BRS VASCULAR ACCESS Special Interest Group

Clinical Practice Recommendations for Needling of Arteriovenous Fistulae and Grafts for Haemodialysis

Foreword

For people undergoing haemodialysis, vascular access is their lifeline. Protecting and maintaining that access, be it an arteriovenous fistula or graft, is paramount to achieve the best dialysis possible. Nurses working in dialysis units require specific training and development of keys skills and competencies to proficiently needle dialysis access. To date the lack of national standards has impacted on patient care as highlighted by the 2017 CKD-PREM survey reporting vast variation in patient experience with needling across centres in England and Wales (https://www.renalreg.org/projects/prem).

The publication of these recommendations could not be timelier and will enable all healthcare professionals working in renal units to improve their knowledge, skills, quality of care and the experience of patients undergoing dialysis with arteriovenous fistulae and grafts. The users of this document will be able to both benchmark and challenge their own clinical practice. Nurses working in dialysis access need to measure evaluate and report in local and national clinical audits, participate in research and quality improvement projects.

The authors are to be congratulated on creating an in depth guide which includes theory, practical skill sets and tools that can be used in the workplace. The development of these recommendations demonstrates the value of collaborative working across multi-professional groups to share their expert knowledge and vast experience of managing vascular access.

I look forward to seeing these recommendations being implemented in renal units across the UK, influencing practice and making a difference to patients.

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Contents

Introduction

Epidemiological data has shown the safety and longevity advantage of arteriovenous (AV) fistula as access modality of first choice in comparison to AV graft and central venous catheter (CVC) (1, 2). The Renal Association guidelines (UK) reflect this, currently recommending use of AV fistula first, AV graft as the second option and CVC as last option (3). Timely placement of AV fistula is essential to reduce the need for the use of CVC which carry highest risk of access related complications, hospitalisation, patient morbidity and mortality (4). Multiple factors may influence the survival of AVF: age, frailty, sex, race, diabetes, smoking, hypotension, body mass index, thrombosis, infection, aneurysm formation, timing of referral to the surgeons, surgical techniques and skills, vessel size and use of adjuvant therapies such as antiplatelet agents and infrared, timing and technique of cannulation (5).

Most national and international guidelines on haemodialysis access have mainly focussed on areas of good practice in the MDT approach in the management of the access pathway in establishing timely AV fistulae and maintenance of patency, prevention and treatment of access related complications (3, 6). Published robust and evidence based recommendations of cannulation of AV fistulae and grafts are lacking and clinical practice varies widely.

Needling of AV fistula or graft prior to haemodialysis is an important part of the haemodialysis process. Successful needling is required to perform the haemodialysis treatment using the AV access. This requires good needle insertion at each haemodialysis session. Incorrect techniques can lead to complications including stenosis and aneurysm development, infections, haematoma, pseudoanuerysm, bleeding and pain (7-11). Ensuring a good technique will reduce such complications and prolong the life-span of the AV access.

It is less well recognised is that needling is of significant concern to haemodialysis patients. In the first Patient Reported Experience Measure (PREM) in the UK, needling was identified as one of 3 issues of concern for renal patients (https://www.renalreg.org/projects/prem/). This is further reiterated in qualitative research (8). In a study exploring dialysis characteristics important to patients and caregivers, needling was 4th. most important factor, after survival and factors related to lack of interference with day to day life (12). Taylor's (13) qualitative study highlights the anxiety and pain haemodialysis patients experience during needling, relating this to nurses with poor needling skills. Casey's (14) systematic review of qualitative studies on patient's experience of haemodialysis vascular access, found that needling was indeed a major issue. There is valid concern that patients will choose CVC to avoid poor needling experiences (14, 15). A patients' experience survey in Canada did indicate patient satisfaction with AV fistula in comparison to other types of access (16), however a later survey identified needling as a major issue of concern for patients (17). To promote AV

access use and patient choice of AV access, providing an optimal patient experience of needle insertions is essential.

The renal community has a strong desire to promote AV access use. However work needs to be done to minimise complications and ensure patients have a better experience of needling. This will ensure that the benefits of AV access are optimised, AV access life-span is prolonged and patients are more likely to choose AV access for haemodialysis. These recommendations aim to outline best practice in needling to achieve these aims, balancing minimisation of complications with an improved patient experience of needling. Whilst we encourage patients to self-needle, these recommendations are targeted at registered nurses and unregistered staff who needle multiple AV access. However, some elements will be relevant to patient's who self-needle.

NB. 1) AV access has been used to denote both AV fistulae and AV grafts, in points relevant to both. When a point is relevant to only AV fistula of AV grafts, the individual term is used.
2) When referring to buttonhole, rope ladder and area puncture techniques, the document uses these terms in relation to the definitions described Recommendation E.

Methodology

Initially these recommendations intended to be evidence based. However, initial examination of the research indicated wide variation in results, disagreement as to best practice recommendations from this research and little relation to practical experiences of experts involved in developing the recommendations. Therefore, these recommendations are based on expert consensus opinion.

Consensus opinion has not been identified through any formal methodology except discussion and agreement among co-authors. This was achieved through monthly telephone conference calls from August 2016 to January 2018. Telephone conference calls were support by the Kidney Quality Improvement Partnership (KQuIP) and included 16 nurses from 14 units across the UK, including paediatric nurses and nurses from Scotland and Wales, as well as England. Contributors were encouraged throughout to discuss their own units practice and endorse recommendations that they would implement in their own unit, ensuring practical application of the recommendations. Co-authors were provided the opportunity to review and edit drafts of each section, to ensure agreement with the content. When practice was not agreed upon, options have been provided as to what could be best practice to include all opinions.

To ensure no research findings were discounted without consideration, a literature search was performed in systematic manner by a clinical librarian (outlined in Appendix 1). This identified a number of unknown articles which were reviewed by the co-authors. No changes were made to the recommendations following this process, but further sources of evidence were incorporated. These recommendations have only referred to research or quality improvement evidence and eliminated expert opinion as a source. Both qualitative and quantitative findings were included in rationales and context provided as to their interpretation.

Following initial drafting of the recommendations, these were reviewed by:

- British Renal Society (BRS) Council
- Vascular Access Society of Britain and Ireland (VASBI) council
- RA – BRS Patient Safety
- Welsh Vascular Access Nurses group
- Scottish Vascular Access Nurses group

Comments through this consultation were considered alongside discussions to formulate the recommendations.

Summary of Clinical Practice Recommendations

Recommendation A: Principles of a Good Needling Technique

1) A good needling technique will:
    a. Minimise damage to the AV access during needling
    b. Minimise complications from needling
    c. Minimise pain and anxiety related to needling
2) A good needling technique will result in either a successful needling or failed attempt at needling of the AV access; with the minimum amount of damage to the vessel and surrounding tissue, whilst minimising pain and inspiring confidence in the patient.
3) A good needling technique involves using either rope ladder or buttonhole needling technique to plan needling.
4) Prior to needle insertion, documentation of previous needling should be reviewed along with a documented needling plan.
5) Prior to needle insertion, a good assessment of the vessel should provide a clear idea of the depth and direction of the needle insertion which will result in the correct position of the needle.
6) If needle insertion is not performed by the patient, prior to needle insertion, the 'needler' should discuss previous needling attempts with the patient.
7) The decision on where and how to insert the needle should occur in discussion with the patient and include consideration of:
    a. How to best perform either buttonhole or rope ladder technique
    b. Directions from the needling plan
    c. Conclusions from their assessment of the vessel
    d. The patient's opinions on how the needle insertion should be performed.
8) Once entering the skin, the needle insertion route should take the most direct route to the vein and not follow a tortuous route to the vein.
9) The needle insertion movement should be accurate, considered, gentle and continuous, minimising pain and discomfort for the patient.
10) Needle insertion is a balance between prompt insertion of the needle and a gentle technique, so whilst insertion should not be rapid, it also should not be unnecessarily prolonged.
11) The needle insertion should aim to finish with the tip of the needle in the centre of the AV access vessel.
12) If insertion is unsuccessful at first attempt, then further attempts may be required through retraction and reinsertion of the needle.
13) Once an individual has attempted 2 unsuccessful needle insertions on one occasion at the same site, if available, they should gain help from another staff member who can needle, rather than persevering with the needle insertion themselves.
14) Registered nurses and non-registered staff who cannulate AV access should constantly aspire to develop a good needling technique. This is on-going development of a skill that is never complete. Skill development can progress through regular needling practice, observation of and guidance from experienced, skilled needlers.
15) A good needling technique requires self-awareness, with the person inserting the needle acknowledging their limitations.
16) Needling should always be an empathetic procedure. The correct balance between sympathy and pragmatism should acknowledge the pain and anxiety caused by the procedure alongside recognising the necessity of the procedure.

Recommendation B: Technical Principles to aid Decision Making Prior to Needle Insertion

Prior to each needle insertion, there are a number of decisions the person inserting the needle needs to make. This section provides advice on what needles to use and how to decide where to put the needle.

1) A pre-needling assessment including a “Look, listen, feel” assessment should be performed prior to every needling, which will aid decision-making on needling sites.
2) The needling decision making model (Appendix 4) should be used to identify appropriate needling technique.
3) The needling strategy should follow the needling technique as defined in Recommendation E and be planned as described in Recommendation F.
4) Select the appropriate needle gauge according to the diameter of the vessel and required blood flow rate.
5) Needle length should be determined and selected according to the depth of the vessel from the surface of the skin.
6) An ideal needling site will be:-
    - A straight segment of vein of sufficient length to accommodate the needle length
    - At least 5cm from the anastomosis
    - A comfortable position for the patient hand/arm to ensure relaxed position during treatment
7) The identification of good sites for needling will depend very much on the length, depth, tortuosity and general condition of the vessel in addition to any recent needling problems, as well as the planned needling technique. This decision requires clinical judgement using the skill and expertise of the person inserting the needle.
8) The following areas should be avoided, regardless of the needling plan:-
    - Swollen, hard or bruised areas
    - Areas with any scabs / damaged skin integrity
    - Red/inflamed areas, erythema, oozing

If possible, aneurysmal areas should be avoided.

9) Needle sites should be positioned at least 5cm apart, if possible, to avoid recirculation.
10) A tourniquet should be used for all needle insertions into AV fistulae, unless the AV fistula is aneurysmal. A tourniquet is not needed for AV grafts.
11) The needle should be inserted bevel up.
12) The angle of insertion of the needle should be dictated by the minimum angle needed to reach the depth of the vessel to allow the needle tip to sit in the centre of the vessel.
13) Ideally both needles should be inserted in an antegrade direction, with the needle pointing away from the anastomosis / with the flow of blood. If required, the arterial needle can be inserted in a retrograde direction, with the needle facing towards the anastomosis / against the flow of blood.
14) Once the needle has been inserted, the needle should not be routinely rotated. This should be avoided if possible, as this can lead to damage to the vessel wall known as ‘coring’.

Recommendation C: Procedural Principles for Good Needle Insertion

When inserting the needle, there are various practice points that minimise complications during needle insertion. This includes good infection control practices, securing the needle correctly to prevent dislodgement and use of safety needles. The points are outlined in the recommendations below.

1) Prior to needle insertion, patients should wash their hands and the AV access site. Octenidine dihydrochloride wash is ideal to use and is preferable to soap and water.
2) Safety needles should be used in all needle insertions to prevent the risk of needle stick injuries to healthcare workers.
3) Healthcare staff performing needle insertion should wear either sterile or non-sterile gloves, dependant on local policy.
4) If non-sterile gloves are worn, the needle site should not be touched once disinfected prior to needle insertion.
5) Prior to needle insertion, the planned needle insertion site should be cleaned using 2% chlorhexidine gluconate with 70% isopropyl alcohol, ensuring this has sufficient dry time (at least 30 seconds) prior to initiating needle insertion. If the patient is allergic to chlorhexidine, then Povidone Iodine solutions or octenidine dihydrochloride can be used to disinfect prior to needle insertion.
6) The principles of Aseptic Non-Touch technique (ANTT) should be adhered to during the needle insertion procedure. This includes:
    a. Handwashing prior to the procedure
    b. Use of an aseptic field. A sterile aseptic field is recommended for needle insertion i.e. sterilised dressing pack, not a tray cleaned with disinfectant wipes
    c. Key part protection, avoiding touching key parts and minimising exposure is essential throughout the needle insertion.
7) Needles can either be flushed with 0.9% Saline or inserted dry, dependant on local policies. If inserted dry, care needs to be taken to ensure the blood in the needle does not clot prior to connection to haemodialysis.
8) Tape that covers the needle insertion site needs to be clean, which can be achieved through a number of methods:
    a. Sterile tape as part of the dressing pack used for needle insertion
    b. Single use rolls of tape for individual patients.

    Alternatively, gauze can be used over the needle insertion site or the needle insertion site can be left exposed to avoid taping directly over this (Figure 1).

    Rolls of tape should always be stored in a designated clean area and not in staff members' pockets.

9) Following insertion, the needle should be taped either using the chevron method (Figure 2) or H technique (Figure 3), to prevent needle dislodgement.
10) Once inserted, rotation of the needle should be avoided, to prevent 'coring' and damage to the vessel wall.

Recommendation D: Assessment of the AV Access prior to Needling

1) Prior to needling, a history should be taken from the patient about the AV access. This should include any changes since their last haemodialysis session and any problems during haemodialysis sessions.
2) A look, listen, feel assessment of the AV access should be performed prior to needling, by the person who will be inserting the needles (aka as the 'needler').
3) When inspecting the AV access, the 'needler' should visually observe the skin over the vessel, the previous needling sites and the general condition of the limb.
4) Any signs of problems with increasing aneurysm size, new aneurysms, skin integrity or infection should be escalated to medical / surgical teams immediately, to minimise the risk of life threatening bleed.
5) The full length of vessel including the anastomosis should be palpated prior to disinfecting the skin for needling.
6) Palpation of the vessel prior to needling allows identification of:
    a. Direction of the vessel for needle insertion including identifying tortuosity
    b. Length of vessel used for needle insertion
    c. Diameter of the vessel
    d. Depth of the vessel
    e. Areas to avoid inserting the needle, including hard areas, areas where the vein dips away and interference from collateral vessels
7) The thrill should be palpated prior to needling.
8) The bruit following the length of AV access should be auscultated using a stethoscope prior to needle insertion.
9) The 'Pre-Needle Insertion Assessment Tool' document in Appendix 2 should be used to record the look, listen, feel assessment and identify appropriate escalation pathways for detection of complications.
10) It is recognised this describes a basic assessment prior to needle insertion. More in-depth assessment of the AV access should occur 1-3 monthly using the ACCESS tool outlined in Appendix 3.
11) It is recommended that haemodialysis nurses have an awareness of the signs of declining access function to incorporate these into their regular assessment of the vessel.

Recommendation E: Definitions of Needling Techniques

1) We recommend use of rope ladder or buttonhole needling techniques and avoidance of area puncture technique.
2) Selecting the needling technique to be used is an individual decision for each patient. Recommendation F and Appendix 4 outline which technique is best utlised, in which situation. We recommend rope ladder needling for both AV fistulae and grafts.
3) Rope ladder technique is defined as needling sites that move progressively up the vessel in a systematic manner, with each needle site approximately 0.5-1cm above the previous site.
4) To perform rope ladder technique, the following criteria should be adhered to:
    a. Rope ladder should utilise as much length of the vessel as possible, using the full length of the vessel in a uniform manner
    b. Once the highest needle site is reached, needling should start at the bottom of the vessel again. We do **not** recommend moving up and down the vessel, as this can easily degrade into area puncture.
    c. Needling sites should cover:

   i. A minimum of 8cm length of vessel if both arterial and venous needle sites join up
   ii. Minimum of 5cm if arterial and venous sites do not join up.

5) Rope ladder can be performed in 2 ways:
   a. Zip rope ladder where needling sites are in the centre of vessel and each needling site is above the previous site. This can be used with all AV fistulae and grafts.
   b. Traditional rope ladder where needling sites move side to side as well as up the vessel. This can be used with AV fistulae or graft with diameter wider than 0.9mm and may minimise damage from repetitive needling over short lengths. However, caution needs to be taken to perform this technique in a systematic manner.
   c. Figure 4 demonstrates the 2 types of rope ladder.
6) How to best perform needling with rope ladder technique is outlined in Recommendation G.
7) Area puncture technique is used to categorise needling sites that do not meet the criteria for rope ladder or butttonhole technique:
   a. A needling site covers less than 5cm
   b. Needling sites do not progress systematically up the vessel, but are ad hoc in a similar area
8) Whilst we do not recommend area puncture, we recognise there may be situations where it is impossible or unfeasible to avoid using area puncture technique. Recommendation I outlines how to avoid area puncture and what to do if performing this technique.
9) We recommend buttonhole technique for use with AV fistulae.
10) Buttonhole needling involves needling each needling site in the same manner during each needle insertion. This means at each needling site, entering the skin through the same hole, following the same route to the vein and entering the vein in the same place each time. Figure 5 shows the elements of a buttonhole needling site.
11) Buttonhole needling involves:
   a. Removing the scab from the previous needle insertion prior to the present needle insertion
   b. A track development phase where consistent needling with sharp needles is performed
   c. Needling with blunt needles once the track is developed
12) Buttonhole needling can involve 2-4 needling sites on one vessel. More than 2 needling sites can allow resting of sites especially when patients dialyse more than 3 times a week.
13) How to best perform buttonhole needling is outlined in Recommendation H.

Recommendation F: Choosing the Needling Technique and Planning Needling

Recommendation F.1 – Choosing the Needling Technique

1) Decisions as to which needling technique should be made with the patient. Individual factors and patient preference will influence the decision made. Whilst recommendations have been made in this section to guide this decision, they should always be taken in context for individual circumstances and patient choice.
2) Selecting the correct technique for individual patients is essential to ensure successful use of the AV access for haemodialysis with minimal complications.
3) We recommend either rope ladder or buttonhole technique is chosen for AV fistulae and rope ladder for AV grafts.
4) There are some AV fistula characteristics that will indicate either buttonhole or rope ladder technique is better as follows:

a. Rope ladder technique (as outlined in Recommendation E) requires systematic needle insertions over either:
    i. At least 5cm segment for one needle insertion site
    ii. At least 8cm segment where needle sites are on the same length of vessel
    If this length of vessel is not available, then rope ladder is not possible. Buttonhole is the recommended technique for short AV fistula segments, but it is recognised there are situations where this is not possible. In this situation, area puncture may be the only option and should be managed as per Recommendation I.
b. Buttonhole technique should be utilised in patients with a low infection risk. In patients with a high infection risk, if the segment available is too short for rope ladder, then area puncture may be the only option and should be managed as per Recommendation I.
c. Buttonhole technique may be a better technique for patients with a vessel where needle insertions are difficult or the patient is very anxious about needle insertions due to a needle phobia. If these patients have a high infection risk, then rope ladder may the better option. Again, in patients with a high infection risk, if the segment available is too short for rope ladder, the area puncture may be the only options and should be managed as per Recommendation I.
d. These factors are outlined in the Needling Decision Making Model in Appendix 4. Units who do not utilise buttonhole technique, will inevitably require use of area puncture technique, although area puncture is not recommended as a technique.

Recommendation F.2 – Infection Screening for Patients with AV Access

1) All patients undergoing needle insertion into AV access should undergo screening for MRSA and MSSA including their AV access site, a minimum of every 3 months.
2) Decolonisation should occur for patients who are positive for MRSA. There is no maximum recommended times that decolonisation should be undertaken, however twice is a common maximum number. Decolonisation protocols should be pragmatic, taking consideration that haemodialysis patients may undergo these on multiple occasions.
3) Patients should be individually risk assessed by the renal team before undertaking buttonhole technique. A recommended infection screening tool for this purpose is included in Appendix 4 and based on work completed at Royal Berkshire renal unit (18).
4) Root cause analysis should be undertaken in all bacteraemia episodes in haemodialysis patients.

Recommendation F.3 – Planning Needle Insertions

1) We recommend all patients who have needles inserted to AV access regularly have a plan for needle insertions.
2) The needling plan should consist of paper documentation that needs to be completed by all haemodialysis nursing staff inserting the needles. It should be designed to promote communication to ensure consistent needle insertions between staff members.
3) The needling plan should be considered a guide rather than prescriptive piece of documentation. The assessment pre-needle insertion may detect factors that warrant divergence from the needling plan.
4) The needling plan should develop with each assessment of the AV access and individual staff members should be encouraged to add their expertise to the plan, maintaining their autonomy and decision making in this process.

5) The needling plan needs to include:
    a. The arm position for optimal needle insertion
    b. Images to demonstrate the needling section of the AV access, possibly with potential needle sites.
    c. Whether a tourniquet should be used
    d. How to best insert the needle, including clearly defined information on both the depth (angle from skin to hub) and the direction of needle insertion.
6) The needling plan should be designed to include patients in needling decisions, either being accessible to patients or patient held.
7) Identifying suitable sites on a mature AV access undergoing rope ladder should also be given due time and consideration to ensure uniform use and development of the full length of the vessel, thus avoiding area puncture which may have damaging consequences. Experienced staff should have the courage and confidence to attempt to use new sites along the vein.

Recommendation G: Rope Ladder Needling Technique

1) Rope ladder needle insertions should be planned with the same consideration as buttonhole, as per Recommendation F.
2) Decide on needle type and size, as per Recommendation B.
3) Prior to needle insertion, assess the AV access using the look, listen, feel assessment, as per Recommendation D. Decide on needling sites and direction and angle of needle insertion, as per Recommendation E. To perform rope ladder, these should be 0.5-1cm above previous sites, unless contra-indicated or commencing needling at the bottom of the vessel, as previous sites reached the top of the needling segment.
4) Ensure the patient washes the area around and over the AV access prior to commencing needle insertion.
5) Prepare aseptic field and don personal protective equipment (PPE) as per local policy, including sterile / non-sterile gloves, a plastic apron and protective eye wear, as per Recommendation C.
6) Cleanse the needling sites as per Recommendation C.
7) Apply tourniquet to AV fistula but not AV graft, as per Recommendation B.
8) If not performing dry needle insertion, prime the needles with Normal saline 0.9%, maintaining a non-touch technique, as per Recommendation C.
9) Insert needle as determined during pre-needle insertion assessment, using a gentle, non-touch technique, as per Recommendations A and Recommendation C. The needle should be bevel up with both needles ideally facing antegrade, unless retrograde needling is used for the arterial needle, as per Recommendation B.
10) Secure needles using chevron or ‘H’ taping technique, as per Recommendation C.
11) Avoid rotating the needle once inserted, as per Recommendation B.
12) Flush the needle to check for patency and to confirm adequate flow.

Recommendation H: Buttonhole Needling Technique

Recommendation H1: Track Development and Needle Insertion for Buttonhole Needling of AV Fistulae

a) Track Development

1) The depth and direction of needle insertion need to be consistent during the track development phase, to allow a consistent collagen track to develop.

2) A tourniquet should be used during track development, as per Recommendation B. Tourniquet use should be consistent, with either use at all times or not at all.
3) Buttonhole track development should ideally occur with established AV fistulae only, to ensure the vein does not change over time.
4) Track development on the arterial and venous needle sites can occur at different times, dependant on the maturity of each site.
5) When the sharp needle glides in place with no resistance, dull/blunt needles can be attempted. This should occur in 6-12 needle insertions using sharp needles.
6) During track development, the patient should be encouraged to discuss the sensations during needling, recalling the positioning of the limb and hand that is optimal for them, to promote information exchange between the patient and needler as to how to best insert the needles.
7) If the patient is planning to insert their own needles, then they should be encouraged to develop the track themselves.
8) If the track is not established and blunt needles are unable to be inserted after 12 sessions of sharp needle insertion, further assessment of the buttonhole sites should occur with consideration as to whether different sites need to be developed.
9) Difficult track development, especially with deep tracks with a lot of subcutaneous tissue, can be supported by insertion of polycarbonate pegs.

b) Buttonhole Sites

1) Buttonhole sites should adhere to the principles outlined in Recommendation B.
2) Avoid developing buttonhole sites on dips, curves, aneurysms on the fistula vein or any area with abnormal skin integrity.
3) 1 patient can have 3-4 active buttonhole sites at one time, to allow rotation of sites, as per Recommendation E.
4) Use of specific buttonhole sites should be reviewed in the following situations and cessation of use of sites with these issues should be considered:

    - Hubbing of the site
    - Sharp needle insertion required regularly to cannulate the buttonhole site
    - Signs of infection at the site
    - Enlarging entry site or signs of tissue damage
    - Prolonged bleeding from buttonhole site
    - Significant pain/discomfort during insertion

c) Buttonhole Needle Insertion

1) Prior to needle insertion, the needler should encourage the patient to describe how the needle is best inserted, promoting consistent needle insertion.
2) The arm and hand position should remain consistent through track development and further blunt needle insertion to ensure alignment of the track and vein.
3) Communication should continue following the track development phase, to ensure all needlers are aware of the track direction, as per Recommendation F.
4) The blunt needle should glide down the track and not require excessive force to cannulate. The force applied during needling can be minimised by holding the tubing rather than the needle wings during needling.
5) The external steel shaft of the needle should never be ‘wetted’ with sterile or non-sterile solutions prior to insertion, as this practice increases the risk of contamination leading to a potential infection.

6) On insertion of the needle, 1-2mm of steel should be visible to prevent hubbing of the needle site.
7) The needle insertion should adhere to those principles outlined in Recommendations A, B, and C.

d) Troubleshooting Buttonhole Needling

1) If the blunt needle is not entering the vein smoothly, check the arm and hand position of the patient and track direction to ensure the needling technique and track position remains consistent at all times.
2) If one blunt needle will not enter the vein, needling should be attempted with a second blunt needle.
3) If a second blunt needle cannot be inserted, the needler who developed the track may insert a sharp needle.
4) It is not advised that a sharp needle is used in the track by anyone other than those involved in track development of that individual track. If a sharp needle insertion is performed by a needler not involved in the track development, then this needle should be inserted at least 2 cm above the buttonhole site. If space is not available above the buttonhole site, then a site at least 2cm below the buttonhole site can be used.

Recommendation H2: Disinfection Procedure and Scab Removal Prior to Buttonhole Needling of AV Fistulae

1) All patients should wash their hands and fistula limb, as per Recommendation C.
2) The needling sites should be cleaned using solutions outlined in Recommendation C. Needling sites should be disinfected immediately before and after scab removal.
3) Softening of scabs prior to removal is not recommended.
4) Sterile tweezers or sterile picks which are supplied with the dull/blunt needles or separately, should be used to remove the scab.
5) To prevent infectious complications, the complete scab should be removed prior to needling of the buttonhole site.

Recommendation H3: Mupirocin use with Buttonhole Needling of AV Fistulae

1) Topical 2% mupirocin ointment / cream should be applied to the needling sites of all patients undergoing buttonhole technique, who are considered to have a high infection risk. The ointment / cream should be applied following needle removal and cessation of bleeding from needling site, after each haemodialysis treatment and left in place for approximately 12 hours.
2) All patients receiving 2% mupirocin ointment / cream regularly should undergo screening for mupirocin resistant *Staphylococcus Aureus.*
3) Patients who develop mupirocin resistance must not continue to use 2% mupirocin, until mupirocin sensitivity is restored. Each case should be risk assessed and consideration given as to whether buttonhole technique should be discontinued or an alternative antibacterial used.

Recommendation I: Area Puncture Needling Technique

1) Area puncture needling technique should be avoided wherever possible and we recommend the use of rope ladder or buttonhole needling technique on all AV fistulae and grafts, whenever it is possible.
2) Area puncture may be the only option on an AV fistula if:
    a. There is not the length available to perform rope ladder
    b. Buttonhole needling technique is not feasible, due to concerns about infection.
3) If area puncture is necessary in an AV fistula, the needling segment should cover as large an area as possible and attempt to progress up the vein in a similar systematic manner to rope ladder needling technique.
4) Area puncture should never be used on AV graft. An AV graft will always supply a suitable length for rope ladder.
5) Area puncture of AV fistula is a better alternative for vascular access provision for haemodialysis, than using a tunnelled CVC.
6) Needling of new AV fistula should be planned to avoid area puncture. Rope ladder is normally feasible in new AV fistula, before aneurysms and tortuosity develop from poor area puncture.
7) Needling practice should be audited regularly, using the definitions developed in these recommendations, to identify how many patients undergo rope ladder, buttonhole and area puncture.

If area puncture of an AV fistula is identified as in use, the following conditions should apply:

8) Assessment of the vessel to ensure that an alternative needling technique cannot be employed.
9) Increased assessment and surveillance of the AV fistula should be implemented to monitor for the signs of complications.
10) Refer the patient to the vascular team to assess alternatives to area puncture and assess the risk of complications developing.

A flow chart outlining what to do if area puncture is identified in use on an AV fistula is in Appendix 5.

Recommendation J: Needling of New AV Access

1) Newly developed fistula veins can be very delicate and fragile. Needling should be carried out very carefully and as gently as possible and only by experienced nurses.
2) AV fistula should be considered mature to needle when the vessel diameter reaches 0.6cm.
3) AV grafts should be first needled 2-4 weeks after insertion, once swelling and bruising has settled in the surrounding tissues. 'Early cannulation' AV grafts can be needled within 24 hours, dependant on manufacturer instructions.
4) The patient should be prepared for the first needle insertion as outlined in Recommendation M.
5) The person inserting the needle will need to decide whether to attempt one or two needle insertions
6) If one needle only is inserted into the AV access, then haemodialysis can either be performed using single needle dialysis or using one CVC lumen as one point of access.
7) The first needle insertion for new AV access should be performed by nursing staff experienced at needle insertion.
8) If only one needle is inserted successfully, a plan should be developed for progression to double needle dialysis promptly within 1-2 weeks, ensuring adequate dialysis. As soon as the vessel is mature enough, 2 needles should be inserted for each haemodialysis session.

9) Initial needle insertion into the AV fistula may need to be nearer to the anastomosis, to ensure successful needle insertion. As the vein is cannulated more, needle sites can be moved further from the anastomosis.
10) Buttonhole track development is not recommended until the AV fistula is mature and established for use in haemodialysis, as per Recommendation H.
11) 17g needles should be used for the first 3-6 needle insertions into AV fistulae. If, after two weeks, needling has been problem free, then progression to 16G will be appropriate, whilst also increasing blood flow rates as above.
12) Needle gauge for AV grafts should follow manufacturer instructions. Early cannulation AV graft may require small needles (17g) for early needle insertions, whilst other AV grafts may be able to commence needle insertion using 15g needles.
13) CVC may remain in-situ whilst commencing use of AV access. This provides an alternative form of access if needle insertion is problematic or may be used in conjunction with the AV access as one form of arterial / venous line access. However, haemodialysis nurses need to consider safe management of the CVC when not utilised for haemodialysis and we recommend prompt removal of the CVC once use of the AV access is established.

Recommendation K: Use of Nurse-Led Ultrasound (US) to Assist with Needling

1) US images can be used:
    a. To assess maturity of the AV fistula vein, to identify if it is ready for needling
    b. To assess the AV fistula vein / graft prior to needling if it is difficult to palpate or has previously been difficult to cannulate
    c. To view the AV fistula vein / graft during needling, undertaking US imaging concurrently with needling, allowing assessment of the vessel's response to needle insertion.
2) US assessment of an AV access should complement clinical assessment and never replace the initial look, listen, feel clinical assessment.
3) US images interpreted by a registered nurse to demonstrate abnormal findings should be referred to an experienced US practitioner for interpretation.
4) Nurses who use and interpret US images need training on how to use the US machine correctly, how to interpret the US images and how to detect signs of complications or abnormal anatomy.
5) US imaging in this context is only recommended for use by experienced, senior registered nurses. These are nurses defined as those who have achieved the 'Gold' Standard of the 'VASBI / BRS VA National Needling Competency'.

Recommendation L: Managing Anxiety during Needling

1) **Preparation information**: all patients should have access to written and/or web based information about having an AV access.
2) **Needle desensitization**: There will be some children, young people and adults who will have a fear of needles. Desensitisation work may be needed over a longer period of time with a gradual move to using a fistula needle.
3) **Provide a calm environment**: The environment can contribute greatly to any anxiety or fear a child, young person or adult may be feeling when beginning to use their AV access. Where possible try to create a calm and relaxed environment utilising equipment such as music and fibre optics.
4) **Written AV Access plans**: Prior to accessing the AV access it is helpful for some patients to feel they have some control over what happens when their AV access is used.

This can be achieved through a written plan devised with the child, young person or adult giving them simple choices and responsibilities as part of the procedure.

5) **Visual routine:** Some children, young people and adults prefer to have a visual routine using pictures or photographs of the procedure as this helps them to understand what needs to happen during the routine of accessing their AV access.
6) **Distraction:** From the preparation sessions the child, young person or adult may decide that they do not want to be involved directly in the procedure but would rather be distracted.

Recommendation M: Involving Patients in Care of their Vascular Access

1) It is critical that patients have the opportunity to become involved with the care and management of their vascular access as early as possible, ideally in the preparation stages before starting haemodialysis. The ideal time to begin this process is when a patient starts pre dialysis education.
2) Pre-dialysis clinic discussions should outline vascular access options. The patient's involvement in this choice and the subsequent implementation of that vascular access care is critical.
3) Educational material about vascular access should be available for all patients who are about to begin dialysis.
4) Pre dialysis educational material should not just include information on their vascular access but also what to expect from their first needle insertion or vascular access use alongside connection to haemodialysis.
5) Information provided to patients on vascular access care and needling should be consistent between staff and with local renal unit needling policies.
6) If the patient is keen to insert their own needles then they should be encouraged and assisted to do this, using techniques recommended in Recommendation N.
7) Continuing careful assessment of the needling sites is critical for sustainable vascular access. The engaged patient will be best placed to assess and note any changes or difficulties with needling, facilitating timely and appropriate intervention. All patients should be shown how to assess changes over time, especially in detecting complications.
8) In order for patients to increase their involvement in their vascular access care, there needs to be a multi-disciplinary approach from the whole team.

Recommendation N: Teaching Patients how to Self-Needle

1) Before embarking on training for self-needling, ensure the patient is a willing participant in inserting their own needles, giving them the chance to make an informed choice.
2) Timing needs to be carefully considered when to commence or even ask the patient about inserting their own needles.
3) An initial step to self-needling may be to allow the patient to commence their training by removing their needles, as this would allow them to get used to handling the needles and allow them to gain confidence in holding the needles.
4) Needle insertion requires dexterity. Patients may require support from nursing staff to perform some elements of the process.
5) Whilst buttonhole technique is often cited as the best technique for patients to insert their own needles, we do not recommend buttonhole technique as the default technique for self-needling. We recommend that the decision is made with the patient and the needling technique used takes into consideration patient preference and clinical considerations, in line with

Recommendation F, as well as identifying which technique is easiest for the patient to complete.

6) If patients do plan to self-needle using buttonhole technique, we recommend where possible the patient develops their own 'tracks', as outlined in Recommendation H1.
7) Teaching a patient to cannulate is different from teaching nurses the same skill and the approach to this is different. Patients should not be expected to learn needle insertion from information designed for nursing staff.
8) Knowledge levels will differ within your patient groups meaning an individual teaching plan for each patient is required.
9) The training to teach patients how to insert the needles themselves should include:
    a. What the fistula / graft is and how it works
    b. The differences between rope ladder, buttonhole and area puncture
    c. The look, listen, feel assessment including recognising problems and how to escalate problems
    d. Feeling the vessel prior to needle insertion, becoming familiar with the structure of the vessel and direction that the blood flow is going in.
    e. The correct cleaning techniques and the importance of the skin site preparation process, especially the appropriate drying times for the solution chosen.
    f. Applying a tourniquet, if used
    g. How to hold the needle for needle insertion
    h. Guidance on how to insert the needle
    i. How to flush the needle
    j. How to tape the needle
10) The patient will need to be taught not just how to wash their hands and access, but also the reasons why these procedures are carried out.
11) Confidence needs to be built in the patient who is learning this new and alien skill to them.
12) The time needed for training must be set aside and not rushed; the patient must feel they are being given adequate time to learn these new skills.
13) Information for children and young adults will need to be tailored dependent on their developmental age and ability, and revised as per local teaching protocol for different ages.
14) On-going support and patient understanding of problems and how to overcome them must also be added to the teaching programme.
15) Once self-needling, the patient is likely to experience problems during difficult needle insertions. Patients should be supported through difficult needle insertions so that they continue to needle themselves. For home patients, this may mean occasional in-centre sessions or home sessions with support from nursing staff.
16) As the patient becomes more familiar with the needle insertion procedure and gains in confidence, there needs to be monitoring pathways to ensure proper technique is being followed at all times. This should include regular re-assessment of technique of self-needling.

Recommendation O: Staff Training to Perform Needling of AV Access

1) All healthcare staff (registered or unregistered) who are learning to insert needles into AV fistulae and grafts must have a theoretical understanding of:
    i. What is an AV fistula and graft, including relevant anatomy and physiology
    ii. Different needle insertion techniques, including their risks and complications
2) Following theoretical teaching, all healthcare staff (registered or unregistered) that are learning to insert needles into AV fistulae and grafts should have a period of supervised clinical practice, using staff experienced at this procedure to supervise learners.

3) An assessment of competency of needle insertion for AV fistulae and grafts should occur for all healthcare staff (registered or unregistered), prior to performing this skill independently. No-one should cannulate an AV access independently, without this assessment.
4) All healthcare staff (registered or unregistered) who perform needle insertion on AV fistulae and grafts should be:
    i. Reassessed every 3 years
    ii. Receive an annual theoretical update.
5) Regular monthly audits should occur of needling practice, to ensure everyday practice adheres to infection control and local needle insertion protocols.

Clinical Practice Recommendations

Recommendation A: Principles of a Good Needling Technique

1) A good needling technique will:
    a. Minimise damage to the AV access during needling
    b. Minimise complications from needling
    c. Minimise pain and anxiety related to needling
2) A good needling technique will result in either a successful needling or failed attempt at needling of the AV access; with the minimum amount of damage to the vessel and surrounding tissue, whilst minimising pain and inspiring confidence in the patient.
3) A good needling technique involves using either rope ladder or buttonhole needling technique to plan needling.
4) Prior to needle insertion, documentation of previous needling should be reviewed along with a documented needling plan.
5) Prior to needle insertion, a good assessment of the vessel should provide a clear idea of the depth and direction of the needle insertion which will result in the correct position of the needle. Needle insertion should not continue without this clear idea of depth and direction.
6) If needle insertion is not performed by the patient, prior to needle insertion, the 'needler' should discuss previous needling attempts with the patient. The patient should be encouraged to disclose their views on how to best insert the needle, how previous needle insertions progressed from their perspective and what may have caused previous problems.
7) The decision on where and how to insert the needle should occur in discussion with the patient and include consideration of:
    a. How to best perform either buttonhole or rope ladder technique
    b. Directions from the needling plan
    c. Conclusions from their assessment of the vessel
    d. The patient's opinions on how the needle insertion should be performed.
8) Once entering the skin, the needle insertion route should take the most direct route to the vein and not follow a tortuous route to the vein.
9) The needle insertion movement should be accurate, considered, gentle and continuous, minimising pain and discomfort for the patient.
10) Needle insertion is a balance between prompt insertion of the needle and a gentle technique, so whilst insertion should not be rapid, it also should not be unnecessarily prolonged.
11) The needle insertion should aim to finish with the tip of the needle in the centre of the AV access vessel.

12) If insertion is unsuccessful at first attempt, then further attempts may be required through retraction and reinsertion of the needle. If the needle is fully withdrawn from the skin at any time during the needling attempt, or clotting of the needle lumen is suspected, then another unused, clean needle must **always** be used to continue the attempt at needling, to prevent infection from an already used needle. Once fully removed away from the skin, a used fistula needle must **never** be reinserted into the skin above the vessel during a needle insertion attempt.
13) Once an individual has attempted 2 unsuccessful needle insertions on one occasion at the same site, if available, they should gain help from another staff member who can needle, rather than persevering with the needle insertion themselves.
14) Registered nurses and non-registered staff who cannulate AV access should constantly aspire to develop a good needling technique. This is on-going development of a skill that is never complete. Skill development can progress through regular needling practice, observation of and guidance from experienced, skilled needlers.
15) A good needling technique requires self-awareness, with the person inserting the needle acknowledging their limitations. Staff who needle need awareness of the type of AV fistula / graft they can needle successfully and ask for assistance with AV access outside their skill level. However experienced guidance can be used to help inexperienced staff insert needles into AV access outside their current skill level and promote their skill development.
16) Needling should always be an empathetic procedure. The correct balance between sympathy and pragmatism should acknowledge the pain and anxiety caused by the procedure alongside recognising the necessity of the procedure.

Rationale for Recommendation A

It is imperative that needlers of AV access develop a good needling technique to minimise damage to the AV access from repetitive needling and minimise the anxiety and pain patients' experience from repetitive needling.

Very little evidence has been produced as to what makes a good needling technique. Harwood (15) performed a qualitative research study to explore this with haemodialysis nurses. They identified multiple aspects that contribute to successful needle insertion, including (15):

- Accurate assessment of the AV access prior to needling
- Involving patients in their needling, which they named patient-centred care
- Practising the needling skill regularly
- Teamwork, using experienced needlers to support skill development in less experienced needlers

- Self-awareness in needlers of their own needling skill level
- Correct training of staff who will insert needles into AV access.

Points for Future Consideration

Needling is a little explored phenomena that is about more than the physical act of inserting the needle (15). Research is urgently needed to examine the patient's experience of needling, what leads to successful needling and how to best develop a good needling technique. Any work that examines needling practices for AV access used for haemodialysis always needs to consider the patient's perspective of needling as part of the evaluation, with consideration that this is more complex than just a pain score.

Concepts raised in this section will be further explored throughout the recommendations.

Recommendation B: Technical Principles to aid Decision Making Prior to Needle Insertion

Prior to each needle insertion, there are a number of decisions the person inserting the needle needs to make. This section provides advice on what needles to use and how to decide where to put the needle.

1) A pre-needling assessment including a “Look, listen, feel” assessment should be performed prior to every needling, which will aid decision-making on needling sites. Recommendation D outlines this assessment in more detail.
2) The needling decision making model (Appendix 4) should be used to identify appropriate needling technique.
3) The needling strategy should follow the needling technique as defined in Recommendation E and be planned as described in Recommendation F.
4) Select the appropriate needle gauge according to the diameter of the vessel and required blood flow rate, as per the following guide:-

Needle gauge	Needle Diameter (mm)	Blood flow rate (mls/min)
17G	1.473	<250
16G	1.651	250 – 300
15G	1.829	300 – 400
14G	2.108	400 or above

The vessel should be large enough to accommodate the diameter of the needle. The needle used should be the smallest gauge required to achieve the desired blood flow rate, to prevent unnecessary damage to the vessel.

5) Needle length should be determined and selected according to the depth of the vessel from the surface of the skin. Needle lengths vary – standard sizes regularly available are 20mm, 25mm and 32mm. Where the vessel is superficial a length of 20-25mm is almost always adequate and will help to prevent penetration of the needle through the back wall of the vessel and consequent damaging infiltration. Conversely, very few vessels will be of a depth that requires the extra-long 32mm needle, but in some patients with larger arms this needle may be necessary to successfully access the vein. Ultrasound scanning of the AV access may be useful in these circumstances to help determine the depth of the vein.
6) An ideal needling site will be:-
    - A straight segment of vein of sufficient length to accommodate the needle length
    - At least 5cm from the anastomosis
    - A comfortable position for the patient hand/arm to ensure relaxed position during treatment

7) The identification of good sites for needling will depend very much on the length, depth, tortuosity and general condition of the vessel in addition to any recent needling problems, as well as the planned needling technique. This decision requires clinical judgement using the skill and expertise of the person inserting the needle.
8) The following areas should be avoided, regardless of the needling plan:-
    - Swollen, hard or bruised areas
    - Areas with any scabs / damaged skin integrity
    - Red/inflamed areas, erythema, oozing

    If possible, aneurysmal areas should be avoided.

9) Needle sites should be positioned at least 5cm apart, if possible, to avoid recirculation.
10) A tourniquet should be used for all needle insertions into AV fistulae, unless the AV fistula is aneurysmal. A tourniquet is not needed for AV grafts. The tourniquet should be applied for assessment of vessel depth and direction to determine needle insertion. However, the tourniquet must **never** be applied for longer than 1-2 minutes. To avoid long periods of application, the tourniquet may need to be released and reapplied during difficult needle insertions.
11) The needle should be inserted bevel up.
12) The angle of insertion of the needle should be dictated by the minimum angle needed to reach the depth of the vessel to allow the needle tip to sit in the centre of the vessel. This decision requires clinical judgement using the skill and expertise of the person inserting the needle.
13) Ideally both needles should be inserted in an antegrade direction, with the needle pointing away from the anastomosis / with the flow of blood. If required, the arterial needle can be inserted in a retrograde direction, with the needle facing towards the anastomosis / against the flow of blood. This decision requires clinical judgement using the skill and expertise of the person inserting the needle.
14) Once the needle has been inserted, the needle should not be routinely rotated. This should be avoided if possible, as this can lead to damage to the vessel wall known as ‘coring’.

Rationale for Recommendation B

The decision making process prior to needle insertion is complex, requiring the skill and knowledge of the person inserting the needle. Each needle insertion will be individual, according to the anatomy of the individual and the current condition of the

vessel. However there are a number of technical principles that can be applied to assist in this decision making.

Fulker (19) identified that placing the needle tip in the centre of the lumen of the vessel created less turbulent flow and shear wall stress, which theoretically reduces the formation of stenosis in the vessel. Using a shallow angle also reduced turbulence (19). This theory is developed from computer simulations and has not been tested on real vessels. However, it is in line with sensible needling practice. Achieving the needle tip in the centre of the vessel will maximise flow rates, minimise flow problems and reduce the risk of infiltration. A shallow angle reduces the risk of infiltration when guiding the needle along the vessel length, as does use of shorter needles. Whilst there is little research evidence for this practice, it was identified that common practices we have recommended minimise damage to the vessel during needle insertion, including:

- Using the smallest needle gauge required
- Inserting the needle bevel up (20)
- Antegrade needle insertion (20)
- Needling a distance away from the anastomosis
- Avoid rotating the needle once insitu (20).

Whilst other recommendations have prescribed needle angles (6, 21), current evidence dictates that the most important aspect of needle insertion is to insert the needle into the centre of the vessel successfully. This requires clinical judgement of angle in relation to the depth of the vessel, not a prescriptive depth that ignores individual variation in vessel depth. Needles should be inserted ideally 5cm apart to optimise clearance during the haemodialysis treatment (22).

Areas on the vessel where there are signs of complications should be avoided, to prevent exacerbation of complications. Ideally, aneurysmal areas should be avoided to prevent exacerbation of the aneurysm formation. However, this is not always possible in a tortuous and aneurysmal fistula. Aneurysmal fistula will often need to undergo area puncture, so should follow the recommendation given in Recommendation I.

Tourniquet use is thought to dilate the vessel making the needle insertion easier and less painful. However, as an AV graft is a rigid tube, the dilation effect with a tourniquet does not occur, meaning there is no benefit to tourniquet use in this context. Tourniquet use does compress the vessel to achieve dilation, hence why prolonged compression is not recommended to prevent thrombosis from static blood in the vessel.

Points for Future Consideration

Little research evidence is available for many of the principles referenced to. Often what is decided as good in day to day clinical practice is correct, due to real time feedback on the results. However, these principles still need testing. Laboratory simulation is useful to identify good principles. However this approach is limited as they are not applied to ‘real-world’ settings. Simulated findings need to be interpreted with caution with consideration of application into clinical practice. We recommend further research into these principles in rigorous but simple studies, alongside common sense interpretation of results by needling experts.

Plastic cannulas to replace metal needles are a new innovation introduced to allow limb movement during haemodialysis, increase patient comfort and reduce infiltrations. Some units are implementing plastic cannulas to minimise these complications. It is strongly recommended that service evaluations of using these cannulas, including patient experience measures, are performed. Units are cautious of use, due to expense and unknown complications. If this practice is beneficial, then the benefits need to be identified and shared to improve future practice.

Recommendation C: Procedural Principles for Good Needle Insertion

When inserting the needle, there are various practice points that minimise complications during needle insertion. This includes good infection control practices, securing the needle correctly to prevent dislodgement and use of safety needles. The points are outlined in the recommendations below.

Clinical Practice Recommendations

1) Prior to needle insertion, patients should wash their hands and the AV access site. Octenidine dihydrochloride wash is ideal to use and is preferable to soap and water. However, if octenidine dihydrochloride wash is not available or the patient is allergic to this, then soap and water is the next suitable alternative. Whilst chlorhexidine washes will disinfect the area, there is concern that this will be too abrasive to use on the skin regularly. If the patient is unable to access a sink, skin cleansing wipes are an alternative.
2) Safety needles should be used in all needle insertions to prevent the risk of needle stick injuries to healthcare workers. Safety needles include blunt needles for buttonhole needling or sharp needles with a protection or retraction device to cover the needle once removed. Sharp safety principles should always be adhered to during needle insertion and removal.
3) Healthcare staff performing needle insertion should wear either sterile or non-sterile gloves, dependant on local policy. This may differ for AV fistulae and graft needle insertion, with some units preferring sterile gloves for AV grafts needle insertion.
4) If non-sterile gloves are worn, the needle site should not be touched once disinfected prior to needle insertion. If the needle site requires touching following disinfection, for example in a difficult needle insertion, then sterile gloves should be worn.
5) Prior to needle insertion, the planned needle insertion site should be cleaned using 2% chlorhexidine gluconate with 70% isopropyl alcohol, ensuring this has sufficient dry time (at least 30 seconds) prior to initiating needle insertion. If the patient is allergic to chlorhexidine, then Povidone Iodine solutions or octenidine dihydrochloride can be used to disinfect prior to needle insertion.
6) The principles of Aseptic Non-Touch technique (ANTT) should be adhered to during the needle insertion procedure. This includes:
    a. Handwashing prior to the procedure
    b. Use of an aseptic field. A sterile aseptic field is recommended for needle insertion i.e. sterilised dressing pack, not a tray cleaned with disinfectant wipes
    c. Key part protection, avoiding touching key parts and minimising exposure is essential throughout the needle insertion. Key parts

include the ends of syringes, both ends of the needle, the skin once disinfected and tape if it covers the needle site. Once disinfected the skin around the needle insertion site can be touched once wearing gloves, but the needle insertion site should not be directly touched.

7) Needles can either be flushed with 0.9% Saline or inserted dry, dependant on local policies. If inserted dry, care needs to be taken to ensure the blood in the needle does not clot prior to connection to haemodialysis.
8) Tape that covers the needle insertion site needs to be clean, which can be achieved through a number of methods:
    a. Sterile tape as part of the dressing pack used needle insertion
    b. Single use rolls of tape for individual patients.

    Alternatively, gauze can be used over the needle insertion site or the needle insertion site can be left exposed to avoid taping directly over this (Figure 1).

    Rolls of tape should always be stored in a designated clean area and not in staff members' pockets.

9) Following insertion, the needle should be taped either using the chevron method (Figure 2) or H technique (Figure 3), to prevent needle dislodgement. The H technique may be easier for patients who cannulate themselves.
10) Once inserted, rotation of the needle should be avoided, to prevent 'coring' and damage to the vessel wall.

Figure 1 Taping Method using Gauze over the needle site

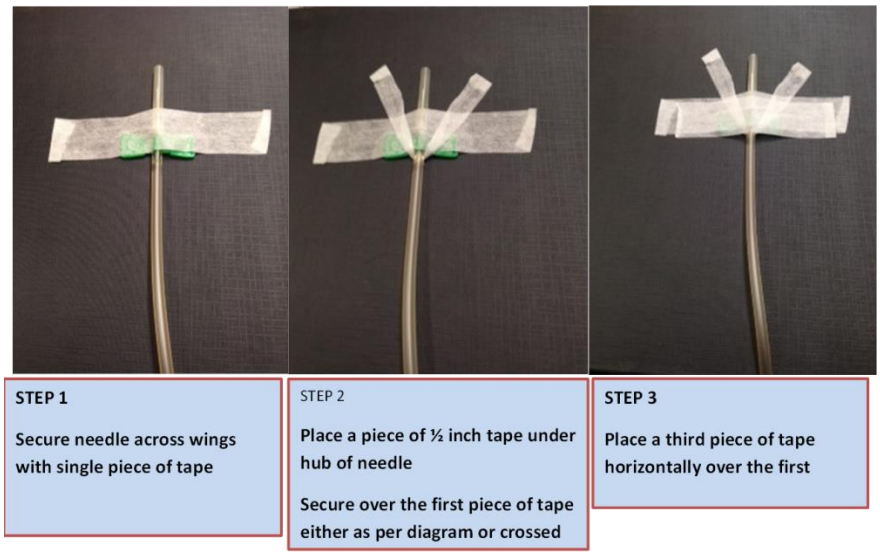

Figure 2: Poster from Oxford Renal Unit demonstrating safe taping methods

Figure 3: Image from Manchester renal unit demonstrating the H technique

Rationale for Recommendation C

Good infection control practice for needle insertion is essential to prevent infections. Whilst AV access is considered to have lower infection rates than CVC, it remains an invasive procedure that can lead to life-threatening infections. There is much disagreement as to the best infection control practices, with little evidence base for various practices. Practice varies across units and discussion indicated that glove selection, flushing of needles with 0.9% Saline and taping practice varies with little

rationale for this. However, using a aseptic non-touch approach was agreed to be most likely to reduce infection.

The solution used to disinfect needling sites is also believed to be important in preventing infections. The EPIC guidelines (23) recommend 2% chlorhexidine gluconate / 70% isopropyl alcohol as this has a rapid (30 seconds) and persistent (up to 48 hours) antimicrobial activity on the skin. Povidone iodine can be used to disinfect skin prior to needling, but needs to be applied for 2-3 minutes for its full bacteriostatic action to take effect and must be allowed to dry prior to needling. Therefore, whilst used routinely by some units (10), this is a less pragmatic disinfectant but can be used if the patient is allergic to chlorhexidine. However, it is important to ensure when using products for skin preparation that manufacturers advice is adhered to which should include technique of application, contact time and drying times to effectively kill bacteria. Octenidine dihydrochloride has been used by 1 unit when chlorhexidine sensitivity developed, with good results (24). Water or 0.9% saline solution (even if it sterile) has no disinfectant properties and is not recommended.

Correct taping of the needles is also essential to prevent venous needle dislodgement (25). Again, variation still occurs across the UK, but the taping techniques recommended are considered best practice. Majority of units use a chevron / butterfly techniques, but H technique has been identified as safe and easy technique for patients who insert their own needles.

Points for Future Consideration

There continues to be variation across the UK and disagreement as to the best infection control practices to prevent infection during needle insertions. Studies need to examine the following points:

- It is unclear whether 0.5% or 2% chlorhexidine (both with 70% isopropyl alcohol) is the best cleaning solution to use pre needling of AV access. Whilst 2% is recommended in many general guidelines, it is unclear whether the repetitive use on skin may cause complications related to either skin necrosis or sensitivity (25). Work needs to be done on what is the optimal cleaning solution for regular use on AV access. 0.5% chlorhexidine / 70% isopropyl alcohol is used in some centres within the UK, with no cited problems with infections.
- Octenidine dihydrochloride has been identified by one unit as an appropriate cleaning solution for patients with chlorhexidine allergy (24). Further investigation needs to occur to identify if this could be suitable alternative disinfectant to chlorhexidine.

- It is unclear whether use of sterile gloves is necessary for needle insertion or whether a non-touch technique suffices. Some units use non-sterile gloves for all needle insertions, whilst others use sterile gloves for AV graft needle insertions. Units also vary as to whether those who insert their own needles should wear gloves. Work needs to be done to identify the best technique.
- Flushing of needles with 0.9% Saline varies across the UK. Some units do not use 0.9% Saline flushes prior to needle insertion, predominantly as it can introduce a further vector for infection. However some units use 0.9% Saline flush to prevent clotting in the needle. Neither approach is evidenced and further work is needed to identify best practice.

Recommendation D: Assessment of the AV Access prior to Needling

1) Prior to needling, a history should be taken from the patient about the AV access. This should include any changes since their last haemodialysis session and any problems during haemodialysis sessions. Difficulty with needle insertion, aspiration of clots and prolonged bleeding can all be signs of developing complications in an AV access.
2) A look, listen, feel assessment of the AV access should be performed prior to needling, by the person who will be inserting the needles (aka as the 'needler').
3) When inspecting the AV access, the 'needler' should visually observe the skin over the vessel, the previous needling sites and the general condition of the limb. This will identify:
    a. Aneurysms
    b. Compromised skin integrity over the AV access
    c. Swelling
    d. Rashes
    e. Signs of infection including redness and oozing
    f. Collateral veins.

    The needler should inspect the colour of extremities, identifying any signs of ischaemia indicating 'steal' syndrome.

4) Any signs of problems with increasing aneurysm size, new aneurysms, skin integrity or infection should be escalated to medical / surgical teams immediately, to minimise the risk of life threatening bleed.
5) The full length of vessel including the anastomosis should be palpated prior to disinfecting the skin for needling. This allows assessment of the vessel for needle insertion and function of the AV access.
6) Palpation of the vessel prior to needling allows identification of:
    a. Direction of the vessel for needle insertion including identifying tortuosity
    b. Length of vessel used for needle insertion
    c. Diameter of the vessel
    d. Depth of the vessel
    e. Areas to avoid inserting the needle, including hard areas, areas where the vein dips away and interference from collateral vessels
7) The thrill should be palpated prior to needling. This should be a vibrating sensation, not a pulsation or thumping sensation. The thrill should lessen as palpation progresses up the vessel.
8) The bruit following the length of AV access should be auscultated using a stethoscope prior to needle insertion. This should be:

   a. A whooshing noise that is uninterrupted and regularity is in line with the patients' normal pulse / heart rate
   b. Gradually diminishes / fades / becomes quieter as you move up the vessel, with no sudden interruption of the sound.
   c. The pitch should be long and low, with no whistling or high pitch sounds.
   d. Asculated at both needling sites, otherwise the needling sites are too far from the anastomosis

9) The 'Pre-Needle Insertion Assessment Tool' document in Appendix 2 should be used to record the look, listen, feel assessment and identify appropriate escalation pathways for detection of complications.
10) It is recognised this describes a basic assessment prior to needle insertion. More in-depth assessment of the AV access should occur 1-3 monthly using the ACCESS tool outlined in Appendix 3. ACCESS stands for:
   a. Assessment
   b. Cannulation
   c. Circulation
   d. Evaluation
   e. Signs / symptoms
   f. Surveillance

   Further recommendations are planned for long-term surveillance, but this is too complex to include in more detail in these recommendations.

11) It is recommended that haemodialysis nurses have an awareness of the signs of declining access function to incorporate these into their regular assessment of the vessel. These include:
   a. Altered arterial / venous pressures
   b. Reduced or interrupted blood flow rate
   c. Reduced Kt/V / URR
   d. Needling difficulties
   e. Prolonged bleeding.

   Intermittent surveillance results should be used to detect signs of altered flow through the vessel, indicating stenosis development, allowing prompt referral for salvage procedures before function is significantly reduced.

Rationale for Recommendation D

A good pre-needle insertion assessment and ongoing-surveillance of the AV access is essential to:

a) achieve a good needle insertion (15)
b) detect and minimise complications (26).

The pre-needle insertion assessment allows identification of the direction and angle of needle insertion, providing a clear planned trajectory of the needle. This includes obtaining an accurate history from patients about previous needle experiences as well as a physical look, listen, feel assessment of the vessel. This is more likely to ensure success first time with needle insertion, with qualitative research identifying this as a trait of successful needlers (15).

The pre-needle insertion assessment also ensures signs of complications are detected promptly. The look, listen, feel assessment can identify signs of infection, issues with skin integrity, signs of steal syndrome and alteration in flow through the vessel indicating development of a stenosis. Detection allows prompt response to these signs, providing treatment of the complication before it escalates to a life-threatening issue or causes failure of the AV access.

More in-depth surveillance can be performed less frequently to also detect the signs of complications, especially decline of function related to stenosis development. Jackson et al (26) performed a systematic review of studies that examined physical assessment and surveillance. They identified that both practices can be useful at detecting complications, but combining both approaches as a complete assessment of the vessel, provided the best sensitivity to detect complications. Using both these tools can help you refer in a timely manner to the appropriate person/department for further assessment or intervention to maintain the patency of the AV access. Consensus agreement indicates that the obtaining a patient history of needling and a basic look, listen, feel assessment provides an essential basis for detecting complications and interpreting more in-depth surveillance results.

Recommendation E: Definitions of Needling Techniques

1) We recommend use of rope ladder or buttonhole needling techniques and avoidance of area puncture technique.
2) Selecting the needling technique to be used is an individual decision for each patient. Recommendation F and Appendix 4 outline which technique is best utilised, in which situation. We recommend rope ladder needling for both AV fistulae and grafts.
3) Rope ladder technique is defined as needling sites that move progressively up the vessel in a systematic manner, with each needle site approximately 0.5-1cm above the previous site.
4) To perform rope ladder technique, the following criteria should be adhered to:
    a. Rope ladder should utilise as much length of the vessel as possible, using the full length of the vessel in a uniform manner
    b. Once the highest needle site is reached, needling should start at the bottom of the vessel again. We do **not** recommend moving up and down the vessel, as this can easily degrade into area puncture.
    c. Needling sites should cover:
        i. A minimum of 8cm length of vessel if both arterial and venous needle sites join up
        ii. Minimum of 5cm if arterial and venous sites do not join up.
5) Rope ladder can be performed in 2 ways:
    a. Zip rope ladder where needling sites are in the centre of vessel and each needling site is above the previous site. This can be used with all AV fistulae and grafts.
    b. Traditional rope ladder where needling sites move side to side as well as up the vessel. This can be used with AV fistula or graft with diameter wider than 0.9mm and may minimise damage from repetitive needling over short lengths. However, caution needs to be taken to perform this technique in a systematic manner.
    c. Figure 4 demonstrates the 2 types of rope ladder.
6) How to best perform needling with rope ladder technique is outlined in Recommendation G.
7) Area puncture technique is used to categorise needling sites that do not meet the criteria for rope ladder or buttonhole technique:
    a. A needling site covers less than 5cm
    b. Needling sites do not progress systematically up the vessel, but are ad hoc in a similar area
8) Whilst we do not recommend area puncture, we recognise there may be situations where it is impossible or unfeasible to avoid using area puncture technique. Recommendation I outlines how to avoid area puncture and what to do if performing this technique.

9) We recommend buttonhole technique for use with AV fistulae.
10) Buttonhole needling involves needling each needling site in the same manner during each needle insertion. This means at each needling site, entering the skin through the same hole, following the same route to the vein and entering the vein in the same place each time. Figure 5 shows the elements of a buttonhole needling site.
11) Buttonhole needling involves:
    a. Removing the scab from the previous needle insertion prior to the present needle insertion
    b. A track development phase where consistent needling with sharp needles is performed
    c. Needling with blunt needles once the track is developed
12) Buttonhole needling can involve 2-4 needling sites on one vessel. More than 2 needling sites can allow resting of sites especially when patients dialyse more than 3 times a week.
13) How to best perform buttonhole needling is outlined in Recommendation H.

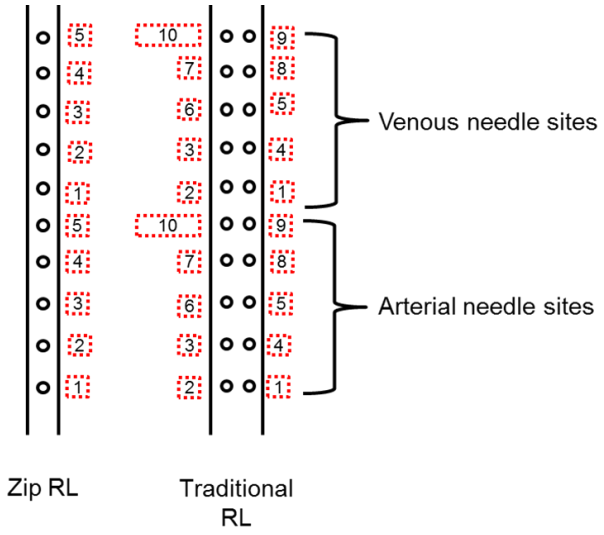

Figure 4: 2 Types of Rope Ladder

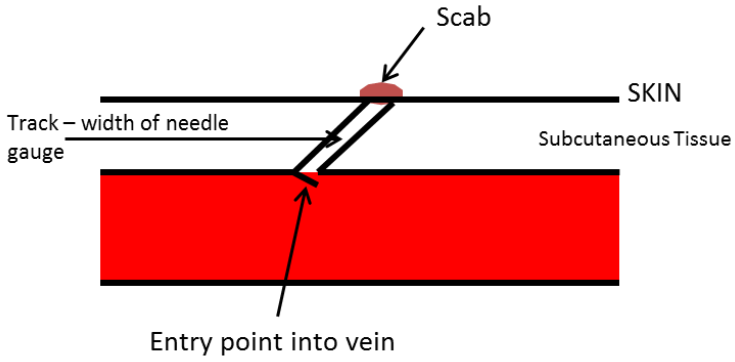

Figure 5: Buttonhole Needle Site

Rationale for Recommendation E

Kronung (9) first described rope ladder, buttonhole and area puncture technique. In his article, he hypothesised that rope ladder and buttonhole led to better preservation of AV access vessel through minimising aneurysm and stenosis development. Stenosis is well accepted as the biggest cause of AV access failure and needling techniques that avoid aneurysm and stenosis formation are optimal. Since then needling culture has developed to recommend rope ladder and buttonhole technique as superior to area puncture.

Various studies have examined the efficacy of buttonhole and rope ladder technique, as demonstrated in various systematic reviews, including Ren et al (11), Wong et al (27), Muir et al (28), Kotwal et al (29) and Grudzinski et al (30). However, strong evidence cannot be drawn due to the poor quality of studies (27, 30). 2 systematic reviews have produced conflicting recommendations with Ren et al (11) recommending buttonhole as the standard technique (in China), whilst Wong et al (27) recommend avoidance of buttonhole unless necessary (in Canada).

5 randomised control trials have been completed to compare various needling technique:

- MacRae et al in Canada (31, 32) – rope ladder to buttonhole
- Vaux et al in Reading, UK (33) – buttonhole to standard practice
- Chow et al in Australia (34) – rope ladder to buttonhole
- Struthers et al in Scotland (35) – buttonhole to rope ladder
- Toma et al (36) – buttonhole to standard practice

Results from these studies disagree, making recommendations based on these findings difficult.

Whilst many studies have examined buttonhole technique, there is less evidence to show that rope ladder leads to better AV fistula or graft survival in comparison to area puncture. Parisotto et al's (37, 38) observational study identified that both buttonhole and rope ladder have less risk of complications than area puncture and Rajoo (39) identified that area puncture was associated with increased complication rate. Current practice accepts that avoidance of area puncture with a preference for buttonhole or rope ladder technique is best practice. Other current recommendations all recommend rope ladder and buttonhole techniques with avoidance of area puncture (3, 6, 21). All contributors are aware of anecdotal cases where area puncture has led to significant problems with AV access.

Historically, claims have been made that units perform rope ladder. Consensus opinion agrees that few patients actually receive rope ladder and the majority receive area puncture. Vaux et al (33) recognise this dilemma and Parisotto's (20) international study, including the UK, identified only 28.2% of patients receive rope ladder, where as 65.8% receive area puncture.

For the first time, we have endeavoured to define rope ladder from area puncture technique. This has never been done before and with no evidence base, these definitions are developed through consensus opinion.

Points for Future Consideration

As highlighted, the research base for needling techniques, especially that rope ladder is better than area puncture, is poor. Studies are needed to compare needling techniques. Comparison between buttonhole and rope ladder needs to be careful to ensure both techniques are performed correctly and consistently. Without this assurance, studies cannot claim to compare the 2 techniques.

Currently we have no concept as to the frequency of use of each technique within the UK. Majority of units will claim that rope ladder is their pre-dominant technique. However this cannot be assumed to be correct without application of definitions that delineate area puncture from rope ladder. Units should apply these definitions to audit their needling practice; ensuring buttonhole and rope ladder are performed consistently. An example of how this audit can change practice was demonstrated by Lister Renal unit through a poster presentation at BRS conference in 2017 (40). National data, using these definitions, is needed to identify needling practice patterns and guide quality improvement initiatives in this area.

Buttonhole technique is currently only recommended for AV fistulae and not for AV grafts. This is based on the theoretical high risk of infection and graft rupture if buttonhole is used on AV grafts. Reported experience from a single centre indicated that buttonhole technique in carefully selected patients was successful (41, 42).

However, clinical trials and qualitative patient focussed studies are needed to evaluate the benefits and risks related to buttonhole and rope ladder on AV grafts.

Recommendation F: Choosing the Needling Technique and Planning Needling

Recommendation F.1 – Choosing the Needling Technique

1) Decisions as to which needling technique should be made with the patient. Individual factors and patient preference will influence the decision made. Whilst recommendations have been made in this section to guide this decision, they should always be taken in context for individual circumstances and patient choice.
2) Selecting the correct technique for individual patients is essential to ensure successful use of the AV access for haemodialysis with minimal complications. We do **not** recommend 'blanket' unit-wide use of buttonhole or rope ladder without individual consideration of each patient's circumstances.
3) We recommend either rope ladder or buttonhole technique is chosen for AV fistulae and rope ladder for AV grafts.
4) There are some AV fistula characteristics that will indicate either buttonhole or rope ladder technique is better as follows:
    a. Rope ladder technique (as outlined in Recommendation E) requires systematic needle insertions over either:
        i. At least 5cm segment for one needle insertion site
        ii. At least 8cm segment where needle sites are on the same length of vessel

        If this length of vessel is not available, then rope ladder is not possible. Buttonhole is the recommended technique for short AV fistula segments, but it is recognised there are situations where this is not possible. In this situation, area puncture may be the only option and should be managed as per Recommendation I.
    b. Buttonhole technique should be utilised in patients with a low infection risk. In patients with a high infection risk, if the segment available is too short for rope ladder, then area puncture may be the only option and should be managed as per Recommendation I.
    c. Buttonhole technique may be a better technique for patients with a vessel where needle insertions are difficult or the patient is very anxious about needle insertions due to a needle phobia. If these patients have a high infection risk, then rope ladder may the better option. Again, in patients with a high infection risk, if the segment available is too short for rope ladder, the area puncture may be the only options and should be managed as per Recommendation I.
    d. These factors are outlined in the Needling Decision Making Model in Appendix 4. Units who do not utilise buttonhole technique, will

inevitably require use of area puncture technique, although area puncture is not recommended as a technique.

Rationale for Recommendation F.1

These recommendations have been developed based on criteria outlined in Recommendation E.

To add to the evidence discussed in Recommendation E, it has been identified that excluding patients with a high infection risk from buttonhole technique negates the risk of serious infections (43). This has been identified within units who have contributed to these recommendations, including work disseminated by Royal Berkshire renal unit via conference abstracts (18).

Buttonhole technique has been associated with less painful needle insertion (44-49), although the evidence for this is not completely conclusive. Rope ladder has been identified as having a higher rate of acute complications including multiple needle attempts and haematoma (48, 50) and is more stressful for patients (47). It is indicated that buttonhole is a better option for patients who are anxious or experience difficult needle insertions (51).

For children, it is recognised that it may be difficult to perform rope ladder due to the short length of vessel. Buttonhole needling is used in some units now to avoid area puncture and findings in one study has shown that use of buttonhole has been successful in children (52, 53).

Recommendation F.2 – Infection Screening for Patients with AV Access

1) All patients undergoing needle insertion into AV access should undergo screening for MRSA and MSSA including their AV access site, a minimum of every 3 months.
2) Decolonisation should occur for patients who are positive for MRSA. There is no maximum recommended times that decolonisation should be undertaken, however twice is a common maximum number. Decolonisation protocols should be pragmatic, taking consideration that haemodialysis patients may undergo these on multiple occasions.
3) Patients should be individually risk assessed by the renal team before undertaking buttonhole technique. The following factors should be considered as to whether buttonhole technique is safe to use or should be avoided:
    i. MSSA and MRSA positive patients (until negative from decolonisation)
    ii. Patients with mupirocin-resistant strains of *Staphylococcus Aureus*

iii. Patients with a history of recurring infections, particularly vascular access infections
iv. Patients with a prosthetic heart valve, pacemaker or history of endocarditis
v. Patients with poor personal hygiene
vi. Patients with poor adherence to recommended cleaning techniques (e.g. refuse to wash arm prior to needle insertion; patients who insert their own needles and do not adhere to correct procedure)
vii. Patients with skin conditions that lead to scratching of the area around the buttonhole needle sites
viii. Patients considered a high infection risk due to other factors

A recommended infection screening tool for this purpose is included in Appendix 4 and based on work completed at Royal Berkshire renal unit (18).

4) Root cause analysis should be undertaken in all bacteraemia episodes in haemodialysis patients.

Rationale for Recommendation F.2

Screening of renal dialysis patients for MRSA was recommended in 'Saving Lives' (54). Whilst recommendations have been updated, renal dialysis patients continue to be considered at high risk of infections and screening for MRSA is still recommended in this population (55). Introduction of screening for MRSA and subsequent isolation and decolonisation of identified patients has been associated with a reduction in bacteraemias (56), especially in high risk areas including Intensive Care Units (57, 58) and dialysis units (59, 60). Therefore, screening of dialysis patients is crucial in preventing infections. Not only does this allow decolonisation and appropriate isolation, but also allows high risk patients to be 'de-selected' from the use of buttonhole technique.

Evidence for screening of MSSA is less obvious, as some studies have shown that screening, decolonisation and other techniques are less effective at preventing MSSA bacteraemias (61). Therefore, recommendations for MSSA screening are less clear. However, Tacconelli et al's (60) reviewed the effect of decolonisation of dialysis patients for all *Staphylococcus Aureus* positive screens and found decolonisation to be effective in all cases. Considering this and the higher risk of infection of buttonhole technique compared to other techniques, screening for MSSA leading to a risk assessment and deselection of 'high-risk' patients, may prevent infections associated with buttonhole technique.

Root cause analysis of all bacteraemia episodes in patients who undergo needle insertions will allow identification of the cause of the infection. This will guide further

practice in preventing infections and identifying patients at high risk, in who buttonhole technique should be discontinued or avoided.

Recommendation F.3 – Planning Needle Insertions

1) We recommend all patients who have needles inserted to AV access regularly have a plan for needle insertions. This should consider previous needle insertions and what will happen with future needle insertions. Neither buttonhole technique nor rope ladder can be adhered to without a needling plan.
2) The needling plan should consist of paper documentation that needs to be completed by all haemodialysis nursing staff inserting the needles. It should be designed to promote communication to ensure consistent needle insertions between staff members. This record is less necessary and not mandatory where the same person inserts the needle each time. However this person can never be a member of haemodialysis nursing staff as staff will always rotate between shifts and leave including unplanned leave.
3) The needling plan should be considered a guide rather than prescriptive piece of documentation. The assessment pre-needle insertion may detect factors that warrant divergence from the needling plan. Whilst consistent needle insertion is encouraged, it is recognised that vessel characteristics may vary between sessions.
4) The needling plan should develop with each assessment of the AV access and individual staff members should be encouraged to add their expertise to the plan, maintaining their autonomy and decision making in this process.
5) The needling plan needs to include:
    a. The arm position for optimal needle insertion
    b. Images to demonstrate the needling section of the AV access, possibly with potential needle sites. Figure 6 shows an example of good use of acetate to map the AV access and plan needle sites, as used in Portsmouth renal unit.
    c. Whether a tourniquet should be used
    d. How to best insert the needle, including clearly defined information on both the depth (angle from skin to hub) and the direction of needle insertion. This could be performed by comparing the fistula vessel and needle position to a clock face. This information is more likely to vary with rope ladder needle insertions than buttonhole needle insertions.
6) The needling plan should be designed to include patients in needling decisions, either being accessible to patients or patient held. Ideally this should be part of a package that engages the patient in their vascular access

care, as outlined in Recommendation M. Patients are in an optimal position to ensure consistent needle insertions in line with the needling plan.

7) Identifying suitable sites on a mature AV access undergoing rope ladder should also be given due time and consideration to ensure uniform use and development of the full length of the vessel, thus avoiding area puncture which may have damaging consequences. Experienced staff should have the courage and confidence to attempt to use new sites along the vein.

Figure 6 Image of an acetate used to plan Rope Ladder Needling from Portsmouth Renal Unit

Rationale for Recommendation F.3

Nursing staff patterns result in haemodialysis patients undergoing needle insertions by multiple staff members. Methods that lead to successful needle insertions should be communicated between multiple nursing staff who will perform the needle insertion. Communication in haemodialysis units is often a challenge due to the large numbers of patients undergoing haemodialysis in one unit. Therefore nursing teams need to consider how they will communicate the needle insertion plan to the whole team.

Both rope ladder and buttonhole technique require needle insertions to be planned. Rope ladder requires systematic progression up the vessel with needle insertions, so those inserting the needles need to understand this planned progression for each individual patient, to ensure they follow this systematically. Buttonhole technique requires consistent needle insertion, to ensure each needle is inserted in the same manner. Due to challenges with communication, this needs to be communicated between needlers.

Currently, no studies have been identified which outline the optimal way to do this.

Points for Future Consideration

Which needling technique is best for which individual patient has not yet been answered by research findings. The majority of studies on needling techniques make comparisons with the assumption that one technique is best for all haemodialysis patients. Future research needs to consider what individual considerations lead to choosing the correct needling technique.

Engaging patients to facilitate shared decision making about the needling technique to be used, whilst ideal, requires good patient information and facilitation. This is discussed further in Recommendation M. Patient information to support this will be extensive, requiring careful design. This is beyond the scope of these recommendations, but requires consideration and work from national organisations.

Recommendation G: Rope Ladder Needling Technique

Rope ladder needling should adhere to all the principles in other sections of the recommendations. Whilst rope ladder needling incorporates all of these principles, the needle insertion procedure is outlined below. This also describes a basic needle insertion procedure, which can also be used for area puncture and provides context for the recommendations on buttonhole technique in Recommendation H.

1) Rope ladder needle insertions should be planned with the same consideration as buttonhole, as per Recommendation F.
2) Decide on needle type and size, as per Recommendation B.
3) Prior to needle insertion, assess the AV access using the look, listen, feel assessment, as per Recommendation D. Decide on needling sites and direction and angle of needle insertion, as per Recommendation E. To perform rope ladder, these should be 0.5-1cm above previous sites, unless contra-indicated or commencing needling at the bottom of the vessel, as previous sites reached the top of the needling segment.
4) Ensure the patient washes the area around and over the AV access prior to commencing needle insertion.
5) Prepare aseptic field and don personal protective equipment (PPE) as per local policy, including sterile / non-sterile gloves, a plastic apron and protective eye wear, as per Recommendation C.
6) Cleanse the needling sites as per Recommendation C.
7) Apply tourniquet to AV fistula but not AV graft, as per Recommendation B.
8) If not performing dry needle insertion, prime the needles with Normal saline 0.9%, maintaining a non-touch technique, as per Recommendation C.
9) Insert needle as determined during pre-needle insertion assessment, using a gentle, non-touch technique, as per Recommendation A and Recommendation C. The needle should be bevel up with both needles ideally facing antegrade, unless retrograde needling is used for the arterial needle, as per Recommendation B.
10) Secure needles using chevron or ‘H’ taping technique, as per Recommendation C.
11) Avoid rotating the needle once inserted, as per Recommendation B.
12) Flush the needle to check for patency and to confirm adequate flow.

Recommendation H: Buttonhole Needling Technique

Recommendation H1: Track Development and Needle Insertion for Buttonhole Needling of AV Fistulae

a) Track Development

1) The depth and direction of needle insertion need to be consistent during the track development phase, to allow a consistent collagen track to develop. This is best performed following these recommendations:

   i. Track development should ideally involve only one person (aka as needler) completing the needle insertion.
   ii. If 1 needler is not feasible, then track development can occur between a maximum of 3 needlers. In this instance, systems need to be in place to ensure communication between all needlers, to ensure each needler implements the same technique, using the same angle and depth each time (see Recommendation F).
   iii. If the patient is to self-cannulate, if feasible, the patient should be supported to be the sole needler during the track development phase.
2) A tourniquet should be used during track development, as per Recommendation B. Tourniquet use should be consistent, with either use at all times or not at all.
3) Buttonhole track development should ideally occur with established AV fistulae only, to ensure the vein does not change over time. The period of time between first needle insertion and established AV fistulae is not set and should be decided on an individual basis. Factors that can indicate an established AV fistula ready for track development include (this is not an exhaustive list):
   a) The vein length, depth and diameter is not expected to mature and change rapidly.
   b) Adequate vein length to insert 2 needles reasonable distance apart – what this distance is will vary dependant on the fistula type, but further maturing of the vein to allow needling higher up the vein should not be expected at this stage. As a minimum, each needle should be 5cm apart and at least 5cm from the anastomosis.
   c) Both needle sites have vein diameter of more than 6mm
   d) Ability to cannulate both sites without problem, allowing the needle to enter the vein in one uninterrupted movement.
   e) Both sites can be cannulated with the needle gauge required to provide the desired blood flow rate, as per Recommendation B.
4) Track development on the arterial and venous needle sites can occur at different times, dependant on the maturity of each site. If the arterial site is

mature, but the segment of vein for the venous site still requires further maturation, the arterial buttonhole site can be established whilst performing rope ladder technique further up the vein.

5) When the sharp needle glides in place with no resistance, dull/blunt needles can be attempted. This should occur in 6-12 needle insertions using sharp needles.
6) During track development, the patient should be encouraged to discuss the sensations during needling, recalling the positioning of the limb and hand that is optimal for them, to promote information exchange between the patient and needler as to how to best insert the needles.
7) If the patient is planning to insert their own needles, then they should be encouraged to develop the track themselves. For patients to insert the needles themselves, they will approach the vessel at a different angle to another person performing this. Patients developing their own tracks will ensure greater success when inserting blunt / dull needles themselves and develop the skills required to troubleshoot problems in later needle insertions.
8) If the track is not established and blunt needles are unable to be inserted after 12 sessions of sharp needle insertion, further assessment of the buttonhole sites should occur with consideration as to whether different sites need to be developed.
9) Difficult track development, especially with deep tracks with a lot of subcutaneous tissue, can be supported by insertion of polycarbonate pegs. Polycarbonate pegs are inserted after needle removal and remain in place until the next needle insertion (33, 36, 52, 53, 62, 63).

b) Buttonhole Sites

1) Buttonhole sites should adhere to the principles outlined in Recommendation B.
2) Avoid developing buttonhole sites on dips, curves, aneurysms on the fistula vein or any area with abnormal skin integrity.
3) 1 patient can have 3-4 active buttonhole sites at one time, to allow rotation of sites, as per Recommendation E. This is particularly useful for patients who dialyse more than 3 times a week.
4) Use of specific buttonhole sites should be reviewed in the following situations and cessation of use of sites with these issues should be considered:
    - Hubbing of the site
    - Sharp needle insertion required regularly to cannulate the buttonhole site
    - Signs of infection at the site
    - Enlarging entry site or signs of tissue damage
    - Prolonged bleeding from buttonhole site
    - Significant pain/discomfort during insertion

c) Buttonhole Needle Insertion

1) Prior to needle insertion, the needler should encourage the patient to describe how the needle is best inserted, promoting consistent needle insertion.
2) The arm and hand position should remain consistent through track development and further blunt needle insertion to ensure alignment of the track and vein.
3) Communication should continue following the track development phase, to ensure all needlers are aware of the track direction, as per Recommendation F.
4) The blunt needle should glide down the track and not require excessive force to cannulate. The force applied during needling can be minimised by holding the tubing rather than the needle wings during needling.
5) The external steel shaft of the needle should never be ‘wetted’ with sterile or non-sterile solutions prior to insertion, as this practice increases the risk of contamination leading to a potential infection.
6) On insertion of the needle, 1-2mm of steel should be visible to prevent hubbing of the needle site.
7) The needle insertion should adhere to those principles outlined in Recommendations A, B, and C.

d) Troubleshooting Buttonhole Needling

1) If the blunt needle is not entering the vein smoothly, check the arm and hand position of the patient and track direction to ensure the needling technique and track position remains consistent at all times.
2) If one blunt needle will not enter the vein, needling should be attempted with a second blunt needle.
3) If a second blunt needle cannot be inserted, the needler who developed the track may insert a sharp needle.
4) It is not advised that a sharp needle is used in the track by anyone other than those involved in track development of that individual track. If a sharp needle insertion is performed by a needler not involved in the track development, then this needle should be inserted at least 2 cm above the buttonhole site. If space is not available above the buttonhole site, then a site at least 2cm below the buttonhole site can be used.

Rationale for Recommendation H1

Buttonhole needling relies on consistent development of a collagen track of scar tissue that the needle follows to the AV fistula vein during needling (64). This

ensures the needle enters the vein at the same place during each needle insertion (64). The track development phase is crucial in ensuring a consistent track is developed. During this phase sharp needles are used to develop the track, but this needs to be done in exactly the same manner each time. A single needler is recommended to avoid potential inconsistencies with track alignment. However it is acknowledged this is difficult to achieve in busy in-centre units, so a method of communication amongst staff is vital to minimise false track formation (65). A maximum of 3 nurses can be used during track formation, which still allows consistent tracks to be formed. If there are plans for self-care or home haemodialysis then the patient could be encouraged to form the tracks (66). False tracks can occur if there have been multiple needlers or the original angle of entry is not followed. It is thought false tracks could be reservoirs for infection, although this is only a theory with no research evidence to justify it. Other aspects that may also alter the AV fistula vein need to be consistent during the track formation phase i.e. arm placement, hand placement, use of tourniquet.

The issues highlighted as consideration for cessation of the use of buttonhole sites have been associated with poor outcomes with buttonhole needling. Hubbing is when the hub of the needle is pushed into the skin causing the needle entrance to stretch, becoming concave and over granulated. Hubbing (67) and sharp needle insertion into established buttonhole tracks have both been associated with an increase in infections. With hubbing, the scab becomes difficult to remove, increasing the infection risk. Concern has also been raised that repetitive needling in the same area during buttonhole needling can lead to problems with skin integrity over the AV fistula, increasing the haemorrhage risk. As with any needling technique, close monitoring of the skin should always occur to identify any degradation in skin integrity.

To ensure successful blunt needle insertion, the blunt needle needs to glide down the track. To allow this to occur the needling needs to copy exactly the technique used during the track development phase. Therefore, conditions for needling need to remain consistent. Whilst blunt needles are used to minimise the damage to the collagen track, excessive force should not be used with a blunt needle as this can still damage the track.

Unsuccessful needle insertion is a frequent complication of buttonhole needling (66). Long periods between needling the site can make the track harder to cannulate, with sites often harder to cannulate after a 2 day break from haemodialysis. Changes in tissue condition, which can particularly be altered by fluid status in a haemodialysis patients, can also alter the track making it problematic to cannulate. Difficulties with placing a blunt needle have the potential for increased sharp usage which is not recommended. Inserting a sharp needle into an established track can potentially cut the established track and lead to creation of false tracks, which in turn makes placing

a blunt needle even more difficult. Prolonged intermittent usage of sharp needles and extensive needle probing to overcome the misalignment will damage the existing track and create false tracks, which is also associated with an increased infection risk. If other troubleshooting methods fail, placing a sharp needle at least 2cm above the buttonhole site avoids trauma to the established track.

Points for Future Consideration

Not all advice included in these recommendations has yet been clarified by research. However, these are good practice points identified by experienced renal nurses across multiple units, who are experienced at performing buttonhole needling. Points for further investigation, consideration or basis for further projects could include:

- Is there a technique that assists with blunt needle insertion, reducing missed needling attempts? Once such recommended practice was twisting the needle, but there is concern this may stretch the buttonhole site.
- Why does the transition onto blunt needles fail in some individual patients?
- What are the major reasons for unsuccessful needle insertion?
- Does inserting the needle bevel up or bevel down alter the needling and is this different for buttonhole needling?

Supercaths / Angiocaths have been used in units to assist with track development (62, 68). These are plastic cannulas which remain in-situ for the whole track development period. They are used as the access for haemodialysis and are flushed and capped in between treatments. These have not yet been researched and are not licensed to be left in place in between treatments, so cannot yet be recommended. However 2 units are known to have good experiences of using these for buttonhole track development, as they eliminate the need for multiple needle insertions during the track development phase. The identified benefits indicate research is required into this practice to ensure it achieves its potential without increasing complication rates. It is not recommended they are used close to the elbow due to known breakages when in place (69).

Recommendation H2: Disinfection Procedure and Scab Removal Prior to Buttonhole Needling of AV Fistulae

1) All patients should wash their hands and fistula limb, as per Recommendation C.

2) The needling sites should be cleaned using solutions outlined in Recommendation C. Needling sites should be disinfected immediately before and after scab removal.
3) Softening of scabs prior to removal is not recommended.
4) Sterile tweezers or sterile picks which are supplied with the dull/blunt needles or separately, should be used to remove the scab.
5) To prevent infectious complications, the complete scab should be removed prior to needling of the buttonhole site.

Rationale for Recommendation H2

With buttonhole technique the key points need to be good disinfection of the needling sites pre and post scab removal and the correct and careful removal of the scab at the buttonhole site (10, 70) and disinfection of the needling site before and after scab removal (70-72) is thought to reduce infectious complications. It has been identified that during buttonhole, the track can become colonised by bacteria (73), so good disinfection of the site prior to needle insertion is essential.

Complete whole scab removal is recommended (10) to prevent particles, which contain bacteria, from entering the blood stream. It is important that this step should not be performed hastily (10). Soaking of scabs to soften prior to removal is thought to cause the scab to rupture into multiple pieces and so is not recommended. Scab removal needs to occur with a blunt, sterile object to prevent complications from utilising invasive tools, which can include scraped, ragged or torn tissue at the mouth of the tunnel (10) leading to wide tunnel mouths and infections from using non-sterile tools (70). Wide tunnel mouths may encourage entry of bacteria into the track and may result in large, often bulbous, scabs post treatment which can lead to infection (67).

Points for Future Consideration

Whilst the above recommendations have been able to be made on best available evidence, there are some aspects that still require further investigation or clarification. Covering the scabs with disinfectant soaked gauze for 1-2 minutes prior to scab removal may be associated with prevention of infections related to buttonhole needling. However, this is of yet unproven and requires further investigation to clarify whether this makes a difference.

Recommendation H3: Mupirocin use with Buttonhole Needling of AV Fistulae

1) Topical 2% mupirocin ointment / cream should be applied to the needling sites of all patients undergoing buttonhole technique, who are considered to have a high infection risk. The ointment / cream should be applied following needle removal and cessation of bleeding from needling site, after each haemodialysis treatment and left in place for approximately 12 hours.
2) All patients receiving 2% mupirocin ointment / cream regularly should undergo screening for mupirocin resistant *Staphylococcus Aureus.*
3) Patients who develop mupirocin resistance must not continue to use 2% mupirocin, until mupirocin sensitivity is restored. Each case should be risk assessed and consideration given as to whether buttonhole technique should be discontinued or an alternative antibacterial used.

Rationale for Recommendation H3

The routine application of mupirocin ointment or cream post dialysis to all patients with native AV fistulae on buttonhole needling method has proved successful at preventing bacteraemia episodes (74-76). However, there is concern that application of mupirocin ointment or cream regularly to all patients, will lead to the development of mupirocin resistant *Staphylococcus Aureus* in individuals (77, 78). Therefore, resistance to mupirocin should be monitored. Mupirocin application should be discontinued as soon as resistance is identified. When using mupirocin routinely, the risk of developing mupirocin resistance should be considered as this is considered a more virulent form of *Staphylococcus Aureus.*

Points for Future Consideration

The following aspects are not yet clarified and could be points for further investigation, consideration or basis for further projects:

- Nesrallah et al (74, 75) recommend the use of topical 2% mupirocin cream use for all patients undergoing buttonhole technique. However, it is unclear whether long term use will lead to problematic mupirocin resistance. This risk needs to be assessed and until ascertained, use for all patients cannot be recommended. Units who use mupirocin routinely should contribute to the evidence base by publishing their resistance rates.
- Alternatives to 2% mupirocin ointment / cream need to be evaluated for patients with mupirocin resistant *Staphylococcus Aureus.* Inadine gauze

(Nesrellah), *o*ctenidine dihydrochloride and Naseptin cream are alternatives that require evaluation.

Recommendation I: Area Puncture Needling Technique

1) Area puncture needling technique should be avoided wherever possible and we recommend the use of rope ladder or buttonhole needling technique on all AV fistulae and grafts, whenever it is possible.
2) Area puncture may be the only option on an AV fistula if:
    a. There is not the length available to perform rope ladder
    b. Buttonhole needling technique is not feasible, due to concerns about infection.

    With an AV fistula with only a short needling segment (e.g. tortuous AV fistulae or small adult / child AV fistula), this is not a simple assessment and requires an assessment of the risks of area puncture against the risks of infection from buttonhole.

3) If area puncture is necessary in an AV fistula, the needling segment should cover as large an area as possible and attempt to progress up the vein in a similar systematic manner to rope ladder needling technique.
4) Area puncture should never be used on AV graft. An AV graft will always supply a suitable length for rope ladder.
5) Area puncture of AV fistula is a better alternative for vascular access provision for haemodialysis, than using a tunnelled CVC.
6) Needling of new AV fistula should be planned to avoid area puncture. Rope ladder is normally feasible in new AV fistula, before aneurysms and tortuosity develop from poor area puncture.
7) Needling practice should be audited regularly, using the definitions developed in these recommendations, to identify how many patients undergo rope ladder, buttonhole and area puncture.

If area puncture of an AV fistula is identified as in use, the following conditions should apply:

8) Assessment of the vessel to ensure that an alternative needling technique cannot be employed.
    a. If rope ladder or buttonhole is possible and will lead to avoidance of area puncture, then the following can be used to promote avoidance of area puncture for individual patients:
        i. Education for the staff cannulating the AV fistula, about avoiding area puncture and how to perform rope ladder / buttonhole
        ii. Individual education for the patient about avoiding area puncture and how to perform rope ladder / buttonhole
        iii. Plan future needling for rope ladder / buttonhole needling, using written documentation to communicate the plan

iv. Consider the use of distraction for adults or play therapy with children to improve the needling experience, promoting confidence in the use of rope ladder

b. If rope ladder or buttonhole is possible, but the patient refuses to be cannulated in this manner, following review by the vascular team, this should be documented and recorded in the nursing and medical notes.

9) Increased assessment and surveillance of the AV fistula should be implemented to monitor for the signs of complications. The frequency of this surveillance should be dictated by clinical assessment of the risk to the individual patient. Complications to monitor for include:
   a. Aneurysm development
   b. Reduction of skin integrity
   c. Formation of stenosis and associated AV fistula thrombosis risk
   d. Development of tortuosity in the AV fistula vein from aneurysm development
10) Refer the patient to the vascular team to assess alternatives to area puncture and assess the risk of complications developing. Alternatives to area puncture could include:
   a. Revision of the AV fistula to allow rope ladder
   b. Consideration of AV graft use
   c. Consideration of the use of single needle dialysis

   Again, this will require a risk assessment of the individual circumstances to assess the risks of alternative options against the risks of area puncture of the AV fistula.

A flow chart outlining what to do if area puncture is identified in use on an AV fistula is in Appendix 5. This is based on a flow chart originally developed in Royal Wolverhampton NHS Trust.

Rationale for Recommendation I

It is recognised that area puncture (aka cluster puncture) is associated with an increased rate of complications, when compared to buttonhole and rope ladder (3, 9). For this reason, we **do not** recommend the use of area puncture, when buttonhole or rope ladder can be performed.

However, we recognise that there will be situations where there is no option but to use area puncture. Tortuous AV fistulae that have previously undergone area puncture will be difficult to convert to rope ladder or buttonhole. With this is in mind, it is critical that needling of new AV fistula is planned to avoid area puncture. If there is no other alternative than to use area puncture on an existing AV fistula, then the vascular and

haemodialysis teams need to consider the risk of area puncture, increase surveillance for the signs of complications and consider and exhaust all alternatives. A unit-wide ban on buttonhole needling technique will mean AV fistula with a short needling segment will undergo area puncture. This decision requires balanced consideration of the risks of buttonhole against the risks of developing complications from area puncture. Aneurysm development and reduced skin integrity from area puncture is associated with life threatening haemorrhage from AV fistulae and grafts (BRS VA Life Threatening Bleed Recommendations (2016) - https://britishrenal.org/aboutus/special-interest-groups/).

Parissotto (20) audited needling practice and identified that across a number of European countries, including the UK, 65.8% of AV access needle insertions were area puncture. Area puncture can be an easy needling technique to undertake, as it involves inserting the needle into a known ‘successful’ area, rather than the unknown of rope ladder needling higher up the vessel. Use of area puncture can be a sign of lack of confidence in needling skills in both nursing staff and haemodialysis patients. Education of staff and patients can promote the use of rope ladder and discourage the use of area puncture.

Points for Future Consideration

Currently, it is unknown how many AV fistulae are unsuitable for both rope ladder and buttonhole. Within the renal community, we have denied the use of area puncture, claiming it as rope ladder. Local clinical practice audit needs to identify honestly how many patients are undergoing area puncture and whether this can be avoided. We need to avoid punitive attitudes to the use of area puncture and recognise it happens for a reason, often due to a lack education, knowledge and confidence in both staff and patients.

Creating an open, honest and pragmatic debate on area puncture, both locally within units and nationally, will help determine the frequency of this practice and how often it can be avoided. Developing the skills and knowledge in both our needlers and patients will help reduce the use of area puncture.

Recommendation J: Needling of New AV Access

1) Newly developed fistula veins can be very delicate and fragile. Needling should be carried out very carefully and as gently as possible and only by experienced nurses. Adequate time should be allowed for the procedure to ensure that this early needling is a positive experience for the patient so as to help allay their anxieties over the ensuing weeks.
2) AV fistula should be considered mature to needle when the vessel diameter reaches 0.6cm. However, it is recognised on occasion needle insertions may be attempted on smaller vessels and that assessment of when to commence needling will involve consideration of individual circumstances. This assessment may also include physical assessment and decision making by experienced nursing staff.
3) AV grafts should be first needled 2-4 weeks after insertion, once swelling and bruising has settled in the surrounding tissues. 'Early cannulation' AV grafts can be needled within 24 hours, dependant on manufacturer instructions.
4) The patient should be prepared for the first needle insertion as outlined in Recommendation M.
5) The person inserting the needle will need to decide whether to attempt one or two needle insertions. This decision should be guided by individual assessment of the AV access by an experienced staff member. Factors that may affect this decision include confidence and competence of the person inserting the needle, size and length of the vessel, and the level of anxiety within the patient. If two needle insertions are attempted, the haemodialysis treatment should be prepared with consideration that both needle insertions might not be successful.
6) If one needle only is inserted into the AV access, then haemodialysis can either be performed using single needle dialysis or using one CVC lumen as one point of access.
7) The first needle insertion for new AV access should be performed by nursing staff experienced at needle insertion. However, inexperienced staff can learn how to perform needle insertions on new AV access through observation of experienced staff and then commencing this skill under observation of experienced staff.
8) If only one needle is inserted successfully, a plan should be developed for progression to double needle dialysis promptly within 1-2 weeks, ensuring adequate dialysis. As soon as the vessel is mature enough, 2 needles should be inserted for each haemodialysis session.
9) Initial needle insertion into the AV fistula may need to be nearer to the anastomosis, to ensure successful needle insertion. As the vein is cannulated more, needle sites can be moved further from the anastomosis.

10) Buttonhole track development is not recommended until the AV fistula is mature and established for use in haemodialysis, as per Recommendation H.
11) 17g needles should be used for the first 3-6 needle insertions into AV fistulae. If, after two weeks, needling has been problem free, then progression to 16G will be appropriate, whilst also increasing blood flow rates, as outlined in Recommendation B.
12) Needle gauge for AV grafts should follow manufacturer instructions. Early cannulation AV graft may require small needles (17g) for early needle insertions, whilst other AV grafts may be able to commence needle insertion using 15g needles. AV graft diameter does not require further maturation to use larger needle sizes.
13) CVC may remain in-situ whilst commencing use of AV access. This provides an alternative form of access if needle insertion is problematic or may be used in conjunction with the AV access as one form of arterial / venous line access. However, haemodialysis nurses need to consider safe management of the CVC when not utilised for haemodialysis and we recommend prompt removal of the CVC once use of the AV access is established.

Rationale for Recommendation J

There is a little evidence as to how to manage the first needle insertion, so much of the recommendations are based on consensus opinion. There continues to be variation in how central venous access is managed when converting from this to AV access. However, discussions indicate practice is consistent with the recommendations developed, indicating this outlines successful management of first needle insertions.

Recommended practice is based on managing and promoting successful needle insertions on a fragile, immature and unpredictable vessel, whilst promoting use of the AV access. AV fistulae are likely to be fragile and immature when first used, whilst AV grafts do not require maturation before use. Due the fragility of the vessel, small needles are recommended for initial needle insertions into AV fistulae, with prompt change to larger needles once the AV fistula use is established (22). Use of single needle during the first 2 weeks of needle insertions can reduce the number of missed needle insertions and reduce the use of CVC during this phase (79).

First needle insertions of both types of access can be difficult, due to the unpredictability of the procedure for both the patient and the person inserting the needle. Mafara et al (80) identified that initial needle insertions on new AV access can be traumatic for patients and lack of understanding from nursing staff can make patients feel vulnerable. When managing an initial needle insertion, nursing staff need to consider this and be empathetic and understanding of the patient's anxiety.

Points for Future Consideration

Wilson and Harwood's (81) qualitative study identifies that patients are poorly prepared for the first needle insertion into their AV access and better preparation will reduce anxiety related to this procedure. Local renal teams need to give better consideration as to how to best prepare patients for their first needle insertion. Recommendation L starts to outline what provision may be required.

Recommendation K: Use of Nurse-Led Ultrasound to Assist with Needling

Use of ultrasound (US) by nursing staff is relatively new practice that some units have started to utilise over the last few years. This practice involves nursing staff using US images to assess the vessel to assist with needling and to assess maturity of an AV fistulae. US images can be used by nursing staff to measure the diameter of the vein, assess the position of the vessel and recognise abnormalities that may require further assessment from a skilled US practitioner.

Consideration should be given as nursing staff do not routinely use US images. Nurses should not use US to diagnose abnormalities. This is the remit of skilled US practitioners. However, US images can be a useful tool to assess the vessel and allow nurses to refer previously unrecognised abnormalities to a more skilled US practitioner.

It is also recognised that not all haemodialysis units currently have access to a portable US machine or have training to support nursing staff. A lack of use of US imaging in haemodialysis units does not make needling unsafe and safe assessment can be performed on AV access without US images, with referral to radiological services as required. However, it is recognised it can make needling of difficult AV access more successful and less traumatic for patients. Each unit should consider investment in this technology and training for nursing staff, to implement this practice to support needling of difficult AV access.

Clinical Practice Recommendations

1) US images can be used:
    a. To assess maturity of the AV fistula vein, to identify if it is ready for needling
    b. To assess the AV fistula vein / graft prior to needling if it is difficult to palpate or has previously been difficult to cannulate
    c. To view the AV fistula vein / graft during needling, undertaking US imaging concurrently with needling, allowing assessment of the vessel's response to needle insertion.
2) US assessment of an AV access should complement clinical assessment and never replace the initial look, listen, feel clinical assessment. The results of US imaging of an AV access should be interpreted in conjunction with clinical assessment. US imaging alone is not a complete assessment of the AV access.
3) US images interpreted by a registered nurse to demonstrate abnormal findings should be referred to an experienced US practitioner for interpretation. The nursing interpretation alone should not lead to a definitive diagnosis.

4) Nurses who use and interpret US images need training on how to use the US machine correctly, how to interpret the US images and how to detect signs of complications or abnormal anatomy.
5) US imaging in this context is only recommended for use by experienced, senior registered nurses. These are nurses defined as those who have achieved the 'Gold' Standard of the 'VASBI / BRS VA National Needling Competency'.

Rationale for Recommendation K

Whilst there is little evidence of the use of nurse-led US imaging to assist with needling of AV access, it has been used in other needling procedures. US imaging during CVC insertions is shown to minimise the complications of catheter insertion in certain circumstances (82-84). For this reason, NICE recommends the use of US guidance for insertion of internal jugular catheters, but not for all CVC insertion (85). Walker (86) also identified that US assessment led more successful peripheral needling.

It can be presumed that some of the benefits in other needling procedures are applicable to AV access. This assumption indicates nurse-led US assessment could lead to more successful needling of AV access and minimise complications from needling. Problems cannulating AV access can lead to anxiety and pain in haemodialysis patients, which can be repetitive trauma for patients (13, 14). In this context, implementing procedures for more successful needling could also be presumed to improve the patient's experience of haemodialysis.

Currently there is no published evidence as to the benefits of nurse-led US assessment of AV access. However, the majority of units involved in the development of the recommendations use US images to assist with difficult needling and all felt it was of benefit. Units do have concerns that US assessment could lead to de-skilling and over-ride clinical assessment, especially in inexperienced hands. It is recognised that the US image does not show everything required to assess an AV access. Use and interpretation should occur alongside clinical assessment.

At national conferences, Derby renal unit (87, 88) have presented their experience of implementing nurse-led US assessment of AV access, completing a service evaluation project. Conclusion of their work demonstrates that this practice is of use when AV access is problematic to needle or for needling of new AV access. In this context, US assessment led to more successful needling and improved the patient's experience of needling, reducing their anxiety and pain (88). However, they were unable to identify an improvement in clinical outcomes when nurse-led US assessment was used to assess AV access (87). Harwood (15) also indicate that US images may lead to a better assessment of AV access prior to needling, leading to more successful needling. These pieces of preliminary work indicate there is a benefit to US assessment of AV access in

specific circumstances i.e. following problematic needling and needling of new AV access.

Fielding et al (89) and NICE (85) highlight that proper training is essential to interpret US images. US image interpretation is not a skill that registered nurses use routinely. Correct interpretation of US images by registered nurses requires the skill of an experienced needlers, with training in understanding and interpreting the US images. As always, registered nurses need to acknowledge their limitations and not hypothesise interpretation of US images beyond their knowledge and skill level. It is also recognised that using US images concurrently with needling is a difficult skill to develop (88). Despite experience in needling, not all registered nurses feel comfortable with this skill (15).

Points for Future Consideration

1) Small hand held US machines have recently become available to assist AV access needling. These may assist development of US imaging concurrently with needling. However they generate an image in a different perspective to normal US images, so still need evaluation.
2) Further work is still required to identify what are the right circumstances to use nurse-led US assessment of AV access and what are the true benefits of this practice.
3) In the future, standards need to be developed for training of registered nurses on how to use US assessment of AV access.

Recommendation L: Managing Anxiety during Needling

Prior to the use of an AV access for haemodialysis, all patients whether a child, young person or adult should be well prepared, using techniques that are appropriate for that individual.

The following information is a guide for preparation and distraction techniques for staff working with patients needing haemodialysis using an AV access. Some techniques maybe more focused on children and young people, however many techniques can be effective in the adult patient and may also be relevant to adults with learning difficulties.

1) **Preparation information**: all patients should have access to written and/or web based information about having an AV access. This should include the following:
    a. What is an AV access
    b. How it is created
    c. What it is used for
    d. When will it be used
    e. How to look after the AV access
    f. Routine for needling the AV access

    Information should include photographs and illustrations, as appropriate and be written at the appropriate level for the patients it is designed for.

    Ideally, in preparation, patients should be given the opportunity to discuss the experience of needling with other patients, ensuring this happens in a constructive manner.

2) **Needle desensitization**: There will be some children, young people and adults who will have a fear of needles. Desensitisation work may be needed over a longer period of time with a gradual move to using a fistula needle.

    Begin the work with general needle, using a small butterfly needle which can then be increased in size as the work progresses. Activities can include allowing patients to touch and hold a needle and encouraging patients to put the needle into a plastic phlebotomy arm, soft toy or a playdough hand/arm. Using the needle to paint with can also desensitise patients to needles.

3) **Provide a calm environment**: The environment can contribute greatly to any anxiety or fear a child, young person or adult may be feeling when

beginning to use their AV access. Where possible try to create a calm and relaxed environment utilising equipment such as music and fibre optics. Try where possible to take the procedure at the patients pace and not rush the needle insertion. However it may be helpful to agree a time scale to get the needle in before you begin.

4) **Written AV Access plans**: Prior to accessing the AV access it is helpful for some patients to feel they have some control over what happens when their AV access is used. This can be achieved through a written plan devised with the child, young person or adult giving them simple choices and responsibilities as part of the procedure. For example wiping the area, or taking off the scab with the picker. Allowing the child, young person or adult to participate in activities as they wish may also foster this sense of control (see Recommendation M & Recommendation N).

5) Visual routine: Some children, young people and adults prefer to have a visual routine using pictures or photographs of the procedure as this helps them to understand what needs to happen during the routine of accessing their AV access. Using pictures or photographs can help to breakdown the process for some patients and can help take away some of the fear of the unknown.

6) Distraction: From the preparation sessions the child, young person or adult may decide that they do not want to be involved directly in the procedure but would rather be distracted. Below are ideas that can be used whilst the child, young person or adult has their vessel accessed.

- **Breathing techniques**: these need to be taught by the health care professional and practiced by the patient a couple of weeks prior to using them in an anxious situation.
- **Relaxation Techniques**: These are helpful for children, young people or adults who are particularly worried or anxious about having their AV vessel accessed. These should be started before the procedure begins to allow the patient to engage and begin to relax.
- **Blowing Bubbles**: This can help to regulate the patients breathing which is helpful if they are anxious or worried about the procedure

Below is a list of relaxation techniques that maybe helpful when accessing an AV access.

- **Age appropriate relaxation scripts:** These are read to the patient throughout the procedure and are a simple and safe form of guided imagery encouraging the patient to picture what is happening in the

story. Encourage breathing techniques to be used in conjunction with the relaxation scripts.

- **Progressive muscle relaxation stories**: These again are available for all ages and encourage the patient to contract and relax certain muscle groups beginning at the patients feet and working up to their arms, hands and head. These are read to the patient throughout the procedure and again can be used in conjunction with breathing techniques.

Rationale for Recommendation L

These recommendations have been developed with paediatric nurses and play therapists from Great Ormond Street Hospital and Manchester renal unit. Paediatric haemodialysis units have extensive experience in managing anxiety related to needle insertion with children. Through discussion, consensus of the group has identified that many of the techniques utilised in the paediatric setting are also relevant to adults. Further information on how paediatric settings manage anxiety related to needle insertion is provided in a video from Great Ormond Street (www.gosh.nhs.uk/medical-information/procedures-and-treatments/arterio-venous-av-fistulae-haemodialysis).

Within the adult setting, anxiety related to needle insertion is poorly recognised and managed, with priorities focussing on timely connection to haemodialysis not a good needle insertion. However, qualitative studies examining experiences of haemodialysis do identify that anxiety related to needle insertion is a major issue for patients (13, 14, 90). This is endorsed by the first Patient Reported Experience Measure for renal patients in the UK, which identified needle insertion experience as an issue with experience far from optimal (PREM report). This can lead to avoidance of AV access use to avoid needle insertions (91).

Some of the techniques recommended have been identified as beneficial in research. Taylor (13) identified that patients are motivated to insert their own needles through a desire to control the needle insertion in response to bad experiences of nursing staff needle insertion. This control over the procedure helps them manage their anxiety related to the needle insertion. Wilson and Harwood (81) identified that anxiety was related to expected pain and that a friendly nurse-patient relationship and a calm environment helped patients manage this anxiety. They suggest music therapy, distraction and good communication between nursing staff could help manage this anxiety. Also the chaotic environment of a haemodialysis unit increases anxiety of patients and is not conducive to a good needle insertion experience (80, 81).

Points for Future Consideration

Anxiety related to needle insertion is significantly under-estimated in the adult population. Haemodialysis nursing staff need to give greater consideration as to how this can be managed. Harwood et al's (90) scoping review identified a huge gap in research findings on how to improve patients' experiences of needle insertion. Future research needs to not just focus on clinical outcomes, but also on patients' experiences of needle insertion.

As the environment of the haemodialysis unit affects patients experiences of needle insertion, senior nurses need to consider how they will promote calmer environments within haemodialysis units.

Recommendation M: Involving Patients in Care of their Vascular Access

1) It is critical that patients have the opportunity to become involved with the care and management of their vascular access as early as possible, ideally in the preparation stages before starting haemodialysis. The ideal time to begin this process is when a patient starts pre dialysis education.
2) Pre-dialysis clinic discussions should outline vascular access options. The patient's involvement in this choice and the subsequent implementation of that vascular access care is critical.
3) Educational material about vascular access should be available for all patients who are about to begin dialysis. This should be written at a level that is generally understood by the patient and be available in alternative language formats. This material needs to be augmented by education from clinical staff, making adjustments appropriate to individual patient's skills and understanding.
4) Pre dialysis educational material should not just include information on their vascular access but also what to expect from their first needle insertion or vascular access use alongside connection to haemodialysis. Further detail of content to be covered is identified in Recommendation L.
5) Information provided to patients on vascular access care and needling should be consistent between staff and with local renal unit needling policies.
6) If the patient is keen to insert their own needles then they should be encouraged and assisted to do this, using techniques recommended in Recommendation N.
7) Continuing careful assessment of the needling sites is critical for sustainable vascular access. The engaged patient will be best placed to assess and note any changes or difficulties with needling, facilitating timely and appropriate intervention. All patients should be shown how to assess changes over time, especially in detecting complications.
8) In order for patients to increase their involvement in their vascular access care, there needs to be a multi-disciplinary approach from the whole team. Encouragement for patients to become involved in their vascular access care should be consistently provided throughout their renal journey, with all members of the multi-disciplinary team reinforcing this.

Some examples of methods of engagement developed by some centres are as follows:

a. Having the patient empowered to observe how long the cleaning solution has been on the access sites and to inform the nurse that there has been sufficient time past to initiate needle insertion.

b. Based upon a patient's knowledge of their AV fistula or graft and needle sites, the clinical team should encourage the patient to vocalise the needle insertion or perform the needle insertion themselves. Those inserting the needle should emphasise that only the patient is truly aware of the sensation of the needle going into the vessel, meaning the patient is best placed to guide this, aware of subtle alterations to allow the needle to enter the vessel in the best possible manner.
c. Patient anger in the dialysis unit can be a sign of frustration that they are out of control of their treatment. This could be channelled into them taking increased personal responsibility by communicating to them that they are probably better placed to outperform the professional staff as they understand their body best.

Rationale for Recommendation M

Patients who have an increased awareness, and more importantly, are engaged with the clinical staff in their care of their AV fistula or graft can be expected to have better outcomes for their access. This is concluded for many reasons:

- Patients are present for every needle insertion, which individual nursing staff are not as they rotate around shift patterns
- Patients know how the needle feels during insertion and can often detect whether the needle insertion is correct or not
- Patients know their individual access well and are more likely to detect problems and escalate these
- Patients have personal investment in preventing complications and problems developing.

Whilst patients are well placed to detect problems, they often require permission to voice their concerns. Patients should feel supported and encouraged to provide their honest opinions and be involved in their access care. This culture is often dictated from initial contact with health care professionals and needs to be promoted at every decision and contact with the patients.

Whilst minimal research has been performed in this area (90), Cavanaugh (92) identified that better dialysis knowledge is associated with AV access use. Wilson and Harwood's (81) qualitative study identified that patients are poorly prepared for the first needle insertion into their AV access and better preparation will reduce anxiety related to this procedure. Involvement in vascular access care can promote feelings of control in patients and reduce anxiety related to needle insertion (13, 80).

Shared HD ethos is to promote involvement in care, whether it be in-centre or encouraging home haemodialysis (93). Vascular access is a significant part of

haemodialysis treatments and should embrace this ethos. However, involvement in vascular access care has a larger scope that the activities outlined in the Shared HD protocol (93), involving more than just preparation of the dressing pack and needle insertion.

Recommendation N: Teaching Patients how to Self-Needle

1) Before embarking on training for self-needling, ensure the patient is a willing participant in inserting their own needles, giving them the chance to make an informed choice. This choice should include identifying how much of the process they wish to participate in:-
    a. Cleansing their arm
    b. Inserting their own needles
    c. Taping the needles
    d. Flushing the needles

    The patient should be allowed to progress as far as they wish. They should have received full information on what is involved and the pros and cons of self-needling. The benefits of inserting the needle themselves include having more control and independence over their haemodialysis treatment and becoming the expert on their AV access. However, if they are not ready to self-needle currently they should always be allowed to revisit self-needling in the future, if they wish to.
2) Timing needs to be carefully considered when to commence or even ask the patient about inserting their own needles. It is important not to frighten the patient. Assessment of the patient and getting to know them may help with the decision of whether to ask at the beginning of their journey or once they are established.
3) An initial step to self-needling may be to allow the patient to commence their training by removing their needles, as this would allow them to get used to handling the needles and allow them to gain confidence in holding the needles.
4) Needle insertion requires dexterity. Patients may require support from nursing staff to perform some elements of the process. If receiving haemodialysis in-centre, self-needling can be considered a joint procedure between patients and nursing staff. Consideration is required as to how the patient is going to manage their needling one handed. They will need to consider the direction of approach they will have to the AV access, which will be different from a nurse's approach. Applying the tape to the needle once inserted and flushing of the needles is also different, and can be difficult, when performed one-handed.
5) Whilst buttonhole technique is often cited as the best technique for patients to insert their own needles, we do not recommend buttonhole technique as the default technique for self-needling. We recommend that the decision is made with the patient and the needling technique used takes into consideration patient preference and clinical considerations, in line with Recommendation F, as well as identifying which technique is easiest for the patient to complete. Whilst this might be buttonhole technique for the majority of patients, this assumption should not be made for individual patients.

6) If patients do plan to self-needle using buttonhole technique, we recommend where possible the patient develops their own 'tracks', as outlined in Recommendation H1.
7) Teaching a patient to cannulate is different from teaching nurses the same skill and the approach to this is different. Patients should not be expected to learn needle insertion from information designed for nursing staff. Patients will require different content and terminology, due to different levels of background knowledge. Examples of word changes may be 'place your own needles', 'put in your own needles' rather than self-cannulation.
8) Knowledge levels will differ within your patient groups meaning an individual teaching plan for each patient is required. A generic template could be used for adaption to individuals. To commence the teaching :
    a. Make an agreed plan with the patient to enable progress with training and set some achievable targets. This could be done as a reward chart if this approach suits the patient.
    b. Each patient will progress at a different pace and this must be allowed to happen. The natural flow will help build confidence, for example doing practice on practice arms, will help to get a feel for placing needles.
    c. Patients will know when they feel ready to attempt needling on themselves. People learn at different speeds and in different ways. Some like to watch whilst others like to do.
    d. Assisted needle insertion can help patients start to insert their own needles, where either:
        i. The staff member holds the needle and the patient holds over the staff member's hand whilst the needle is inserted
        ii. The patient holds the needle and the staff member holds over the patient's hand whilst the needle is inserted.

       This allows a halfway attempt, allowing the patient to gain experience of the feel of self-needling, which will help to build confidence.
    e. It needs to be acknowledged that some patients, even if they want to, may not progress to performing full needle insertion. This needs to be handled with care, and they should always be allowed and encouraged to do as much as they are comfortable doing.
9) The training to teach patients how to insert the needles themselves should include:
    a. What the fistula / graft is and how it works
    b. The differences between rope ladder, buttonhole and area puncture
    c. The look, listen, feel assessment including recognising problems and how to escalate problems
    d. Feeling the vessel prior to needle insertion, becoming familiar with the structure of the vessel and direction that the blood flow is going in.

e. The correct cleaning techniques and the importance of the skin site preparation process, especially the appropriate drying times for the solution chosen.
f. Applying a tourniquet, if used
g. How to hold the needle for needle insertion
h. Guidance on how to insert the needle
i. How to flush the needle
j. How to tape the needle

10) The patient will need to be taught not just how to wash their hands and access, but also the reasons why these procedures are carried out. Patients will need to understand basic infection control and aseptic non-touch technique.
11) Confidence needs to be built in the patient who is learning this new and alien skill to them. It is important to reassure them that they are capable to learn the skill. Speaking to other patients who have mastered the technique will be of benefit. Patients should be encouraged to try and be reassured when they are unsuccessful.
12) The time needed for training must be set aside and not rushed; the patient must feel they are being given adequate time to learn these new skills. It will take some patients longer than others and they will need more than one training session; again with an individual plan with a record of achievement recorded. Consideration needs to be given to the time required to teach patients to insert their own needles. This should be allowed for when planning rotas of nursing assignments.
13) Information for children and young adults will need to be tailored dependent on their developmental age and ability, and revised as per local teaching protocol for different ages. Information for children and young adults will either need to be created independently or adapted from adult information to be presented appropriately for this population.
14) On-going support and patient understanding of problems and how to overcome them must also be added to the teaching programme. They will need to know when to stop and ask for help.
15) Once self-needling, the patient is likely to experience problems during difficult needle insertions. Patients should be supported through difficult needle insertions so that they continue to needle themselves. For home patients, this may mean occasional in-centre sessions or home sessions with support from nursing staff.
16) As the patient becomes more familiar with the needle insertion procedure and gains in confidence, there needs to be monitoring pathways to ensure proper technique is being followed at all times. This should include regular re-assessment of technique of self-needling.

Rationale for Recommendation N

Little evidence is available as to how to teach patients how to insert needles themselves. However technique failure for vascular access use in the home setting can lead to failure of home haemodialysis (94). Supporting and developing a good needle insertion technique in people who insert their own needles, is essential to promote this practice.

This recommendation has been developed through expert opinion not just from vascular access nurses, but also those with expertise teaching patients how to self-needle and new staff how to insert needles in to AV access. It is critical to create a supportive environment for patient's to learn to insert their own needles, building the patient's confidence to perform a complex procedure. Patients' need support over multiple needle insertions and on-going support to maintain self-needling through difficult needle insertions. Nursing staff need to understand this can be a difficult and anxiety provoking procedure for patients to learn, but it is worth perseverance to promote self-needling.

Points for Future Consideration for Recommendations M & N

The following aspects could be points for further investigation, consideration or basis for further projects:

- Very little evidence is available that identifies the benefits of engaging patients in their vascular access care, how to engage them in their vascular access care and what support they may need. Further work needs to be done to provide this evidence base.
- Like staff, patients require education to learn how best to care for their vascular access. However, this information and education needs to be tailored to patients' needs, rather than using staff education packages. Consideration needs to be given to what is the best way to do this and what content is required to provide this support to patients on:
    - Vascular access information and care
    - Needle insertion.

  Whilst many individual units have their own ideas, there is little coherence on this across renal units and minimal work on identifying patient needs in this area.

Recommendation O: Staff Training to Perform Needling of AV Access

1) All healthcare staff (registered or unregistered) who are learning to insert needles into AV fistulae and grafts must have a theoretical understanding of:
    i. What is an AV fistula and graft, including relevant anatomy and physiology
    ii. Different needle insertion techniques, including their risks and complications
2) Following theoretical teaching, all healthcare staff (registered or unregistered) that are learning to insert needles into AV fistulae and grafts should have a period of supervised clinical practice, using staff experienced at this procedure to supervise learners.
3) An assessment of competency of needle insertion for AV fistulae and grafts should occur for all healthcare staff (registered or unregistered), prior to performing this skill independently. No-one should cannulate an AV access independently, without this assessment.
4) All healthcare staff (registered or unregistered) who perform needle insertion on AV fistulae and grafts should be:
    i. Reassessed every 3 years
    ii. Receive an annual theoretical update.
5) Regular monthly audits should occur of needling practice, to ensure everyday practice adheres to infection control and local needle insertion protocols.

Rationale for Recommendation O

Education and knowledge of healthcare staff (both registered and unregistered) performing needling of AV access is crucial to ensure safe needling that minimises complications and optimises AV access life span. The person inserting the needle will choose where the needles are inserted, how they are inserted and whether they adhere to recommended policy, all of which dictates the success of the needle insertion and preservation of AV access function. This process involves clinical decision making, which not only requires knowledge, but also clinical experience, the opportunity to reflect on experience and mentorship from experienced staff (95). To develop the skill of cannulating multiple and varying AV access, healthcare staff require knowledge and the opportunity to practice the skill through teaching and clinical support. This enables staff to develop needling skills that will preserve vascular access function.

Education and adherence to asepsis protocols has been identified as essential to perform buttonhole technique successfully and prevent infections (76, 96-99). O'Brien et al (65) hypothesised, following their analysis of infectious episodes related to buttonhole technique, that expertise was required to utilise buttonhole technique successfully and minimise complications. The same has not been studied for rope ladder needling, the same could be assumed. Hulse (100) identified that needle insertion for peripheral needle insertion required not just theoretical and simulated training, but also required support from experts in clinical practice. This improves skill acquisition and reduces anxiety from patients due to poor procedure execution. The same principles can be applied to haemodialysis patients with AV access, which is potentially more critical due to the damaging nature of repetitive needle insertion in this context.

Haemodialysis patients find needle insertion a stressful procedure and providing nursing staff with the skills to do this well is necessary to minimise this fear and anxiety (14). If needling skills are not developed, CVC use can increase (66, 101).

Once this skill and procedure are learnt, the procedure also needs to be maintained. Cultural behaviours and personal experiences (known as hind-sight bias) start to influence clinical decision making, not only in positive ways but also in destructive ways (102, 103). Training and re-training of needlers is essential to prevent degradation of needling techniques and prevent complications like infection (10, 65, 98). Therefore, not only is initial training important to prevent complications, including bacteraemias, but continuing education and monitoring of clinical practice is required. This will ensure expertise development and prevent variations in procedures, thus minimising the complications associated with needle insertion.

Conclusion

As discussed in the introduction, good needling practice is essential to promote AV access use for haemodialysis, minimising complications and promoting a good patient experience. These recommendations outline how to achieve this, with the best practical knowledge currently available, from experts across the UK. Throughout the recommendations we have included consideration of the patient experience of needle insertions. Needle insertion is a traumatic and stressful procedure that haemodialysis patients undergo on an endlessly repetitive basis. Best needling practice should not just minimise complications, but also improve patients' experiences of needle insertions and allow consideration for individual patient requisites.

Many of the 'Points for Future Consideration' highlight the lack of a good evidence base of needling practice, with a call for further research. In the last few years, there has been a plethora of studies related to needling practice. However, this has not yet added to the strength of evidence available or provided clarification on what is best practice. Future studies need to consider how to minimise bias, strengthening the knowledge of needling practice rather than introducing further controversy. In particular, multi-centre collaborations involving the experts in needling, namely haemodialysis nurses and haemodialysis patients, will aid with better design of studies into needling practice. We need to recognise that common sense interpretation and reflection on day to day practice potentially provides a better evidence base than poorly performed research, interpreted without clinical knowledge of the procedure. Whilst further research is recommended, this needs to be correctly performed and with well-considered design and interpretation.

These recommendations highlight the importance of the patient's individual experience of needling. Qualitative research highlights this is a complex phenomenon, creating anxiety not just about pain but also success of needle insertion. The needling experience goes beyond the actual procedure itself, impacting on patients' lives away from haemodialysis. However current research continues to solely use pain scores or other indicators of pain to measure this experience. Future research needs to consider how to capture this complex phenomenon accurately. Further investigation of patients' experiences of needling to develop an adequate measure of this is essential to support further research and quality improvement to improve needling practice.

We consider these recommendations a valuable addition to what is currently available. However, due to poor evidence base and lack of consistency in needling, practice needs to continue to develop and we envision these recommendations will also do likewise. We hope haemodialysis nurses will consider the concepts outlined

in these recommendations, but also continue to develop their practice, sharing achievements with others that will promote best needling practice.

References

1. Woo K, Lok CE. New Insights into Dialysis Vascular Access: What Is the Optimal Vascular Access Type and Timing of Access Creation in CKD and Dialysis Patients? *Clin J Am Soc Nephrol*. 2016;11(8):1487-94.
2. Almasri J, Alsawas M, Mainou M, Mustafa RA, Wang Z, Woo K, et al. Outcomes of vascular access for hemodialysis: A systematic review and meta-analysis. *J Vasc Surg*. 2016;64(1):236-43.
3. Kumwenda M., Mitra S., Reid C. *Vascular Access For Haemodialysis* Renal Association https://renal.org/wp-content/uploads/2017/06/vascular-access.pdf; 2015.
4. Besarab A, Kumbar L. Vascular access cannulation practices and outcomes. *Kidney Int*. 2014;86(4):671-3.
5. Siddiqui MA, Ashraff S, Carline T. Maturation of arteriovenous fistula: Analysis of key factors. *Kidney Res Clin Pract*. 2017;36(4):318-28.
6. Vascular Access 2006 Work Group Clinical Practice Guidelines for Vascular Access. *American Journal of Kidney Diseases*. 2006;48(Supplement 1):S176-247.
7. Figueiredo AE, Viegas A, Monteiro M, Poli-de-Figueiredo CE. Research into pain perception with arteriovenous fistula (AVF) cannulation. *Journal of Renal Care*. 2008;34(4):169-72.
8. Fielding C, Spooner H, Aitken M. Cannulation of arteriovenous fistulae and grafts for dialysis. *Journal of Kidney Care*. 2018;3(2):74-83.
9. Kronung G. Plastic deformation of Cimino fistula by repeated puncture. *Dialysis and Transplantation.* 1984;13:365-68.
10. Labriola L, Crott R, Desmet C, André G, Jadoul M. Infectious complications following conversion to buttonhole cannulation of native arteriovenous fistulas: a quality improvement report. *American Journal of Kidney Diseases*. 2011;57(3):442-8.
11. Ren C, Han X, Huang B, Yuan L, Cao Y, Yang X. Efficacy of buttonhole cannulation (BH) in hemodialysis patients with arteriovenous fistula: A meta-analysis. *International Journal of Clinical and Experimental Medicine*. 2016;9(8):15363-70.
12. Morton RL, Tong A, Webster AC, Snelling P, Howard K. Characteristics of dialysis important to patients and family caregivers: a mixed methods approach. *Nephrol Dial Transplant*. 2011;26(12):4038-46.
13. Taylor MJ, Hanson CS, Casey JR, Craig JC, Harris D, Tong A. "You know your own fistula, it becomes a part of you"--Patient perspectives on vascular access: A semistructured interview study. *Hemodial Int*. 2016;20(1):5-14.
14. Casey JR, Hanson CS, Winkelmayer WC, Craig JC, Palmer S, Strippoli GF, et al. Patients' perspectives on hemodialysis vascular access: a systematic review of qualitative studies. *Am J Kidney Dis*. 2014;64(6):937-53.
15. Harwood LE, Wilson BM, Oudshoorn A. Improving vascular access outcomes: attributes of arteriovenous fistula cannulation success. *Clin Kidney J*. 2016;9(2):303-9.
16. Kosa SD, Bhola C, Lok CE. Measuring patient satisfaction with vascular access: vascular access questionnaire development and reliability testing. *J Vasc Access*. 2015;16(3):200-5.
17. Kosa SD, Bhola C, Lok CE. Hemodialysis patients' satisfaction and perspectives on complications associated with vascular access related interventions: are we listening? *J Vasc Access*. 2016;17(4):313-9.

18. Swain A. *5 Years on from Our RCT on Buttonhole Cannulation - Where are we now?* Poster Presentation at UK Kidney Week https://britishrenal.org/ukkw2018-2/abstracts/ 2016.
19. Fulker D, Simmons A, Barber T. Computational Model of the Arterial and Venous Needle During Hemodialysis. *J Biomech Eng*. 2017;139(1).
20. Parisotto MT, Schoder VU, Miriunis C et al. Cannulation technique influences arteriovenous fistula and graft survival. *Kidney International*. 2014;86(4):790-7.
21. Parisotto M, Pancirova J. *Cannulation and Care: A Nursing Best Practice Guide for Arteriovenous Fistula.* EDTNA / ERCA; 2014.
22. Gauly A, Parisotto MT, Skinder A, Schoder V, Furlan A, Schuh E, et al. Vascular access cannulation in hemodialysis patients - a survey of current practice and its relation to dialysis dose. *J Vasc Access.* 2011;12(4):358-64.
23. Loveday HP, Wilson JA, Pratt RJ, Golsorkhi M, Tingle A, Bak A, et al. Epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J Hosp Infect*. 2014;86 Suppl 1:S1-70.
24. Debling P. *Octenilin Wound Irrigation Solution as an Alternative to Chlorhexidene in the Haemodialysis Setting* Poster presentation - British Renal Society Conference 2015.
25. Rylance P, C.A. F. What are the main risks for safety of renal patients? *British Journal of Renal Medicine*. 2014;19(3):23-6.
26. Jackson VE, Hurst H, Mitra S. Structured physical assessment of arteriovenous fistulae in haemodialysis access surveillance: A missed opportunity*? J Vasc Access.* 2018;19(3):221-9.
27. Wong B, Muneer M, Wiebe N, Storie D, Shurraw S, Pannu N, et al. Buttonhole versus rope-ladder cannulation of arteriovenous fistulas for hemodialysis: a systematic review. *Am J Kidney Dis*. 2014;64(6):918-36.
28. Muir CA, Kotwal SS, Gallagher MP, Jardine MJ, Hawley CM, Polkinghorne K, et al. Buttonhole cannulation and clinical outcomes in a home hemodialysis cohort and systematic review*. Clinical Journal of the American Society of Nephrology.* 2014;9(1):110-9.
29. Kotwal S, Muir C, Gallagher M, Jardine M, Hawley C, Polkinghorne K, et al. Buttonhole cannulation and infection outcomes: Systematic review and meta-analysis. *Nephrology*. 2013;18:17-8.
30. Grudzinski A, Mendelssohn D, Pierratos A, Nesrallah G. A systematic review of buttonhole cannulation practices and outcomes. *Seminars in Dialysis.* 2013; 26(4):465-75.
31. MacRae JM, Ahmed SB, Hemmelgarn BR. Arteriovenous fistula survival and needling technique: Long-term results from a randomized buttonhole trial. *American Journal of Kidney Diseases.* 2014;63(4):636-42.
32. Macrae JM, Ahmed SB, Atkar R, Hemmelgarn BR. A randomized trial comparing buttonhole with rope ladder needling in conventional hemodialysis patients. *Clinical Journal of the American Society of Nephrology*. 2012;7(10):1632-8.
33. Vaux E, King J, Lloyd S, Moore J, Bailey L, Reading I, et al. Effect of buttonhole cannulation with a polycarbonate PEG on in-center hemodialysis fistula outcomes: a randomized controlled trial. *American Journal of Kidney Diseases.* 2013;62(1):81-8.
34. Chow J, Rayment G, Miguel SS, Gilbert M. A Randomised Controlled Trial of Buttonhole Cannulation for the Prevention of Fistula Access Complications. *Journal of Renal Care.* 2011;37(2):85-93.

35. Struthers J, Allan A, Peel RK, Lambie SH. Buttonhole needling of ateriovenous fistulae: a randomized controlled trial. *Asaio j.* 2010;56(4):319-22.
36. Toma S, Shinzato T, Fukui H, Nakai S, Miwa M, Takai I, et al. A timesaving method to create a fixed puncture route for the buttonhole technique. *Nephrology, Dialysis, Transplantation* 2003;18(10):2118-21.
37. Parisotto MT, Schoder V, Kaufmann P, Miriunis C, Grassmann A, Marcelli D. Does cannulation technique impact av-fistula and graft survival? *Nephrology Dialysis Transplantation*. 2013;28.
38. Parisotto MT, Schoder VU, Miriunis C, Grassmann AH, Scatizzi LP, Kaufmann P, et al. Cannulation technique influences arteriovenous fistula and graft survival. *Kidney International*. 2014;86(4):790-7.
39. Rajoo A. A study on arteriovenous fistula cannulation practices, dialyser blood flow and venous pressure in non-government organisation dialysis centres in Johor. *BJU International*. 2015;116:8
40. Samme S, Thiele B, Workstream DQ. *Changing fistula / graft cannulation practice: use of a Dialysis Quality Workstream.* BRS Conference 2017: Lister Renal Unit; 2017.
41. Kattenhorn S, Dagunan J, Whitehill C, Coles S, Gibbs P. Introduction of buttonhole needling in PTFE thigh loop. *Journal of Vascular Access*. 2016;17(1):e18.
42. Sangala N, Kattenhorn S, Whitehill C, Gibbs P. Using the buttonhole technique to cannulate arterio venous grafts: A single centre experience. *Hemodialysis International*. 2017;21(1).
43. Nadarajah L, Ashman N, Rajakariar R, Blunden M. Time to reconsider the buttonhole bandwagon-a review of staph aureus infection in a haemodialysis service. *Nephrology Dialysis Transplantation*. 2015;30.
44. Aitken E, McLellan A, Glen J, Serpell M, Mactier R, Clancy M. Pain resulting from arteriovenous fistulae: prevalence and impact. *Clin Nephrol.* 2013;80(5):328-33.
45. Ludlow VRNMNC. Buttonhole cannulation in hemodialysis: Improved outcomes and increased expense-Is it worth it? *CANNT Journal*. 2010;20(1):29-37.
46. Marticorena RM, Hunter J, Macleod S, Petershofer E, Dacouris N, Donnelly S, et al. The salvage of aneurysmal fistulae utilizing a modified buttonhole cannulation technique and multiple cannulators. *Hemodialysis International*. 2006;10(2):193-200.
47. Shibata K, Yamada Y, Yanagi M, Toya Y, Umemura S, Iwamoto T, et al. Buttonhole needling of hemodialysis arteriovenous fistulae results in less pain and stress comparing to the rope-ladder puncture technique. *Nephrology Dialysis Transplantation.* 2012;27(Supplement 2) ii256.
48. Silva Gdos S, Silva RA, Nicolino AM, Pavanetti LC, Alasmar VL, Guzzardi R, et al. Initial experience with the buttonhole technique in a Brazilian hemodialysis center. *J Bras Nefrol.* 2010;32(3):257-62.
49. Ward J, Shaw K, Davenport A. Patients' perspectives of constant-site (buttonhole) cannulation for haemodialysis access. *Nephron - Clinical Practice*. 2010;116(2).
50. Parisotto MT, Pelliccia F, Grassmann A, Marcelli D. Elements of dialysis nursing practice associated with successful cannulation: result of an international survey. *The Journal of Vascular Access.* 2017;18(2):114-9.
51. Verhallen AM, Kooistra MP, van Jaarsveld BC. Cannulating in haemodialysis: Rope-ladder or buttonhole technique? *Nephrology Dialysis Transplantation*. 2007;22(9):2601-4.

52. Cruijsen-Cuppen M, Van Hoek F, Koster-Kamphuis L. Experience with the use of the buttonhole technique for vascular access in a single pediatric hemodialysis center in the Netherlands. *Hemodialysis International.* 2012;16(1):131-2.
53. Koster-Kamphuis L, Van Hoek F, Cruijsen-Cuppen M. Experience with the use of buttonhole technique for vascular access in children: A single pediatric hemodialysis centre experience. *Pediatric Nephrology*. 2013;28(8):1677.
54. Depertment of Health *Screening for Methicillin-Resistant Staphylococcus Aureus (MRSA) Colonisation: A Strategy for NHS Trusts: A Summary of Best Practice* http://webarchive.nationalarchives.gov.uk/20130107105354/http:/www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_078128.pdf 2007.
55. Department of Health *Implementation of Modified Admission MRSA Screening Guidance for NHS* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/345144/Implementation_of_modified_admission_MRSA_screening_guidance_for_NHS.pdf 2014.
56. Lawes T, Edwards B, López-Lozano JM, Gould I. Trends in Staphylococcus aureus bacteraemia and impacts of infection control practices including universal MRSA admission screening in a hospital in Scotland, 2006-2010: retrospective cohort study and time-series intervention analysis. *BMJ Open*. 2012;2(3).
57. Robicsek A, Beaumont JL, Paule SM, Hacek DM, Thomson RB, Jr., Kaul KL, et al. Universal surveillance for methicillin-resistant Staphylococcus aureus in 3 affiliated hospitals. *Ann Intern Med*. 2008;148(6):409-18.
58. Huang SS, Septimus E, Kleinman K, Moody J, Hickok J, Avery TR, et al. Targeted versus Universal Decolonization to Prevent ICU Infection. *New England Journal of Medicine.* 2013;368:2255-65.
59. Tacconelli E. Screening and isolation for infection control. *Journal of Hospital Infection*. 2009;73(4):371-7.
60. Tacconelli E, Carmeli Y, Aizer A, Ferreira G, Foreman MG, D'Agata EM. Mupirocin prophylaxis to prevent Staphylococcus aureus infection in patients undergoing dialysis: a meta-analysis. *Clin Infect Dis*. 2003;37(12):1629-38.
61. Public Health England. *Annual Epidemiological Commentary: Mandatory MRSA, MSSA and E.Coli Bacteraemia and C.Difficile Infection Data, 2014/15*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/442952/Annual_Epidemiological_Commentary_FY_2014_2015.pdf 2015.
62. Marticorena RM, Hunter J, Cook R, Kashani M, Delacruz J, Petershofer E, et al. A simple method to create buttonhole cannulation tracks in a busy hemodialysis unit. *Hemodialysis international* 2009;13(3):316-21.
63. Marticorena RM, Hunter J, Macleod S, Petershofer E, Kashani M, De La Cruz J, et al. Use of the BioHole™ device for the creation of tunnel tracks for buttonhole cannulation of fistula for hemodialysis. *Hemodialysis International*. 2011;15(2):243-9.
64. Grudzinski A, Mendelssohn D, Pierratos A, Nesrallah G. A systematic review of buttonhole cannulation practices and outcomes. *Semin Dial*. 2013;26(4):465-75.
65. O'Brien FJ, Kok HKT, O'Kane C, McWilliams J, O'Kelly P, Collins P, et al. Arterio-venous fistula buttonhole cannulation technique: a retrospective analysis of infectious complications. *Clinical Kidney Journal*. 2012;5(6):526-9.
66. Van Loon MM, Tordoir JHM, Goovaerts T, Kessels AGH, Van Der Sande FM. Buttonhole needling of haemodialysis arteriovenous fistulae results in less

complications and interventions compared to the rope-ladder technique. *Nephrology Dialysis Transplantation*. 2010;25(1):225-30.
67. Sato S, Shinzato T, Sakai N, Ohkuri K, Sasaki M, Nakai S, et al. Deformity of Buttonhole Entry Site Causes Higher Frequency of Vascular Access-Related Infection. *Contributions to Nephrology*. 2015;186:48-56.
68. Martyn S. Using angiocaths to create buttonhole tunnel tracks. *Hemodialysis International.* 2011;15(1):128.
69. Donnelly SM, Goldstein MB, Marticorena RM, Hunter J. Supercath safety clampcath buttonhole creation: Complication of catheter breakage. *Hemodialysis International.* 2013;17(3):450-4.
70. Doss S, Schiller B, Moran J. Buttonhole Cannulation - An Unexpected Outcome. *Nephrology Nursing Journal.* 2008;35(4):417-9.
71. Labriola L, Crott R, Desmet C, Andre G, Jadoul M. Infectious complications following conversion to buttonhole cannulation of native arteriovenous fistulas: a quality improvement report*. Am J Kidney Dis*. 2011;57(3):442-8.
72. Chow J, Rayment G, Miguel S. A randomised controlled trial of buttonhole cannulation for the prevention of fistula access complications. *Journal of Renal Care.* 2011;37(2):85-93.
73. Christensen LD, Skadborg MB, Mortensen AH, Mortensen C, Hogsberg I, Moller JK, et al. Bacteriology of the Buttonhole Cannulation Tract in Hemodialysis Patients: A Prospective Cohort Study. *American Journal of Kidney Diseases*. 2018.
74. Agarwal A, Nesrallah G. Long-Term Safety of Buttonhole Cannulation and Efficacy of Mupirocin Prophylaxis. *Contributions to Nephrology*. 2015;186:64-70.
75. Nesrallah GE, Cuerden M, Wong JHS, Pierratos A. Staphylococcus aureus bacteremia and buttonhole cannulation: long-term safety and efficacy of mupirocin prophylaxis. *Clinical Journal of the American Society of Nephrology*. 2010;5(6):1047-53.
76. Park Y, Tsang P, Siu F, Mission E, Haberecht L, Sacremento R, et al. Practice changes decrease buttonhole infection rates in home haemodialysis patients. *Nephrology.* 2014;19:20.
77. Teo BW, Low SJ, Ding Y, Koh TH, Hsu LY. High prevalence of mupirocin-resistant staphylococci in a dialysis unit where mupirocin and chlorhexidine are routinely used for prevention of catheter-related infections. *J Med Microbiol.* 2011;60(Pt 6):865-7.
78. Upton A, Lang S, Heffernan H. Mupirocin and Staphylococcus aureus: a recent paradigm of emerging antibiotic resistance. *J Antimicrob Chemother.* 2003;51(3):613-7.
79. Wilson B, Harwood L, Thompson B. Impact of single-needle therapy in new chronic hemodialysis starts for individuals with arteriovenous fistulae. *Cannt j.* 2009;19(2):23-8.
80. Mafara K, Magarey J, Rasmussen P. The lived experience of haemodialysis patients who have had a new arteriovenous fistula cannulated in a satellite unit. *Renal Society of Australasia's Journal*. 2016;12(3):88-92.
81. Wilson B, Harwood L. Outcomes for Successful Cannulation of the Arteriovenous Fistula: Perspectives from Patients on Hemodialysis. *Nephrol Nurs J.* 2017;44(5):381-8.
82. Brass P, Hellmich M, Kokodziej J, Schick G, Smith A. Ultrasound guidance versus anatomical landmarks for internal jugular vein catheterization (Review). *Cochrane Database of Systematic Reviews*. 2015(1):Art. No.: CD006962.

83. Brass P, Hellmich M, Kolodziej L, Schick G, Smith A. Ultrasound guidance versus anatomical landmarks for subclavian or femoral vein catheterization (Review). *Cochrane Database of Systematic Reviews.* 2015(1):Art. No. CD011447.
84. Rabindranath KS, Kumar E, Shail R, Vaux EC. Ultrasound use for the placement of haemodialysis catheters. *Cochrane Database Syst Rev.* 2011(11):Cd005279.
85. NICE *Guidance on the use of ultrasound locating devices for placing central venous catheters | Guidance and guidelines* NICE. 2002.
86. Walker E. Piloting a nurse-led ultrasound cannulation scheme. *Br J Nurs.* 2009;18(14):854, 6, 8-9.
87. Berino L, Fluck R, Chesterton L, Fielding C. *Comparison of Clinical Outcomes for Patient UNndergoing Cannulation of New Arteriovenous Fistulae, with and without Nurse-Led Ultrasound Assessment.* British Renal Society Conference; 2017.
88. Fielding C, Berino L, Fluck R, Owen P, John S, Chesterton L *A Service Evaluation of Nurse-Led Ultrasound Assessment of Arteriovenous Fistulae and Grafts for Haemodialysis.* UK Kidney Week; 2016.
89. Fielding C, Owen P, Chesterton L, Fluck R, Pitt H. *Development of a Training Package to Assist Senior Haemodialysis Nursing Staff to Utilise Ultrasound Images to Assess Arteriovenous Fistulae.* UK Kidney Week; 2014
90. Harwood L, Wilson B, Goodman M. Cannulation Outcomes of the Arteriovenous Fistula for Hemodialysis: A Scoping Review. *Nephrol Nurs J.* 2017;44(5):411-25.
91. Murray MA, Thomas A, Wald R, Marticorena R, Donnelly S, Jeffs L. Are you SURE about your vascular access? Exploring factors influencing vascular access decisions with chronic hemodialysis patients and their nurses. *Cannt j.* 2016;26(2):21-8.
92. Cavanaugh KL, Wingard RL, Hakim RM, Elasy TA, Ikizler TA. Patient dialysis knowledge is associated with permanent arteriovenous access use in chronic hemodialysis. *Clin J Am Soc Nephrol*. 2009;4(5):950-6.
93. Fotheringham J, Barnes T, Dunn L, Lee S, Ariss S, Young T, et al. Rationale and design for SHAREHD: a quality improvement collaborative to scale up Shared Haemodialysis Care for patients on centre based haemodialysis. *BMC Nephrol.* 2017;18(1):335.
94. Nikam M, Ebah L, Summers A, Mitra S, Jayanti A, Evans J, et al. Vascular access in home haemodialysis: Trends and outcomes. *Nephrology Dialysis Transplantation*. 2012;27.
95. Wainwright SF, Shepard KF, Harman LB, Stephens J. Factors that influence the clinical decision making of novice and experienced physical therapists. *Phys Ther.* 2011;91(1):87-101.
96. Labriola L, Crott R, Desmet C, André G, Jadoul M. Infectious complications following conversion to buttonhole cannulation of native arteriovenous fistulas: a quality improvement report. *American journal of kidney diseases*. 2011;57(3):442-8.
97. Priyesh P, Smith K, Henner D. Effect of implementation of standardized protocol on infection rates in patients utilizing the buttonhole cannulation technique for accessing AV fistulas. *American Journal of Kidney Diseases.* 2013;61(4).
98. Verhallen A. Successful Vascular Access Management For Home Haemodialysis: A Practical Approach. *Journal of Renal Care*. 2013;39:28-34.

99. Wilson M, Holcombe S, Underwood P, Cigliana S, Miller B. The importance of re-education for prevention of infection in home hemodialysis patients. *Hemodialysis International.* 2012;16(1):157.
100. Hulse AL. Designing and evaluating vascular access training using educational theory. *Br J Nurs*. 2018;27(2):S27-S33.
101. Wilson B, Harwood L, Oudshoorn A, Thompson B. The culture of vascular access cannulation among nurses in a chronic hemodialysis unit. *Cannt j.* 2010;20(3):35-42.
102. Deegan J. A view from the outside: Nurses' clinical decision making in the twenty first century. *Australian Journal of Advanced Nursing*. 2013;30(4):12-8.
103. Dougherty L, Sque M, Crouch R. Decision-making processes used by nurses during intravenous drug preparation and administration. *J Adv Nurs.* 2012;68(6):1302-11.

Appendix 1 - Systematic Literature Search Strategy

Search Strategy on

Cannulation of AVG (Arteriovenous Graft) and AVF ((Arteriovenous Fistula) including Buttonhole, Rope Ladder, Area Puncture. What is considered to be “good practice”?

Search Strategy

We have searched Medline, Embase, Cinahl, Pubmed, Dynamed Plus and The Cochrane Library. The limits used were English Language only.

The Medical Subject Headings (MeSH) headings used included Renal Replacement Therapy; Renal Dialysis; Kidney Failure, Chronic, Arteriovenous Fistula; Arteriovenous Shunt, Surgical and Catheterization. Keywords included hemodialysis; haemodialysis; hemodial*; chronic kidney disease; renal dialysis; arteriovenous fistula; arteriovenous graft; cannulation; buttonhole; rope ladder; area puncture; area puncture; cluster puncture.

The search was limited to document types; clinical study; clinical trial, phase I; clinical trial,phase II; clinical trial, phase III; clinical trial, phase IV; controlled clinical trial; meta-analysis; multicentre study; randomized controlled trial; validation studies.

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VASBI Vascular Access Society of Britain and Ireland

Appendix 2 – AV Fistula / Graft (AVF/AVG) Pre-Needle Insertion Assessment Tool

Signs and symptoms	Score	Actions
○ No scabs larger than the needle sites ○ No pain or new swelling ○ No necrosed areas ○ No aneurysms ○ No erythema ○ Normal bruit / thrill ○ No hardness over AVF/AVG	0	**No action required** Safe to needle
❖ No scabs larger than the needle sites ❖ No pain or new swelling ❖ No necrosed areas ❖ No erythema ❖ Normal bruit / thrill ❖ No hardness over AVF/AVG ❖ Aneurysms present and stable ○ Not increasing in size ○ Skin not shiny or thin over aneurysms	1	**Monitor** Consider photograph AVF/AVG for reference Document aneurysm size, by measuring arm diameter at aneurysm and position Safe to needle
• No necrosed areas • No scabs larger than needle sites anywhere on AVF/AVG Any of the following ○ Pain or discomfort to any area on the AVF/AVG ○ Aneurysms increasing in size or pulsating ○ New aneurysms ○ Thin and shiny skin around AVF/AVG ○ Whistling bruit on auscultation ○ Non needling segments hard on palpation ○ Bleeding around needle site during dialysis ○ Extended post dialysis bleeding >20minutes ○ Erythema >3mm anywhere on the AVF/AVG	2	**Refer to Vascular Access Team** Previous actions <u>and</u> Patient information given on actions and escalation if AVF/AVG bleeds at home Review individual's antiplatelet and anticoagulation prescription Consider swabbing erythema Lift arm above head, to assess whether aneurysms drain
Any of previous signs <u>with</u> any of the following: ❖ Pain / swelling to AVF/AVG ❖ Necrosed area on AVF/AVG ❖ Patient reports sites bleed at home ❖ Scabs at needle sites or elsewhere >3mm ❖ Absent or changed thrill on palpation ❖ Absent bruit on auscultation ❖ Cannulation segments hard on palpation ❖ Oozing (pus) from red/inflamed areas ❖ Erythema increased in size	3	**Do not needle** **Urgently refer to Renal / Vascular Team** **Keep patient in department** Previous actions <u>and</u> Swab pus / erythema Take blood cultures if erythema or pus present Take U&Es

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Please complete before each needle insertion. Document any abnormal findings with action taken, in detail in the normal nursing documentation.

Date	**AVF Score (0-3)**	**Aneurysm** Present – Y/N	**Bruit** Normal (N) / Abnormal (A) / Absent (NIL)	**Thrill** Normal (N) / Abnormal (A) / Absent (NIL)	**Feel** Soft (S) / Hard (H)	**Safe to Use** Y / N	**Initials**

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Appendix 3 – ACCESS Assessment

Assessment

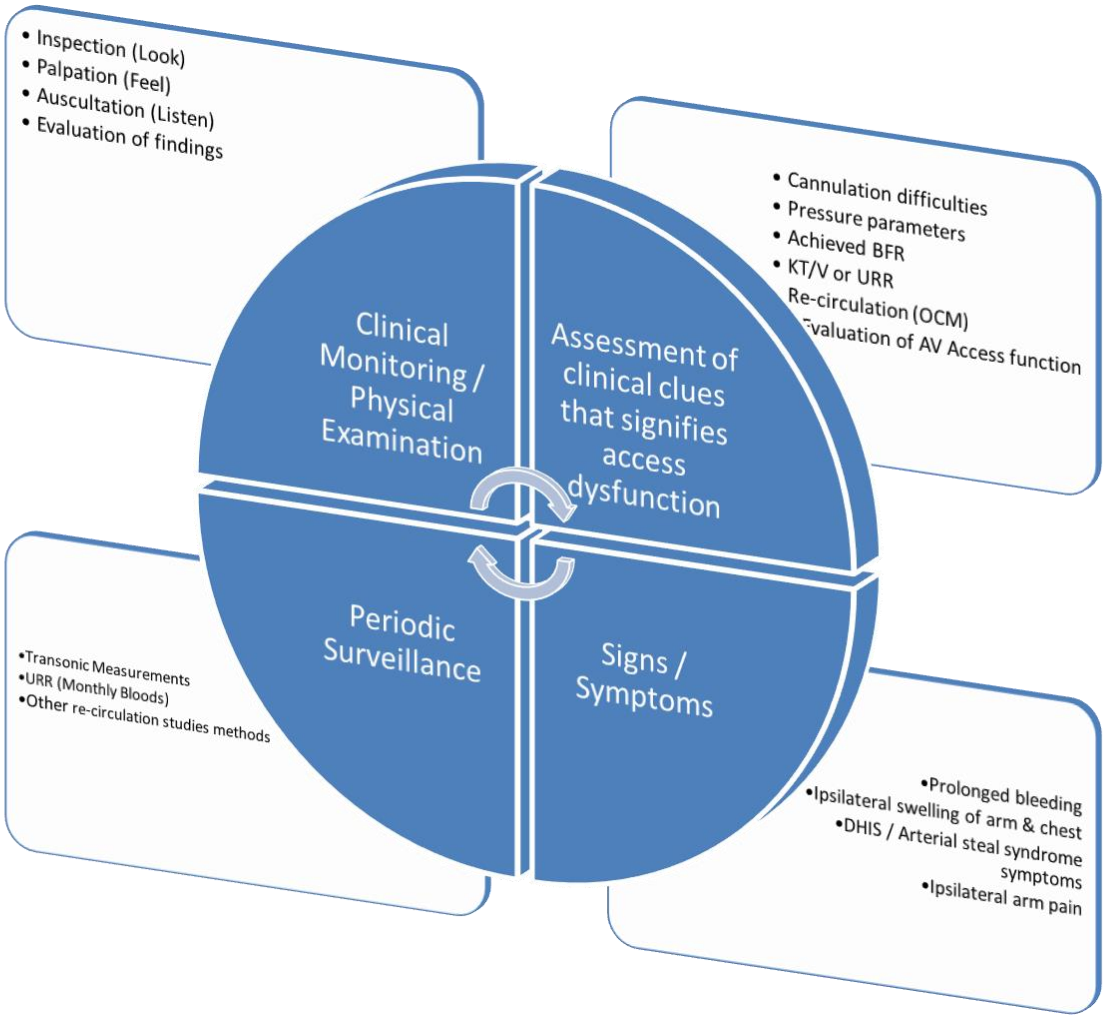
Cannulation

Circulation

Evaluation

Signs/**S**ymptoms

Surveillance



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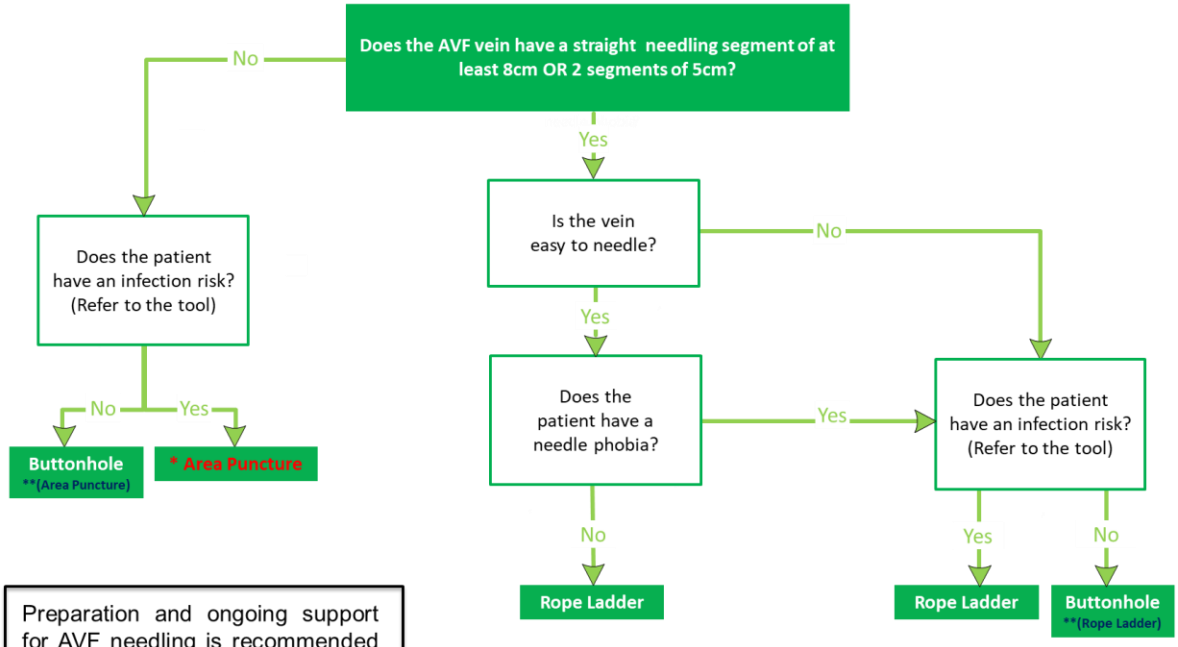
Appendix 4 – Needling Decision Making Model

NEEDLING DECISION MAKING MODEL

This tool has been developed to help haemodialysis nurses and patients decide which needling technique is best for each individual arteriovenous fistula (AVF). However, this assessment will be unique and individual to each patient, so you will still need to apply clinical judgement. You may diverge from the decision making aid, so consider how your clinical expertise can justify this divergence. In particular, patient's who self needle their AVF may prefer to use buttonhole needling technique, although this will still be related to personal consideration.

Arteriovenous grafts (AVG) are not included in this model. AVG always have a long, straight needling segment, so should automatically undergo rope ladder needling.



Preparation and ongoing support for AVF needling is recommended in all age groups. Coping techniques such as relaxation, distraction and play therapy should be considered.

* BRS and VASBI do **not** recommend area puncture. If this assessment results in area puncture, please refer to the 'Area Puncture Action Chart.'

** If your unit does not use buttonhole, then you will need defer to the technique in brackets in the relevant box.

Infection Risk Screening Tool		
Criteria present: (Please tick)	Yes	No
Metallic Heart Valve		
Pacemaker		
Previous MSSA/MRSA bacteraemia		
Previous endocarditis		
Significant structural valvular heart disease		
MSSA / MRSA positive		
Mupirocin resistant MSSA		
Skin disorders causing itching or skin breakdown around cannulation sites		
Poor adherence to hygiene protocols		
Clinical Judgement/Other Considerations: On the basis of the above, this patient is / is not (delete as applicable) suitable for using buttonhole needling technique.		

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Appendix 5 – Area Puncture Action Chart

AREA PUNCTURE ACTION CHART

This tool has been developed to summarise the potential actions to take when area puncture needling has been implement on an AVF or AVG. This summarises the actions recommended in the BRS / VASBI Clinical Practice Recommendations for Needling of Arteriovenous Fistulae and Grafts.

Identify area puncture is in use on one or both cannulation sites
Needling sites on same segment of vein and cover less than 8cm on same needling segment
OR
Needling sites are on separate segments and one site covers less than 5cm

Complications associated with area puncture include:

- Increased aneurysm development, with / without associated tortuosity
- Increased development of stenosis and related AVF thrombosis
- Reduced skin integrity, leading to increased risk of life-threatening bleed

Can rope ladder or buttonhole technique be used?
(Use AVF Needling Decision Making Model for AVF)

No

Yes

Explain to patient alternative needling techniques.
Include the risks of area puncture and advantages of buttonhole or rope ladder.

Does the patient agree to rope ladder or buttonhole technique?

No

Yes

No

Explore reasons for refusal

Is this this due to pain or anxiety?

Yes

- Consider use of distraction / play therapy to improve needling experience
- Educate patient about signs of complications related to area puncture
- Review needling options with patient, following an agreed time

Does the patient agree to rope ladder or buttonhole technique?

No

Yes

Area Puncture

- **Refer to vascular team to explore alternatives**
- **Increase surveillance for complications related to area puncture**
- **Educate patient about signs of complications related to area puncture**
- **Review options with patient, following an agreed time**
- **Document risk assessment and rationale for use of area puncture**

Rope Ladder or Buttonhole

- **Educate staff about use of rope ladder / buttonhole**
- **Document cannulation plan for future cannulations**
- **Consider use of distraction or play therapy to improve cannulation experience**

Appendix 6 - Acknowledgments

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