Government of **Western Australia**
Department of **Health**

Guideline for Vein Preservation in Chronic Kidney Disease

Renal Health Network 2017

better health ▪ better care ▪ better value

© Department of Health, State of Western Australia (2017)

Copyright to this material produced by the Western Australian Department of Health belongs to the State of Western Australia, under the provisions of the Copyright Act 1968 (Commonwealth Australia). Apart from any fair dealing for personal, academic, research or non-commercial use, no part may be reproduced without written permission of the Health Networks, Western Australian Department of Health. The Western Australian Department of Health is under no obligation to grant this permission. Please acknowledge the Western Australian Department of Health when reproducing or quoting material from this source.

Suggested citation

Western Australian Department of Health. Department of Health Engagement Suite: Framework. Perth: Health Networks, Western Australian Department of Health; 2017.

Important disclaimer

All information and content in this Material is provided in good faith by the Western Australian Department of Health, and is based on sources believed to be reliable and accurate at the time of development. The State of Western Australia, the Western Australian Department of Health and their respective officers, employees and agents, do not accept legal liability or responsibility for the Material, or any consequences arising from its use.

Contents

Abbreviations

ANZDATA	Australian New Zealand Dialysis and Transplant Registry
AVF	Arteriovenous fistula
AVG	Arteriovenous graft
CARI	Caring for Australians with Renal Impairment
CVC	Central venous catheter
CKD	Chronic Kidney disease
eGFR	Estimated glomerular filtration rate
ESRD	End stage renal disease
FSH	Fiona Stanley Hospital
HD	Haemodialysis
IV	Intravenous
PICC	Peripherally inserted central catheters
PD	Peritoneal Dialysis
RRT	Renal replacement therapy
RPH	Royal Perth Hospital
SCGH	Sir Charles Gairdner Hospital

Acknowledgements

The Renal Health Network acknowledges the valuable contribution of the following people in the drafting of this document:

Dr Doris Chan	Renal Physician, Sir Charles Gairdner Hospital
Ms Duxxa Tailor	Vascular Access Nurse Coordinator, Sir Charles Gairdner Hospital
Dr James Rippey	Emergency Physician, Sir Charles Gairdner Hospital
Dr Harry Moody	Renal Physician, Sir Charles Gairdner Hospital and Renal Health Network Co-Lead
Dr Hemant Kulkarni	Renal Physician, Royal Perth Hospital and Renal Health Network Co-Lead
Dr Claire Italiano	Infectious Disease Physician, and Chair of the WA Infectious Diseases Physician Group

Executive Summary

The Renal Health Network (RHN) developed the *Guideline for Vein Preservation in Chronic Kidney Disease* (hereafter, the Guideline) in partnership with clinical staff across WA involved in the care of patients with chronic kidney disease (CKD). The Guideline provides guidance and practical recommendations for optimal vein preservation in patients with CKD.

The prevalence of Renal Replacement Therapy (RRT) in Australia is 928 per million population.[1] Of those receiving dialysis as part of their RRT, 81% are on maintenance haemodialysis (HD). Successful HD requires long term permanent vascular access in the form of an arteriovenous fistula (AVF) or arteriovenous graft (AVG). These are associated with reduced risk of infection and mortality compared with dialysing through temporary central venous catheters (CVC). Creation of a well-functioning permanent vascular access is largely dependent on the presence of suitable peripheral forearm veins.

The following recommendations have been drafted to assist Health Service Providers who provide clinical services to CKD patients to develop localised policies to support optimal vein preservation practices for people with CKD.

Recommendations

Recommendation 1: Patient Education

Education regarding forearm vein preservation should be initiated in all patients with stage 3b chronic kidney disease (CKD) and higher who are likely to require dialysis therapy, in those on dialysis (haemodialysis or peritoneal dialysis), and in patients with a kidney transplant.

Recommendation 2: Peripheral Venous Access

The dorsal veins of the dominant hand should be used for insertion of peripheral venous access when possible.

Recommendation 3: Central Venous Access

Placement of a non-tunnelled central venous catheter (CVC), particularly in the subclavian vein, should be avoided in all patients with CKD, if possible. If unavoidable, the preferred site for central venous access in decreasing order is the internal jugular vein, external jugular vein and lastly the femoral vein.

Recommendation 4: Prolonged Intravenous Access

Peripherally inserted central catheter (PICC) should be avoided in patients with CKD and only considered if there are no other options. A small bore CVC in the internal jugular vessels is preferred if prolonged intravenous access is required.

Recommendation 5: Antibiotic Use

Appropriate oral antibiotic alternatives should be considered for all patients with CKD, whenever possible and medically suitable. In haemodialysis patients, consider the use of longer acting, renally cleared intravenous antibiotics particularly those which can be delivered during dialysis. Consultation with the infectious disease team is recommended.

[1] "Australia & New Zealand Dialysis and Transplant Registry Annual Reports", last modified September 29, 2015, http://www.anzdata.org.au/v1/report_2014.html

Purpose

To provide guidance and practical recommendations on optimal vein preservation in patients with Chronic Kidney Disease (CKD) and assist Health Service Providers in creating localised policies to support patient health and reduce complications.

Application

This guideline applies to Health Service Providers who provide clinical services to people with CKD. As such, "Health Service Providers" is used in this document to mean only those that provide clinical care to CKD patients. See Appendix A for a suggested implementation guide for the recommendations.

Background

In accordance with its commitment to improving outcomes in patients with end stage renal disease (ESRD), the West Australian Renal Health Network endeavours to promote the importance of vein preservation with the vision of improving incident and permanent vascular access rates and outcomes for all Western Australians with kidney disease. This document aims to provide guidance and practical suggestions for vein preservation in patients with chronic kidney disease (CKD) which serve to improve patient care, decrease complications, and enhance infection control.

Patients with stage 3-4 CKD are at increased risk of progression to ESRD and need for renal replacement therapy (RRT). The prevalence of RRT in Australia continues to rise and is currently at 928 per million population.[2] RRT may take the form of haemodialysis (HD), peritoneal dialysis (PD), or kidney transplantation. Amongst those on dialysis, the majority (81%) undergo maintenance HD.[3]

Table 1: Stages of Chronic Kidney Disease based on updated Kidney Disease Improving Global Outcomes (KDIGO) [4]

Stage	GFR (ml/min/1.73m^2)	Description
G1	>90	Normal or high
G2	60-89	Mildly decreased
G3a	45-59	Mildly to moderately decreased
G3b	30-44	Moderately to severely decreased
G4	15-29	Severely decreased
G5	<15	Kidney failure

Successful HD is dependent on the presence of a well-functioning permanent vascular access which allows for adequate and effective blood flow from the patient to the haemodialyser. The three main types of vascular access are native arteriovenous fistula (AVF), arteriovenous graft (AVG), and central venous catheter (CVC). The AVF, a surgically created anastomosis between an artery and a vein, is the access of first choice and is considered as the gold standard for vascular access in maintenance HD patients. It has been associated with the lowest infection and thrombosis rates, longest patency rates, and lower risk of morbidity and mortality compared with other types of vascular access.[5,6]

[2] "Australia & New Zealand Dialysis and Transplant Registry Annual Reports"
[3] "Australia & New Zealand Dialysis and Transplant Registry Annual Reports"
[4] Levey AS, de Jong PE, Coresh J, El Nahas M, Astor BC, Matsushita K, et al. The definition, classification, and prognosis of chronic kidney disease: a KDIGO Controversies Conference report. Kidney international. 2011 Jul;80(1):17-28. PubMed PMID: 21150873.
[5] Dixon BS, Novak L, Fangman J. Hemodialysis vascular access survival: upper-arm native arteriovenous fistula. American journal of kidney diseases: the official journal of the National Kidney Foundation. 2002 Jan;39(1):92-101. PubMed PMID: 11774107.
[6] Keuter XH, De Smet AA, Kessels AG, van der Sande FM, Welten RJ, Tordoir JH. A randomized multicenter study of the outcome of brachial-basilic arteriovenous fistula and prosthetic brachial-antecubital forearm loop as vascular access for hemodialysis. Journal of vascular surgery. 2008 Feb;47(2):395-401. PubMed PMID: 18155872.

When there is no suitable vein to create an AVF, an AVG which is created by placing a looped plastic tube to connect an artery and a vein, provides a suitable second option. However, AVGs have been associated with higher risk of infection, thrombosis and need for re-intervention compared with an AVF.[7] Non-tunnelled or tunnelled CVCs are large bore, bi-lumen catheters which can be placed in the large vein of the neck or groin to access the circulation for HD. These are the least ideal type of vascular access given that they are associated with the highest risk of infection, thrombosis, morbidity and mortality.

In 2013, only 33% of patients commencing HD in WA had a permanent vascular access (AVF/AVG) compared with the national incident permanent vascular access rate of 38%. These figures are below the benchmark set by the Caring for Australians with Renal Impairment (CARI) guidelines which states that at least 60% of all new starts to HD should have a functioning permanent access if known to a renal service for at least 3 months. Amongst those who were on chronic HD therapy, 77% of patients in WA were dialysing with a permanent vascular access in 2013. The best performing state had a prevalent permanent vascular access rate of 92%.[8]

One of the potential contributing factors to the low permanent vascular access rate is poor vein preservation practices. The ability to establish an AVF for dialysis is dependent upon having a suitable peripheral vein of sufficient size and elasticity which allows for dilatation and maturation. Frequent venepuncture and indiscriminate insertion of intravenous device into any central or peripheral vein has the potential to injure vessels either directly at the puncture site or indirectly by inciting phlebitis, sclerosis, thrombosis and stenosis.[9,10] Thus, the implementation of a practical and effective vein preservation policy to minimise and prevent injury to both central and peripheral veins caused by frequent venous cannulation and venesection is vital in the management of all patients with CKD.

[7] Fitzgerald JT, Schanzer A, McVicar JP, Chin AI, Perez RV, Troppmann C. Upper arm arteriovenous fistula versus forearm looped arteriovenous graft for hemodialysis access: a comparative analysis. Annals of vascular surgery. 2005 Nov;19(6):843-50. PubMed PMID: 16177869.

[8] "Australia & New Zealand Dialysis and Transplant Registry Annual Reports"

[9] Allen AW, Megargell JL, Brown DB, Lynch FC, Singh H, Singh Y, and Waybill, P. Venous thrombosis associated with the placement of peripherally inserted central catheters. Journal of vascular and interventional radiology: JVIR. 2000 Nov-Dec;11(10):1309-14. PubMed PMID: 11099241

[10] Grove JR, Pevec WC. Venous thrombosis related to peripherally inserted central catheters. Journal of vascular and interventional radiology : JVIR. 2000 Jul-Aug;11(7):837-40. PubMed PMID: 10928518.

Recommendations

Recommendation 1: Patient Education

Education regarding forearm vein preservation should be initiated in all patients with stage G3b chronic kidney disease (CKD) and higher who are likely to require dialysis therapy, in those on dialysis (haemodialysis or peritoneal dialysis), and in patients with a kidney transplant.

Rationale

Patients with CKD are at increased risk of progressive renal disease and future need for HD therapy. The rate of renal progression is dependent on the underlying aetiology, age, co-morbidities and presence of intercurrent illness. CKD is a lifelong illness and its associated co-morbidities frequently results in multiple presentations to various health practitioners who may not be aware of the presence of CKD or importance of vein preservation. Patient engagement and empowerment through education programs on vein preservation may help assist in preventing vessel injury for future vascular access.

Vein preservation practices remain important in HD patients with a functioning permanent vascular access given the high risk of access failure and need for creation of a new AVF/AVG in the contralateral arm. Similarly, patients on PD may require a temporary or permanent transition to HD given that PD technique survival rates in Australia is approximately 80% at 1 year and 40% at 3 years.[11] Patients with a functioning kidney transplant, particularly those with impaired kidney function, may still be at risk of graft loss and thus require vascular access for future HD therapy.

Recommendation 2: Peripheral Venous Access

The dorsal veins of the dominant hand should be used for insertion of peripheral venous access when possible.

Rationale

Successful creation of native AVFs are largely dependent on the availability of good quality upper limb veins. The initial AVF is preferentially created in the anterior forearm of the non-dominant hand using the cephalic vein at the wrist. Upper arm basilic and cephalic veins are used as alternatives if there are no suitable forearm vessels. While the antecubital veins are rarely used for direct needle access, maintaining the integrity of these vessels remain important for adequate drainage from any forearm vascular access and construction of the arterial portion of any upper arm fistula.[12] Ensuring patent central veins (subclavian and brachiocephalic) are also important to allow for uninterrupted venous drainage from a functional AVF.[13]

To preserve vessel integrity for future vascular access creation, the dorsal veins of the dominant hand are the preferred first option for insertion of peripheral venous access in all patients with CKD. If there is no suitable vein for cannulation, the dorsal veins of the non-dominant could be considered ensuring that a tourniquet is not applied on or above a functioning vascular access. The forearm veins of the dominant hand should only be used as a last resort. The median cubital and the cephalic veins are the most commonly used sites for venepuncture. To minimise venous scarring, the venepuncture site should be rotated.

See Appendix B for an outline of the vein selection hierarchy.

[11] "Australia & New Zealand Dialysis and Transplant Registry Annual Reports"
[12] Saad TF, Vesely TM. Venous access for patients with chronic kidney disease. Journal of vascular and interventional radiology : JVIR. 2004 Oct;15(10):1041-5. PubMed PMID: 15466788
[13] Mick Kumwenda, Sandip Mitra, & Claire Reid, Clinical Practice Guideline Vascular Access for Haemodialysis (UK: UK Renal Association, 2015), http://www.renal.org/docs/default-source/guidelines-resources/final-version-update-va-guidelines-2015-docx-2.pdf?sfvrsn=2

Recommendation 3: Central Venous Access

Placement of a non-tunnelled central venous catheter (CVC), particularly in the subclavian vein, should be avoided in all patients with CKD if possible. If unavoidable, the preferred site for central venous access in decreasing order is the internal jugular vein, external jugular vein and lastly the femoral vein.

Rationale

Previous placement of central venous catheter is associated with central venous stenosis and should be avoided in patients with CKD, if possible. If unavoidable, the right internal jugular vein is the preferred initial CVC insertion site as this has been associated with the least vessel wall contact thereby minimizing the risk of endothelial injury, turbulent flow and venous stenosis.[14] In addition, its straight course to the superior vena cava and superficial location which allows for easy ultrasonic visualization reduces the risk of mechanical complications.[15] The femoral vein is the least favoured catheter insertion site given that it is associated with higher risk of infection and thrombosis compared with other sites.[16]

The subclavian vein should be avoided given the higher rate of venous stenosis and thrombosis compared with the internal jugular vein.[17] While a randomised controlled trial has shown reduced risk of bacteraemia with insertion of subclavian CVC compared with the internal jugular or femoral site,[18] this should be weighed against the risk of mechanical complications and subclavian stenosis for all CKD patients who require native vascular access in the future.

Recommendation 4: Prolonged Intravenous Access

Peripherally inserted central catheter (PICC) should be avoided in patients with CKD and only considered if there are no other options. A small bore CVC in the internal jugular (IJ) vessels is preferred if prolonged intravenous access is required.

Rationale

The superficial forearm veins, cephalic and basilic veins, are important for the creation of AVFs and AVG. Whenever possible, insertion of peripherally inserted central catheter (PICC) lines should be avoided in patients with CKD. Use of PICC lines has been associated with increased risk of venous thrombosis rendering these vessels unusable for vascular access creation.[19] In a large cohort of US adults who commenced dialysis patients with a CVC, PICC line placement was significantly associated with a lower likelihood of transitioning to a functioning permanent vascular access.[20] Compared with PICC lines, small bore CVCs inserted into the internal jugular vein are easier to place and associated with fewer complications.[21]

---

[14] Vats HS. Complications of catheters: tunneled and nontunneled. Advances in chronic kidney disease. 2012 May;19(3):188-94. PubMed PMID: 22578679

[15] Bannon MP, Heller SF, Rivera M. Anatomic considerations for central venous cannulation. Risk management and healthcare policy. 2011;4:27-39. PubMed PMID: 22312225. Pubmed Central PMCID: 3270925

[16] Merrer J, De Jonghe B, Golliot F, Lefrant JY, Raffy B, Barre E, et al. Complications of femoral and subclavian venous catheterization in critically ill patients: a randomized controlled trial. Jama. 2001 Aug 8;286(6):700-7. PubMed PMID: 11495620

[17] Cimochowski GE, Worley E, Rutherford WE, Sartain J, Blondin J, Harter H. Superiority of the internal jugular over the subclavian access for temporary dialysis. Nephron. 1990;54(2):154-61. PubMed PMID: 2314526

[18] Parienti JJ, Mongardon N, Megarbane B, Mira JP, Kalfon P, Gros A, et al. Intravascular Complications of Central Venous Catheterization by Insertion Site. The New England journal of medicine. 2015 Sep 24;373(13):1220-9. PubMed PMID: 26398070

[19] Allen et al, Venous thrombosis associated with the placement of peripherally inserted central catheters. Journal of vascular and interventional radiology.

[20] McGill RL, Ruthazer R, Meyer KB, Miskulin DC, Weiner DE. Peripherally Inserted Central Catheters and Hemodialysis Outcomes. Clinical journal of the American Society of Nephrology : CJASN. 2016 Jun 23. PubMed PMID: 27340280

[21] Sasadeusz KJ, Trerotola SO, Shah H, Namyslowski J, Johnson MS, Moresco KP, et al. Tunneled jugular small-bore central catheters as an alternative to peripherally inserted central catheters for intermediate-term venous access in patients with hemodialysis and chronic renal insufficiency. Radiology. 1999 Oct;213(1):303-6. PubMed PMID: 10540677

Recommendation 5: Antibiotic Use

Appropriate oral antibiotic alternatives should be considered for all patients with CKD whenever possible and medically suitable. In haemodialysis (HD) patients, consider the use of longer acting, renally cleared intravenous antibiotics particularly those which can be delivered during HD. Consultation with the infectious disease team is recommended.

Rationale

Infection is a common cause of hospitalization for patients with CKD. The prolonged half-life of renally cleared intravenous antibiotics such as vancomycin, gentamicin and long acting cephalosporins allows for less frequent drug delivery and administration at the end of haemodialysis sessions which then eliminates the need for venous access. Use of antibiotics which achieve equivalent systemic activity when administered orally such as quinolones (ie ciprofloxacin) may also obviate the need for venous access.[22] Whenever possible and medically suitable, appropriate oral antibiotic alternatives should be considered for all patients with CKD. In HD patients, consider the use of longer acting, renally cleared intravenous antibiotics particularly those which can be delivered during HD. Consultation with the infectious disease team is recommended.

[22] Hoggard J, Saad T, Schon D, Vesely TM, Royer T, American Society of D, et al. Guidelines for venous access in patients with chronic kidney disease. A Position Statement from the American Society of Diagnostic and Interventional Nephrology, Clinical Practice Committee and the Association for Vascular Access. Seminars in dialysis. 2008 Mar-Apr;21(2):186-91. PubMed PMID: 18364015

Reference Guidelines

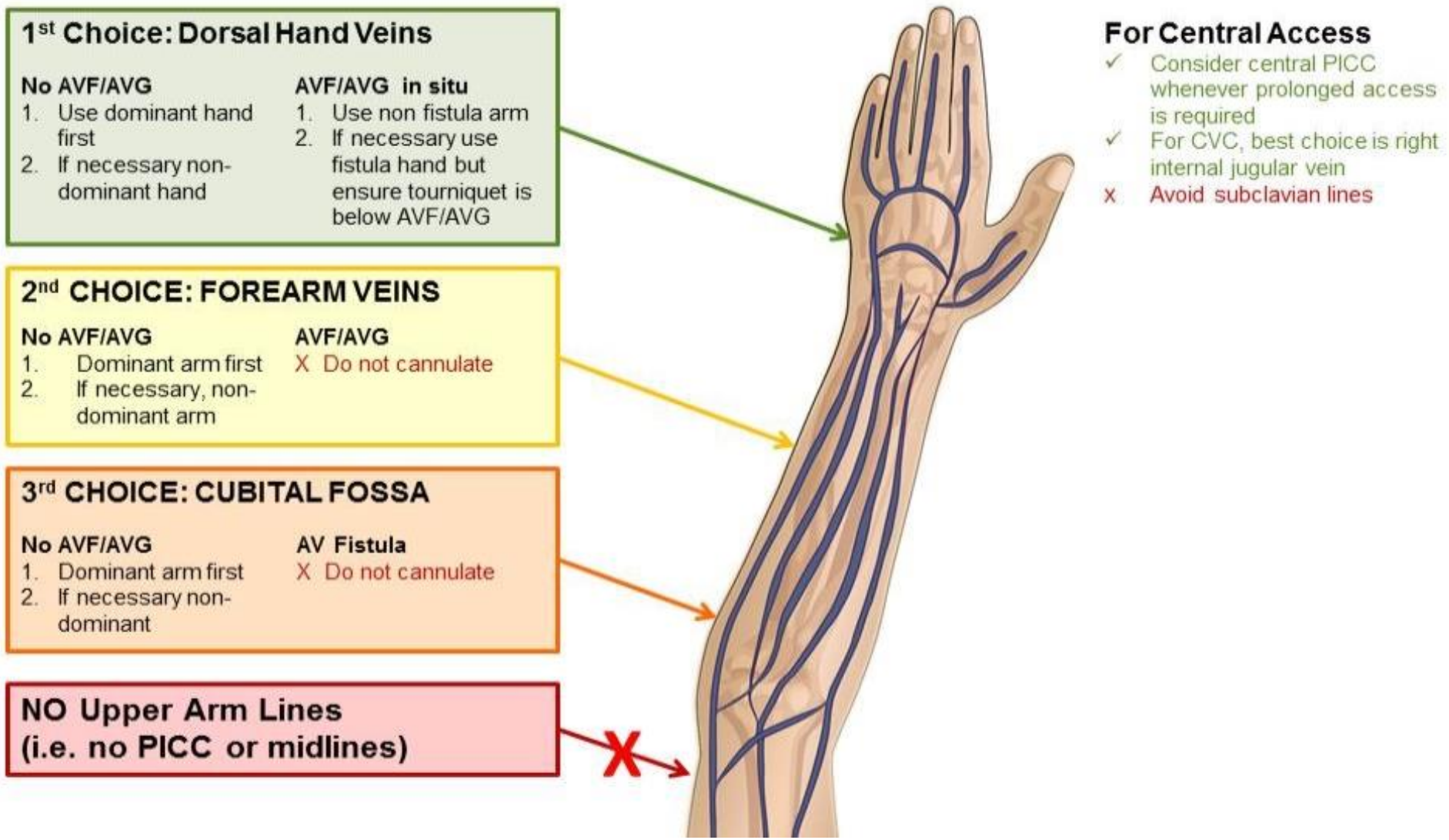
- BC Renal Agency Chronic Kidney Disease Vascular Access Guideline: Vein Preservation (Final 9 March 2011)
- National Guideline Clearinghouse (NGC). Guideline Summary: Preservation of peripheral veins in patients with chronic kidney disease. [Association for Vascular Access] In: National Guideline Clearinghouse (NGC) [Web site]. Rockville (MD): cited 1984 Apr (revised 2008 Jan 01). Available: http://www.guideline.gov
- Kumwenda M, Mitra S, Reid. Clinical Practice Guideline: Vascular access for Haemodialysis. UK Renal Association. 6th Edition (based on literature search up to 31.03.15)

Appendix A: Suggested Implementation Guide

This Implementation Guide provides advice for Health Service Providers (HSPs) that they might consider when implementing the Guideline in their services. The advice below is not exhaustive and HSPs should endeavour to identify implementation strategies that optimise existing education, training, and engagement mechanisms that already exist in their services.

Recommendation	Strategy	Target Audience	Suggested Timeframe
Recommendation 1: Patient Education	Disseminate the Guideline to all staff	• Co-Directors • Policy Managers • Safety & Quality staff • Renal Heads of Department (HODs)	Within 3 month of publication of the Guideline
	Renal medical staff and CKD nurse educators to provide frequent and opportunistic education to CKD patients on forearm vein preservation	• Renal HODs • Renal Resident Medical Officers (RMOs), Registrars, and Consultants • Renal ward nursing staff	3 to 6 months
	Appropriate patients receive formal instruction and education on forearm vein preservation during consults and outpatient appointments	• HODs for Renal, Infectious Diseases, and Hospital in the Home (HITH) • Renal RMOs, Registrars, and Consultants	3 to 6 months
Recommendation 2: Peripheral Venous Access	Review and revise staff education modules relating to peripheral vein cannulation (medical and nursing)	• Safety & Quality staff • Co-Directors	3 to 6 months
	Emergency Department medical and nursing staff are educated about change to peripheral venous access	• Emergency HODs • Nurse Educators	3 to 6 months
	Inpatient ward staff are educated about change to peripheral venous access	• Safety & Quality staff • Nurse educators	3 to 6 months
Recommendation 3: Central Venous Access	Critical care leads in ED, ICU, Anaesthetics, Infectious Diseases, and HITH are educated about change to central venous access	• HODs for Emergency, ICU, Anaesthetics, Infectious Diseases, and HITH • Nurse educators	3 to 6 months
Recommendation 4: Prolonged IV Access	All staff educated about the hospital Access Service, if applicable	• Safety & Quality staff • Hospital Access Service Staff	3 to 6 months
Recommendation 5: Antibiotic Use	Cross collaborative education and training occurs between Renal and Infectious Disease staff	• Renal HODs • Infectious Diseases HODs • Renal and Infectious Diseases RMOs, Registrars, and Consultants.	3 to 6 months

Appendix B: Recommendation 2 – Vein Selection Hierarchy



This document can be made available in alternative formats on request for a person with a disability.

© Department of Health 2017

Copyright to this material is vested in the State of Western Australia unless otherwise indicated. Apart from any fair dealing for the purposes of private study, research, criticism or review, as permitted under the provisions of the *Copyright Act 1968*, no part may be reproduced or re-used for any purposes whatsoever without written permission of the State of Western Australia.