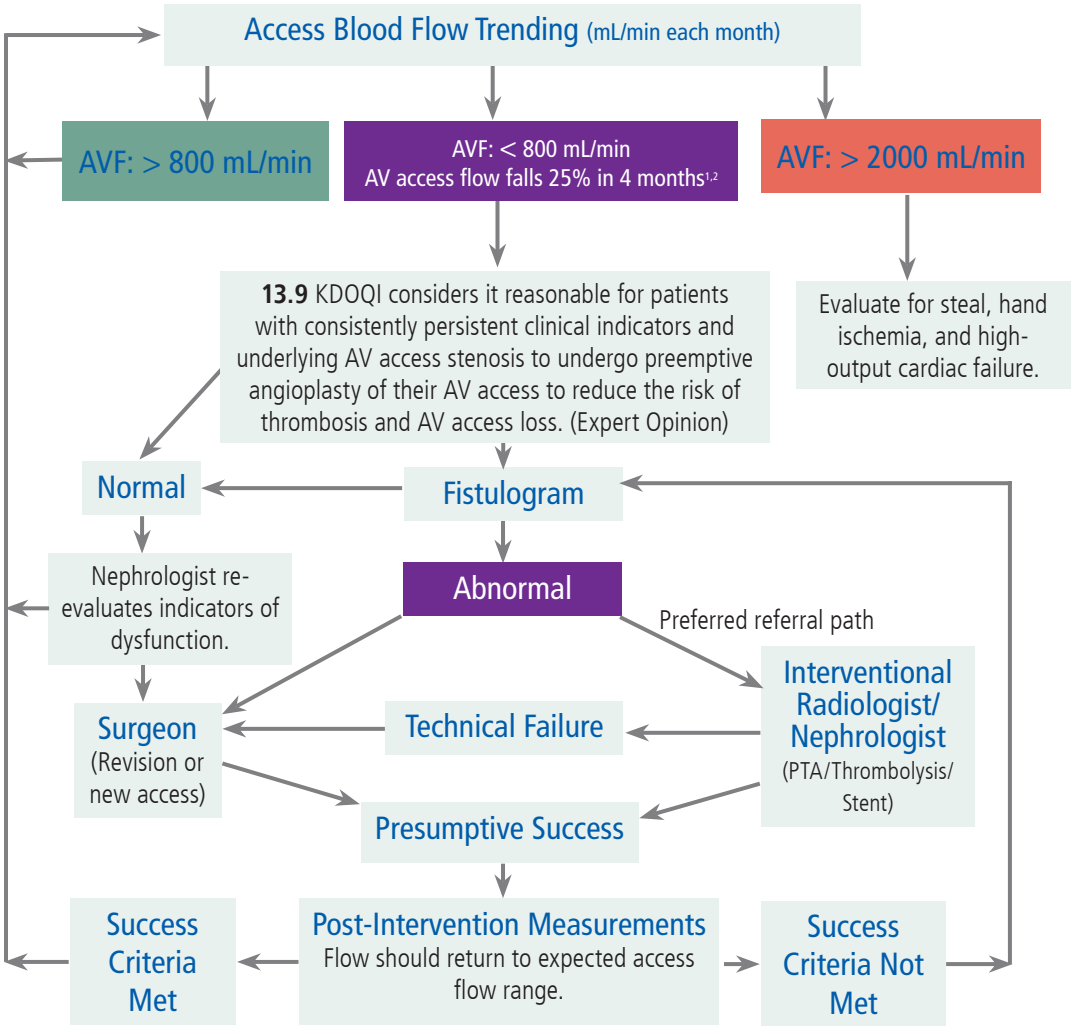
CLINICAL INTERPRETATION KEY:

Probable risk for Hemodynamically Significant Stenosis/Recirculation as flow decreases (indicated by color progression from blue to purple)	Expected Access Flow Range Expected flow range is ideal. However, a sudden drop of 25% in this range may signal a potential onset of stenosis.	Probable risk for Cardiac Failure as flow increases (indicated by color progression from yellow to red)
Action: **Consider Clinical Examination & Imaging**	**Action:** **If Flow Is Steady, Continue Monitoring. If 25% Decrease Occurs, Consider Clinical Exam & Imaging**	**Action:** **Evaluate the patient for signs and symptoms of high output cardiac failure.**

Notes:

- Actual flow levels for AV fistula and graft patients should be customized by the nephrologist.
- A clinical examination (look, listen, feel, arm elevation and augmentation) should be used routinely as part of the pre-cannulation process.
- Transonic access flow measurements are intended to be utilized in conjunction with a clinical examination to detect/confirm indications of access dysfunction.
- Snuffbox or endovascular fistulas may have a lower access flow range depending on the location of the anastomosis and the vessel's outflow configuration.
- Upper arm AV fistulas typically have a higher access flow range due to the larger artery size.
- A potential for cardiac overload exists at flow >1600-3000 mL/min. Evaluate patient for signs and symptoms of high-output cardiac failure.

Upper Arm Arteriovenous (AV) Fistula



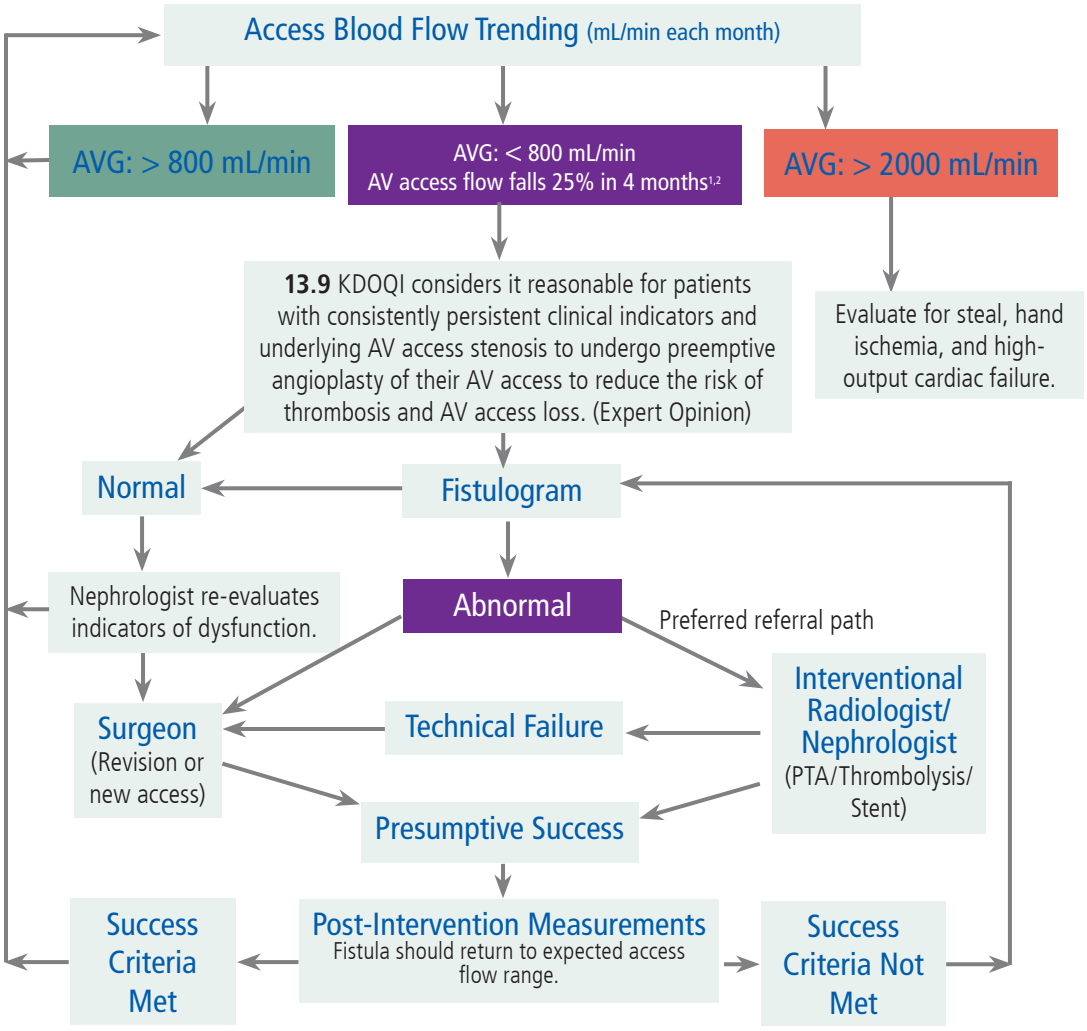
CLINICAL INTERPRETATION KEY:

Probable risk for Hemodynamically Significant Stenosis/Recirculation as flow decreases (indicated by color progression from blue to purple)	Expected Access Flow Range Expected flow range is ideal. However, a sudden drop of 25% in this range may signal a potential onset of stenosis.	Probable risk for Cardiac Failure as flow increases (indicated by color progression from yellow to red)
Action: **Consider Clinical Examination & Imaging**	**Action:** **If Flow Is Steady, Continue Monitoring. If 25% Decrease Occurs, Consider Clinical Exam & Imaging**	**Action:** **Evaluate the patient for signs and symptoms of high output cardiac failure.**

Notes:

- Actual flow levels for AV fistula and graft patients should be customized by the nephrologist.
- A clinical examination (look, listen, feel, arm elevation and augmentation) should be used routinely as part of the pre-cannulation process.
- Transonic access flow measurements are intended to be utilized in conjunction with a clinical examination to detect/confirm indications of access dysfunction.
- Snuffbox or endovascular fistulas may have a lower access flow range depending on the location of the anastomosis and the vessel's outflow configuration.
- Upper arm AV fistulas typically have a higher access flow range due to the larger artery size.
- A potential for cardiac overload exists at flow >1600-3000 mL/min. Evaluate patient for signs and symptoms of high-output cardiac failure.

Arteriovenous (AV) Graft



CLINICAL INTERPRETATION KEY:

Probable risk for Hemodynamically Significant Stenosis/Recirculation as flow decreases (indicated by color progression from blue to purple)	Expected Access Flow Range Expected flow range is ideal. However, a sudden drop of 25% in this range may signal a potential onset of stenosis.	Probable risk for Cardiac Failure as flow increases (indicated by color progression from yellow to red)
Action: **Consider Clinical Examination & Imaging**	**Action:** **If Flow Is Steady, Continue Monitoring. If 25% Decrease Occurs, Consider Clinical Exam & Imaging**	**Action:** **Evaluate the patient for signs and symptoms of high output cardiac failure.**

Notes:

- Actual flow levels for AV fistula and graft patients should be customized by the nephrologist.
- A clinical examination (look, listen, feel, arm elevation and augmentation) should be used routinely as part of the pre-cannulation process.
- Transonic access flow measurements are intended to be utilized in conjunction with a clinical examination to detect/confirm indications of access dysfunction.
- Snuffbox or endovascular fistulas may have a lower access flow range depending on the location of the anastomosis and the vessel's outflow configuration.
- Upper arm AV fistulas typically have a higher access flow range due to the larger artery size.
- A potential for cardiac overload exists at flow >1600-3000 mL/min. Evaluate patient for signs and symptoms of high-output cardiac failure.

2019 Vascular Access KDOQI Guidelines

Statements: Appropriate Use of Monitoring/Surveillance for AV Access Flow Dysfunction

Physical Examination (Monitoring)

13.1 KDOQI recommends regular physical examination or check of the AVF by a knowledgeable and experienced health practitioner to detect clinical indicators of flow dysfunction of the AVF. (Conditional/Strong Recommendation, Moderate Quality of Evidence) See Table 13.2 for clinical indicators.

13.2 KDOQI recommends regular physical examination or check of the AVG, by a knowledgeable and experienced health practitioner, to detect clinical indicators of flow dysfunction of the AVG. (Conditional/Strong Recommendation, Moderate Quality of Evidence) See Table 13.2 for clinical indicators.

13.3 KDOQI considers it reasonable for nephrology trainees and health practitioners involved with clinical HD patient care to be properly trained in physical examination of the AV access to monitor for and detect AV access flow dysfunction. (Expert Opinion)

Surveillance to Facilitate Patency

13.4 There is inadequate evidence for KDOQI to make a recommendation on routine AVF surveillance by measuring access blood flow, pressure monitoring, or imaging for stenosis, that is additional to routine clinical monitoring, to improve access patency. *Note: In other words, monitoring of vascular access is primary, while surveillance findings are supplementary, and action should not be based solely on surveillance findings.*

13.5 KDOQI does not suggest routine AVG surveillance by measuring access blood flow, pressure monitoring, or imaging for stenosis, that is additional to regular clinical monitoring, to Guideline 13. AV Access Flow Dysfunction—Monitoring/ Surveillance S80 AJKD Vol 75 | Iss 4 | Suppl 2 | April 2020/

Endovascular Interventions to Improve Patency

13.6 KDOQI does not recommend pre-emptive angioplasty of AVFs with stenosis, not associated with clinical indicators, to improve access patency. (Conditional Recommendation, Moderate Quality of Evidence)

13.7 KDOQI does not recommend pre-emptive angioplasty of AVGs with stenosis, not associated with clinical indicators, to improve access patency. (Conditional Recommendation, Moderate Quality of Evidence)

Surgical Interventions to Improve Patency

13.8 There is inadequate evidence for KDOQI to make a recommendation on pre-emptive surgical interventions in AVFs with stenosis, not associated with clinical indicators, to improve access patency.

Statement: Pre-emptive Intervention for AV Access Stenosis Associated With Clinical Indicators

13.9 KDOQI considers it reasonable for patients with consistently persistent clinical indicators and underlying AV access stenosis to undergo preemptive angioplasty of their AV access to reduce the risk of thrombosis and AV access loss. (Expert Opinion)

KDOQI Guidelines cont.

Table 13.1. Routine AV Access Monitoring by Physical Examination

Exam Steps	Fistula (Normal)	Graft (Normal)	Flow-related Dysfunction or Poor Maturation (Abnormal)	Infection, Steal Syndrome, or Aneurysm/Pseudoaneurysm[a] (Abnormal)
Look	Well-developed main venous outflow, no irregular/dilated areas or aneurysm formations, adequate areas of straight vein that can be used for 2-needle, rope-ladder cannulation Vessel collapses when arm is elevated above head	Uniform-sized graft in a loop or straight configuration No irregular areas or aneurysm or seroma formations with organized site rotation used for cannulation	AVF with poor maturation—multiple venous outflow veins (accessory veins), poorly defined cannulation areas **AVF:** Stenosis can occur in artery or any venous outflow vein Look for a narrowing of the outflow vein, abnormal pulsations, or aneurysm formations **AVF or AVG:** Dilated neck veins or surface collateral veins in the arm or neck above the vascular access	**Infection:** Redness, swelling, induration, drainage, or pus **Steal syndrome:** Extremity/hand discoloration, skin ulceration due to poor arterial blood flow to the hand Check nail beds, fingers and hand for unusual skin changes **Aneurysm** Abnormal areas of dilatation with overlying skin thinning
Listen with a stethoscope	Low-pitch continuous diastolic and systolic	Low-pitch continuous diastolic and systolic	High-pitch discontinuous systolic only	**Steal syndrome** AVF may have a very strong bruit
Feel with your fingers	Thrill at the arterial anastomosis and throughout the entire outflow vein that is easy to compress	Thrill strongest at the arterial anastomosis but should be felt over entire graft and be easy to compress	**AVF:** Pulse at the site of a stenotic lesion—may be water-hammer in quality and feel **AVG:** Thrill and/or pulse strong at the site of stenotic lesion pulse has a water-hammer feel An AVG with a low intra-access blood flow feels mushy Local area of the graft that feels mushy or irregular in shape can be a site of aneurysm formation	**Infection** Warm or painful to touch, swelling **Steal syndrome** Feel bilateral limbs (hands and fingers) and compare for the access limb to be the same as the nonaccess limb Compare temperature, grip strength, and range of motion and any complaints of changes in sensation or pain If the access limb has any major differences than the nonaccess limb, consider steal syndrome

Abbreviations: AVF, arteriovenous fistula; AVG, arteriovenous graft.
[a]Also see Guidelines 16 through 19 for specific complications.

Table 13.2. Clinical Indicators (Signs and Symptoms) Suggesting Underlying Clinically Significant Lesions During Access Monitoring

Procedure	Clinical Indicators	
Physical examination or check	• Ipsilateral extremity edema • Alterations in the pulse, with a weak or resistant pulse, difficult to compress, in the area of stenosis • Abnormal thrill (weak and/or discontinuous) with only a systolic component in the region of stenosis • Abnormal bruit (high pitched with a systolic component in the area of stenosis) • Failure of the fistula to collapse when the arm is elevated (outflow stenosis) and lack of pulse augmentation (inflow stenosis) • Excessive collapse of the venous segment upon arm elevation	354,365 378 239 360 267
Dialysis	• New difficulty with cannulation when previously not a problem • Aspiration of clots • Inability to achieve the target dialysis blood flow • Prolonged bleeding beyond usual for that patient from the needle puncture sites for 3 consecutive dialysis sessions • Unexplained (>0.2 units) decrease in the delivered dialysis dose (Kt/V) on a constant dialysis prescription without prolongation of dialysis duration	379 239 360

AV Fistula or AV Graft: Delivered Blood Flow Protocol

Measure Delivered Blood Flow Rate

With the bloodlines configured as normally used (document configuration), measure flow. Transonic Delivered Blood Flow Rate (Qb) is within 0-10% of the hemodialysis machine's set blood pump speed or delivery flow rate.*

YES

Transonic Delivered Blood Flow Rate (Qb) is within 0-10% of the Hemodialysis Machine's Set Blood Pump Speed or Delivery Flow Reading.

True Delivered Blood Flow correlates with the Hemodialysis machine's setting.

Proceed to Recirculation Measurement

NO

The discrepancy between Transonic's Delivered Blood Flow Rate (Qb) and the Hemodialysis Machine's Set Blood Pump speed is >10% or Delivery Flow Reading* is >10%.

Turn pump speed to 200 mL/min and repeat the blood flow measurement.

YES

Transonic Delivered Blood Flow rate (Qb) is within 0-10% of the Hemodialysis Machine's Set or Delivered Flow Reading.

True Delivered Blood Flow correlates with the Hemodialysis machine's setting. The previous deviations at high pump settings could be due to needle size, and/or site of needle placement.

Proceed to Recirculation Measurement

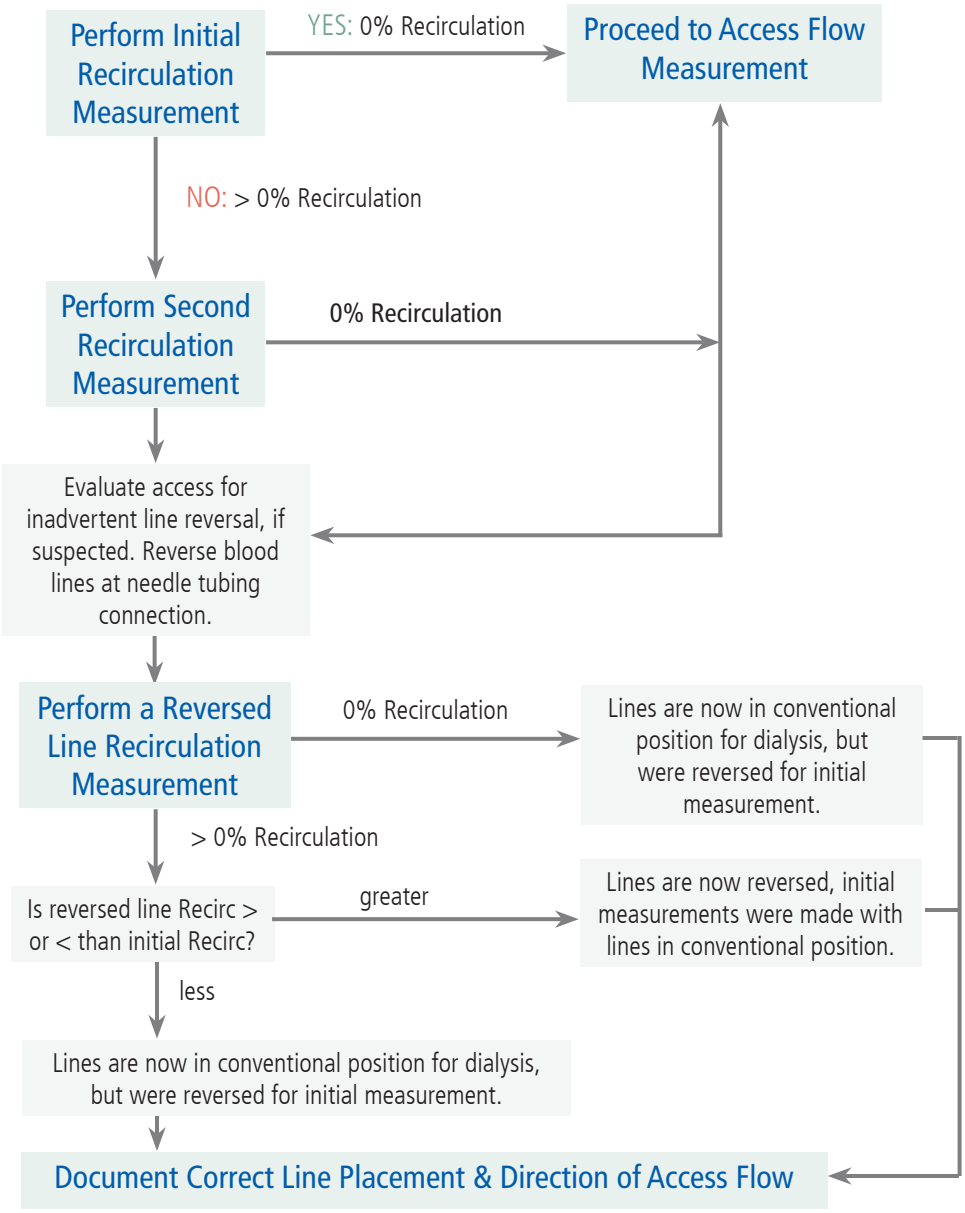
NO

Transonic Delivered Blood Flow Rate (Qb) Does Not Agree with the Hemodialysis Machine's Blood Pump Speed Setting at 200 mL/min.

- Verify correct bloodline was selected from the tubing list.
- Verify proper sensor placement and coupling.
- Check for kinking of lines.
- Verify correct needle placement.
- Verify the dialysis blood pump is correctly calibrated.

*Some Hemodialysis Machines display both a Set Blood Pump Speed and Delivery Flow Reading. If both readings are displayed on your Hemodialysis machine, use the Delivery Flow Reading.

Recirculation Protocol: AV Fistulas & Grafts



Optimizing HD Adequacy in Catheters

Step 1:

Measure Delivered Blood Flow Rate

With the bloodlines configured as normally used (document configuration), measure flow. Transonic Delivered Blood Flow Rate (Qb) is within 0-10% of the hemodialysis machine's set blood pump speed or delivery flow rate.*

YES

Transonic Delivered Blood Flow Rate (QB) is within 0-10% of the Hemodialysis Machine's Set or delivery flow reading*

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration

Proceed to Recirculation Measurement

NO

Transonic Delivered Blood Flow Rate (QB) is >10% Lower than the Hemodialysis Machine's Set Blood Pump Speed or Delivery Flow Reading*

Only proceed if both catheter lumens had blood return with treatment initiation.

Using aseptic technique, reverse the catheter configuration by reversing the bloodlines to the opposite lumens of the catheter used for the initial measurement. Document configuration.

Repeat the blood flow measurement.

YES

Transonic Delivered Blood Flow Rate (QB) is within 0-10% of Hemodialysis Machine's Set, or Delivery Flow reading*

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration

Proceed to Recirculation Measurement

NO

Transonic Delivered Blood Flow Rate (QB) is 10% Lower than the Hemodialysis Machine's Set Blood Pump Speed

Carefully document measurement and catheter configurations.

Proceed to recirculation measurements with both catheter configurations.

Escalate the results of the findings to the nephrologist for possible catheter evaluation or prescription adjustment to address catheter dysfunction.

*Some Hemodialysis machines display both a Set Blood Pump Speed and Delivery Flow Reading. If both readings are displayed on your Hemodialysis machine, use the Delivery Flow Reading.

Catheter Configurations:

- Normal Configuration: Arterial Catheter Hub to Arterial Bloodline + Venous Catheter Hub to Venous Bloodline
- Reverse Configuration: Arterial Catheter Hub to Venous Bloodline + Venous Catheter Hub to Arterial Catheter Hub

Optimizing HD Adequacy in Catheters

Step 2:

Check Recirculation

With the bloodlines configured from Step One with maximized Delivered Blood Flow Rate,

Measure Recirculation

Recirculation is within 0 - 10%

NO

Recirculation is Greater than 10%

Only proceed if both catheter lumens had blood return with treatment initiation.

Using aseptic technique, reverse the catheter configuration by reversing blood-lines to the opposite lumens of the catheter used for the initial measurement.

Repeat Recirculation Measurement

YES

Recirculation is within 0-10%

Current blood pump setting is maximizing Delivered Blood Flow with the current catheter to bloodline configuration.

NO

Recirculation is Greater than 10%

Carefully document measurement and catheter configurations.

Escalate the results of the findings to the nephrologist for possible catheter evaluation or prescription adjustment to address catheter dysfunction.

YES

Recirculation is within 0-10%

Current blood pump setting is maximizing Delivered Blood Flow with the current catheter to bloodline configuration.

Optimizing HD Adequacy in Catheters

For Use with Hemodialysis machines that have Compensated Blood Flow Rate Capabilities

Step 1:

Measure Delivered Blood Flow Rate

With the bloodlines configured as normally used (document configuration), measure flow.

Transonic Delivered Blood Flow Rate (Qb) is higher than the set blood pump speed or within 0-10% lower than the set blood pump speed.

NOTE: Both higher and lower differences are displayed in red on the Transonic screen.

YES

Transonic Delivered Blood Flow Rate (QB) is Higher than the Set Blood Pump Speed or is within 0-10% Lower than the Set Blood Pump Speed.

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration

Proceed to Recirculation Measurement

NO

Transonic Delivered Blood Flow Rate (QB) is >10% Lower than the Set Blood Pump Speed.

Only proceed if both catheter lumens had blood return with treatment initiation.

Using aseptic technique, reverse the catheter configuration by reversing bloodlines to the opposite lumens of the catheter used for the initial measurement. Document configuration.

Repeat the blood flow measurement.

YES

Transonic Delivered Blood Flow Rate (QB) is Higher than the Set Blood Pump Speed or is within 0-10% Lower than the Set Blood Pump Speed.

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration

Proceed to Recirculation Measurement

NO

Transonic Delivered Blood Flow Rate (QB) is 10% Lower than the Set Blood Pump Speed

Carefully document measurement and catheter configurations.

Proceed to recirculation measurements with both catheter configurations.

Escalate the results of the findings to the nephrologist for possible catheter evaluation or prescription adjustment to address catheter dysfunction.

Catheter Configurations:

- Normal Configuration: Arterial Catheter Hub to Arterial Bloodline + Venous Catheter Hub to Venous Bloodline
- Reverse Configuration: Arterial Catheter Hub to Venous Bloodline + Venous Catheter Hub to Arterial Catheter Hub

Optimizing HD Adequacy in Catheters cont.

For Use with Hemodialysis machines that have Compensated Blood Flow Rate Capabilities

Step 2:

Check Recirculation

With the bloodlines configured from Step One with maximized Delivered Blood Flow Rate,

Measure Recirculation

Recirculation is within 0 - 10%

NO

Recirculation is Greater than 10%

Only proceed if both catheter lumens had blood return with treatment initiation.

Using aseptic technique, reverse the catheter configuration by reversing blood-lines to the opposite lumens of the catheter used for the initial measurement.

Repeat Recirculation Measurement

YES

Recirculation is within 0-10%

Current blood pump setting is maximizing Delivered Blood Flow with the current catheter to bloodline configuration.

NO

Recirculation is Greater than 10%

Carefully document measurement and catheter configurations.

Escalate the results of the findings to the nephrologist for possible catheter evaluation or prescription adjustment to address catheter dysfunction.

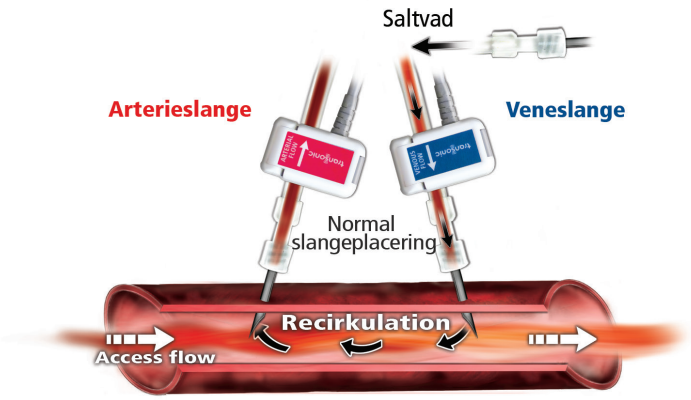
YES

Recirculation is within 0-10%

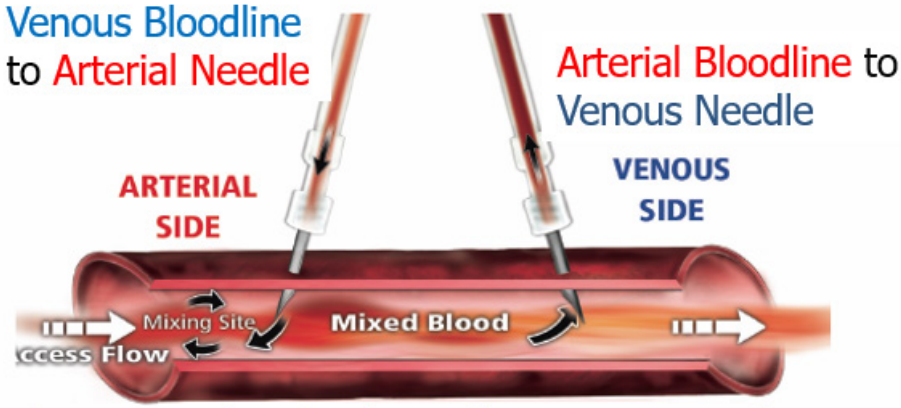
Current blood pump setting is maximizing Delivered Blood Flow with the current catheter to bloodline configuration.

Transonic Ultrasound Dilution Measurements

Recirculation



Access Flow



Hemodynamics of access flow measurement with lines reversed by Krivitski Method. Line reversal relates an artificial recirculation loop with mining site at the arterial side of the access.

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