

## **Supplemental Material**

### **Supplemental Material Table of Contents**

Supplemental Table S1. Standards for Quality Improvement Reporting Excellent Guidelines and manuscript section with relevant content.....	2
Supplemental Table S2. Focus group and interview guides.....	3
Supplemental Table S3. Research sub-study questionnaires.....	5
Supplemental Table S4. Characteristics of the pre-intervention focus group and interview participants.....	7
Supplemental Table S5. Overview of vascular access educational brochure and education session content.....	9

**Supplemental Table S1.** SQUIRE guidelines and manuscript section with relevant content.<sup>25</sup>

<b>Title and Abstract</b>	
<b>1. Title</b>	Indicated that the initiative was undertaken to improve the quality of healthcare (AV access-based HD initiation)
<b>2. Abstract</b>	Provided adequate information to aid in searching and indexing; summarized key information, following the journal format
<b>Introduction</b>	<b><i>Why did you start?</i></b>
<b>3. Problem Description</b>	Suboptimal patient experiences during vascular access planning and rates of AV access-based HD initiation
<b>4. Available Knowledge</b>	Introduction and Discussion
<b>5. Rationale</b>	The QI program was designed to target both patient and health system barriers to AV access-based initiation based on existing evidence and additional data collected in the pre-intervention period as described in the Introduction, Methods, and Results.
<b>6. Specific Aims</b>	To: 1) improve the patient experience during pre-HD vascular access care, 2) improve the rate of AV access-based HD initiation, and 3) gain insights into optimal program implementation practices.
<b>Methods</b>	<b><i>What did you do?</i></b>
<b>7. Context</b>	Introduction, Results, and Table 2
<b>8. Intervention(s)</b>	Methods, Results, Table 1, and Figure 1
<b>9. Study of the Intervention(s)</b>	Methods
<b>10. Measures</b>	Methods and Supplemental Tables S2 and S3
<b>11. Analysis</b>	Methods
<b>12. Ethical Considerations</b>	Methods
<b>Results</b>	<b><i>What did you find?</i></b>
<b>13. Results</b>	Results, Tables 2 and 4, and Figure 3
<b>Discussion</b>	<b><i>What does it mean?</i></b>
<b>14. Summary</b>	Discussion
<b>15. Interpretation</b>	Discussion
<b>16. Limitations</b>	Discussion
<b>17. Conclusions</b>	Discussion
<b>Other Information</b>	
<b>18. Funding</b>	This work was funded by grant R21 DK116115 from the NIH/NIDDK. The funder did not play a role in project design; collection, analysis, and interpretation of data; writing the report; nor the decision to submit the report for publication.  Dr. Flythe is supported by the National Institute of Diabetes, Digestive and Kidney Diseases (NIDDK: K23 DK109401).

Abbreviations: AV, arteriovenous; HD, hemodialysis; SQUIRE, Standards for Quality Improvement Reporting Excellence.

**Supplemental Table S2.** Focus group and interview guides.

<b>Patient and Care Partner Focus Group Moderator Guide</b>	
<b>1. Welcome, Introduction, and Ground Rules</b>	
<b>2. Knowledge and Perceptions of Vascular Access</b>	<p>Q. What was the first thing you learned about vascular access? PROBE: Can you describe your reaction?</p> <p>Q. From whom did you first learn about vascular access? PROBE: When did this person first tell you about vascular access? (at what point in your kidney care did you receive this information?) PROBE: What kinds of things did you learn?</p> <p>Q. Please tell me about the education on vascular access, if any, that you received. PROBE: Did you feel like you had an adequate understanding of the types of vascular access and the process for having a vascular access placed? Why or why not? PROBE: Was follow-up education provided? If so, how often?</p> <p>Q. (<i>For advanced CKD patients</i>) Do you have any fears or worries about vascular access? PROBE: If so, with whom do/did you discuss them? Do you still have those fears? PROBE: Do/did you feel supported? If not, how could your support have been improved?</p> <p>Q. (<i>For dialysis patients</i>) Knowing what you know now, what information do you wish you had when you started the vascular access process?</p>
<b>3. Involvement in vascular access decision-making and navigating care processes</b>	<p>Q. Who helped you make the decision about vascular access type? PROBE: If you put it off, why? How were you feeling at the time? Was the complexity of the process overwhelming? Were you nervous?</p> <p>Q. How much of a role did you play in the decision-making about vascular access type? PROBE: Did you feel like you had a choice in type of vascular access?</p> <p>Q. How well does this process fit or not fit with your experience with vascular access planning and creation prior to starting dialysis?</p> <div style="text-align: center; border: 1px solid black; padding: 10px; margin: 10px 0;"> <p><b>Possible steps in vascular access creation process</b></p> <pre> graph LR     A[Kidney disease worsens; choose hemodialysis] --&gt; B[Plan for fistula or graft]     B --&gt; C[See surgeon]     C --&gt; D((Have surgery))     D --&gt; E[Monitor access, get ready for dialysis]     E --&gt; F[Start hemodialysis]             </pre> </div> <p>Q. (<i>For dialysis patients</i>) Think back to when you started the process of having your first vascular access placed. How informed or educated did you feel about the steps associated with vascular access planning? Now that you have started dialysis, how confident do you feel in navigating these steps?</p> <p>Q. (<i>For advanced CKD patients</i>) How informed or educated do you feel about the steps associated with vascular access planning? How confident do you feel navigating these care processes associated with vascular access planning?</p>
<b>4. Barriers to and facilitators of AV access creation</b>	<p>Q. Did you encounter challenges navigating the AV access creation process? PROBE: If yes, in what step? What was the challenge? How might have it been avoided?</p> <p>Q. Beyond those that we have discussed, what other barriers to AV access creation prior to HD start have you encountered? PROBE: Any personal barriers? Education barriers? Process or system barriers? (e.g. attitudes or fears, transportation, insufficient knowledge, etc.)</p> <p>Q. What would you suggest that medical providers like doctors or nurses do to improve patients' experiences related to vascular access?</p>

5. Final thoughts & Wrap-up	Q. Does anyone have any final thoughts that they haven't gotten to share yet? Was there something you were hoping to talk about today that we didn't discuss?
<b>Medical Provider and Clinic Personnel Interview Guide</b>	
1. Welcome, Introduction, and Ground Rules	
2. Role in the vascular access creation process	<p>Q. What role do you play in the vascular access creation process?</p> <p>Q. In general, how is the vascular access type determined (fistula, graft, catheter)?          PROBE: What decision-making role, if any, do patients play in selecting the type of access they receive?          PROBE: How do you typically explain vascular access to patients?          PROBE: When do you typically provide vascular access education or explanations to patients? (e.g. at process time points? GFR threshold? CKD stage?)          PROBE: Do you use resources like decision aids or other educational materials to help patients understand vascular access? If yes, which ones? Do you know what other educational materials patients receive, if any?</p>
3. Knowledge, beliefs, and perceptions of vascular access and vascular access education	<p>Q. Please tell me what type of vascular access (fistula, graft, catheter) you think is the best access for dialysis patients.          PROBE: What makes you say this?</p> <p>Q. What type of vascular access education do patients at this institution receive?          PROBE: Tell me about the format (in-person, on-line, pamphlets). Who provides the education?</p>
4. Perceived patient-level and system-level barriers to AV access creation	<p>Q. What are the main patient barriers to creation of AV access prior to HD start? (e.g., attitude or fears, transportation, insufficient knowledge, etc.)</p> <p>Q. What are the main health system barriers to creation of AV access prior to HD start? (e.g., delayed presentation to nephrology, delayed surgical referral, missed appointments, long surgical wait times, etc.)</p> <div data-bbox="479 934 1437 1522" data-label="Diagram"> <p style="text-align: center;"><b>Arteriovenous (AV) access creation process steps before hemodialysis start</b></p> <pre> graph LR     Start[Kidney disease progresses; choose dialysis type] --&gt; Step1[1. Receive access education]     Step1 --&gt; Step2[2. Vein mapping (ultrasound)]     Step2 --&gt; Step3[3. Undergo AV access evaluation and placement]     Step3 --&gt; Step4[4. Surgery]     Step4 --&gt; Step5[5. AV access matures; follow-up procedures as needed]     Step5 --&gt; End[Dialysis initiation]      subgraph Care_Providers         PC[Primary Care]         Nephrology[Nephrology (Kidney doctor) Care]         Surgery[Surgery Care]         Interventional[Interventional Care]     end      PC --- Step1     Nephrology --- Step1     Nephrology --- Step2     Nephrology --- Step3     Surgery --- Step3     Surgery --- Step4     Interventional --- Step4     Interventional --- Step5         </pre> </div> <p>Q. At what steps do you see patients having the most challenges in the AV access creation process?</p> <p>Q. What kind of support do patients receive in navigating these care processes?</p> <p>Q. How confident do you feel in helping patients navigate these processes?          PROBE: How could your confidence be improved? Would any training or education improve your confidence?</p> <p>Q. How is the communication among providers during this process?          PROBE: Are there pre-established modes of communication (EHR messaging, email, other)? How could communication be improved?</p>
5. Wrap-up	Q. Do you have any final thoughts that you have not gotten to share yet? Was there something you wanted to talk about that we didn't discuss?

**Supplemental Table S3. Research sub-study questionnaires.**

**Patient Perceived Kidney Disease Self-Management Scale (self-efficacy)<sup>a</sup>**

*Response Options: strongly disagree (1), somewhat disagree (2), neutral (3), somewhat agree (4), strongly agree (5).*

1. It is difficult for me to find effective solutions to problems that occur with managing my kidney disease.
2. I find efforts to change things I don't like about my kidney disease are ineffective.
3. I handle myself well with respect to my kidney disease.
4. I am able to manage things related to my kidney disease as well as most other people.
5. I succeed in the projects I undertake to manage my kidney disease.
6. Typically, my plans for managing my kidney disease don't work out well.
7. No matter how hard I try, managing my kidney disease doesn't turn out the way I would like.
8. I'm generally able to accomplish my goals with respect to managing my kidney disease.

**Patient Perceived Confidence in Navigating Vascular Access Care Processes<sup>b</sup>**

*Response Options: not at all confident (1) to totally confident (10)*

1. How confident do you feel completing the steps involved in getting a dialysis vascular access?
2. How confident do you feel that you know who to go to for questions about vascular access?
3. How confident do you feel that you understand the importance of getting a vascular access?

**Patient Perceived Vascular Access Knowledge<sup>c</sup>**

*Questions and response options*

1. What does a vascular access do? (1 point for correct answer C)
  - a. It helps you figure out what you can eat and drink when you start hemodialysis
  - b. It makes a way for your doctor to know how well your kidneys are doing
  - c. It makes a way for your blood to get to the hemodialysis machine
  - d. Don't know
2. What are the 3 kinds of vascular access for hemodialysis? (1 point each for correct answers A, B, & C)
  - a. Fistula
  - b. Graft
  - c. Catheter
  - d. Other: \_\_\_\_\_
  - e. Don't know
3. What kind of vascular access can get infected most easily? (1 point for correct answer C)
  - a. Fistula
  - b. Graft
  - c. Catheter
  - d. Don't know
4. What kind of vascular access usually lasts the longest? (1 point for correct answer A)
  - a. Fistula
  - b. Graft
  - c. Catheter
  - d. Don't know
5. Who picks the kind of vascular access and where it will go on the body? (1 point for correct answer D)
  - a. Kidney doctor only
  - b. Patient only
  - c. Surgeon only
  - d. Kidney doctor, patient, and surgeon together
  - e. Don't know
6. Vein mapping helps you figure out the best place on your body for your access. (1 point for correct answer A)
  - a. True
  - b. False
  - c. Don't Know
7. Vein mapping happens after vascular access surgery. (1 point for correct answer B)
  - a. True
  - b. False
  - c. Don't Know
8. A fistula is ready to be used for dialysis (in other words, ready to be stuck with a needle for dialysis) within one week after it is made. (1 point for correct answer B)
  - a. True
  - b. False
  - c. Don't Know

## Medical Provider/Personnel Perceived Confidence in Helping Patients Navigate Vascular Access Care Processes<sup>d</sup>

*Response Options: not at all confident (1) to very confident (10)*

1. How confident are you in doing your part to assist your patients through the vascular access creation process?
2. How confident are you in knowing how far your patients have progressed in the vascular access creation process?
3. How confident are you in your own understanding of the vascular access creation steps?
4. How confident are you in your ability to explain vascular access to your patients?
5. How confident are you in your ability to explain the vascular access creation process to your patients?
6. How confident are you in your ability to help your patients overcome barriers to vascular access creation?
7. How confident are you in your ability to communicate with your patients about their emotions surrounding the vascular access creation process?
8. How confident are you in communicating appropriate and timely information to other providers about your patients who are going through the vascular access creation process?
9. How confident are you that you are receiving appropriate and timely information from other providers about your patients who are going through the vascular access creation process?
10. How confident are you that you are giving your patients the educational materials and information they need to get through the vascular access creation process?
11. How confident are you that your healthcare system is set up to support your patients' successful navigation of the vascular access creation process?

<sup>a</sup> Patient Perceived Kidney Disease Self-Management Scale Scoring: Reverse-score questions 1, 2, 6, & 7. Individual score range: 1 (strongly disagree) – 5 (strongly agree). Total score range: 8 (low) – 40 (high) perceived ability to self-manage kidney disease.<sup>28</sup>

<sup>b</sup> Patient Perceived Confidence in Navigating Vascular Access Care Processes Question Scoring: Individual score range: 1 (not at all confident) – 10 (totally confident). Total score range (responses averaged): 1 (low) – 10 (high) perceived confidence in ability to navigate the vascular access creation process.

<sup>c</sup> Patient Perceived Vascular Access Knowledge Question Scoring: Individual score range: 0 (no correct answers) - 3 (highest number of correct answers for a single question). Total score range: 0 (low) – 10 (advanced) knowledge of vascular access, including the creation process.

<sup>d</sup> Medical Provider/Clinic Personnel Perceived Confidence in Helping Patients Navigate Vascular Access Processes Question Scoring: Individual score range: 1 (not at all confident) – 10 (very confident). Total score range (responses averaged): 1 (low) – 10 (high) confidence in ability to help patients navigate the vascular access creation process (average of total questionnaire score range: 11 – 110).

**Supplemental Table S4.** Characteristics of pre-intervention focus group and interview participants.

<b>Characteristic</b>	<b>UNC (n=11)</b>	<b>Geisinger Health (n=13)</b>
<b>Patients</b>		
Participant type		
Hemodialysis patient	5 (45)	4 (31)
Advanced CKD patient	4 (36)	5 (38)
Care partner	2 (18)	4 (31)
Female	5 (45)	7 (54)
Age (years)	67 [61.5-72]; (33-82)	64 [59-73]; (25-87)
Race		
African American	7 (64)	0
White	4 (36)	13 (100)
Education		
<High school	0	0
Some high school	1 (9)	1 (8)
High school graduate or GED	6 (55)	6 (46)
Some college or 2-year degree	2 (18)	1 (8)
4-year college graduate or more	2 (18)	5 (38)
Household income (\$)		
30,000	6 (67)	3 (33)
>30,000	3 (33)	6 (67)
	(n=9)	(n=9)
Nephrology care (years)	4 [2-6]; (0.5-17) (n=9)	4.5 [3.8-6]; (2-12) (n=8)
Vascular access type		
Fistula	4 (36)	12 (100)
Graft	1 (9)	0
Catheter	2 (18)	0
None	3 (27)	0
Fistula & Catheter	1 (9)	0
		(n=12)
Hemodialysis vintage (years)	0.5 [0.5-0.83]; (0.3-1) (n=5)	0.4 [0.4-0.7]; (0.3-1) (n=3)
Kidney Disease Stage [CKD]		
Stage 4	1 (25)	4 (80)
Stage 5	2 (50)	1 (20)
Don't know	1 (25)	0
	(n=4)	(n=5)
Aware of last eGFR [CKD only]	4 (100) (n=4)	3 (60) (n=5)
Last eGFR, mL/min/1.73m <sup>2</sup> [CKD only]	10.3 ±4 (n=4)	15.2 ±0.3 (n=3)
Had first visit with vascular surgery [CKD only]	2 (50) (n=4)	5 (100) (n=5)
<b>Medical providers and clinic personnel</b>	<b>N=8</b>	<b>N=8</b>
Participant type		
Nephrologist	2 (25)	1 (13)
Surgeon	1 (13)	1 (13)
Educator	1 (13)	1 (13)
Nephrology scheduler	0	1 (13)
Vascular surgery nurse	1 (13)	1 (13)
Nurse Manager	2 (25)	2 (25)
Interventional Nephrologist	1 (13)	0
Interventional Radiologist	0	1 (13)
Female	5 (63)	6 (75)
Age (years)	43 [39-50.3]; (35-64)	40.5 [38-53]; (34-63)

Race		
African American	0	0
American Indian/Alaskan	0	0
Asian American	2 (25)	0
Hawaiian/Pacific Islander	0	0
White	6 (75)	6 (75)
Other	0	2 (25)
Hispanic ethnicity	1 (13)	2 (25)
Time worked in current position (years)	5 [2.6-8.1]; (0.92-18)	5.5 [4.3-7.8]; (1-14)
Time worked in role (years)	6.5 [4.8-8.1]; (0.92-18)	9 [6.8-13]; (5-14)

<sup>a</sup> Values are given as a number (percentage), mean  $\pm$  standard deviation, or as median [interquartile range]; (range). [CKD]-designated characteristics are provided for CKD patient participants only.

Abbreviations: CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; GED, General Educational Development; HD, hemodialysis.

**Supplemental Table S5.** Overview of vascular access educational brochure and education session content.<sup>a</sup>

<b>Vascular access educational brochure: Your Dialysis Vascular Access Journey</b>	
<b>Section</b>	<b>Content</b>
Vascular access overview	What is it? Why do I need it? When do I need it?
Types of vascular access	Fistula, graft, and catheter
Pros and cons of each type	General statement that there is no right or wrong type of access and that one may need a different type of access at different points in their dialysis journey. Fistula (Pros: usually lasts the longest, less likely to get infected than grafts and catheters, allows for swimming and showering; Cons: takes time to mature, may need extra procedures (1 out of 3 needs extra procedures to mature), uses needles, can look lumpy under the skin) Graft (Pros: usually ready for HD quicker than a fistula, less likely to get infected than a catheter, allows for swimming and showering; Cons: may not last as long as a fistula, can get clotted and need extra procedures, uses needles, can look lumpy under the skin) Catheter (Pros: does not require surgery, can be used for HD immediately, no needles, can be helpful for short periods when fistula/graft stops working; Cons: can get infected easily, may need exchanges, cannot get wet, sticks out of the body)
Decision-making	Patient fears, worries, and questions Medical team recommendation based on anatomy and comorbidities Care team discussions
Vascular access journey for fistulas and grafts	Care steps involved in AV access creation (learn about vascular access, vein mapping, meet with surgeon, have surgery, access maturation, HD initiation)
Appointment tracker	Space to record vascular access-related appointments
Glossary of terms	Definitions of common vascular access-related terms
Questions and notes	Space to record questions and notes
<b>Vascular access educational session facilitator guide</b>	
<b>Resources: Your Dialysis Vascular Access Journey (investigator-developed) and Understanding your Hemodialysis Access Options (American Association of Kidney Patients, AAKP)<sup>b</sup></b>	
<b>Section</b>	<b>Content/Script</b>
Introduction	<b>Prior to the education class, the navigator will:</b> Review patient electronic health record to get appointment information to fill out in educational booklets with patient.  <b>At education session:</b> Navigator should introduce themselves as the Dialysis Access Navigator and explain their role. Explain the purpose of the education session.  <b>SHOW/DISTRIBUTE:</b> Pass out the educational booklets – 1) Program educational booklet: “ <i>Getting Your Body Ready for Hemodialysis: The Vascular Access Journey</i> ”, and 2) AAKP brochure: “ <i>Understanding your Hemodialysis Access Options</i> ”.
Current knowledge: treatment	Gauge patient knowledge of treatment options.  <b>ASK:</b> Where did you learn about your treatment options for kidney failure, such as hemodialysis, peritoneal dialysis, and transplant?
Current knowledge: vascular access	Gauge patient knowledge of vascular access.  <b>ASK:</b> What do you know about vascular access so far?
What, why, and when of vascular access	<b>REVIEW:</b> Discuss the following sections of the educational booklet: – What is a vascular access? – Why do I need a vascular access? – When do I need a vascular access?

Vascular access types	<b>REVIEW:</b> Discuss explanations and pictures for all access type options <b>SHOW/DISTRIBUTE:</b> Show large laminated pictures of each access type.
Vascular access creation process	<b>REVIEW:</b> Explain the vascular access journey/process. Include what the patient can expect at each step.
Emotional aspects of HD preparation	Assess patient emotional status (fears, worries, denial, misconceptions, etc.). <b>ASK:</b> How do you feel about the need to start dialysis? <b>ASK:</b> How do you feel about getting a fistula or graft? What concerns do you have?
Logistical aspects of HD preparation	Assess patient logistical status (transportation, finances, etc..). <b>ASK:</b> What are some things you think might get in your way of getting a vascular access?
Access type decision-making	<b>REVIEW:</b> Explain the pros and cons of each access type, including the patient-to-patient variability in access experiences (need for extra procedures, access failure, etc.).
Vascular access care	<b>REVIEW:</b> Explain how to care for the vascular access once it has been created. Discuss sound, feel, and look of a fistula or graft that is healing well, and things to look out for that require the patient to go to the doctor. <i>(from AAKP booklet)</i>
Access use during HD	<b>REVIEW:</b> Explain how vascular access will be accessed during hemodialysis treatment.
Vascular access journey	Navigator will work with the patient to fill out patient appointment information in the investigator-developed educational brochure.
Peer mentoring	<b>REVIEW:</b> Explain peer mentor program, including program logistics, durations, and benefits of participating.  Some benefits of having a peer mentor: <ul style="list-style-type: none"> <li>- Learning from someone who has been through the process</li> <li>- Getting emotional support</li> <li>- Getting tips on how to navigate the process</li> <li>- Better understanding of what is involved with hemodialysis treatments</li> </ul>
Peer mentoring interest	<b>ASK:</b> Would you be interested in talking with a peer mentor?
Closing	Pass out resource guide.  [Optional]: Administer needs and barriers assessment (or make arrangements to complete later).  Offer patients additional educational sessions (in person or via phone) as needed as they navigate the process. Let them know that you'll be reaching out to them periodically throughout their journey.

<sup>a</sup> Overview of the contents of the investigator-developed vascular access educational brochure, "Your Dialysis Vascular Access Journey" and key topics from the educational session facilitator guide. Educational sessions were conducted with individual patients and with groups of patients, per preference and schedule availability.

<sup>b</sup> Available at: <https://aakp.org/wp-content/uploads/2019/09/Hemo-Access-Options-Final.pdf>.