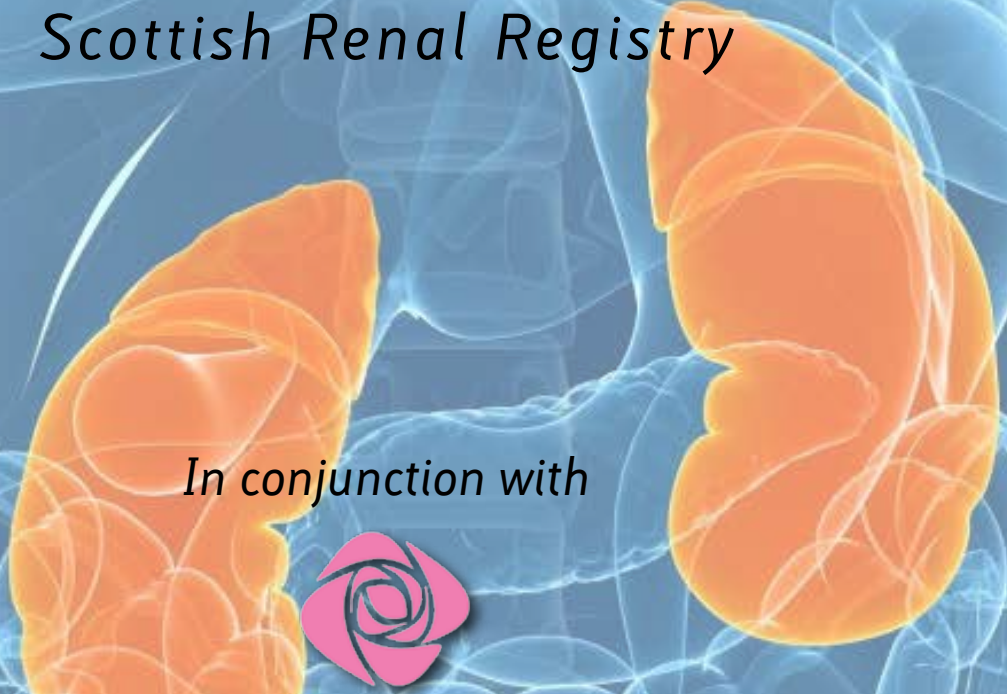
NHS SCOTLAND

Scottish Haemodialysis Vascular Access Appraisal Report:

Relating Variation in Outcomes to Variation in Processes

Scottish Renal Registry



In conjunction with

Darlinda's Charity for Renal Research
and the University of Glasgow

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LIST OF ACRONYMS

AVF .....Arteriovenous fistula
AVG .....Arteriovenous graft
ARI .....Aberdeen Royal Infirmary
CVC .....Central venous catheter
DGRI .....Dumfries and Galloway Royal Infirmary
eGFR .....Estimated glomerular filtration rate
EHR .....Electronic Health Record
GLAS .....Glasgow Renal and Transplant Unit
HD .....Haemodialysis
MDT .....Multidisciplinary Team
MONK .....Monklands Hospital
NTCVC ....Non-tunnelled central venous catheter
NHS .....National Health Service
NINE .....Ninewells Hospital
PD .....Peritoneal Dialysis
RAIG .....Raigmore Hospital
RDU .....Regional Dialysis Unit
RHSC .....Royal Hospital for Sick Children, Yorkhill
RIE.....Royal Infirmary of Edinburgh
SAB .....Staphylococcus aureus bacteraemia
SIMD.....Scottish Index of Multiple Deprivation
SRR .....Scottish Renal Registry
TCVC .....Tunnelled central venous catheter
UKRR.....UK Renal Registry
UKRA.....UK Renal Association
USS .....Ultrasound Scan
VA.....Vascular Access
VAC .....Vascular Access Coordinator
VAN .....Vascular Access Nurse
VHK .....Victoria Hospital Kirkcaldy
XH .....Crosshouse Hospital

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BACKGROUND

In 2014 the Scottish Renal Registry in conjunction with Darlinda's Charity for Renal Research and the University of Glasgow, undertook a National Appraisal of Haemodialysis Vascular Access Services in NHS Scotland. This project attempted to understand vascular access as a whole system rather than simply measuring individual statistics relating to certain aspects of its productivity.

This was an unprecedented exercise and was undertaken in light of significant variation between Scottish NHS Health Boards in the proportion of patients who receive haemodialysis through arteriovenous access. Low rates of arteriovenous access are well recognised as incurring enormous costs to health boards, not to mention considerable morbidity, hospitalisation and mortality to renal patients, often through the development of *Staphylococcus aureus* bacteraemia (SAB).

The project involved several strands:

- Visits to all nine adult and one paediatric renal units around Scotland to conduct interviews with patients and key members of the nephrology, vascular surgery and radiology teams;
- An internal validation study to assess the face validity of the interview process;
- The collection and analysis of variables that relate to the haemodialysis population, the haemodialysis vascular access pathway, and haemodialysis vascular access practices in use in all nine adult and one paediatric renal services in NHS Scotland. This included measurement of all vascular access-related activity in Scotland during a six-week census period.

This approach provided us with new insights into the organisational means that can enable the delivery of more efficient working around the creation and maintenance of vascular access for an individual patient. As such this report was constructed to inform all the relevant groups who have a stake in the provision of haemodialysis vascular access.

We hope that these findings will be used to optimise services and improve the delivery of safe, effective, person-centred haemodialysis care.

SUMMARY AND RECOMMENDATIONS

This project represents a comprehensive exploration of the Vascular Access services operated by all ten adult and paediatric renal units in Scotland. A vast array of quantitative and qualitative data were gathered through visits to all ten renal units, interviews with key members of the vascular access team in each centre, and working with the Scottish Renal Registry. The quantitative data provided insights into the heavy workload associated with the delivery of vascular access services, while several key themes emerged from the qualitative data that described services' operational realities, their relative successes and their vulnerabilities. These data were grouped into five broad categories:

(i) The patient experience;

(ii) Creation of vascular access;

(iii) Maintenance of vascular access;

(iv) Service performance; and

(v) Development needs.

Whilst most services perform to an excellent standard in some or most areas, it is clear that for Scotland overall, vascular access services would benefit from a degree of formalisation and reorganisation to enhance delivery of safe, effective and patient-centred care. A heightened sense of urgency is necessary to ensure patients receiving renal replacement therapy each have an optimised, 'personal access solution' that goes some way towards countering the burden of morbidity and mortality they currently face. At present, elective vascular access activity is mistakenly assumed to be 'routine' and arranged around competing clinical priorities, and unplanned complications are deemed as urgent, rather than emergency, as other means of providing HD are available such as TCVC use. A paradigm shift is needed wherein access creation surgery becomes 'urgent'; access maintenance procedures are considered 'important'; and the threatened loss of an AVF or AVG is deemed to be a 'medical emergency'.

A number of recommendations arise from the data presented in this report. They reflect a need for more formal multi-disciplinary team working; protected, accessible slots for access creation and maintenance procedures; measurement and discussion of clinical outcomes; and education for all stakeholders in the process.

Each recommendation is given within the text at the appropriate section. For ease of reference they are also listed below:-

POPULATIONS

Recommendation 1 **– CVC use as a proportion of all renal replacement therapies should be regarded as the preferred method of studying the variation in vascular access methods between populations.**

Recommendation 2 **– SAB rates expressed as the number of events per 1000 HD-exposed days should be routinely reported by renal services.**

Recommendation 3 **– Renal services should expect an average of 70 surgical procedures per 100 prevalent HD patients per year to create and maintain arteriovenous access for haemodialysis.**

Recommendation 4 – **Renal services should expect an average of 100 interventional radiology procedures per 100 prevalent HD patients per year to create and maintain haemodialysis access.**

Recommendation 5 – **Renal services should expect an average of 70 departmental vascular access ultrasound sessions per 100 prevalent HD patients per year to create and maintain haemodialysis access.**

Recommendation 6 – **Renal services should expect 25% of all haemodialysis access procedural activity to require an overnight inpatient hospital stay of at least one day in duration.**

PATIENT EXPERIENCE

Recommendation 7 – **Measurement of patient experience should be a focus for future assessments of a vascular access service.**

Recommendation 8 – **Time should be allocated for the delivery of education about vascular access methods and maintenance to all patients for whom haemodialysis is being contemplated. This should include information about avoiding venepuncture and blood pressure measurement on the appropriate arm.**

Recommendation 9 – **Education on vascular access methods and maintenance should be provided regularly to patients throughout their tenure on haemodialysis. This should be considered a cornerstone of routine haemodialysis care, rather than a single intervention delivered prior to commencing haemodialysis, with the aim of facilitating patient-reporting of potential access problems.**

CREATION OF VASCULAR ACCESS

Recommendation 10 - **All patients who may require haemodialysis should have a clear "personal access strategy" that defines optimal form of vascular access and is framed within the wider context of their "personal renal replacement therapy solution".**

Recommendation 11 – **All patients' "personal access strategies" should be documented by the time their eGFR reaches 15 ml/min, following which the strategy may be reviewed regularly, and activated when necessary.**

Recommendation 12 – **Clinicians or teams running low clearance clinics are responsible for documenting the "personal RRT strategy" and "personal access strategy" for each patient.**

Recommendation 13 – **Clinicians or teams running low clearance clinics should have access to the current waiting times for successful AV access creation in their service.**

Recommendation 14 – **Renal units should have clearly articulated, written pathways for the creation and maintenance of vascular access.**

Recommendation 15 – **Electronic health records should be utilised to simplify referral into access creation and maintenance pathways, and to assist in tracking the patient journey thereafter.**

Recommendation 16 – **Pre-operative vein map ultrasound scanning is preferable prior to undergoing arteriovenous fistula creation surgery, however in some instances may not be required where there is a clear native arteriovenous access option on clinical examination.**

Recommendation 17 - **All renal services should have access to a suitably trained sonographer to perform ultrasound vein mapping.**

Recommendation 18 – **In the majority of patients there is uncertainty as to what native arteriovenous access options exist. For these patients, they should have access to a one-stop vascular access clinic, where ultrasound scanning, clinical review and a decision for theatre may all be undertaken at a single attendance.**

Recommendation 19 - **USS duplex vein mapping scan should be available for all patients within two weeks of referral.**

Recommendation 20 - **All patients who present late with likely advanced chronic kidney disease and require renal replacement therapy should have an initial personal access strategy determined within one week of referral to nephrology. This strategy should be activated once recovery of sufficient native renal function appears to be unlikely.**

Recommendation 21 – **Patients who require emergency vascular access provision in the setting of established renal failure should be routinely audited in the setting of a vascular access morbidity and mortality meeting.**

Recommendation 22 – **All renal services should have access to protected slots for IR and surgical vascular access procedures related to their expected workload (see Table 3).**

Recommendation 23 – **Slots for elective vascular access creation procedures should be available to book with at least four weeks' notice.**

Recommendation 24 – **Slots for emergency vascular access creation and maintenance procedures should be available with 48 hours' notice.**

Recommendation 25 – **Vascular access procedures should be categorised as 'urgent' or 'emergency' and should not be subject to displacement by other cases for non-clinical reasons**

Recommendation 26 – **Any vascular access procedure that is cancelled for non-clinical reasons should be routinely audited and reviewed at a vascular access morbidity and mortality meeting.**

Recommendation 27 - **Vascular Access Coordinators should have the clinical authority, the technical knowledge and the administrative capability to directly allocate specific surgery or interventional radiology slots to named patients for the creation or maintenance of vascular access in keeping with the clinical confidence of the clinicians on the team.**

Recommendation 28 - **Vascular Access Coordinators should be enabled to re-order existing vascular access surgery and radiology procedure lists.**

Recommendation 29 – **Where administrative staff are required to book procedures, they should be available during normal working hours to liaise with VAC, and their role should be prospectively covered in the event of planned or unplanned absences.**

Recommendation 30 – **Renal units should maintain a 'priority list' of patients that identifies which patient is next in line to have a procedure performed, in the event of an additional slot becoming available. This should be easily accessible to all relevant members of the broader clinical team.**

Recommendation 31 – **Administrative delays should be routinely audited and discussed at the vascular access morbidity and mortality meeting.**

Recommendation 32 – **Referrals made that do not involve the referral pathway for vascular access should be considered 'adverse events' and specifically discussed at a vascular access morbidity and mortality meeting.**

Recommendation 33 – **Renal services should have access to 'Day surgery' beds for elective/semi-elective arteriovenous access work.**

Recommendation 34 – **Renal inpatient services should have co-located vascular surgical and interventional radiology services available for patients undergoing complex access work or who require an overnight stay.**

MAINTENANCE OF VASCULAR ACCESS

Recommendation 35 – **A vascular access-specific multidisciplinary team (MDT) meeting should be regularly convened with at least one nephrologist, one surgeon, one interventional radiologist and a vascular access coordinator in attendance. Appropriate secretarial support should be provided and an attendance register should be kept.**

Recommendation 36 - **All clinicians who are responsible for the care of patients receiving HD should have job-planned time allocated to attending at least one vascular access MDT meeting per month. In larger centres this time could be allocated between groups of clinicians.**

Recommendation 37 – **The amount of time required for MDT discussion equates to the same number in minutes, per week, as 10-15% of the prevalent HD population size. This reflects the average MDT duration currently seen in the Scottish renal services. It may be appropriate to hold these meetings on a fortnightly or three-weekly basis.**

Recommendation 38 - **Systems should be in place to enable the direct booking of interventional radiology and surgical procedures from the MDT meeting.**

Recommendation 39 – **MDT outcomes should be recorded on the EHR in a format that is accessible and meaningful to the wider clinical team.**

Recommendation 40 - **Discussion of strategic elements of the vascular access service should take place in a regular meeting that is separate to the clinical discussion of individual patients' cases.**

Recommendation 41 – **RDU staff should be trained in the assessment of fistulae and to identify potential fistula problems.**

Recommendation 42 – **The performance of the specific haemodialysis vascular access in use should be documented at each haemodialysis session.**

Recommendation 43 – **Challenging vascular access should be identified and, where possible, these patients should receive their haemodialysis care in an area of the RDU where there is a sufficient concentration of staff with the appropriate cannulation (and other related) skills.**

Recommendation 44 – **AVF and AVG patency should be routinely audited and discussed at the VA morbidity and mortality meeting.**

Recommendation 45 – **An 'intervention history' should be recorded on the patient's health record for every AVF and AVG.**

Recommendation 46 – **A 'threatened AVF / AVG' should be considered as a medical emergency and managed accordingly.**

Recommendation 47 – **Renal services should adopt a proactive approach to identifying the failing arteriovenous AVF that involves patients and front-line staff, with early access to investigative imaging and intervention where problems are identified. The associated workload and procedure outcomes should be recorded and discussed at the vascular access morbidity and mortality meeting.**

Recommendation 48 – **RDUs should have a written policy that describes and governs the escalation of potential access problems.**

Recommendation 49 – **Renal units should have a written policy that describes and governs the management of clotted AVF or AVG.**

Recommendation 50 – **All cases of clotted AVF or AVG should be routinely audited and discussed at the VA morbidity and mortality meeting.**

Recommendation 51 – **Patients with a clotted AVF or AVG should have urgent access to a combined surgical / interventional radiology or IR declotting procedure in a timely fashion to avoid the use of a central venous catheter.**

Recommendation 52 – **Patients who have undergone access creation or maintenance surgery should have a plan documented at the time of surgery to direct further action in the event that the AVF is unsatisfactory at the time of this assessment.**

Recommendation 53 – **Patients who have undergone access creation or maintenance surgery should be assessed at 2-4 weeks postoperatively by a suitably trained clinician.**

SERVICE PERFORMANCE & DEVELOPMENT NEEDS

Recommendation 54 – **A vascular access coordinator role is required to facilitate the efficient flow of patients through the elective access pathway. Part of this role requires clinical expertise and demands a clinical background. Part of this role involves an administrative remit that could be performed by a non-clinician – e.g. a vascular access 'tracker'.**

Recommendation 55 – **Renal services should expect a minimum requirement of 0.75 WTE vascular access coordinators per 100 prevalent haemodialysis patients (inclusive of both clinical and administrative roles), reflecting the average level of vascular access coordinator provision across the Scottish renal services currently.**

Recommendation 56 – **The dynamic nature of vascular access provision (especially emergent problems) requires that formal, accessible mechanisms are needed to keep track of active patients and optimally allocate resources to them. This would also help with capacity control and planning of catch-up lists.**

Recommendation 57 – **Renal services should routinely audit their access creation and access maintenance pathway waiting times and procedure outcomes. These should be published on a quarterly basis and used to inform clinical decision making within the unit.**

Recommendation 58 – **Renal services should conduct a quarterly strategic service review meeting. This would be the forum for discussion of service performance, waiting times, procedures outcomes, morbidity and mortality.**

Recommendation 59 – **There is a need to develop service performance data that can be presented in a standardised format that facilitates a national overview.**

Recommendation 60 – **A successful vascular access service should be defined according to the proportion of patients for whom incident and prevalent vascular access is according to their pre-defined 'personal access solution'.**

Recommendation 61 – **NHS boards should have a nominated board-level stakeholder (eg Medical Director) who must work alongside a named lead vascular access nephrologist, vascular surgeon, interventional radiologist and service manager to oversee the strategic deliver of vascular access services.**

Recommendation 62 – **The roles and responsibilities of each member of the VA team should be clearly defined in a written description of the VA service. This should be accessible to patients and members of the wider clinical team.**

Recommendation 63 – **Renal units should develop educational secondment programmes that enable RDU nurses to have protected time to working with VAN.**

Recommendation 64 – **Cases of central venous stenosis should be routinely audited and discussed at the VA morbidity and mortality meeting.**

Recommendation 65 – **All patients should have access to AVG if required. In some instances this may require the establishment of 'complex access centres' who provide this as a specialist service.**

Recommendation 66 – **Vascular access service needs should be considered as part of any recruitment exercise into relevant clinical and non-clinical departments within NHS Boards.**

Recommendation 67 – **Nephrology, Vascular Surgery and Interventional Radiology specialty training curricula should include a formalised Vascular Access training block as a core competency**

Recommendation 68 – **Training should be given to nurses and other clinical staff who provide peri-procedural care for patients undergoing access creation or maintenance procedures.**

Recommendation 69 – **All vascular access service delivery should be formally job planned. NHS Boards should backfill vascular access activity in periods of prolonged absence.**

Recommendation 70 – **The financial cost of haemodialysis vascular access services needs to be clearly visible to NHS Boards. This must be based on all nephrology, surgical AND radiological vascular access related activity. These data must be overseen by a named service manager and viewed as a whole by the board.**

Recommendation 71 – **All patients should have access to an appropriately trained team (nephrologist, surgeon or interventional radiologist) irrespective of the geographical location, within a clinically appropriate timeframe when they develop a vascular access-related problem.**

INTRODUCTION

There are approximately 4700 people in Scotland who have established renal failure and are receiving renal replacement therapy (RRT)[1]. The level of morbidity, hospitalisation and mortality experienced is considerably greater than that of their peers within the general population[1,2]. For those reliant on RRT, the most favourable outcomes are for patients who receive a functioning kidney transplant. For most, a kidney transplant is either not immediately forthcoming which results in regular dialysis treatment for a period of indeterminate duration, or not ever a viable option, which then means lifelong dialysis treatment is required.

There are currently just fewer than 1900 people in Scotland who receive regular dialysis treatment with haemodialysis (HD)[1]. Most commonly this involves attending a dialysis centre three times a week where access to the bloodstream is opened and the blood circulated through a dialysis machine, removing waste and water from the body, before the blood is returned to the patient.

One of the major determinants of morbidity, hospitalisation and mortality for patients on haemodialysis is the method by which the bloodstream is accessed for blood to be circulated to/from the HD machine. There is a well-established hierarchy of these HD vascular access methods with those patients who undergo needle cannulation of surgically created arteriovenous (AV) access experiencing fewer infections, access failures, structural complications, hospitalisations and deaths than those who use indwelling central venous catheters (CVC) for HD vascular access[3-6]. One previous SRR study demonstrated a 2-3 fold increased risk in mortality (all-cause mortality, cardiovascular, or infection-related mortality) and a 7-fold increase in death from septicaemia with the use of tunnelled central venous catheters (TCVCs)[3].

Surgical creation of AV access however is challenging and is reliant on good quality blood vessels (often requiring radiological imaging to identify them), technically demanding vascular surgery, and an indeterminate period of maturation that may last several weeks or months (thus necessitating early identification and planning of access by nephrologists). Even once AV access has been successfully created it may fail due to thrombosis or developing stenosis in the blood vessels. CVCs on the other hand provide a near-immediate usable access point to the bloodstream and therefore have traditionally been the default vascular access method of choice when AV access has not been successfully established.

There is therefore a tension between the labour intensive process of successfully creating and maintaining AV access so as to have the best clinical outcomes in the future, versus the ease and immediacy of use that CVCs provide, albeit with generally worse clinical outcomes. Having fast, efficient and productive pathways to AV access creation are crucial to ensuring patients have limited CVC exposure and achieve the best clinical outcomes.

Since inception of an annual vascular access census in 2007 Scottish Renal Registry data have demonstrated variation between the Scottish Renal Units with regard to the proportion of incident and prevalent HD patients who have AV access[1]. This issue is not isolated to Scotland, but has been reported globally[7]. It is a notoriously complex area and a multitude of potential explanations for this variation have been put forward.

The Scottish Haemodialysis Vascular Access Appraisal was set up to explore and describe this variation, specifically through scrutiny of the differing populations served, the clinical pathways employed to deliver successful AV access creation and the clinical practices employed in maintaining established HD vascular access. The overall aim of this was to identify the elements that are crucial to delivering vascular access services.

The appraisal project involved several strands:

- Visits to all nine adult and one paediatric renal units around Scotland to conduct interviews with patients and key members of the nephrology, vascular surgery and radiology teams;
- An internal validation study, consisting of an online questionnaire to interviewees to assess the face validity of the interview process;
- The collection and analysis of variables that relate to the HD population, the haemodialysis vascular access pathway, and HD vascular access practices in use in all nine adult and one paediatric renal services in NHS Scotland. This included measurement of all vascular access-related activity in Scotland during a six-week census period.

Our methodology, along with its underpinning sociological theory, was subjected to peer-review when presented at the Human Factors and Ergonomics in Healthcare Conference, in Baltimore, USA, in April 2015. Our internal validation study confirmed the face-validity of our methodological approach.

All renal centres in Scotland were visited where a total of fifty-two interviews were conducted and audio-recorded. The audio-recordings from each interview were transcribed by a team of secretarial staff. The transcripts were extensively quality assured and analysed using nVivo software (nVivo version 10, QSR International Pty; Melbourne, Australia).

These data along with numerical data on variables that related to the HD populations, the vascular access pathways, and vascular access practices in use in all the renal centres were then collated and analysed.

This approach has provided new insights into the organisational means that can enable the delivery of more efficient working around the creation and maintenance of vascular access for an individual patient. We hope that units can use these findings to streamline services and optimise the delivery of safe, effective person-centred HD care.

METHODS

OVERVIEW

We undertook a mixed-methods approach to explore the workings of HD vascular access provision systems to develop an understanding of their strategic alignment, operational reality and the impact of their function as currently configured.

This understanding was achieved through consideration of existing measures of quality, as evidenced from routinely published data from national reports[1] and national guidelines[8], using these to frame a series of semi-structured interviews with key informants in each of the nine adult and one paediatric renal services in Scotland. The qualitative data gained from these interviews was then used to collate a profile of the processes and practice undertaken in each renal service. Quantitative data were also sought at the time of each interview, as well as through data routinely collected from each service by the Scottish Renal Registry. A further exercise was undertaken following the interview process where all vascular access activity undertaken in each unit was measured for a 6-week period.

Together the cumulative quantitative and qualitative data gained by this approach described each organisation's operation of the clinical systems in question. When applying these data to a model of socio-technical systems theory it became possible to analyse each system's function, output and relative success.

THE THEORETICAL BASIS FOR A MIXED-METHODS APPROACH

We characterised vascular access as a complex socio-technical system. This may be defined as any system in which humans and technologies interact in some way. The delivery of contemporary healthcare invariably relies on human and/or technological interactions and therefore this was a natural starting point when considering a study.

A system may be defined as a group of inter-dependent and interactive component parts that together form a whole[9]. The system cannot be understood simply by deconstructing and examining its constituent parts in isolation, since these components interact in ways that are both predictable and unpredictable and give rise to the 'emergent properties' of the system.

Complex systems are often a product of their environment rather than purposely-designed entities[10,11]. The nature and function of system components may change over time. Changes may be so subtle as to go unnoticed by regulators or operators within the system, and one designed adaptation may result in unforeseen changes to overall system function. The operational movement of a system over time, 'migration', has been extensively documented in the published literature[12]. Migration might affect particular strategic or operational aspects of system components, or could relate to the political, economic, social, technical, legal and environmental milieu within which the system exists. Migration can be positive where it results in improved efficiency or enables better overall system productivity. It can also however modify the potential and nature of emergent properties arising from the system, and this brings with it a risk of adverse performance.

Defining vascular access services as a complex socio-technical system enables the utilisation of these established theoretical frameworks to examine clinical systems, and illuminate hitherto

unseen opportunities for improvement, innovation and collaboration. This approach remains extremely unusual in the wider healthcare context, and has not, to our knowledge, been attempted before in the field of HD vascular access.

RELATING SYSTEMS THINKING TO CLINICAL PRACTICE

Systems thinking may be unfamiliar to clinical audiences but several frameworks arising from the systems theory literature are recognisable in clinical practice, for example the 'Swiss Cheese' model[13], 'root cause analysis'[14] and 'systems-theoretic accident model and process (STAMP)[15]. These provide a useful, practical framework for rapid evaluation of adverse events, and have been used extensively in many healthcare organisations to investigate a variety of critical incidents.

These analytic tools make an important departure from old-fashioned approaches that sought to attribute 'blame' to a particular individual without accounting for the context in which an incident arose. This reflects changes in thinking whereby critical events may reflect the precipitation of unwanted emergent factors in addition to or rather than a simple failure of one system component.

Recognition that adverse events may be a function of a systems' design can assist with the design of processes and implementation of safety features that attenuate the risk of a subsequent problem occurring[16].

Nonetheless, unpredictable system component interactions cannot be understood purely by examining instances where emergent properties conspired to result in an adverse outcome. Critics would suggest that such a 'Safety I' approach takes account only of times where emergence leads to an overt system failure. An alternative 'Safety II' approach involves examining normal system function in order to better understand its constituents, their interactions, and some of the potential hazards that may arise[17]. This has led to the development of the 'resilient healthcare engineering' movement, which seeks to understand the normal functioning of healthcare systems and to proactively design them in a way that minimises the potential for harm. We therefore took a 'Safety II' approach when considering our study design – we sought to examine the 'normal' systems currently in use.

STUDY DESIGN

Whilst many will be familiar with the concept of gathering descriptive quantitative data on systems, the use of qualitative data capture may be a less familiar strategy. Qualitative enquiry can reveal a substantial depth and breadth of information that is difficult to obtain using quantitative methods. Our study design was focussed on gaining a hybrid of both of these types of data.

Data capture was primarily driven by visits to each of the nine adult and one paediatric renal services in Scotland and performing a series of semi-structured interviews to gain insights into the qualitative data elements, whilst also taking the opportunity to gather quantitative metrics covering vascular access provision and maintenance. Further data were gained by scrutiny of the standardised data that is reported routinely to the SRR. Finally, we also approached an individual within each adult renal service to record all vascular access related activity for a 6-week period from 26/01/2015 to 06/03/2015 inclusive.

INTERVIEWING AS A METHOD

An interview format was considered the most efficient way to gather the relevant information. Questionnaire-based studies typically show low response rates[18], and a paper questionnaire was considered unlikely to provide the necessary level of detail to achieve our study's aims. Telephone interviews were not thought to be practical for a number of reasons[18] and in the absence of specialist equipment it would be difficult to record the audio from a telephone interview. It would also become difficult to involve multiple interviewers in the process. Participants' body language and other nuances of conversation could be better appreciated in person. On a practical level it would also be difficult to obtain written interviewee consent were the interview conducted remotely. We considered therefore that face-to-face discussion with key members of the vascular access team in each renal unit was most likely to yield useful data. From a logistical perspective it was considered most practical for interviewers to visit each renal unit site rather than representatives from each site being invited to attend a central point for interview.

'Deviant case analysis'[19] was considered as an alternative to involving all ten renal units in the study. This would involve selecting units considered to be 'very good' and 'very bad' for the purposes of comparison, rather than including every unit in the data collection. While this would significantly reduce the time and cost associated with the study, it was judged unlikely to provide a credible description of how vascular access is delivered across Scotland. Firstly the traditional measures used to judge success of a vascular access service are recognised as having some limitations and may only provide a one-dimensional view on quality that would limit the potential yield from this study. Omitting centres from the study would also carry a high risk of missing important, subtle points from services that had previously effected significant positive changes.

SAMPLING / RECRUITING INTERVIEWEES

Within each centre it was considered necessary to gain the perspective of one individual representing each key member of the vascular access team; a vascular access coordinator; a nephrologist; a vascular access surgeon; an interventional radiologist; and a patient. This list was then modified to suit the specific staffing arrangement in each centre along with the willingness of individuals to be interviewed.

Each renal centre in Scotland has a representative on the SRR steering group and this network was utilised to identify key members of staff in each renal unit, who were then invited to participate in the study by email. The technique of 'snowballing'[20,21] was used to identify and recruit additional interviewees on each site, with the aim of interviewing team members who would be best placed to describe the realities of their service. Several of the study authors (PT, DK, RK) were themselves key members of the vascular access service in Glasgow. In order to reduce bias their colleagues in the nephrology, vascular surgery and interventional radiology departments were recruited to participate in the project. Interviews were conducted by one author (SO) accompanied by an external interviewer from another health board, without the direct involvement or presence of PT, DK or RK. More interviews were conducted in Glasgow than in other centres to compensate for the inability to interview key team members.

A nominated individual on each site agreed to act as an informal host for interview days, arranging an interview room and coordinating the times of each interview. Interviewees were asked to sign a consent form prior to participating in the interview.

SEMI-STRUCTURED INTERVIEWS

A semi-structured interview was devised that provided a standardised investigative approach that allowed for exploration of potentially important topics that become apparent during the conduct of the interview. We rejected alternative forms of data collection including unstructured and structured interviews and focus groups.

Unstructured interviews were not considered as it would be difficult to ensure consistency between interviews. This was judged to be important since we planned to interview clinicians from a variety of professional backgrounds and who were likely to hold quite different perspectives on vascular access. In contrast we considered that structured interviews would potentially limit the potential value of each interview, by providing too rigid a format to explore potential avenues of interest.

Focus groups were not chosen due to concerns that they might be unduly biased by dominant personalities, and subtle political, financial and other service influences would be more difficult to ascertain[18]. Scheduling and other logistical considerations also made this approach seem less attractive.

INTERVIEW SCHEDULES

Interview schedules were created to guide questioning and to provide a standard format for each interview. The staff interview schedule used seven general questions that were constructed such that as much of the vascular access service was explored as possible, including its structure, function and productivity. The patient interview schedule used 3 open questions designed to explore their past experience and present view of their vascular access journey. Copies of the interview schedules are in Appendix 1.

Key issues were highlighted on the schedule document to act as prompts to the interviewer, to ensure consistent discussion of these issues with each interviewee while allowing for emergent probing to maximise data collection from each interview. A series of mock clinical cases were included in the schedule document to act as a stimulus for discussion if necessary. These were not real patient cases, but were designed to be illustrative of typical patients within a vascular access service, based upon the clinical experience of the interview panel. The technique of 'constant comparison'[18,22] was employed between interviews to optimise data capture and to enable any necessary modifications to the interview schedule or format during the course of the investigation.

INTERVIEW PANEL

The interview panel consisted of between two and four interviewers, with at least two interviewers present at each interview. A single investigator (SO) was present at every interview and led every discussion to ensure consistency. The remaining interviewers included a consultant nephrologist (PT), consultant transplant and vascular surgeon (DK), consultant interventional radiologist (RK), consultant vascular surgeon (Mr Stuart Suttie), associate specialist nephrologist (Dr Ann Humphrey). When the lead interviewer had completed the discussion based upon the interview schedule, the remaining interviewers then asked questions to clarify or expand upon the topics of discussion. This was designed to optimise data capture, facilitate real-time sense-checking of the discussion, and to further standardise the interview format. Investigators did not form part of the panel interviewing colleagues from their own institution. Where possible the investigators were not interviewed themselves, unless this was absolutely necessary based upon their role in their home institution. Where this was necessary the interview was conducted before the investigator played any part in the study design, conduct or analysis.

INTERVIEW CONDUCT

The nine adult and one paediatric renal services in Scotland were visited to conduct interviews between September 2014 and February 2015 [Appendix – Interview details]. The researchers visited the same centre on more than one occasion when this was necessary to fit with interviewees' scheduling requirements. Interviews were held within a private room within the interviewee's host institution during their normal working hours. Where possible the participants were interviewed individually. Each interview was audio recorded using a laptop computer and the audio files were subsequently transcribed by secretarial staff. Field notes were recorded by each interviewer during the interviews.

FACE VALIDITY

All interviewees were asked to provide an email address at the conclusion of their interview. An invitation to complete an anonymous, online survey was then sent to the provided email addresses once the interview panel had departed from the institution and before the end of the next working day. A single invitation email was sent to each participant and the survey was continuously available for response for a period of four weeks. No reminder invitations were sent as the anonymous nature of the survey prevented the ability to track non-responders. The survey was undertaken to determine the face-validity of the interview process. This was necessary to determine the credibility of the process to interviewees, and to ensure that all necessary topics of discussion had been considered.

TRANSCRIPT ANALYSIS

Typed interview transcripts were quality assured by the lead interviewer (SO) by comparison of each prepared transcript with the original recorded audio. The completed, quality assured transcripts were thematically analysed using qualitative data analysis software (nVivo 10, QSR International Pty, Melbourne, Australia). One researcher (SO) performed line-by-line analysis of each transcript. The content of each transcript was considered in light of the field notes recorded by all the interviewers during the interview visits, researcher group discussions between interview sessions, and the overall clinical and socio-technical systems context. The data was assigned a code based upon the emergent themes that became apparent through this process of transcript analysis. The fully coded dataset was then subject to further analysis by the group of researchers who considered each theme and the relevant data subset in light of the overall project context. Verbatim quotes from the transcripts were used where appropriate to illustrate the themes that were being scrutinised.

QUANTITATIVE DATA COLLECTION

In addition to describing the configuration of vascular access in Scotland we aimed to quantify the level of access-related clinical activity distributed between each renal unit. Quantitative data was collected from each unit after the interview process was completed. The paediatric centre was excluded from this component of the project owing to the low access-related workload described during interviews. A coordinating clinician on each site was recruited by email or telephone discussion. Data was collected using a pre-formatted spreadsheet that was provided electronically to each unit. Centres were asked to record all hospital admissions, all surgical procedures and all interventional radiology (IR) procedures related to vascular access during a six-week period from 26/01/2015 – 06/03/2015 inclusive. These data were then collated to provide a national picture of access-related clinical activity.

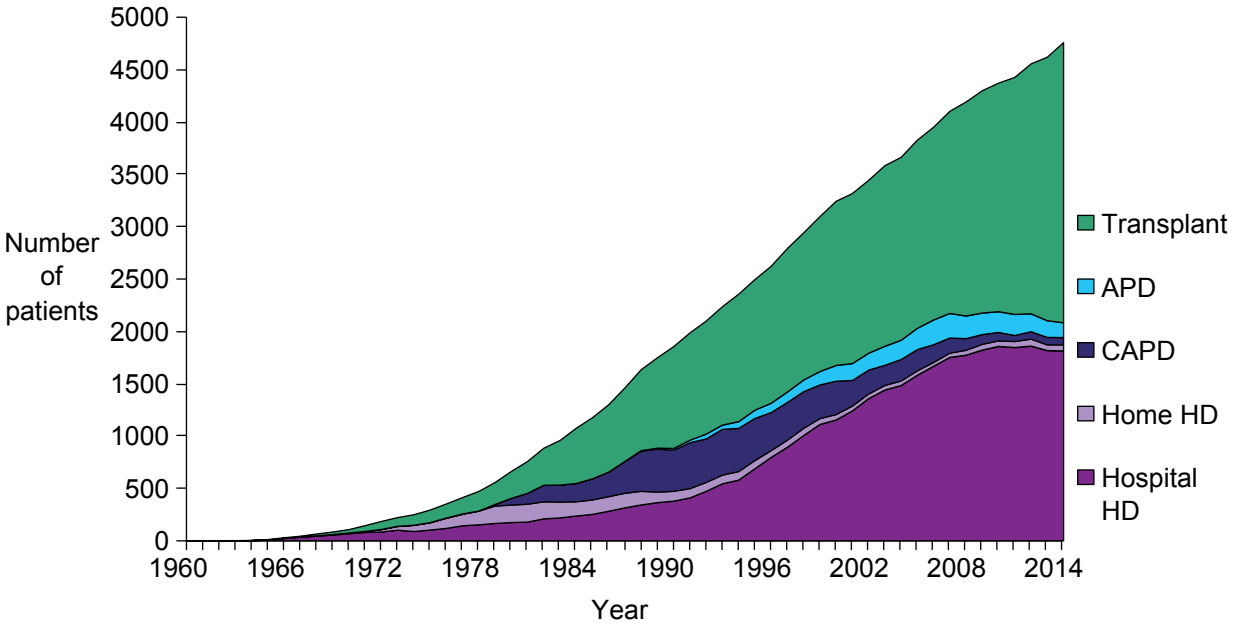
Data were provided by the Scottish Renal Registry on the incident RRT population for the period 01/01/2014 to 31/12/2014, the prevalent RRT population on 31/12/2014, and the prevalent HD access method in use on the date of the SRR national vascular access census during May 2014. Data on the development of *Staphylcococcus aureus* Bacteraemia (SAB) in patients on regular HD was generated through a linkage exercise between the SRR and Health Protection Scotland's Electronic Communication of Surveillance in Scotland (ECOSS) system. SAB events that occurred within 14 days of each other were regarded as single episodes. Single SAB episodes were tallied for each geographic health board area and apportioned to the appropriate renal service. This was then allied to the total cumulative number of HD days during the period 01/01/2014 to 31/12/2014 so as to generate a pooled SAB event rate per 1000 HD exposed days for each unit over this period.

RESULTS POPULATIONS

THE RENAL REPLACEMENT THERAPY POPULATION

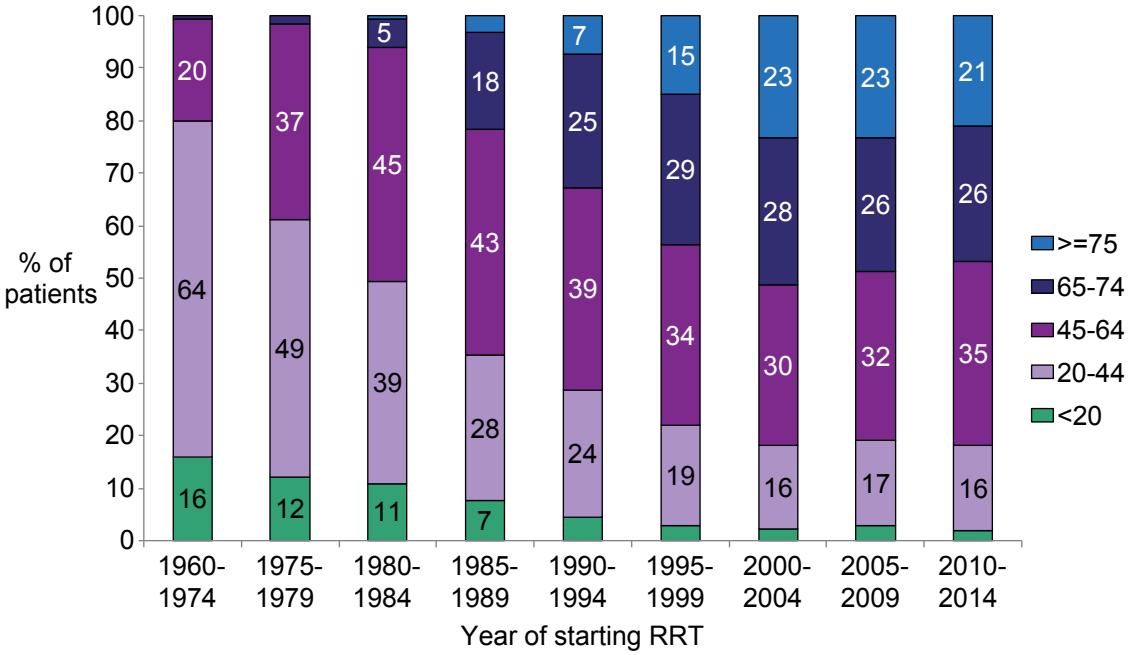
To develop a clear understanding of how HD vascular access services have evolved it is important to gain an appreciation of the dynamic changes that the HD population has undergone in recent years. Firstly, the prevalent HD population in Scotland grew continuously until 2012 [Figure 1]. Thereafter the prevalent number of patients receiving regular HD stabilised and on 31 December 2014 was a population of 1873 individuals[1].

Figure 1 **Prevalent patients on RRT in scotland according to modality of treatment on 31 December each year from 1960–2014[1].**



When looking at the characteristics of this population, they too can be seen to have changed over time, with patients aged 65 years or more now accounting for nearly half of patients who start RRT [Figure 2].

Figure 2 **Distribution of age at starting RRT in Scotland 1960–2014[1].**



With increasing age there is an observed association with increasing comorbidity, and cardiovascular – specific disease burden [Figure 3 and Figure 4].

Figure 3 **Percentage of patients with comorbidity by ethnic origin in each age group at the start of RRT 2011–2012 [UK Renal Registry 16th Annual Report Chapter 5][2].**

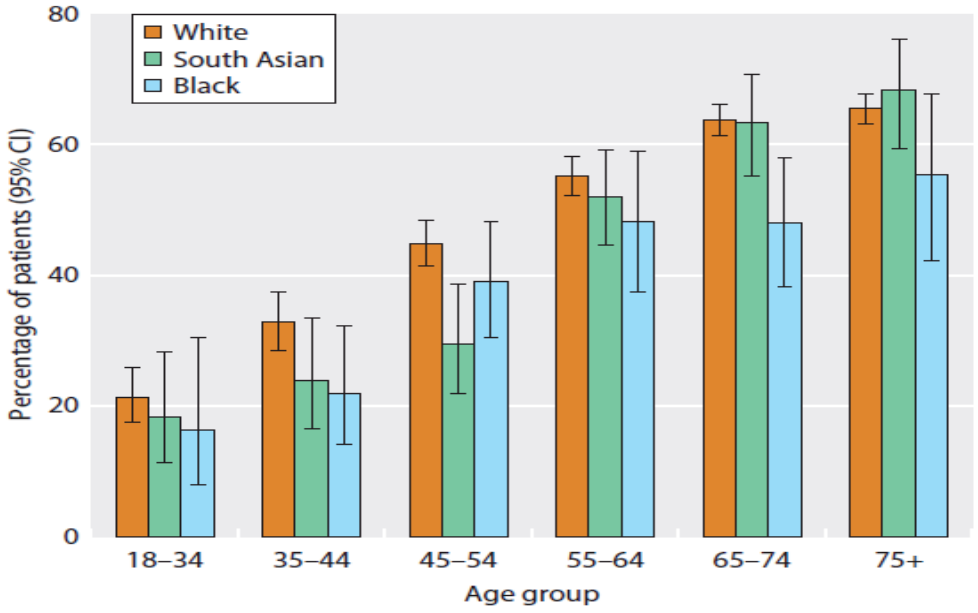
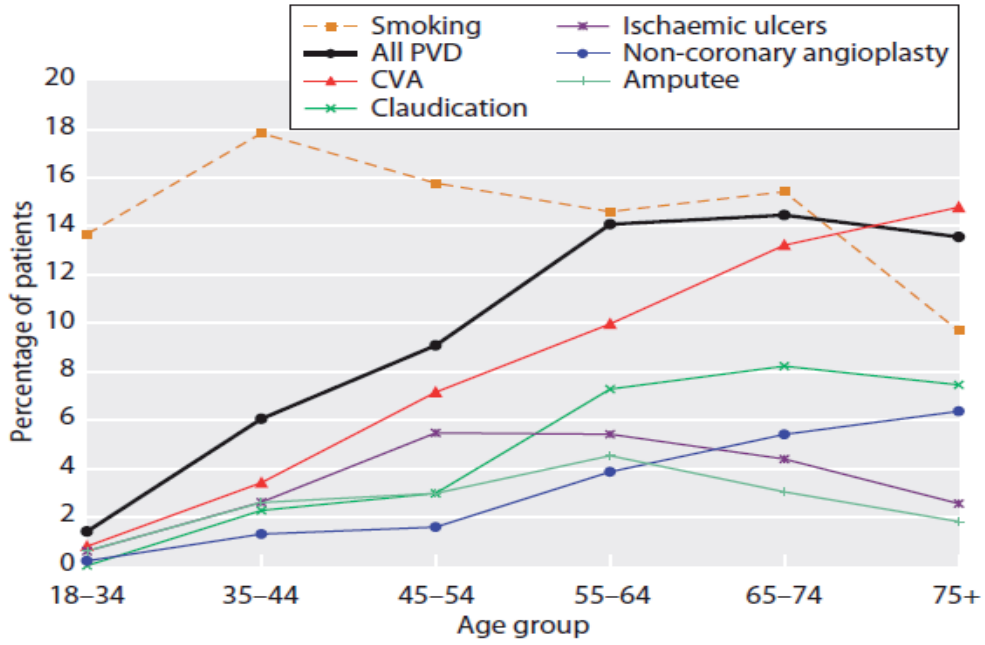


Figure 4 **Prevalence of non–coronary vascular disease amongst incident patients 2011–2012 by age at start of RRT [UK Renal Registry 16th Annual Report Chapter 5][2].**



It is not implausible that this combination of an increasing size of HD population, of increasing age, of increasing comorbidity and increasing cardiovascular burden has placed the provision of HD vascular access under increasing strain. This may be particularly evident when considering the chances success or failure of creating a functioning native AV vascular access.

THE HAEMODIALYSIS POPULATION

Traditionally focus has been placed on measuring the proportion of incident patients who start on HD, or are prevalent on HD, with AV access. Up until their revision in 2015, the 5th Edition of the UK Renal Association Haemodialysis Vascular Access Guidelines advocated that 65% of incident HD patients, and 85% of prevalent HD patients, should receive dialysis through AV access. How Scottish units are currently performing to these targets is shown below [Figure 5 and Figure 6]:-

Figure 5 **Incident dialysis access method in the adult HD population (01/01/2014 – 31/12/2014)[1].**

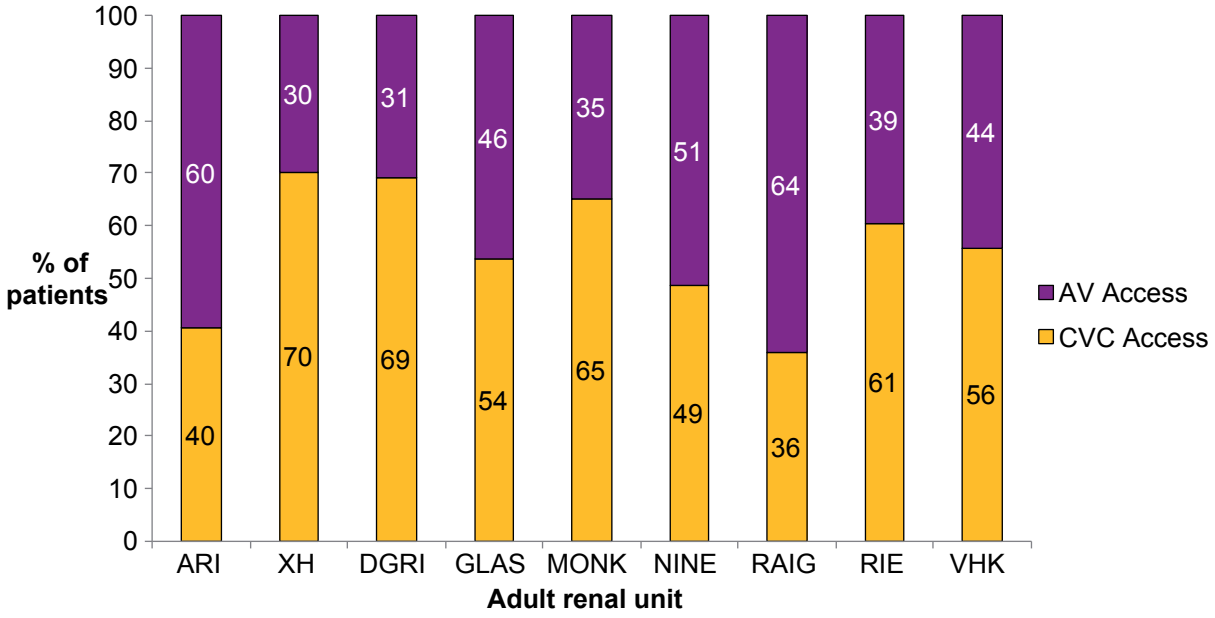
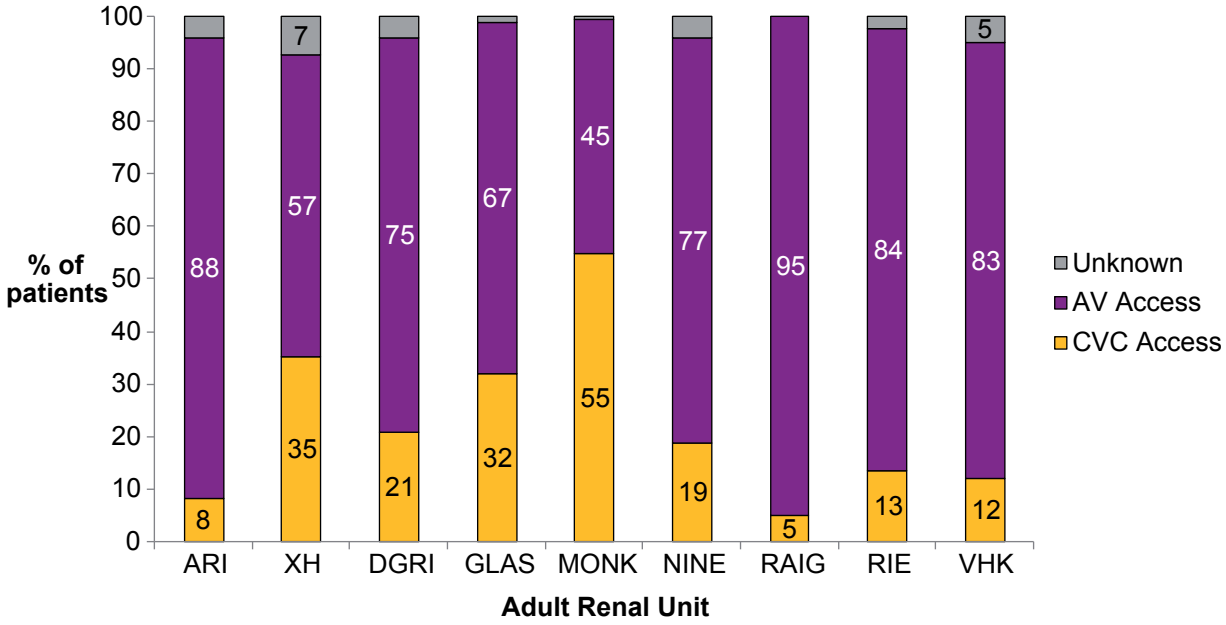
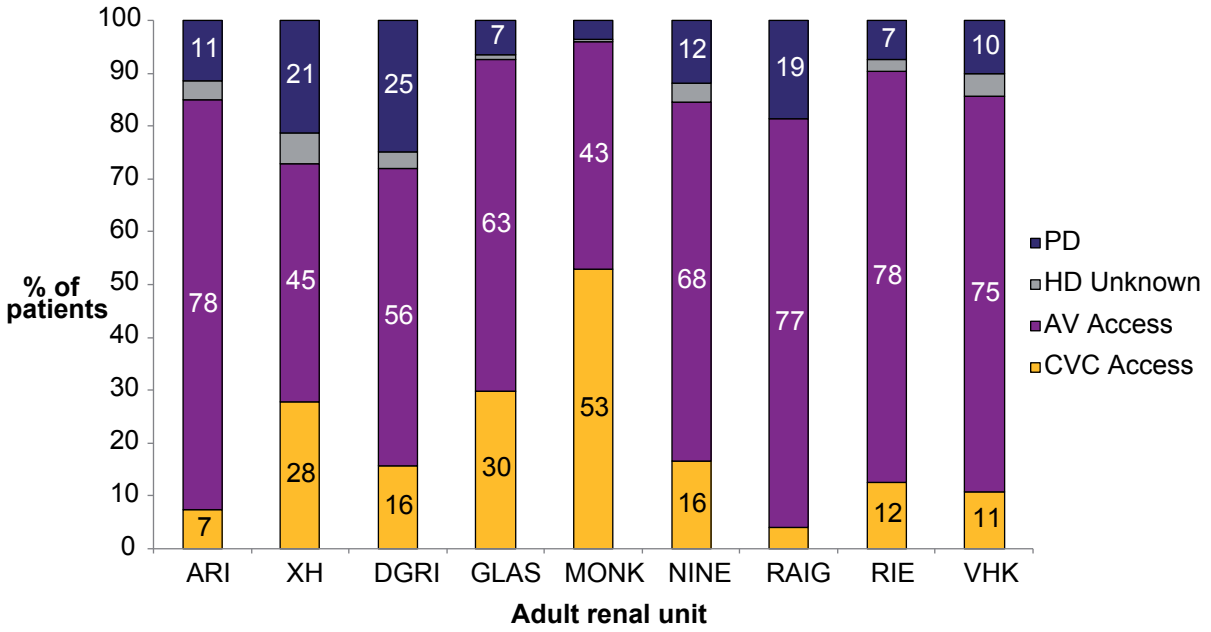


Figure 6 **Prevalent dialysis access method in the adult HD population 31/12/2014 (CVC and AV access proportions based on HD access during May 2014 census).**



It is recognised however that AV access may not be appropriate for all, and there is little evidence to suggest what the correct proportional split of AV and catheter access should be in either of these groups. This metric may also be undermined by the exclusion of peritoneal dialysis uptake that may vary between units. The 2015 update to the UK Renal Association Haemodialysis Vascular Access Guidelines suggests that 80% of prevalent non-transplant RRT patients should be receiving either AV access HD or peritoneal dialysis[8]. How the Scottish units perform on this metric is demonstrated below [Figure 7]:-

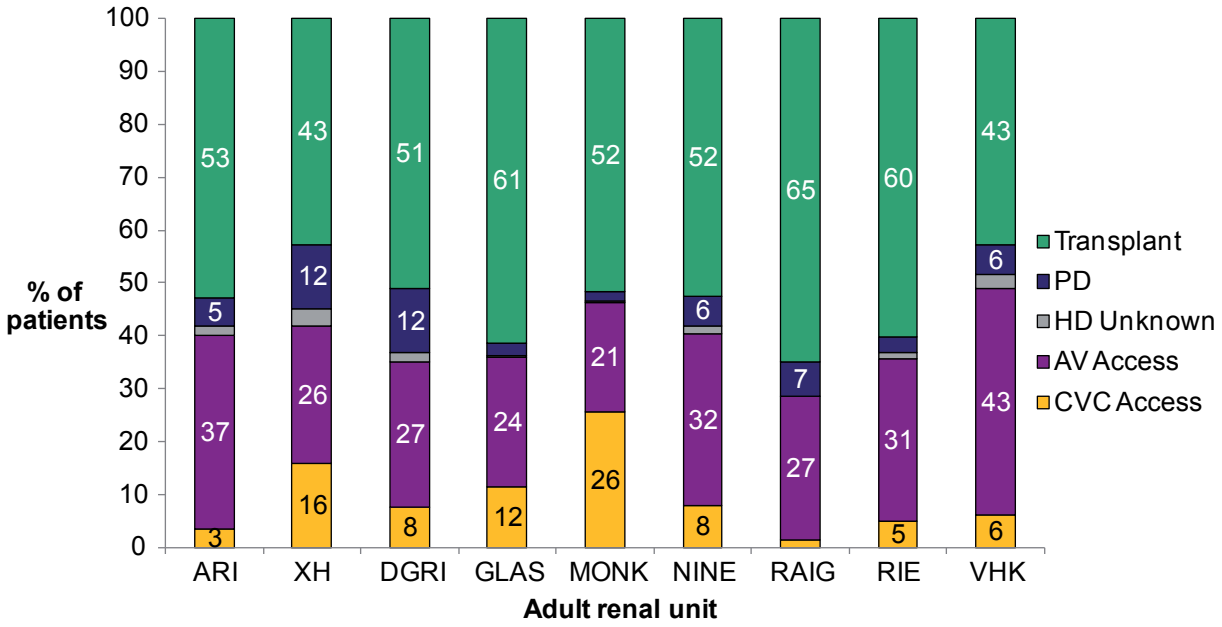
Figure 7 **Proportion of patients on HD and PD on 31/12/2014 (CVC and AV access proportions based on SRR census May 2015).**



It can also be seen, however, that variation in the proportion of prevalent patients receiving RRT who have a functioning renal transplant may also impact upon this latest metric. The fittest patients tend to be transplant candidates, and may plausibly be the most likely to have successfully established AV access. A unit with an especially active transplant programme may therefore have patients in receipt of a transplant whom other units may still have receiving HD through an arteriovenous AVF (AVF). This creates the paradoxical situation where an inappropriately critical view may be placed on a unit that is performing transplantation optimally and thus has a low proportion of HD patients using AV access.

Through the May 2015 census data obtained by the SRR, the full differential split of the prevalent RRT population, by RRT method, and based on geographic health board of residence, is presented below. Whilst this may also be undermined through not reporting variation in the proportion of patients opting for conservative care, in the absence of standard definitions of conservative care and reliable methods of measuring the numbers receiving conservative care, this is appears to be the most inclusive metric upon which to examine the variation of CVC use between units [Figure 8]:-

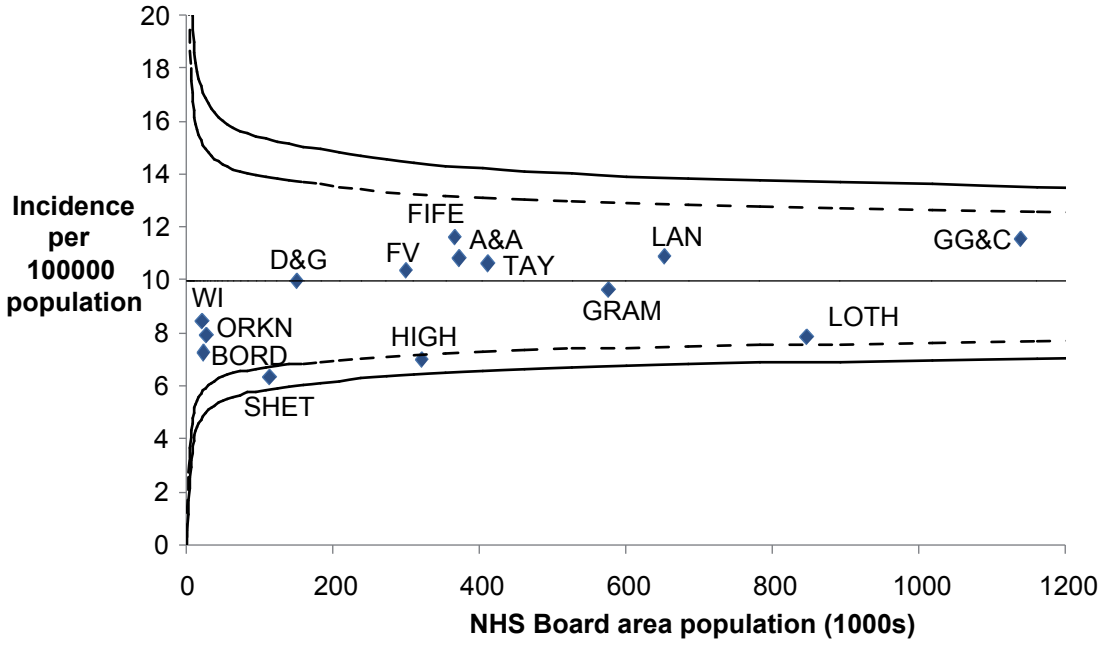
Figure 8 **Proportion of patients on HD, PD and Transplant on 31/12/2014 (CVC and AV access proportions based on SRR census May 2015).**



Recommendation 1 – CVC use as a proportion of all renal replacement therapies should be regarded as the preferred method of studying the variation in vascular access methods between populations.

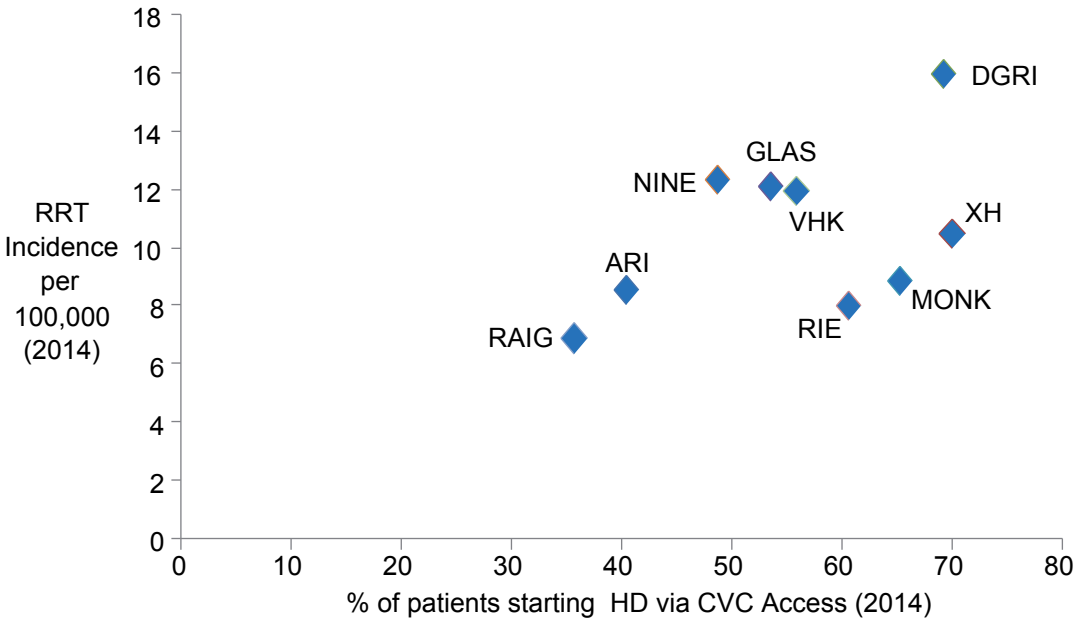
One potential surrogate marker for conservative care uptake is the observed variation in incidence rate of RRT per 100,000 [Figure 9].

Figure 9 **Incident patients 2011–2014 standardised for Health Board Age, Gender and SIMD[1].**



Whist many other factors may impact account for the incident rate, on a simple univariate analysis, we found that when comparing the crude incident rate of patients starting RRT per 100,000 population in 2014 for each of the geographic renal services this did not appear to have any strong correlation with the proportion of patients starting HD with a CVC in 2014 (R2=0.23, p=0.19) [Figure 10].

Figure 10 **Plot of crude incidence of patients starting RRT per 100,000 population in 2014 by the percentage of patients who started HD in 2014 using a CVC[1].**



Another element which could account for some of the variation in CVC use is the level of deprivation within the population with the hypothesis being that those patients with greater levels of deprivation may be less likely to have successfully established AV access, and thus a greater likelihood of using CVC access. Figures 11 and 12 (below) display the proportion of incident and prevalent HD patients in Scotland using a CVC, categorised by Scottish Index of Multiple Deprivation (SIMD) quintiles (groups 1 and 2 being most deprived, groups 4 and 5 being most affluent).

Figure 11 **The Deprivation category (SIMD quintiles – 1 and 2 most deprived, 4 and 5 most affluent) for patients starting HD in Scotland during 2014, split by type of first Access[1].**

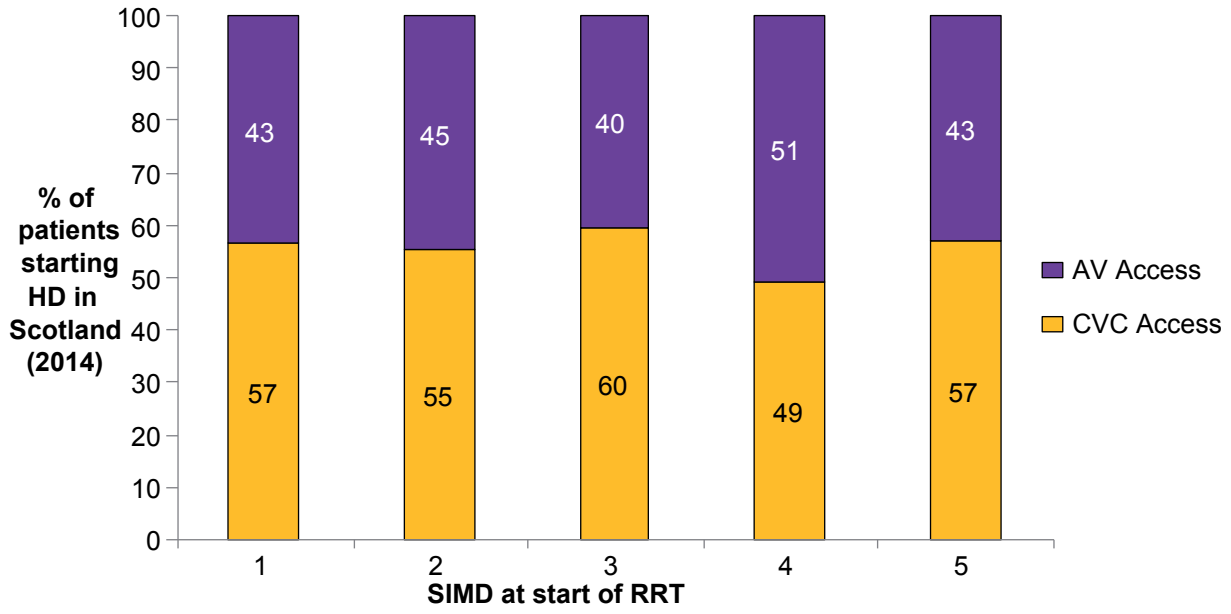
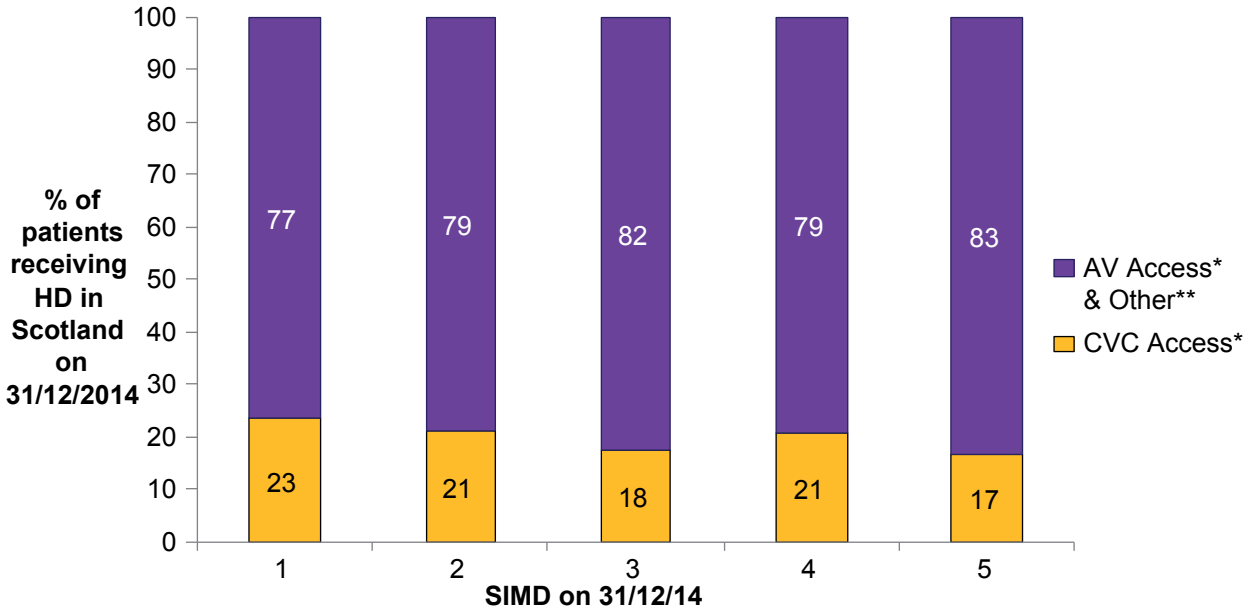


Figure 12 **The Deprivation category SIMD quintiles (1 and 2 most deprived, 4 and 5 most affluent) for patients receiving HD on 31/12/14, split by type of access.**



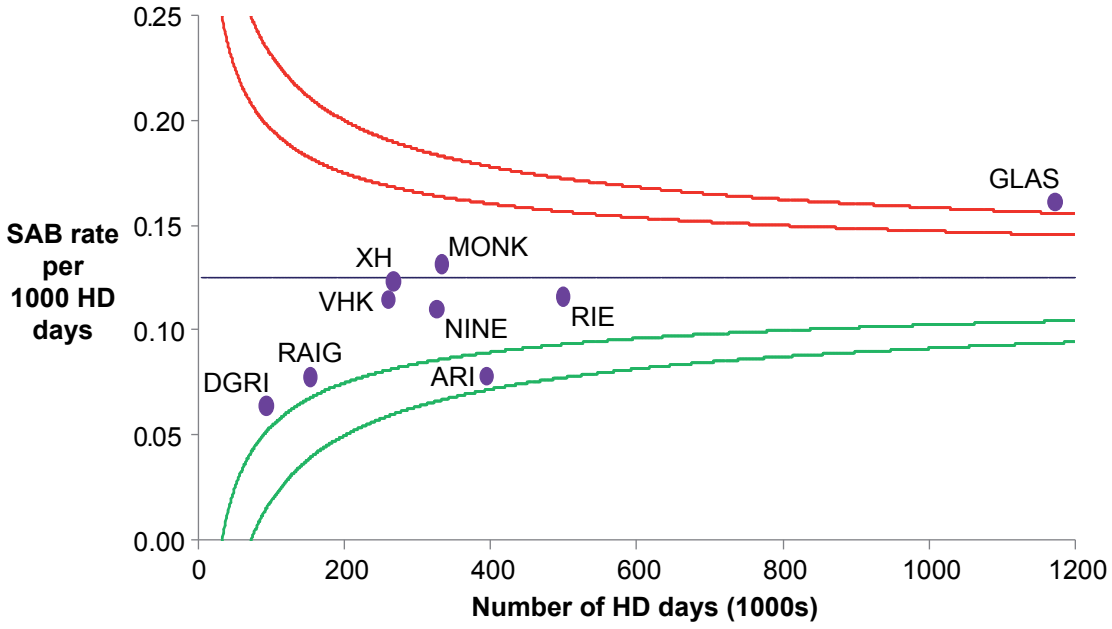
* Represents the HD access the patients were on during the May 2014 census.
** Other represents patients who were on HD on 31/12/14 but access was not known during May 2014 census[1].

These data suggest no specific trend towards being more likely to start HD on a CVC across the SIMD categories however a trend towards decreasing CVC use with increasing affluence is perhaps seen in the prevalent HD population. As such renal services with an especially deprived population may plausibly experience marginally more CVC prevalence than others who serve a more affluent population.

STAPHYLOCOCCUS AUREUS BACTERAEMIA

One of the most cited harms from CVC usage in particular is the risk of developing SAB. Through a linkage with Health Protection Scotland the SRR have been able to provide data on the number of SAB cases for each calendar year from 2006 onwards which shows that there has been a significant decrease in the percentage of SAB reported in the Scottish RRT HD population between 2006-2014[1]. The pooled SAB rate for each adult renal service for the period 2010-2014 is demonstrated in Figure 13 below.

Figure 13 **SAB rate per 1000 HD–exposed days for HD patients by adult renal service 2010–2014[1].**



Recommendation 2 – **SAB rates expressed as the number of events per 1000 HD-exposed days should be routinely reported by renal services.**

CURRENT ACTIVITY LEVELS

All nine adult renal services provided data on all investigations, procedures and admissions that were undertaken with regard to the establishment or maintenance of vascular access during a six-week period from 26/01/2015 – 06/03/2015 inclusive. All units provided complete data with the exception of NHS Tayside where data on the number of admissions (both day case and overnight) was reported as not being fully complete. In this 6 week period 429 patients were noted to have undergone a total of 550 procedures, of which 118 procedures required an overnight stay of at least one day, and 331 procedures were undertaken as day cases. Data on the number of procedures and investigations are detailed below [table 1 and table 2].

Table 1 **Number of vascular access procedures undertaken in each adult renal service in Scotland between 26/01/2015 – 06/03/2015 inclusive.**

Procedure	ARI	XH	DGRI	RIE	VHK	GLAS	MONK	RAIG	NINE	Total
AVF Creation	5	6	2	17	5	23	4	3	7	72
AVF Ligation	0	0	0	1	1	4	0	0	0	**6**
AVF Declot	4	1	1	1	0	3	0	0	1	**11**
AVF Revision	1	4	2	9	0	7	0	3	0	**26**
AVF Maintenance	4	0	1	1	0	0	0	0	0	**6**
AVG Creation	3	1	1	1	0	4	0	1	2	**13**
AVG Ligation	1	0	0	0	0	0	0	0	0	**1**
AVG Declot	0	0	0	0	0	5	0	0	0	**5**
AVG Revision	0	0	0	0	0	0	0	1	0	**1**
AVG Maintenance	0	0	0	0	0	1	0	0	0	**1**
TCVC Insertion	5	5	0	14	5	34	4	7	10	**84**
TCVC Exchange	0	0	0	3	0	10	0	0	5	**18**
TCVC Removal	0	4	0	0	0	5	0	1	0	**10**
TCVC Declot/ Strip	0	0	0	1	0	0	0	1	0	**2**
NTCVC Insertion	8	0	0	5	1	8	4	0	1	**27**
PD Insertion	1	0	0	0	3	0	0	0	3	**7**
PD Exchange	1	0	0	0	0	0	0	0	0	**1**

Table 2 **Number of vascular access investigations undertaken in each adult renal service in Scotland between 26/01/2015 – 06/03/2015 inclusive.**

Investigation	ARI	XH	DGRI	RIE	VHK	GLAS	MONK	RAIG	NINE	Total
Fistulogram	6	0	1	0	0	4	4	6	4	**25**
Fistuloplasty	0	3	0	7	0	3	8	7	0	**28**
Fistulogram and Plasty	7	0	5	0	5	16	0	0	0	**33**
Fistulogram, Plasty and Stent	0	0	0	0	0	2	0	0	1	**3**
Venogram	1	0	0	0	0	2	0	1	3	**7**
Lineogram	0	0	0	0	0	0	3	0	0	**3**
Stent	0	0	0	0	0	0	0	2	0	**2**
Clinical Science USS	0	0	0	63	0	0	0	0	0	**63**
Departmental Duplex USS	1	0	26	0	0	25	0	24	0	**76**
Vein Mapping	0	0	3	0	0	10	0	6	0	**19**

Based on these data, and grouping these procedures into their parent procedural classification, the following predicted workload over a 52-week period may be calculated [Table 3].

Table 3 **Expected vascular access activity in Scotland over a 1–year period, based on data received during the 6 week census.**

	Total in 1 Year	Total per prevalent HD Patient per Year	Total per prevalent 100 HD Patients per Year
All Surgical Activity	1309	0.699	69.9
All Interventional Radiology Activity	1863	0.995	99.5
All NTCVC insertions	234	0.125	12.5
All USS	1364	0.731	73.1
All Overnight Bed Procedures*	1019	0.546	54.6
All Day Case bed procedures*	2858	1.532	153.2

* Incomplete 6-week census data makes these projections a likely underestimate of true activity.

It should be noted that the calculations within Table 3 are based upon an incomplete dataset and represent the real world workload of vascular access systems that are not yet optimised. The expected workload in the event of fully optimised systems may be higher than projected here, particularly in the initial stages where centres are 'catching up' with patients who do not currently have the most advantageous form of vascular access for their specific circumstances. Furthermore centres with high historical TCVC use are likely to have a high burden of central venous stenosis within their population, which brings with it a higher-than-expected ongoing Interventional Radiology workload.

Recommendation 3 **– Renal services should expect an average of 70 surgical procedures per 100 prevalent HD patients per year to create and maintain arteriovenous access for haemodialysis.**

Recommendation 4 **– Renal services should expect an average of 100 interventional radiology procedures per 100 prevalent HD patients per year to create and maintain haemodialysis access.**

Recommendation 5 **– Renal services should expect an average of 70 departmental vascular access ultrasound sessions per 100 prevalent HD patients per year to create and maintain haemodialysis access.**

Recommendation 6 **– Renal services should expect 25% of all haemodialysis access procedural activity to require an overnight inpatient hospital stay of at least one day in duration.**

RESULTS QUALITATIVE DATA ANALYSIS

A total of 52 interviews were conducted across ten renal unit sites, generating a total of 27hrs 50mins of recorded audio. Mean interview length was 39mins 46secs which is as expected for this format[23]. A breakdown of interview duration by interviewee specialty and also by site is detailed in Table 4 and Table 5:-

Table 4 Interview duration by interviewee specialty.

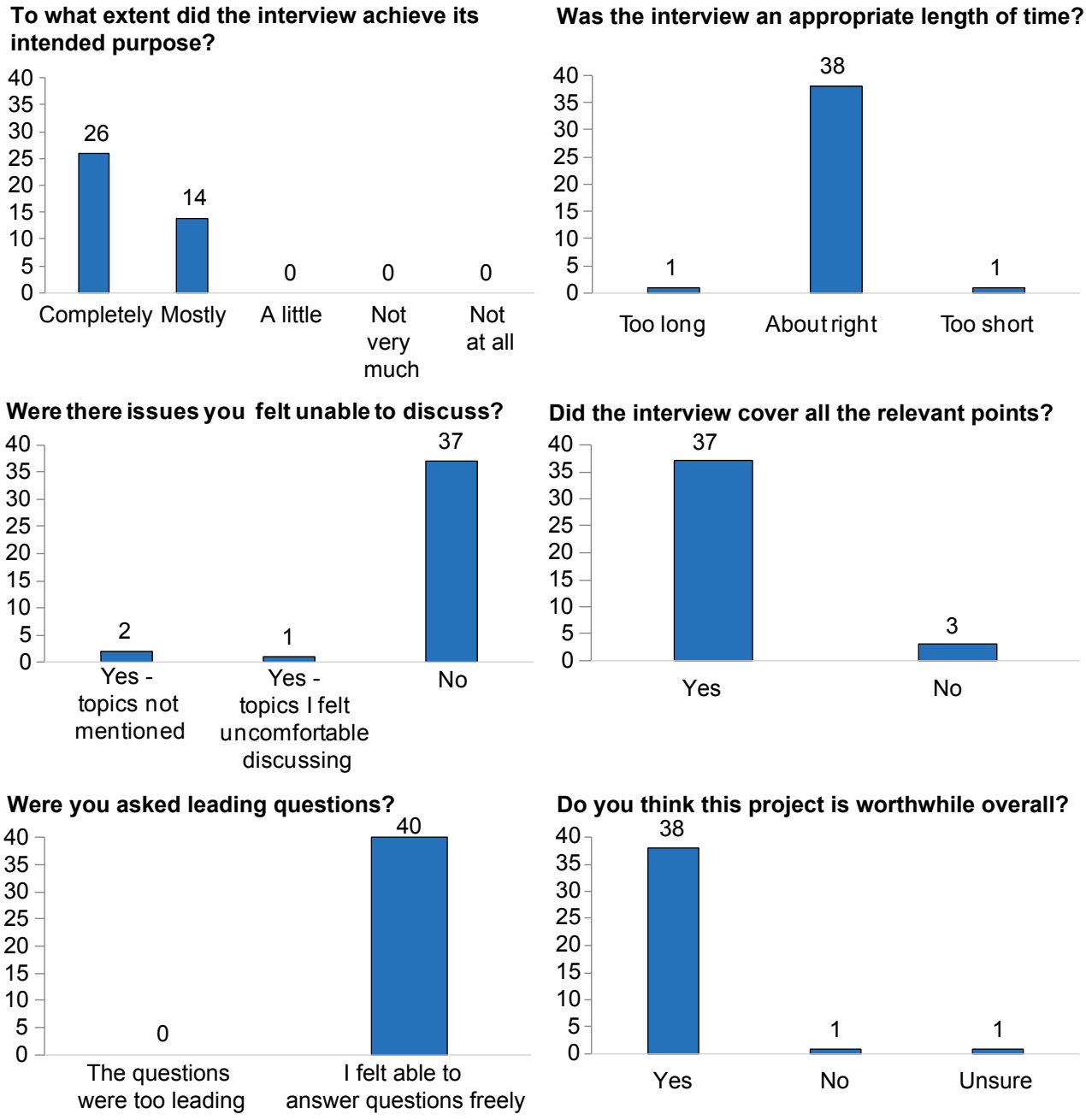
Specialty	Total Duration of recorded audio
Nephrology	8hrs 35mins
Nurse	2hrs 42mins
Vascular Access Nurse	5hrs 25mins
Vascular Surgeon	6hrs 14mins
Interventional Radiologist	4hrs 32mins
Sonographer	20mins

Table 5 Interview duration by site of renal service.

Renal Service	Total Duration of recorded audio
Aberdeen	3hrs 3mins
Crosshouse	2hrs 18mins
Dumfries	2hrs 21mins
Dundee	2hrs 8mins
Edinburgh	2hrs 52mins
Fife	43mins
Glasgow	6hrs 48mins
Lanarkshire	3hrs 32mins
Raigmore	2hrs 57mins
Yorkhill	1hr 3mins

After each interview, participants were invited by email to complete a validation questionnaire. An anonymous, online format was used to seek opinion about the interview process and the overall project. 40/52 (76.9%) interviewees completed the questionnaire. The results from this questionnaire are presented below in Figure 14:-

Figure 14 **Results from the 40/52 respondents to the post–interview questionnaire.**



The recorded interviews were all successfully transcribed. In total 40 topics of discussion were identified and coded into the transcripts. These were further refined into five axial codes representing the major themes emerging from the interviews. These were grouped as;

(i) The patient experience;

(ii) Creation of vascular access;

(iii) Maintenance of vascular access;

(iv) Service performance; and

(v) Development needs.

Inevitably a degree of overlap was seen between these themes given the nature of the topic and the methodology in use. The key issues arising from each theme are presented in the following five sections.

THE PATIENT EXPERIENCE

All patients expressed gratitude towards the doctors, nurses and other health professionals who were involved in their care. Most patients had been through multiple hospital admissions, procedures and treatments over the course of developing renal failure and establishing on RRT. The onset of renal failure and becoming aware of the requirement for dialysis was clearly a traumatic experience for many patients, who reported feeling bewildered and distressed during that time.

> *"Of course you're panicking and for some… well personally I had never heard of dialysis before. You know, it was just something that had never cropped up.... And when I first came here, you know, I thought 'oh my god'…'what's going to happen now?'... But as you go on you get used to it and you can accept it a bit better." (Patient)*

> *" I think most people have just…It's been… it's been a bad experience but only because it's the last thing on earth you expected to, you know, but the actual doctors and nurses and everything have been excellent, I can't fault them in any way." (Patient)*

Most patients described having been through a large number of access-related procedures, and many could describe the procedures and the surrounding hospital admission in great detail. Initially most patients described their overall experience as being positive, but when asked about individual procedures in detail their language became noticeably more negative. CVC insertion procedures were commonly described as particularly traumatic with several patients describing repeated attempts to have CVCs inserted without adequate (local) anaesthesia or analgesia. Several patients had had failed AVF creation procedures. They expressed great frustration about the futility of having gone through multiple logistical hurdles, and a surgical procedure, for apparently no gain.

> *"In fact at one stage I thought oh 'I've got to have this again – I'll just die' (laughs) you know. You know. I'd rather just go on and be… it was really bad." (Patient)*

Patients who were largely self-caring or who attended a centre with high prevalent AVF usage tended to report being told that CVCs were not a long-term solution, and that having an AVF would make dialysis safer and better.

> *"I think it was the safer option and it was the safer option for me. The lines sometimes get infected, that was a key point and they are not long-term it is more of a short-term strategy." (Patient)*

> *"My pump speed was 350 as opposed to the neckline being 250 so we get better dialysis for that." (Patient)*

Patients in other centres, with lower prevalent AVF usage, had more mixed views about the utility of an AVF over TCVC for access. In these centres their views were influenced more by fellow patients in the regional dialysis unit (RDU) than purely by what clinicians were telling them.

"You know the catheter coming out of the neck… I can't understand how in this day and age why they can't come up with something much more convenient, you know, like the catheter you just, you know, undid it and that was it. Getting the needles in is really difficult. You know. It would be nice if there was some other method." (Patient)

Patients' recollections of AVF education sessions tended to be relatively vague. This was noted across most centres and was occasionally at odds with clinical teams' perceptions of a robust on-going patient education programme.

"I was just told by my doctor, I think [surgeon] gave me the stethoscope and the ball but I went to a clinic with [surgeon] and [vascular access coordinator] and they kind of all discussed it with me and if I had any questions then I could answer them and they could answer me. I can't really remember vividly what happened but I think it was just a kind of clinic." (Patient)

"Just to, you know, keep it clean, just give it a wipe, you know with a disinfectant thing." (Patient)

Patients were accustomed to telling healthcare professionals about their AVF, and to directing against blood pressure measurement or venepuncture around the AVF. Some patients reported a frustration at having to do this.

"The odd ones try to and if I have not come across them before and I say you can't do that because of…" (Patient)

"Yes I am quite protective over [my AVF] and I kind of…..it surprises me that some people, you say right you know I have renal dialysis and they immediately go and take your blood pressure, they don't ask what arm your AVF is on and I kind of think if you are… some other nurses and some doctors even, especially GPs they don't think to ask and I have to tell them and I think when they know the history of the patient or at least you are on dialysis it is something that you would always say or ask first it shouldn't really be the job of the patient to say don't use that arm sorry." (Patient)

It was notable that almost no effort had been made to formally enquire about the patient experience of vascular access. In a few cases patients had been surveyed about their experience on a particular day in hospital, but this arose in the context of more general 'department experience surveys' and did not address their wider experiences having vascular access created and maintained.

Recommendation 7 **– Measurement of patient experience should be a focus for future assessments of a vascular access service.**

Recommendation 8 **– Time should be allocated for the delivery of education about vascular access methods and maintenance to all patients for whom haemodialysis is being contemplated. This should include information about avoiding venepuncture and blood pressure measurement on the appropriate arm.**

Recommendation 9 **– Education on vascular access methods and maintenance should be provided regularly to patients throughout their tenure on haemodialysis. This should be considered a cornerstone of routine haemodialysis care, rather than a single intervention delivered prior to commencing haemodialysis, with the aim of facilitating patient-reporting of potential access problems.**

CREATION OF VASCULAR ACCESS

WHAT TRIGGERS REFERRAL FOR VASCULAR ACCESS? WHAT FACTORS INFLUENCE LATE REFERRALS?

Most nephrologists refer patients for the creation of vascular access based upon an absolute estimated glomerular filtration rate (eGFR) and the relative rate of decline. There was substantial variation between individual clinicians, even in the same unit. This variation can be attenuated where the vascular access coordinator has an overview of the whole low clearance, or where named consultant nephrologists maintain responsibility for individual patients. Having a strategic overview of the low clearance cohort, and to a lesser extent an overview of an individual patient's journey, seems necessary to enable timely referral for incident access.

Vascular access referral generally does not happen until the patient has received RRT modality education, which is usually delivered by nursing staff in the low clearance clinic. There is a reluctance to enter into detailed RRT modality education with patients until they reach an advanced stage of CKD. Some nephrologists expressed a view that it was preferable to allow a patient to start RRT with suboptimal vascular access, rather than creating access in a patient who ultimately does not require it. This was particularly the case where a patient requires complex surgery to create an AVF or to insert an AVG. Clinicians cited examples of patients undergoing access surgery but not starting HD until several years later. These views seemed to be driven more by anecdote than evidence. One centre reported conducting a limited audit of unused fistulae, but nowhere systematically audited rates of unused fistulae, complications from unused AVF or framed this in the context of patients starting haemodialysis using suboptimal vascular access.

In most units eGFR is seen as a trigger for initiating RRT education, followed by referral for vascular access. Whilst most interviewed nephrologists reported an eGFR of 15-20 for referral on initial questioning, more detailed questioning showed that this actually meant RRT education referral rather than vascular access referral. Thus the true eGFR at which VA referral was made was deemed more likely to be 12. The configuration of the low clearance and vascular access services within each unit determines the point at which vascular access coordinators become aware of such patients. Patients who take time deciding upon their RRT modality may be referred for access relatively late, which compromises the ability to deliver their optimum access modality prior to starting HD.

There is widespread acknowledgement that rate of decline is difficult to predict and many patients who are known to the low clearance service are seen to require RRT sooner than originally anticipated. Nephrologists express that this was unavoidable and unpredictable in the vast majority of cases. No centre systematically audits and discusses these cases on a regular basis, nor counts them as avoidable adverse events.

No units utilise metrics relating to the current waiting times for successful AV access creation to modify the point at which access referral is made. Most clinicians were unable to give an accurate measure of waiting times within their units, although nephrologists who judged waiting times to be excessively long also tended to report earlier referral for access creation.

Recommendation 10 - **All patients who may require haemodialysis should have a clear "personal access strategy" that defines optimal form of vascular access and is framed within the wider context of their "personal renal replacement therapy solution".**

Recommendation 11 – **All patients' "personal access strategies" should be documented by the time their eGFR reaches 15 ml/min, following which the strategy may be reviewed regularly, and activated when necessary.**

Recommendation 12 – **Clinicians or teams running low clearance clinics are responsible for documenting the "personal RRT strategy" and "personal access strategy" for each patient.**

Recommendation 13 – **Clinicians or teams running low clearance clinics should have access to the current waiting times for successful AV access creation in their service..**

HOW DO PATIENTS FLOW THROUGH THE ELECTIVE ACCESS PATHWAY?

All adult renal units have a referral process and pathway for the elective creation of vascular access. The formality, clarity and credibility of the process with clinicians varies between centres. In the paediatric centre vascular access referrals are done on an ad hoc basis reflecting low patient numbers and an infrequent need to refer a patient for vascular access. The unit process maps (see appendix) describe the specific pathways reported to be employed in each unit while the text below comments on the reported referral mechanisms employed by each unit with their relative successes and vulnerabilities.

In Aberdeen each consultant nephrologist has responsibility for their own patient group, but the nephrologist Vascular Access Coordinator (VAC) attends the low clearance clinic and has a responsibility for attending to the vascular access needs of the whole cohort. This enables early identification of patients who require an access referral and discussion with the relevant consultant, rather than waiting for the consultant to refer the patient. Early access referral is supported by a strong clinical belief in the merit of AVF or AVG access over CVC. Interestingly this was a uniform view expressed voluntarily by all relevant disciplines, professions and patients. Access creation is managed through a '1 stop' Vascular Access Clinic attended by a named vascular surgeon and the VAC. At this clinic the patient is clinically assessed, has a duplex scan, and a plan is made for access surgery. The VAC then allocates the patient to a surgeon based upon their available capacity. Some surgeons appoint patients directly however the access coordinator can directly schedule and reschedule patients onto theatre lists to optimise resource usage.

Inverness operates a similar process whereby the VAN maintains an overview of the low clearance cohort through participation in a formalised regular meeting with the Consultant Nephrologists managing these patients. Patients are referred to VAN who organises vein mapping and discussion at the vascular access multidisciplinary team (MDT) meeting. Access surgery can then be triggered when needed. Patients are prioritised and allocated to theatre lists by VAN. If the patient resides in the Western Isles it is usual for the patient to have a compressed version of this pathway whereby their vein mapping and surgery is performed during one short hospital admission, without formal MDT discussion. When the plan is for complex access surgery the patient often starts dialysis with a CVC and then has surgery once commenced on dialysis.

In Crosshouse patients are referred for access using a paper form which is then duplicated onto the electronic health record (EHR) by the VAN. This standard referral form is a recent development that intends to prevent the haphazard access referrals that were said to be common previously. A '1 stop clinic' is being established, where patients have a duplex scan, see a surgeon and a plan for surgery is determined, usually accompanied by a fall back to facilitate rapid relisting for theatre if the first AVF fails to mature. Local anaesthetic surgery occurs predominately in Crosshouse Hospital. More complex procedures are done in Ayr Hospital, where inpatient nephrology review is not routinely provided.

In Dumfries patients are referred for AV access creation once an RRT modality decision is made. Following referral patients have a duplex scan, and surgical review is usually timed to coincide with the scan appointment; patients will be listed for theatre following this review. If the surgeon is unable to see the patient around the scan they will be seen at a surgical clinic or, if the scan appears straightforward, be listed without being seen. Most procedures are done under local anaesthetic as a day surgery case. There is no IR involvement in the access service in Dumfries; nephrologists place TCVC when they are needed, and the vascular surgeon also performs endovascular procedures.

In Dundee patients are referred to the VAN once an RRT modality decision is made. They are seen in a vascular lab clinic where they are scanned by sonographer, seen by a surgeon at the same time, and leave the clinic with a plan for access creation. Broad prioritisation is given to the urgency of clinic review but it is challenging to then prioritise theatre lists. TCVC can be placed on a weekly nephrology-led list.

In Edinburgh the nephrologists send a referral letter to the VAN, who assesses the patient, performs a duplex scan and lists the patient for theatre in a '1 stop clinic'. The patient first meets a surgeon on the day of surgery. If there is no obvious AVF option the patient is listed for an 'explore and proceed' procedure and it is reported that a workable AVF can usually be fashioned using this approach. The VAN can directly schedule and reschedule theatre lists. By maintaining an overview of all 'active' patients and all available theatre slots it is possible to optimally schedule procedures according to clinical need.

In Glasgow patients are referred by nephrologists to the VAN by using the electronic health record to populate a referral document. Some may be listed directly for theatre based upon the referral letter but this is highly unusual. Typically patients are first seen in a Vascular Access Clinic by the VAN; if an AVF option is apparent the patient is then listed for theatre; in the vast majority of cases however patients are referred for departmental vein mapping and subsequent MDT discussion. USS vein mapping is performed by a radiologist and waiting times can exceed six months, although a new sonographer has been trained to assist with this subsequent to the review. Some nephrologists circumvent the process by writing or verbally referring directly to a surgeon.

Fife does not have a VAN or equivalent, and each consultant maintains their own low clearance patient cohort. Referral for vascular access involves sending a letter or email to the vascular surgeon and the vascular secretary. The nephrologist then has little further involvement in the pathway, which is thought to be similar to the Dundee model.

In Lanarkshire patients are referred to the VAN either using the electronic outpatient clinic system, or are informally referred if not seen in a clinic setting. Patients are seen in a VA clinic by the VAN and a surgeon; sometimes they require onward referral for formal USS vein mapping before a plan can be made. Every patient is routinely referred for anaesthetic pre-assessment, which incurs a significant waiting time and commonly results in patients being declined. The surgeon conducting the clinic does not perform VA surgery; the operating surgeon meets the patient on the day of surgery in either Monklands or Hairmyres Hospital. In Monklands Hospital the day surgery theatre space is utilised but patients typically stay in hospital overnight in a general surgery ward. Staff and patients are commonly confused with the ambiguous use of a day surgery theatre for complex surgery and this can result in cancellations. In Hairmyres there is no on-site nephrology cover but patients are accommodated on the vascular surgery ward perioperatively.

In paediatrics the nephrologist addresses HD modality and vascular access as part of the overall discussions around end-stage renal failure. Access placement is coordinated between the nephrologist, surgeon and anaesthetist on an ad hoc basis; this is an infrequent process hence

they have no formal process for doing it. TCVC are their default access modality and they have not had a patient with an AVF since 2009.

Recommendation 14 – Renal units should have clearly articulated, written pathways for the creation and maintenance of vascular access.

Recommendation 15 – Electronic health records should be utilised to simplify referral into access creation and maintenance pathways, and to assist in tracking the patient journey thereafter.

WHAT IS THE ROLE OF VEIN MAPPING PRIOR TO AVF CREATION SURGERY?

In most centres, vein mapping is commonly performed as part of the planning process for AVF creation surgery. This is usually in the form of a duplex ultrasound scan, although venography is used as an adjunct in some centres too. Some surgeons consider vein mapping to be a necessary prerequisite for any AVF creation surgery, although it can be acceptable for patients with clinically healthy vessels to proceed directly to surgery without being imaged. This relies upon the referring nephrologist and / or the vascular access coordinator having the skills to do this, and the willingness of surgeons to operate on patients who have not been formally vein mapped.

Outside of centres where patients are routinely scanned during an AVF planning clinic there is no clearly articulated policy for performing vein mapping. In general terms this is done for any patient in whom suitable vessels cannot be satisfactorily identified by clinical examination alone. The lack of a policy is reflected in a lack of allocated slots for vein mapping scans, which can be a significant problem in centres with limited scanning capacity, and who rely upon sonographers or radiologists to perform vein map imaging. In these centres the speed of the elective access pathway can become dependent upon this waiting time.

Vein mapping is performed by a number of people in the vascular access team including surgeons, radiologists and sonographers. Access to vein mapping seems to be faster when performed by sonographers while centres that rely on a radiologist to perform vein mapping have longer waiting times. Vein-mapping done by the surgeons performing the access surgery in a vascular access clinic, enables decision-making and planning during the clinic appointment.

Where imaging is performed by sonographers or radiologists for later discussion at an MDT it is important that referral and reporting systems for this process are robust. Some centres report difficulties tracking patients' progress using paper-based referral systems. Imaging reports and the captured images should be available to the MDT and operating surgeons, ideally using electronic systems that reduce the delays associated with paper reports sent by internal mail.

Sonographers appear to provide the quickest access to imaging; where this is rapidly followed by a decision as to the preferred surgical approach this probably represents optimal organisation of vein mapping.

Recommendation 16 – Pre-operative vein map ultrasound scanning is preferable prior to undergoing arteriovenous fistula creation surgery, however in some instances may not be required where there is a clear native arteriovenous access option on clinical examination.

Recommendation 17 - All renal services should have access to a suitably trained sonographer to perform ultrasound vein mapping.

WHAT IS THE ROLE OF THE VASCULAR ACCESS CLINIC?

Every adult renal unit runs some form of vascular access clinic however the function, location and staffing of this clinic varied greatly between units. Clinic functions include:

- Assessment of new patients for creation of vascular access;
- Review of post-operative patients who have recently had vascular access created;
- Review of patients with existing vascular access in whom problems have been identified.

The clinic tends to take place either in a vascular laboratory or general outpatient setting. In the vascular laboratory it is common for the clinic to be staffed by a VAC, vascular surgeon and sonographer. In general outpatient areas clinics are staffed by a VAC who is usually accompanied by a vascular surgeon; in some centres the vascular surgeon attends alternate clinic dates. Clinics tend to be cancelled when a surgeon or sonographer is unavailable but it is uncommon to cancel the clinic when the VAC is unavailable unless they are the only person scheduled to staff the clinic.

Some centres operate a '1 stop clinic' whereby patients attend the clinic, have a USS duplex scan and a plan made for AV access creation during one appointment. This is uniformly reported to substantially reduce the lead-time required to schedule AVF creation in new, elective patients. In some centres it is normal practice for VAC to plan AVF creation, and the patient first meets a surgeon on the day of surgery. It is uncommon for AVF planning clinic appointments to include the documentation of a 'plan B' in case the initial AVF strategy fails.

There is considerable variation in the reported necessity and frequency for postoperative review. These appointments typically take place in a vascular access clinic or in the renal dialysis unit for patients who are already receiving HD. Some centres review patients frequently in the immediate perioperative period whereas others see patients once at six weeks. When a problem is identified with a new AVF the case is typically referred to the multi-disciplinary team meeting for discussion, although in centres that have pre-emptively specified a first and second choice AVF procedure it can be normal practice to automatically relist the patient for a further procedure without clinic or MDT review.

When patients experiencing problems with their existing access attend for clinic review they typically require further imaging studies and subsequent discussion at an MDT meeting. It is unusual for such patients to leave the clinic with a definitive plan for intervention or surgery. The processes involved in managing such patients are discussed later in this report (see "Maintenance of Vascular Access" section).

Recommendation 18 – In the majority of patients there is uncertainty as to what native arteriovenous access options exist. For these patients, they should have access to a one-stop vascular access clinic, where ultrasound scanning, clinical review and a decision for theatre may all be undertaken at a single attendance.

HOW ARE AVF OPERATIONS PLANNED?

In Aberdeen the surgeon assesses the patient clinically, performs a duplex scan in clinic and makes a plan, sometimes with an alternative plan to fall back upon too. The surgeon who operates is not necessarily the surgeon who has met the patient in clinic; usually the clinic plan is ultimately followed but operating surgeons have freedom to proceed as they see fit.

In Crosshouse the surgeon plans a procedure along with an option to fall back upon. In Dumfries the surgeon plans a procedure at the time of the patients' Duplex scan. In Dundee the surgeon plans a procedure in clinic at the time of the patients' scan. Patients are listed on any available vascular access list and operating surgeons tend to follow the original plan.

In Edinburgh the surgeon or VAN plans the procedure. There are defined parameters for doing this, and patients who fall beyond these will be listed for an 'exploration and proceed' procedure which is said to ultimately lead to AVF creation in the vast majority of cases.

In Glasgow most procedures are planned in the MDT meeting following vein mapping, although straightforward cases can be directly listed by VAN. It is felt that more patients could be listed directly at the point of referral. In the absence of a clinically apparent vessel to use most surgeons will explore the patient's arm under general anaesthetic and usually be able to create a usable AVF.

In Lanarkshire one surgeon plans the procedure in clinic but does not perform access surgery. A separate surgeon who performs access surgery does not attend the clinic for clinical review or planning.

In Inverness all patients are discussed through the MDT each week. They are listed by VAN according to which surgeon has most capacity.

HOW IS EMERGENCY NEW ACCESS ARRANGED?

In Aberdeen the VAC is the point of contact for any urgent new access. They can book the patient into an access clinic at short notice, or discuss with a surgeon or radiologist and directly list them for a procedure if this seems appropriate. This can be a face-to-face or telephone discussion, rather than simply submitting an electronic request and waiting for a response. IR and surgery buy into this process and will accommodate patients at short notice if this will avoid a CVC. When patients present late a CVC is used initially but both NTCVCs and TCVCs are positioned as 'temporary' CVCs whose function is to act as a bridge to having an AVF or AVG available for use. They try to create an AVF during the same admission if this is feasible.

In Crosshouse the VAN is not directly involved with patients who are admitted to the renal ward. Referral for inpatient TCVCs and for AV access are made separately. The VAN officially has no involvement with inpatient TCVC organisation but does usually become involved. Referrals to surgeons are usually made by phone or in person, while radiology referrals are normally made electronically. There is no on-site IR which can lead to logistical challenges, and it is effectively not possible to have TCVC insertion without a notice period.

> *"I suppose if it is required that day, in all honesty, they will probably end up getting temporary lines, sadly,… and then they will come at a later date for a permanent. Obviously we will try to avoid that but the logistics of getting people across from Crosshouse to Ayr is such that we can't really meet that requirement. And there are a number of temporary lines going in, sadly, for that reason."*

In Dumfries patients who need HD unexpectedly in normal hours can have a TCVC as their incident access if theatre space is available for a nephrologist to place one. In other cases an NTCVC is placed for incident access. While there isn't a formal forum for discussing these patients with the vascular surgeons, the close proximity of their working environments and the strong team cohesion means the surgeons quickly hear about the patient. The process then proceeds as per elective access creation.

In Dundee patients who present late are educated as inpatients with an aim to have a modality choice during the admission. It would be unusual to have AV access surgery during the same admission, partly due to theatre space constraints but also to give the patient time to adjust to their diagnosis and the need for RRT. NTCVC is the usual first access modality for this patient cohort, and these are typically converted to TCVC within one week in the nephrology-led TCVC

list. A vascular lab duplex scan is performed early in the admission to enable preservation of the appropriate vessels from an early stage. IR are not involved directly in emergency access (since nephrology insert TCVC) but schedule activities to support AVF use over TCVC wherever possible.

In Edinburgh it is usual for patients to be referred for AVF creation early in their admission. Occasionally the initial referral has to be delayed until the patient is clinically optimised for vascular imaging. When TCVCs are required IR liaise with VAN to optimise the CVC position for a future AVF. During the initial hospital admission it is normal to perform a duplex scan but unusual to have access creation surgery.

In Glasgow patients usually start with NTCVC. Patients are referred to VAN to arrange a TCVC and more definitive access. There is a weekly, nurse-led TCVC insertion list but most patients fall outside the clinical criteria for this service. Patients may remain in hospital for several weeks awaiting IR-led TCVC placement. Electronic referrals are made to radiology, usually followed by a face-to-face discussion by either VAN or a nephrologist with the radiology team. It is unusual for a duplex scan to be performed during the initial admission. In January 2014 it became possible to have an early cannulation AVG placed as an alternative to a TCVC or AVF in some cases. Occasionally access surgery can be performed during the index admission, although typically this reflects that a theatre slot has become available with insufficient notice to enable it to be offered to another patient on the waiting list.

In Fife most late presenting patients start with NTCVC or TCVC depending on the timing of their presentation. IR-led TCVC can be placed at relatively short notice. There is no VA coordinator but the vascular lab and vascular surgeons can usually facilitate a duplex scan and sometimes access surgery during the admission.

In Lanarkshire late presenting patients have NTCVC as their initial access. They are verbally referred to the VAN to arrange a TCVC and more definitive access. A fortnightly, nephrology-led TCVC list has two slots and is usually oversubscribed with patients. Many patients wait to go offsite for an IR-led TCVC, which can incur a significant delay. An electronic referral is made for this, followed by emails to each radiologist alerting them to the waiting patient. The nephrologists prefer to give patients time to think about modality so it is unusual to have duplex scanning or a date for AVF creation at the point of discharge.

In Inverness late presenting patients usually have a NTCVC placed initially. They are verbally referred to the VAN to organise an IR-led TCVC; this usually occurs within a few days and occasionally can be achieved as the incident access. Any patient receiving a TCVC is automatically added to the MDT list for discussed at every subsequent MDT meeting until they have AV access. An AV access plan will be made for all patients and put on hold if they are thought to be recovering function. It is possible to perform a duplex scan and create an AVF within 1 week of referral.

Recommendation 19 - USS duplex vein mapping scan should be available for all patients within two weeks of referral.

Recommendation 20 - All patients who present late with likely advanced chronic kidney disease and require renal replacement therapy should have an initial personal access strategy determined within one week of referral to nephrology. This strategy should be activated once recovery of sufficient native renal function appears to be unlikely.

Recommendation 21 – Patients who require emergency vascular access provision in the setting of established renal failure should be routinely audited in the setting of a vascular access morbidity and mortality meeting.

ARE PROTECTED SURGERY AND RADIOLOGY SLOTS AVAILABLE FOR VASCULAR ACCESS CREATION AND MAINTENANCE?

Across Scotland there is variable formal and informal protection of slots for vascular access procedures. Formal protection effectively means that slots must be made available for access work regardless of other service pressures. With informal protection slots are typically available when patients require them, but are vulnerable to being lost. When slots are not formally protected activity is typically displaced by other clinical activity (both clinically urgent, and non-urgent but where subject to treatment time guarantee e.g. varicose vein surgery). Patients can wait inappropriately and, ultimately, services become dependent upon favour and goodwill.

It is typical for units to have a small number of protected surgery slots and for other cases to be slotted into other lists wherever space becomes available. Advanced warning of slot availability is variable, ranging from a few days to several weeks. This modifies the potential to use the slot for patients who have complex logistical requirements. Where theatre scheduling is most unprotected and subject to shortest notice, with no protection of slots for AV access work, it is often the most dependent or vulnerable of patients who disproportionately suffer. Whilst some smaller renal services report historical VA lists which were under-utilised, most have sufficient clinical activity to justify slot protection to some degree.

It is uncommon for IR slots to be protected for vascular access work although this can occur in units with a regular MDT meeting where slot protection enables direct booking of procedures at the MDT. Where IR and nephrology are not co-located it is unusual for any priority to be afforded to VA procedures. Some units have protected nephrology-led TCVC lists. This is perceived to enhance IR availability for AVF-related procedures. Some units without protected IR slots do protect generic 'emergency slots' each week to accommodate emergent cases as they arise; while these are not exclusively available for vascular access cases they do provide a buffer.

Recommendation 22 **– All renal services should have access to protected slots for IR and surgical vascular access procedures related to their expected workload (see Table 3).**

Recommendation 23 **– Slots for elective vascular access creation procedures should be available to book with at least four weeks' notice.**

Recommendation 24 **– Slots for emergency vascular access creation and maintenance procedures should be available with 48 hours' notice.**

DO TREATMENT TIME GUARANTEES IMPACT UPON THE CREATION AND MAINTENANCE OF VASCULAR ACCESS?

Across Scotland the treatment time guarantee (TTG) states patients should not wait longer than 12 weeks for treatment after a decision has been made to treat. This only applied to those awaiting surgery for AVF/AVG creation surgery and not maintenance surgery or any IR procedure. There is an overarching target that states that patients should not wait more than 18 weeks from referral to treatment (e.g. date the initial referral is received to the surgery taking place).

Most centres view the TTG as a safety net rather than a mechanism for ensuring access surgery takes place with the major influence being in displacing potential access surgery with patients with other elective procedures planned as they approach their TTG breach date. It is reported that TTG patients are treated preferentially over access surgery in view of the scrutiny of TTG in contrast with the lack of oversight of vascular access. In many centres it is common to add AVF procedures to the end of standard theatre list to work around this rather than viewing them as a standard listed procedure.

Recommendation 25 – **Vascular access procedures should be categorised as 'urgent' or 'emergency' and should not be subject to displacement by other cases for non-clinical reasons**

Recommendation 26 – **Any vascular access procedure that is cancelled for non-clinical reasons should be routinely audited and reviewed at a vascular access morbidity and mortality meeting.**

HOW ARE ACCESS PROCEDURES SCHEDULED? IS IT POSSIBLE TO RESCHEDULE EXISTING PROCEDURES?

The ability to schedule and rescheduling access procedures is a key component of success in any unit. There are a number of prerequisites if this is to be optimised:

- Knowledge of the clinical priority required for a specific patient's procedure;
- Overview of the patient cohort and awareness of which patients are waiting;
- Prior decision making as to the specific procedure required for a given patient;
- Basic knowledge of the clinical and logistical requirements for each procedure;
- Availability of slots allocated for vascular access work;
- Administrative access and authority to directly allocate slots to named patients.

The challenges within each unit vary according to their population size and geography, clinical capacity and the relative engagement of each department with the vascular access team. As mentioned earlier the key determinants of success appears to be the availability of slots that are pre-allocated for vascular access work, and knowledge of the patient cohort to enable optimal allocation of spaces. When there are no protected slots patients then become reliant upon clinician goodwill in order to have access created or maintained.

> *"The problem is it's not a priority because what's happening is these patients get their AVFs, and a lot of it is through my colleagues' good will, you know, yeah we will do it, stick it on the end of the list… and in fact the priority is this 3 month target that's come up, and that's actually swung things to the detriment of the renal patients" (Surgeon)*

Many booking processes are unnecessarily complicated by the involvement of multiple administrative staff (particularly those who work on a part-time basis but whose role is not filled on a whole-time equivalent basis), computer systems and a lack of protection for vascular access-related activity. Such convoluted booking processes create a barrier to successful vascular access creation and maintenance.

Scheduling appears most successful in units where the VAC has the knowledge and ability to schedule and reschedule lists for theatre and IR. This relies on the VAC having appropriate administrative privileges, slot availability, and credibility with clinicians to permit their lists to be managed. Many centres use the MDT meeting as a forum for vetting and authorising procedures and this is seen to reduce administration. Whenever the booking process involves the VAC contacting an administrator by email and awaiting a response this introduces delay and difficulties tracking patients' progress.

In units with a high proportion of TCVC usage the VAC tends to spend a large proportion of time contending with logistical arrangements. This tends to disproportionately distract from AV access activity. In units with a high proportion of AVF use a large proportion of access-related decision making appears to occur within the MDT meeting (or equivalent) and this enables rapid allocation

of slots to patients. Centres who view all access surgery as emergency rather than elective procedures tend to have more capacity to create and maintain AVFs and AVGs.

In Aberdeen scheduling problems mostly arise when their VAC or more experienced surgeons or radiologists are on leave.

> *"So if one of the experienced ones are off it is problematic to get them in and the person who organises it all is away for 3 weeks and then it's trying to get them, you know, it is the organisational aspects that can be difficult in getting messages to somebody who, you know there is nobody sort of taking that over then it can be difficult." (Nephrologist)*

The nephrology team schedules and manages virtually everything beyond the technical procedure itself, and takes the view that this optimises the number of procedures their surgeons and radiologists can perform. A high degree of mutual trust is evident and their vascular access coordinator can directly place (and replace) patients into allocated theatre slots. A 'running order' of patients awaiting access procedures is maintained to facilitate this.

> *"So I think having one person in charge of that is the key and I think also having flexibility so that I trust that [coordinator] will arrange for my patient to get an AVF just as much as any of my other renal colleagues so we have all… she talks to us all about it 'can I cancel this one and do this one', and things so it is done on a clinical need for the population." (Nephrologist)*

TCVC scheduling is more challenging as there is no ability to directly list patients, however there are usually 'emergency' slots available towards the end of each week to prevent patients waiting beyond that week for TCVC or other urgent procedures.

In Crosshouse renal access is considered by IR to have the same priority as any other request. Appointment scheduling is outside the practical influence of the vascular access team, and patients receive a letter from IR to attend the offsite hospital once appointed.

> *"We do everything within a day, like you know the VAN gets details on the same day, the access form is done on the same day and we fill in the request on RIS-web on the same day, but then it stops there until you hear from the interventional team so that depends on how free they are and how busy they are." (Nephrologist)*

There is no routine MDT forum for discussion of cases with IR. VAN and nephrology often have to prioritise patients for procedures. The logistics of coordinating dialysis, transport to Ayr Hospital, prophylactic antibiotics and so on uses a substantial proportion of VAN time. Surgery scheduling is more straightforward from a VAN perspective, and VAN can reschedule lists in accordance with patient priority. There is limited capacity since just one surgeon performs vascular access procedures, but he engages fully with the service and is flexible to accommodate patients wherever possible.

Scheduling cases in Dumfries tends to be straightforward as they usually have capacity to list cases at short notice, and there is willingness on the part of the sonographer and surgeons to do so. It's usual for a duplex to be done within a day or so, and for theatre to be dealt with as an emergency list procedure or scheduled electively within 1 month. Occasionally radiology theatre space can be limited but this is not seen as an overwhelming challenge.

> *"We get a reasonably good service from the radiology department wherein can find a slot within 48 hours or so. Occasionally it might take three to four days. It is usually because of multiple things like us not being free when they are free and vice versa. But usually it's ok." (Nephrologist)*

In Dundee patients are scheduled for IR and surgery directly from the MDT and VA clinic respectively. Radiologists allocate named patients to specific slots during the MDT meeting, intending that all discussed patients will then have a procedure outcome to be discussed three weeks later at the next MDT meeting. Slots are informally protected in advance for renal access patients.

> *"You talk about job planning time; there isn't any, but that makes it more efficient for me because I can then you know put two AVFs into three lists for every three weeks, depending what… who is around, so you just get swallowed up by the rest of the work. There's no official time." (Radiologist)*

At the VA clinic patients are added to a surgical waiting list; slots are allocated when they become available from a waiting list office at a later date, to whichever theatre list has the most capacity. VA procedures do not have 'emergency' priority and other clinical activity can displace access surgery. It can be challenging to prioritise the waiting list at the point of slots becoming available although the VAN can reschedule lists on a like-for-like basis.

> *"We feel or I feel it's the renal physicians that need to advise us of the running order of how we should and when we should do operations. It is very difficult to translate that, oh it's easy in someone with a line needing an AVF, but sometimes it can be a little bit more tricky… we just are unaware of what priorities and pressures are. We just see the patients, make an approximation of what we think is the priority for that patient, there is no fine tuning." (Surgeon)*

There is not a system for specifying which patient should take the next slot in the event of new spaces becoming available.

> *"One of our patients had an AVF planned for Tuesday and he got called for a transplant on Sunday night. So then on Monday when I came in, I was scrambling about in my low clearance… who, because we have to swap like for like so if the surgeon was going to do an RC I can only put an RC in that space because that's all he's got space to do." (Vascular Access Coordinator)*

In Edinburgh there are emergency IR slots to accommodate urgent scheduling, and they liaise with VAN to determine individual patients' clinical priority. IR procedures that are determined at an MDT meeting tend to be formally requested by the appropriate consultant nephrologist rather than being allocated within the MDT meeting. Surgery slots are typically available at least one month in advance; VAN allocates slots to named patients but would prefer more active, real-time scheduling.

> *"We get dates every month from the waiting list, obviously we know what slots we've got for that particular month for patients and then what I would do is then allocate the patients to the theatre lists." (Vascular Access Coordinator)*

> *"It's very fragmented because there is a waiting list office and they will say 'We can give you so many slots', and it's out of, I mean it's out of my control, I don't know what I am going to do….you know, I'm at the mercy of the waiting list coordinator. And so vascular access will say well we have only been given, you know, two or three slots…..this is what we… can you add another patient in? So then they come up to myself or any of my colleagues to just add it on to that and then they will email the waiting list office to say 'right I've added more AVFs'. It's not ideal." (Surgeon)*

In Glasgow patients are directly added to the surgery waiting list from the MDT meeting. Slot availability can be haphazard. Slots are often allocated to inpatients because the short notice precludes allocation to an outpatient list, or inpatients are seen to have a more urgent need or because there are no beds.

> *"I have space next week, then we will phone to let [Vascular Access Coordinator] know, the Access Sister, and say I have space for two or three AVFs… [my secretary] will contact the Access Sister who will then come up with some names and/or people on the ward who are actually inpatients." (Surgeon)*

> *"They would slot them in to spaces first of all because they're patients who are in for access issues and problems, so I think they would probably go to the wards first and find out who was in." (Nurse)*

Access surgery isn't routinely given an 'urgent' prioritisation.

> *"We've had a lot of discussion recently about how they… we've never cancelled a transplant. Never cancelled a live donor transplant. We've cancelled many, many AVFs and people need to be thinking that, under many circumstances, an AVF is as lifesaving, or an AVG, is as lifesaving as live donor transplant." (Nephrologist)*

Some nephrologists informally refer directly to surgeons to schedule urgent cases to circumvent what would otherwise be a long waiting time.

> *"So that depends which route you want to use… so either you fill in the screen in the same way that I usually do and set them off into dialysis in whatever unit they're doing and then wait, wait, and wait or… or you go and [find] a surgeon! And say come down this person's got reasonably good veins. Do you think you can fit them in sometime!" (Nephrologist)*

Surgeons appreciate the rationale for this but find it frustrating.

> *"There's a handful get referred informally, particularly people who are currently inpatients… someone will speak to us and you can fit them in somewhere. And that creates a problem in that we don't….there's no-one tracking that and there's no overarching prioritisation… that's a particular problem area." (Surgeon)*

PD catheters are considered easier to schedule as they tend to occupy emergency theatre space. There are no protected IR slots and the weekly duplex scan list is frequently cancelled. Routine appointments are communicated by the radiology office to VAN, who contacts RDU, who coordinates logistics with their patient. VAN is unable to directly list patients, and it is technically not possible for her to request interventional procedures using the electronic test requesting system. Patients can be added to an 'acute waiting list' whiteboard within the radiology department, often remain in hospital for prolonged periods awaiting acute procedures.

In Fife the MDT is the vehicle for prioritising and scheduling AVF surgery and PD catheter insertion. IR requests are made on an ad hoc basis and it is possible for a patient who has a problem identified by a sonographer to be directly taken to the IR suite without nephrology involvement.

In Lanarkshire patients are added to a surgical waiting list from the surgery clinic. Slots tend to become available with relatively short notice although VAN can prioritise which patient is given a

particular slot. Prioritisation tends to rely upon memory and depends upon VAN being available. IR slot availability is more variable with limited scope for VAN to negotiate for a specific slot. Surgical and radiological procedures can be scheduled on more than one site. It can be difficult to account for each patient's logistical requirements.

> *"I'd go back into my head and jiggle about…. obviously I've got people sitting on the waiting list…..so I'd look at that and try and see…. I get this 5 minute session with them at the access clinic… sometimes I have got to sort of chase other people up to say, is this patient…..are they infirm, are they alright, are they elderly…" (Vascular Access Coordinator)*

In Inverness routine surgery and IR scheduling takes place in the MDT, although the allocation of specific slots involves VAN liaising with secretarial staff after the meeting. A list of all 'active' patients forms the agenda for each weekly MDT and provides a strategic overview of clinical activity. Urgent activity is scheduled outside the MDT if necessary.

> *"Our sonographers, if they notice that there's a critical stenosis or there may be thrombus within the AVF or what have you, they will just bring the card directly to one of the interventionalists." (Radiologist)*

Routine follow-up is scheduled at the point of any interventional procedure taking place. VA surgery is given 'urgent' priority.

> *"They do get priority, they certainly get priority over, well the venous work, some of the ischaemic legs, so…. it usually works out okay. We're usually able to fit them in at very, very short notice." (Surgeon)*

Recommendation 27 **- Vascular Access Coordinators should have the clinical authority, the technical knowledge and the administrative capability to directly allocate specific surgery or interventional radiology slots to named patients for the creation or maintenance of vascular access in keeping with the clinical confidence of the clinicians on the team.**

Recommendation 28 **- Vascular Access Coordinators should be enabled to re-order existing vascular access surgery and radiology procedure lists.**

Recommendation 29 **– Where administrative staff are required to book procedures, they should be available during normal working hours to liaise with VAC, and their role should be prospectively covered in the event of planned or unplanned absences.**

Recommendation 30 **– Renal units should maintain a 'priority list' of patients that identifies which patient is next in line to have a procedure performed, in the event of an additional slot becoming available. This should be easily accessible to all relevant members of the broader clinical team.**

Recommendation 31 **– Administrative delays should be routinely audited and discussed at the vascular access morbidity and mortality meeting.**

Recommendation 32 **– Referrals made that do not involve the referral pathway for vascular access should be considered 'adverse events' and specifically discussed at a vascular access morbidity and mortality meeting.**

HOW DOES BED BOOKING INFLUENCE ACCESS PROVISION?

Bed booking is generally seen as a challenge, both in terms of the variable ability to 'reserve' a bed (and to have that reservation honoured) and the frequent tendency to have patients boarded outwith their specialty. This is universally perceived as being beyond the control of the clinical team. It seems more problematic to book a bed that is normally utilised for unscheduled care (for example on a general renal ward) and it tends to work best in elective surgery beds (day surgery units, 23 hour beds) or where a 'buffer bed' is being used (for example a day-case area that is not officially designated for this purpose). It's common to use non-overnight beds as a reservoir of beds to fall back on to prevent cancellations or to accommodate short-stay patients. The ability to efficiently book beds facilitates efficient scheduling of procedures and provides assurance to surgeons and radiologists that makes it easy for them to agree to take on a case.

There is variation in the degree of difficulty that is found between units, ranging from 'an inconvenience' in some to others where it represents a significant barrier to access creation and can modify clinical activity.

The key problem revolves around the challenge of managing a postoperative patient with complex medical needs but who does not require admission to a critical care facility. This is particularly the case in units in which nephrology is not co-located with vascular surgery: patients are either on a surgical ward and do not benefit from perioperative involvement of a nephrologist, which can be crucial if the patient is already treated with RRT or has particularly complex renal disease, or patients are on non-co-located renal wards and do not have immediate access to a vascular surgeon in the event of a complication.

Aberdeen use short-stay medicine beds to admit AVF patients, and were previously the only medical specialty to admit directly to short-stay surgery beds. If the procedure is more complex they attempt to keep the patient on the renal ward wherever possible.

> *"What the VAC has always tried to do since long before I was here is just say to the surgeons, 'We will organise everything if you can just assess what you thing the best option is and do it', and tell us when you can do it, we will sort of get them clerked in and do their bloods and that kind of thing." (Nephrologist)*

They consider AVFs to be semi-elective or emergency procedures and this enables them to be more creative with beds during times of pressure.

> *"We have always said that vascular access isn't elective, we are doing it because we think it is required at that time. So they are occasionally vulnerable but I think it is usually because the guys are fixing an aneurysm or something not because… and so they are busy doing something lifesaving rather than doing an AVF. It is not usually because we don't have a bed." (Nephrologist)*

Geography may be a factor as patients from Shetland and Orkney will arrive the evening before surgery, stay overnight post-procedure and return home thereafter, where they would otherwise have been a day-surgery case had they lived on mainland.

In Crosshouse there are significant problems caused by the lack of co-location of nephrology and vascular surgery. This brings concern as to the optimal perioperative management of patients when there is no surgeon on site. It seems easier to find a bed to facilitate TCVC insertion, since the vascular access coordinator deals with every aspect of that process.

Dumfries use day surgery beds which means they are predictable and controllable. It's normal to either go home or alternatively to a 23-hour unit. It is unusual for patients to have a general anaesthetic procedure and if the patient requires admission the renal unit is geographically very close to the vascular surgery ward.

Dundee try to use day surgery as a default for AVF surgery; patients who require an inpatient stay typically are admitted to the renal unit.

"Renal wards, we always prefer it, it's safer for the patient." (Surgeon)

Edinburgh also use day surgery for routine elective cases whilst trying to place complex cases into the renal ward; boarding occasionally occurs however the senior charge nurses on the renal wards work hard to avoid this and usually find a solution. The team tries to prevent unnecessary hospital admissions, for example patients whose access had failed would usually have a TCVC placed on the same day to prevent admission.

In Glasgow some procedures are carried out as day cases in ambulatory care centres. When patients require hospital admission they typically go to the renal surgical unit overnight. For day procedures the renal day area provides a useful reservoir of beds in which patients can be observed between 07h00 and 19h00. The primary challenge with bed availability often revolves around a large number of patients who require to remain in hospital while awaiting a vascular access procedure (typically TCVC insertion), rather than being unable to book beds for patients who require admission.

Similarly, Monklands often uses the PD area as a fallback day bed area to accommodate patients requiring observation after a procedure. When patients are admitted overnight they usually go to a general surgery (not vascular surgery) bed as this is more amenable to booking than a renal unit bed. The day surgery theatre is often used for Monklands AVF operations, even when patients are due to stay overnight; this causes significant confusion and has led to cases being cancelled where anaesthetists consider them inappropriate for day surgery, or when patients did not understand the need for hospital admission. Their major challenge however relates to IR procedures, since these are mostly performed offsite with no agreement as to where patients should be accommodated peri-procedure. As a result of this patients are effectively unable to undergo IR procedures unless they can immediately return to the renal unit in Monklands. This is very challenging for acutely unwell patients, as there is no dedicated inter-hospital transport service and nowhere to accommodate patients in the IR site.

In Inverness most patients are admitted to a 23-hour bed for AVF procedures. Those requiring more complex procedures are admitted to the vascular ward and are seen during the admission by the renal team. The surgical secretary books the bed. If no beds are available the patient may be admitted as a medical emergency. Transport home can become a problem and the VAN often has to assist with this, for example booking taxis. This influences the timing of procedures, meaning that distant patients won't be scheduled for late in the day. Distant geography is seen to increase the likelihood of an overnight stay. Patients who are already maintained on HD are typically admitted after a dialysis session the evening before surgery, to go home the following evening.

Recommendation 33 **– Renal services should have access to 'Day surgery' beds for elective/semi-elective arteriovenous access work.**

Recommendation 34 **– Renal inpatient services should have co-located vascular surgical and interventional radiology services available for patients undergoing complex access work or who require an overnight stay.**

MAINTENANCE OF VASCULAR ACCESS

WHAT IS THE PURPOSE OF THE MULTIDISCIPLINARY TEAM MEETING?

The role, composition and function of the MDT meeting varies between centres. Generally the role of the MDT is to optimise incident and prevalent vascular access, and to optimise the primary and secondary patency of access. In practical terms the meetings are used for:

- Discussion of patients requiring access creation surgery;
- Discussion of patients with problematic access;
- Review of patients who have undergone interventional procedures;
- Prioritisation and allocation of radiology and surgery slots to patients.

Although across Scotland the team composition includes nephrology, vascular surgery, IR, VACs, sonographers and administrative support, the extent to which each group engages with the meeting and the wider clinical access issues varies between centres. In some a surgeon and VAC discuss patients without regular input from nephrology, IR or others. Elsewhere there is a weekly meeting attended by several representatives of each clinical group.

Surgeons and radiologists seemed more likely to value MDT meetings than nephrologists; however nephrology involvement is regarded by surgeons and IR as a key factor in the meeting's success. Surgeons and radiologists are perhaps more familiar with MDT processes in other aspects of their clinical roles where meetings help them plan procedures in conjunction with colleagues. Nephrologists tended to view their role as being more passive participants, with limited insight into the value with which surgeons and radiologists hold their opinions.

While an MDT is traditionally regarded as a physical meeting that is timetabled and held in a specific meeting place, this is not always the case. In some centres there is an infrequent meeting that is poorly attended, and which does not reliably fulfil any of the above roles. In other centres there is no regular, formal meeting but in spite of this the MDT function is effective and team members cooperate and communicate about shared patients with vascular access problems. The MDT is seen to partly depend upon individual clinicians' personalities, but more importantly upon strong clinical buy-in from each group and the ability to develop a collegial atmosphere in which to work with a clinically challenging patient group. The co-location of nephrology, vascular surgery and radiology, along with the provision of protected job-planned time to attend meetings and manage the associated clinical issues, influences individual clinicians' ability to engage with the MDT.

The importance of a vascular access MDT meeting appears to be as much about the interpersonal relationships that it facilitates as with the clinical discussions that take place. In some units the mutual trust that has established as a function of the MDT has enabled the development of efficient clinical processes, for example the direct listing of patients for theatre at clinic by the VAN without the direct involvement of a surgeon. Some centres clearly regard the MDT as the cornerstone of their vascular access strategy, and credit it with better clinical outcomes for patients and substantial reductions in unscheduled care. In centres without a functioning MDT it was common for clinicians to be unfamiliar with the names of their colleagues who worked in other parts of the service; in some instances they reported having never met one another in person.

Important prerequisites for a successful MDT meeting appear to be as follows:

- Availability of a comprehensive patient list for discussion;
- Reliable presence of all stakeholders groups;
- Administrative support to record and disseminate decisions and to book procedures;
- Available slots to be allocated to named patients who require radiological or surgical procedures.

In Aberdeen the MDT was previously viewed as a useful forum for discussing problem cases, however meetings have become increasingly infrequent and it is now more common for surgeons to interface with radiology during a general vascular surgery MDT meeting. The surgeons feel it enables closer multidisciplinary working than would otherwise be possible.

> *"it's most useful because it allows the interventional radiologists to be engaged with a case and take on something that they might not have been very keen to do or they may have just not done what was wanted"*

IR suggest it helps them feel more involved in the overall care of the patient rather than acting as a technician.

> *"But I think the structure was better, the overall management picture was better when we had the MDT because everyone was involved and even a simple fistulogram that was done was discussed and there was an MDT approach but now we tend to treat when there is a problem we will fix it….kind of a thing so it's…..there was a structure previously and that was good and I think it would be useful if we could go back to that." (Radiologist)*

Crosshouse has a monthly MDT meeting that is almost never attended by consultant nephrologists or interventional radiologists. One staff grade nephrologist does try to attend but other timetabled clinical commitments can hamper attendance. Functionally the MDT is mostly an informal discussion between the surgeon and VAN in the RDU, where the surgeon attends on at least a weekly basis. Interface between surgeons and IR occurs through the general vascular MDT without direct nephrology or VAN involvement.

The Dumfries unit previously tried to establish a formal MDT meeting but found there was insufficient workload to justify a regular meeting. Team members clearly trust one another to assist with vascular access cases and there is willingness to accommodate patients at short notice, whether for a sonographer-led scan, nephrology-led TCVC, or surgeon-led (radiologically-guided or open) procedure.

In Dundee the MDT meeting is held every three weeks and it is rarely cancelled. Despite being scheduled at the end of the working day there is strong clinical buy in and it is well attended by each specialty. The focus is upon problematic prevalent patients; IR intervention is scheduled, with slots allocated to named patients during the meeting. Follow-up vascular lab scans are arranged such that the results will be available for review at the next MDT meeting. IR see great value in a VA specific MDT meeting.

> *"When I used to go to other centres in Scotland, they didn't have specific vascular access MDTs. They didn't have surveillance. I strongly believe that, having seen it here, that it works very well having a specific MDT to only discuss vascular access cases, having surveillance programme with interested sonographers running it and having some protected slots to some extent." (Radiologist)*

In Edinburgh the MDT is seen to provide a forum for discussing clinical challenges and for planning new access when existing access is suboptimal. Decisions from the MDT are circulated to nephrologists after the meeting, who are then responsible for formally requesting the relevant procedure. Surgeons view the MDT as a helpful forum in which recent interventions and new AVFs can be reviewed, but consider the most important aspect to be the bringing together of the team. The MDT meeting is credited with reducing the overall service workload. It is generally well attended but geography and service pressures can create a barrier to attendance.

> *"MDTs have been very good in terms of, you know, not even just about the discussion. The discussion can be quite really boring, because we've actually sorted things out but it actually brings everyone together and we discuss other aspects of problems." (Surgeon)*

In Glasgow the MDT meeting is used to plan new access (in patients who have attended for vein mapping) and to discuss problematic existing access. Attendance is usually limited to a small number of individuals but nephrology, vascular surgery and IR are usually represented along with the VAN. RDU link nurses cannot attend the meeting while working due to a lack of protected time and geographical concerns. The meeting outcome is recorded on the electronic patient record and the VAN liaises with radiology and surgery secretaries to place the patients on a waiting list for the appropriate procedure afterwards. Specific slots cannot be allocated to named patients at the meeting. Most nephrologists do not attend the meeting as they feel the majority of time is spent discussing patients not known to them. Nephrologists have some insight into the meeting's benefits for managing complex access problems but it can also lack credibility, especially where the course of action taken for a particular patient differs from what was initially agreed at the MDT meeting.

Fife has a monthly MDT meeting to discuss elective access creation and to plan intervention for problematic access identified by their surveillance programme.

In Lanarkshire nephrology is not co-located with surgery or IR. MDT meetings are held immediately before the general vascular MDT meeting at lunchtime on a Friday, offsite from the renal unit. The logistics and geography are such that VAN and nephrology almost never manage to attend the meetings, and without VAN in attendance VA patients are not discussed. Cases for discussion are brought to the meeting on an ad hoc basis. It is not routine to discuss patients who have recently required intervention or whose access is otherwise problematic.

Inverness holds a weekly MDT that is coordinated and chaired by the VAN, who books agreed tests, prioritises theatre lists, tracks outcomes and schedules further discussion of patients at the next meeting. There is an 'active patient list' including all patients with TCVC in-situ and those with any active access creation or maintenance issues. This forms the agenda for each meeting and also provides an overview of workload, although other strategic service issues are discussed separately in an annual review meeting. Sonographers attend each meeting and maintain an intervention history for each AVF. This is used to plan further intervention to a problematic AVF, or to begin looking for new access if this seems more appropriate. Patients are directly booked for IR or listed for theatre at the meeting or by VAN following the meeting. IR credits the MDT with substantially reducing inappropriate IR requests and reducing delays before treatment. Surgeons first hear about patients during the MDT meeting; this provides a robust referral mechanism for emergency and elective new access, although ad hoc referral can also take place between meetings via the VAN. The surgeons credit the MDT with large reductions in unscheduled care of vascular access. When a queue is starting to build of patients awaiting procedures the VAN raises this at the MDT but there is little other strategic overview at the meeting.

"We still have difficult patients and there are still failures. We've had a few patients who needed a few attempts to get an access going but just sharing that around helps a lot." (Surgeon)

Recommendation 35 **– A vascular access-specific multidisciplinary team meeting should be regularly convened with at least one nephrologist, one surgeon, one interventional radiologist and a vascular access coordinator in attendance. Appropriate secretarial support should be provided and an attendance register should be kept.**

Recommendation 36 **- All clinicians who are responsible for the care of patients receiving HD have job-planned time allocated to attending at least one vascular access MDT meeting per month. In larger centres this time could be allocated between groups of clinicians.**

Recommendation 37 **– The amount of time required for MDT discussion equates to the same number in minutes, per week, as 10-15% of the prevalent HD population size. This reflects the average MDT duration currently seen in the Scottish renal services. It may be appropriate to hold these meetings on a fortnightly or three-weekly basis.**

Recommendation 38 **- Systems should be in place to enable the direct booking of interventional radiology and surgical procedures from the MDT meeting.**

Recommendation 39 **– MDT outcomes should be recorded on the EHR in a format that is accessible and meaningful to the wider clinical team.**

Recommendation 40 **- Discussion of strategic elements of the vascular access service should take place in a regular meeting that is separate to the clinical discussion of individual patients' cases.**

WHAT STEPS ARE TAKEN TO PRESERVE EXISTING AVFS?

There is variable understanding between team members as to the mechanics and practicalities involved in AVF creation and needling, problems than can potentially arise and how they may be addressed. It is considered important that patients and team members, particularly nephrologists and RDU staff, are aware of warning signs of impending AVF problems, and how to deal with them. Significant educational needs are identified for a variety of stakeholders, and this is discussed in detail later in this report.

Most units have formal or informal mechanisms intended to preserve existing AVFs, separate to any surveillance programme (which are considered separately: see "Surveillance" section). The most patient-centred approach involves educated, empowered patients; rapid attempts to correct identified problems and clear anticipation of future problems. It is thought that this may lead to a greater number of IR cases, but less IR involvement overall in view of a reduction in the number of emergency procedures that are necessary. Less surgical intervention is necessary, and crucially the overall patient experience is better.

Aberdeen encourage patients to buttonhole, and facilitate self-cannulation and self-caring dialysis wherever possible. AVFs are graded according to their perceived "cannulation difficulty"; this flags an AVF for investigation, and more experienced staff cannulate the AVF in the meantime. New staff have to work through a series of 'renal competences' before they can cannulate a patient, and a similar competency framework is offered to patients who wish to learn to self-cannulate. AVF problems are typically dealt with on the same day with strong clinical engagement from nephrology, surgery and radiology in this regard. The relatively prompt availability of IR slots means fistuloplasty can usually be carried out on an 'urgent' basis before an AVF thromboses.

In Dumfries a significant element of VAN role lies in RDU staff education; this has resulted in a high standard of AVF cannulation. Patients are educated about their AVF but this is relatively informal. When problems are identified there is usually capacity to rapidly intervene. When patients present with a thrombosed AVF there is limited scope to manage this out-of-hours but it can usually be dealt with on the next working day.

A large proportion of patients in Dundee buttonhole their AVF. A 'higher care' area of RDU enables the concentration of staff expertise for particularly challenging access. The vascular lab provides rapid access to high quality duplex scanning that has largely replaced diagnostic fistulography, meaning there is usually scope within IR to perform interventional fistuloplasty whenever this is needed. The intervention history is used to determine whether an AVF will undergo further intervention or if new access should be created in view of recurrent problems.

In Edinburgh it is common to cannulate new and problematic AVFs under ultrasound guidance. When problems are detected an early fistulogram is planned, and in parallel to this VAN will begin planning ahead to create a new AVF if this becomes necessary. RDU staff can request AVF imaging and intervention via VAN, or a case can be raised at the MDT, without waiting for formal nephrology or surgery opinion.

In Glasgow the major challenge for AVF preservation is the significant lead-time to any IR imaging or intervention. Staff are not confident that identified problems will be fixed before losing the AVF. The long waiting time makes it difficult to properly prioritise patients; those waiting procedures are regular reprioritised based upon whether their case is an 'emergency' or a 'crisis', and 'routine' cases commonly wait until becoming a 'crisis' before intervention.

> *"They put them on a list and then an emergency does come in and radiology will tell us to make a choice that you've got two routines booked in tomorrow or two patients on the waiting list but if you want your AVF that's clotted done, you're going to have to postpone them and reappoint. So then they get bumped and they might get bumped for 2 weeks or 3 weeks so that the emergency can get done. So it can be at the end of that time most of them reappear and they become the emergency and then the patients get bumped so the circle… the vicious circle goes on." (Nurse)*

The AVF intervention history is found difficult to access by some, which prevents forward planning as to whether an AVF should undergo further intervention or be abandoned in the event of thrombosis. There is a perception from some clinicians that peripheral RDU staff are inadequately supported to cannulate AVGs or identify problematic access, although some formal training has been implemented to address this.

In Fife a skilled and engaged IR team, coupled with robust surveillance, are credited with the longevity of several AVFs. There is uncertainty around whether buttonholing or rope ladder cannulation is best for the patient, and buttonhole was reported as unfashionable in the wake of several bacteraemia episodes.

In Lanarkshire the challenges lie around AVF creation; patients cannot usually be accommodated in the renal unit leading to difficulties optimising blood pressure postoperatively. Waiting times for radiology are perceived to be longer than is clinically appropriate for urgent AVF intervention, and such referrals are not given urgent priority as a matter of course. It is logistically difficult to discuss cases with IR, and challenging to obtain a surgical review since vascular surgery is offsite. The vascular surgeon does review patients in the renal unit in the early morning or late afternoon, but this is typically performed as a goodwill gesture in the surgeon's own time.

Inverness aims to use buttonhole cannulation where possible. They educate patients about their AVF, encouraging them to report problems to RDU staff or the VAN. When an AVF becomes problematic they plan ahead for potential new AVF creation while intervening on the existing AVF. New AVFs are routinely reviewed via the MDT meeting; if they are failing to mature they plan a CT angiogram and/or fistuloplasty. Patients who enter recurrent cycles of AVF intervention are flagged as having a failing AVF, and new access is created with the intention of being mature before the existing access fails. Patients with central venous stenosis undergo regular six-monthly angiography and angioplasty without waiting for clinical signs to emerge, to prevent interference with existing or future fistulae.

Recommendation 41 **– RDU nurses should be trained to assess vascular access, identify potential problems, and safely cannulate AVFs and AVGs. Untrained staff should not cannulate AVFs or AVGs without direct supervision.**

Recommendation 42 **– The performance of the specific haemodialysis vascular access in use should be documented at each haemodialysis session.**

Recommendation 43 **– Challenging vascular access should be identified and, where possible, these patients should receive their haemodialysis care in an area of the RDU where there is a sufficient concentration of staff with the appropriate cannulation (and other related) skills.**

Recommendation 44 **– AVF and AVG patency should be routinely audited and discussed at the VA morbidity and mortality meeting.**

Recommendation 45 **– An 'intervention history' should be recorded on the patient's health record for every AVF and AVG.**

Recommendation 46 **– A 'threatened AVF / AVG' should be considered as a medical emergency and managed accordingly.**

HOW DO UNITS UNDERTAKE SURVEILLANCE OF VASCULAR ACCESS?

The term "surveillance" is variably used in different units to describe one or more of the following activities:

- Postoperative follow-up after surgery to create or maintain an AVF or AVG;
- Routine checks by RDU nurses of AVF appearance, palpable thrill or audible bruit, and dialysis indices including urea reduction ratios;
- Transonic measurements with or without routine RDU nurse checks;
- Duplex ultrasound scans with or without any of the above.

Patients being reviewed after AVF creation are a separate cohort from those undergoing surveillance of existing access. The optimal arrangement appears to be a single review within 2-4 weeks of surgery, the purpose of which is to assess whether or not an AVF is maturing as expected. When this is not the case a pre-specified strategy should be pursued.

The timing and degree of formality with which surveillance is undertaken varies significantly between and within centres. There is general agreement that patients with AVGs probably require a higher degree of surveillance activity than those with an AVF. There is significant uncertainty around the frequency of AVG surveillance and the necessary actions when a potential problem is encountered in the absence of a clinically apparent issue.

"And as far as AVGs are concerned, we are sort of still feeling our way because I haven't done very many of them, so we probably would do scans now and again just so that we're, we've got an idea of what's happening." (Surgeon)

There is a perception in some units that AVF surveillance may not provide value for patients that is proportionate to the resource commitment it requires, while others credit robust surveillance programmes with AVF longevity and fewer unscheduled care episodes. Surgeons tended to be most favourable in their views of surveillance, while nephrologists were least certain of its utility. In centres where IR tended to favour more aggressive AVF intervention strategies there seemed to be faster access to fistuloplasty and considerably fewer reports of AVF thrombosis. Optimisation of surveillance and intervention appeared to be where centres maintained an 'AVF history' and referred to this in the planning of any AVF intervention.

It seems important that RDU staff are appropriately trained and supported in the general care of an AVF. Involving patients in AVF care seems straightforward and beneficial to individual patients and the service as a whole. Whatever form of surveillance is used, patients must have rapid access to formal imaging and intervention in the event that a problem is identified with an AVF. Centres with direct VAN access to AVF imaging and subsequent intervention perceived that they had fewer AVF thrombosis episodes.

No centre routinely measures the degree of surveillance activity or clinical outcomes resulting from these activities (see also "Outcomes and M&M" section).

In Aberdeen there is formal AVG surveillance and informal RDU-led observation of AVF. There is some uncertainty around managing AVG problems identified on surveillance in the absence of a clinical issue. AVF surveillance is supported by formal 'renal competences' for patients and for staff. There is a plan to commence routine, RDU nurse-led AVF scanning but this hasn't yet been fully determined. The VAC has overview of a small group of patients who have had recurrent access problems. They are directed towards regular, scheduled central vessel or AVF angioplasty procedures rather than continually attending for screening duplex scans. In the event that this strategy is unsuccessful a pre- defined 'next access' option can be pursued in advance of losing the index AVF.

In Crosshouse and satellite units RDU nurses and VAN perform monthly transonic imaging for all dialysis shifts including night shift. VAN maintains a schedule to prevent patients being missed. Those who require formal duplex imaging are referred to the cardiology department (in lieu of a formal vascular lab); there may be a considerable waiting time for this. Where fistulogram or fistuloplasty is deemed necessary this has to be requested by a nephrologist or surgeon as VAN is unable to directly request IR procedures or allocate slots to patients, and there is no routine forum for discussion of patients with an interventional radiologist.

In Dumfries surveillance is performed by RDU nurses, including regular transonic scans, as part of the general 'named nurse package' for patients receiving HD. When duplex imaging is necessary this can be requested by VAN and patients are usually appointed within one week. There is uncertainty as to the best surveillance strategy for AVGs but they are imaged at least as frequently as AVFs. Pre-dialysis patients who have an AVF do not have any formal surveillance beyond their initial post-operative check.

In Dundee dialysis patients have regular transonic scans, while duplex scans are performed on a scheduled basis in the vascular lab for all patients with an AVF. The vascular lab imaging is performed by a highly skilled operator and has largely replaced the need for diagnostic

fistulography. When a patient requires fistuloplasty a regular follow-up duplex scan is also arranged. It is thought that early identification and management of AVF problems has reduced the volume of AVF creation surgery within the prevalent dialysis patient cohort.

> *"And I get the feeling that our surveillance programme has identified… failing AVFs… early before they've failed and we intervene and maintain AVFs. We seem to have been maintaining a large number of AVFs by repeat angioplasties or stents, and creating less." (Surgeon)*

> *"I think it's probably the identification of what you're supposed to do is the important thing and places that have, you know do maybe lots of thrombectomies are probably not identifying those AVFs that are just about to go down in a satisfactory manner, in my view." (Radiologist)*

The team consider that successful surveillance needs full IR engagement with sufficient capacity to attend to identified clinical problems.

> *"One of the things is because of surveillance, AVFs just turning up thrombosed is not that often for us. Unexpected thrombosis of AVFs, which is what I have seen in other centres where I was training, where they more often than not, the fellow used to do the last fistuloplasty thrombectomy of the day – it doesn't happen here. It's very rare." (Radiologist)*

Close team working is thought to enable effectively working beyond simply providing patients access to the necessary technical procedures.

> *"So I suspect some of…how units work has much more of an impact than what they actually do when they find something." (Radiologist)*

In Edinburgh surveillance tends to focus around monitoring of dialysis indices, and formal imaging is only requested if a clinical problem is detected, albeit there is a drive to increase the routine use of ultrasound guidance to cannulate AVFs repetition and not relevant to surveillance. When problems are identified VAN finds that IR requests are usually accommodated, and there are opportunities to discuss patients at the vascular access clinic or MDT meeting. Post-operative monitoring of new AVFs typically involves two reviews in the first six weeks; there is some appetite for audit and adaptation of this process. The success of their surveillance is attributed to the strong sense of team working rather than just technical elements of the process

> *"If the patient [has] other symptoms then [RDU nurses] tell the VAN…. they bring them to the MDT and I think that communication has been really crucial… when the VAN role started it was almost as if…. this is our domain… and she can't tell us, you know…this is what we should do. But I think there's a lot of mutual respect now between the two." (Surgeon)*

In Glasgow surveillance is mostly informal, RDU nurse-led observation. Staff are not formally trained to assess an AVF or AVG and there are no formal parameters for requesting further action, although patients with potential problems can be referred to the access clinic for VAN-led imaging. When problems are identified patients are discussed at the MDT or referred directly for fistulography or fistuloplasty. There can be a delay of several weeks or months to be appointed to an IR slot. It is felt that most clinically apparent access problems are predictable but when patients present with a thrombosed AVF there is little capacity to correct the problem. There is

some appetite for formalising surveillance and establishing a programme of routine imaging, but not at the expense of the access creation pathway.

> *"Why on earth would you start doing surveillance when you can't even do the very basics when somebody clearly doesn't have an AVF there! It is definitely not working because it's not there!" (Nephrologist)*

In Fife patients have a four-monthly routine AVF scan in the vascular lab, and where problems are encountered there is direct coordination between the sonographer and radiologist. USS-guided AVF cannulation is also possible via the vascular lab. There are no formal parameters or guidance for RDU staff to monitor AVFs, but there is an appetite to introduce these and create a more formal surveillance programme in coordination with IR.

In Lanarkshire VAN measures transonic readings every four months, supported by RDU nurse-led AVF checks at each dialysis session. There is little IR or surgery support in the event that a problem is identified, and this is seen as a barrier to increasing AVF or AVG usage.

> *"There is no point in us creating more AVFs if we are not going to look after them properly and deal with a problem, which we can't." (Nephrologist)*

There is a tendency for every access-related question or clinical concern to be routed through VAN, resulting in an overwhelming workload that distracts from other aspects of the role. VAN conducts post-operative AVF checks three times per week in the first fortnight after surgery, involving significant more contact than in other centres. As with the general surveillance programme there is limited scope for intervention in the event that a problem is encountered.

Inverness perform monthly (in Raigmore) or three monthly (in mainland satellite units) transonic readings, supported by patient education and informal RDU nurse-led assessment. Western Isles patients have no imaging as there is no transonic machine available. If potential AVF problems are identified the patient can be referred directly to the sonographer by VAN. When the sonographer identifies a problem they directly refer to IR, and patients commonly undergo fistuloplasty that day. Patients from Western Isles are flown to Inverness, where they slot into the same pathway. Sonographers maintain an 'AVF intervention history' and this informs discussion at the MDT, where alternative access will be considered for patients with an increasingly problematic AVF. Surgeons consider that the MDT and surveillance programme has led to large reductions in unscheduled access work.

> *"We have reduced this dramatically we think by having our MDT and in particular having our sort of surveillance scan programme and scanning all problematic AVFs so the majority of our workload now is elective which is great" (Surgeon)*

Recommendation 47 **– Renal services should adopt a proactive approach to identifying the failing arteriovenous AVF that involves patients and front-line staff, with early access to investigative imaging and intervention where problems are identified. The associated workload and procedure outcomes should be recorded and discussed at the vascular access morbidity and mortality meeting.**

Recommendation 48 **– RDUs should have a written policy that describes and governs the escalation of potential access problems.**

Recommendation 49 **– Renal units should have a written policy that describes and governs the management of clotted AVF or AVG.**

Recommendation 50 – **All cases of clotted AVF or AVG should be routinely audited and discussed at the VA morbidity and mortality meeting.**

Recommendation 51 – **Patients with a clotted AVF or AVG should have urgent access to a combined surgical / interventional radiology or IR declotting procedure in a timely fashion to avoid the use of a temporary line.**

Recommendation 52 – **Patients who have undergone access creation or maintenance surgery should have a plan documented at the time of surgery to direct further action in the event that the AVF is unsatisfactory at the time of this assessment.**

Recommendation 53 – **Patients who have undergone access creation or maintenance surgery should be assessed at 2-4 weeks postoperatively by a suitably trained clinician.**

HOW DO RENAL UNITS MANAGE 'DIFFICULT ACCESS' AND CLOTTED AVFS/ AVGS?

Patients whose vascular access is considered to be 'difficult' are managed differently between units.

In some centres AVFs are 'graded' according to perceived difficulty in cannulation, or patients with new or problematic access may be cohorted into a 'higher care area' of the RDU. Elsewhere a 'vascular access SBAR' document is available for RDU nurses to document concerns about access, resulting in discussion of the case at next MDT meeting. Each of these mechanisms make it easy to highlight potential problems, and concentrate staff expertise on the patients with the greatest need.

Some centres practise aggressive, early intervention at the first hint of an AVF problem; the most aggressive approaches involve:

- Initial identification of a problem by RDU nursing staff based on the AVF appearance, difficulty in cannulation, or a drop in blood flow, urea reduction ratio or other dialysis indices;
- Duplex scanning on the same day or at least within a week, facilitated by VAN referral to the vascular lab (or equivalent);
- Where duplex imaging suggests a stenosis the sonographer directly liaises with IR and is performed on the same day;
- The next MDT meeting reviews the intervention outcome and begins planning for alternative access in the event of further problems.

"There are a number obviously who [surgeon] is seeing for regular surveillance, there is a number who come through for regular, who just go straight to radiology regularly for fistulograms and plasties you know recurrent stenosis and stuff. There is usually a plan in place when that goes pear shaped." (Nephrologist)

"Once people are starting to get into that cycle of regular fistuloplasties, and I think once you're going to less than a month then I think that AVF is failing in which case you going to start looking for some other form of access." (Radiologist)

It seems important that all clinicians involved in access recognise and react to the urgency of potential problems with an AVF. A variable approach is sometimes reported, with active management approaches more likely from clinicians who are routinely involved in the vascular access service.

"A lot of the challenge is in the out-of-hours work in ensuring that the cases are appropriately assessed and the correct decisions are made and people, you know bear in mind just the long term and not just the short term fix." (Surgeon)

"Some nights you know people would be right in there and there are other nights they wouldn't… there is a degree of operator dependency." (Nephrologist)

Other centres have a more passive approach to access problems, with challenging access being 'nursed along' until the AVF thromboses or in the case of a CVC, the lumens are entirely blocked. This usually then precipitates an emergency admission and potentially the loss of the existing access modality altogether. This seemed more common in centres with limited access to duplex scanning and IR, where there was less of a sense of integrated MDT working, and in centres without a routine active surveillance programme.

"And the rest of them would be referred on for another day or passed over or sometimes it's deemed that it's not as urgent and you know if they can dialyse through a single needle or something and then they'll just be appointed into a routine appointment." (Nurse)

It was not clear whether the presence of a surveillance programme reduced the overall incidence of AVF problems, or if the programme simply provided a clearer pathway for managing problems when they arose. Support for RDU nursing staff seems important to maintain a large prevalent cohort of patients with an AVF or an AVG. Where RDU staff feel unsupported it can be common for seemingly trivial problems to be escalated to VAN, which has the effect of reducing the available VAN time to coordinate the other aspects of the access service.

The approach to managing clotted AVFs also varies between centres. While most centres aspire to providing a combined surgical / IR procedure, this is not yet possible on a routine basis in many units. Challenges to providing this service include the availability of interventional theatre space, proximity of the renal unit (and the patient) to interventional facilities, and clinical buy-in from the surgeons and radiologists who provide out-of-hours cover.

"We don't always have adequate cover out-of-hours in IR and it causes a huge logistic problem in terms of the staff cause we need staff from theatre so when you do that it stops the emergency list and you need the interventional staff, including the nurses who also cross-cover cardiology, their interventional suite, so you have got three different lots, four different lots of on call people all trying to get into the same place at the same time and not being somewhere else or having some other…" (Surgeon)

"When an AVF is thrombosed any other centre would try to fix it within 48 hours, ours takes about a week until you even figure out what to do." (Nephrologist)

The benefits of a combined approach seem most apparent to surgeons and radiologists working in centres where this is normal practice. These centres typically adopt aggressive, early interventional strategies for problematic fistulae, maintain an 'AVF history', and tend to have fewer overall need to perform declotting procedures. The benefits of combined procedures were least likely to be discussed by nephrologists in centres with more passive surveillance programmes and where combined declotting procedures were not routinely available.

"We don't end up doing that many salvage thrombectomies because most of the AVFs we do… we are seeing a trend of them coming more and more frequently for angioplasty and

we have decided that, you know, look if this goes down, it is time to create another AVF than trying to do a 7 hour procedure trying to clear which could go down again in 24 hours." (Radiologist)

"I see places that, again I think we've moved on from that, who do a lot of AVF thrombectomy and they present reams and reams of publications on AVF thrombectomies and actually… there's something going wrong there because you shouldn't have many, really, you know." (Radiologist)

In centres without aggressive correction or rapid access to IR it can be common for potential problems to evolve into clinical emergencies before action is taken. This typically results in patients requiring an NTCVC and/or TCVC for the short or medium term while new access is then created. Without allocated slots for such patients, and with very limited overall IR capacity, staff report that interventional procedures for problematic access are conducted "as a favour" rather than as a core clinical activity.

"Still ticking along and you know, it's not failed yet. They will not have the priority for someone who's access has fallen out, the AVF's collapsed and it's not working and it needs to go back to theatre, you know" (Nurse)

"If somebody needed something done urgently we would certainly make a real play for it. What they'll often do is they might not be able to give us a day right away, but they put a name on the board and if they get a cancellation… We just phone them every day look really this patient really needs done, is there any chance, and eventually I think they just cave in and say let's just do it… Sometimes it feels like they're doing you a favour, but you probably have to see the pressure on them." (Nurse)

SERVICE PERFORMANCE & DEVELOPMENT NEEDS

HOW DO UNITS KEEP TRACK OF THEIR ACCESS-RELATED ACTIVITY?

A number of logistical and technical steps are necessary to create and maintain a patient's vascular access, in the broader context of what is often a complex, multi morbid illness. Most interviewees recognised the challenges in monitoring individual patients' progress within the vascular access system and a number of strategies were described for doing so. Many clinicians assume this to be the major focus of the VAC role; in reality VACs tend to spend most of their time attending to operational, clinical issues rather than maintaining a strategic overview. This reflects the multifaceted role of the VAC and the contrasting need to provide clinical expertise in RDU; MDT liaison and negotiation; and logistical coordination for a very large and demanding patient cohort. There seems to be a requirement for a 'vascular access tracker' role within VA services whose role would mirror that of a 'cancer tracker' within cancer services.

Most units rely heavily on individual VACs to track patients' journeys, assisted to a greater or lesser extent by paper or electronic databases. Record keeping in relation to a specific patient's journey generally revolved around that patient's personal medical record, and it was highly unusual for a unit to track the whole 'active' patient cohort and maintain awareness of how many patients were at each step of the process. In one unit a series of whiteboards were used to track active patients, available theatre slots and other acute clinical issues.

"I wake up in the middle of the night thinking….. that patient's got to be done! And my head sort of swings and that's how we've managed to get them all done." (Vascular Access Coordinator)

Where electronic databases existed they tended to be spreadsheets that were effectively inaccessible to the wider clinical team, for example a list of patients awaiting an AVF operation saved on a particular computer. Where the EHR was involved in vascular access activity it tended to be used to document clinical decisions for individual patients rather than as a searchable means of tracking patients' journeys as a group. Examples of EHR usage include one unit that routinely copies/pastes clinical letters into individual patients' records, and another where the EHR is used to generate access-related referral letters and to document MDT decision making. No EHR currently in use provides an easy means of monitoring the whole patient cohort, measuring waiting times or determining the priority order for scheduling procedures.

"We have essentially what's called an electronic kind of spreadsheet but everybody that's referred goes on to the front page, which is just the referral and all the waiting list dates and as they're appointed, they move on to whatever date… and then [vascular access coordinator] does her MDT list she just pulls through all the dates in the last week to look up the last and see who's all been seen by radiology etc. and she'll put them on to a list to be discussed at the MDT" (Nurse)

Without a robust means of tracking patients it can be difficult to optimise the use of radiology and surgery slots when they become available. There is also the potential for a patient to be missed or to have an unnecessary delay in progressing through the access pathway.

Every unit uses some form of electronic record but it is uncommon for access-related interventions to be recorded in ways that facilitate clinical audit and outcome measurement. Where access-related activities are recorded it is common for this to be recorded in 'free text' fields rather than in other formats that are easier to audit. A significant volume of access-related discussion and decision making is communicated by email; it is uncommon however for the content of these messages to be accessible to the wider VA team.

Most units do not systematically record the placement of NTCVC beyond a written entry in the paper record. In most other cases the electronic capture of access creation or maintenance activity relies on data entered by clinicians with inevitable omissions in the dataset. Where data is rigorously collected the dataset is generally viewed as an audit resource rather than as a tool to aid clinical decision making.

Recommendation 54 **– A vascular access coordinator role is required to facilitate the efficient flow of patients through the elective access pathway. Part of this role requires clinical expertise and demands a clinical background. Part of this role involves an administrative remit that could be performed by a non-clinician – e.g. a vascular access 'tracker'.**

Recommendation 55 **– Renal services should expect a minimum requirement of 0.75 WTE vascular access coordinators per 100 prevalent haemodialysis patients (inclusive of both clinical and administrative roles), reflecting the average level of vascular access coordinator provision across the Scottish renal services currently.**

Recommendation 56 **– The dynamic nature of vascular access provision (especially emergent problems) requires that formal, accessible mechanisms are needed to keep track of active patients and optimally allocate resources to them. This would also help with capacity control and planning of catch-up lists.**

ARE PROCEDURE OUTCOMES ROUTINELY MEASURED? WHAT COUNTS AS M&M, AND WHERE IS IT DISCUSSED?

No renal service in Scotland routinely collects, measures or discusses data relating to vascular access service performance. There is no systematic collation of procedure referrals or procedure outcomes, and no routine discussion of vascular access-specific morbidity and mortality. Significant adverse events are typically reviewed in an ad hoc fashion or slotted into an existing morbidity and mortality meeting, without the routine presence of nephrologists, interventional radiologists and vascular surgeons.

There is a striking paucity of data relating to access creation and access maintenance procedures. While it is usual to count the number of AVF and AVG creation procedures there is no routine measurement of waiting times and no accounting for patients who are referred but do not ultimately undergo the procedure. There is little, if any, record of access maintenance procedures, whether for routine surveillance or emergency intervention. Where numbers of procedures are recorded it is highly unusual for the outcome of the procedure to be recorded or for this to then be tethered to the overall patient outcome. Individual operators are typically aware of their personal clinical activity, but with little insight into the overall service context.

Where any formal audit of vascular access activity had taken place within a unit this tended to be in the context of a medical student attachment or similar activity. Administrative and other organisational support was not provided to assist. In comparison a significant effort continues to be made in each unit to investigate isolated bacteraemia episodes.

No unit considers or records incident dialysis without optimised vascular access as 'morbidity'. There is no routine forum for discussing cases where patients commenced dialysis with suboptimal vascular access. There is a sense of nihilism about many such patients although it is very unusual for their cases to be reviewed in any detail, or with a view to modifying the existing access pathway.

When NTCVC are inserted these are usually recorded in patients' individual notes. NTCVC episodes are not reliably documented in any searchable electronic record that facilitates patient tracking or service audit. When patients have a TCVC inserted this is sometimes tracked via the electronic health record, but it is unusual for there to be an automatic mechanism flagging this patient for access review. Just one centre routinely discusses every patient with a TCVC in the weekly MDT meeting; patients remain on the meeting agenda until the TCVC is removed.

Recommendation 57 **– Renal services should routinely audit their access creation and access maintenance pathway waiting times and procedure outcomes. These should be published on a quarterly basis and used to inform clinical decision making within the unit.**

Recommendation 58 **– Renal services should conduct a quarterly strategic service review meeting. This would be the forum for discussion of service performance, waiting times, procedures outcomes, morbidity and mortality.**

Recommendation 59 **– There is a need to develop service performance data that can be presented in a standardised format that facilitates a national overview.**

Recommendation 60 **– A successful vascular access service should be defined according to the proportion of patients for whom incident and prevalent vascular access is according to their pre-defined 'personal access solution'.**

Recommendation 61 – **NHS boards should have a nominated board-level stakeholder (eg Medical Director) who must work alongside a named lead vascular access nephrologist, vascular surgeon, interventional radiologist and service manager to oversee the strategic delivery of vascular access services.**

HOW AWARE ARE CLINICIANS OF THE PROCESSES OR TIMINGS IN THEIR UNIT? DOES THIS MATTER?

Clinicians have a variable knowledge of access creation and access maintenance pathways in their unit, and it was common for interviewees within the same centre to contradict one another when discussing elements of the processes. Nobody has a clear overview of the timescales involved in each part of the pathway although most team members had an awareness of substantial bottlenecks. Most clinicians assume the VAN has a database of service metrics and statistics and do not appreciate the extent of VAN involvement in the routine, operational workings of the service.

It is clear that waiting times are rarely discussed within the VA team or in the wider nephrology, vascular surgery or radiology services. It was unusual for the specific processes to be presented in a written format, and where a document did exist this was usually in the context of a recent service development exercise. There is some insight from clinicians that an awareness of timelines and procedural success is helpful to optimise the VA service.

> *"Our intention would be that it would be ready for use in 6 weeks but in reality it's usually more like 2 to 3 months and that's because of the rate of primary failure, reintervention, maturation interventions, so I think about 50% of them require procedures which will delay things." (Nephrologist)*

Without a functioning MDT there can be a lack of awareness of the clinical urgency of a given procedure, and limited insight into the 'referral threshold' of colleagues in the VA team. There may also be a tendency for less appropriate referrals for imaging or intervention without a regular forum for discussing VA problems.

> *"I think what then used to happen was that, clinicians would make a decision to make a fistuloplasty and they'd send a request card round and then my colleague who does them would then go… this is a load of rubbish! Whereas, you know, now he knows that I have pretty much vetted them all and therefore you don't get that sort of discrepancy as much." (Radiologist)*

> *"The only two people who actually do the referrals [to IR], because there were some mix-ups, are [nephrologist] and [surgeon]. They do referrals so we will go and highlight there's an issue and discuss what it is and they will see yeah ok that warrants a duplex or a fistulogram." (Vascular Access Coordinator)*

When clinicians in the wider nephrology team are unaware of the process or likely timescale this can lead to frustration with the service and may encourage attempts to circumvent the normal process in an effort to expedite access creation or maintenance for a particular patient.

> *"Yes it's not quite clear to me who ends up where… See the difficulty is we spend time in the clinic thinking well I've fed that person to that pathway and nothing's happening. So now their creatinine is getting worse and now I need to go and rattle some cages now. I need*

to go and find someone and persuade them to do such and such. But if you thought it… worked smoothly, you wouldn't need to do all that." (Nephrologist)

Within the RDU it seems important that staff have knowledge of the processes involved in access creation and maintenance. Secondment programmes that allow RDU staff to work alongside VAN appear to be highly successful in improving the general RDU awareness of the VAN role and the complexity of providing a VA service.

Recommendation 62 – **The roles and responsibilities of each member of the VA team should be clearly defined in a written description of the VA service. This should be accessible to patients and members of the wider clinical team.**

Recommendation 63 – **Renal units should develop educational secondment programmes that enable RDU nurses to have protected time to working with VAN.**

DOES GEOGRAPHY INFLUENCE VASCULAR ACCESS PROVISION?

Access provision does not seem to be particularly dependent upon the geographical size of the catchment area [Table 6].

Table 6 CVC prevalence, area size and population size for the separate renal services in Scotland in 2014.

Specialty	CVC Prevalence (% of all RRT)	Area Size (in square kilometres)	Population
ARI	3	11,191	629,060
XH	16	3,369	371,110
DGRI	8	6,427	149,940
GLAS	12	3,747	1,442,990
MONK	26	2,242	653,310
NINE	8	7,527	413,800
RAIG	1	35,625	348,010
RIE	5	6,456	972,120
VHK	6	1,325	367,260
SCOTLAND	**10**	**77,910**	**5,347,600**

Patients living in particularly rural areas tended to need hospital admission for procedures that would otherwise be performed on an outpatient basis, but this was not reported to significantly affect service provision besides causing inconvenience to the patients.

Patients who required significant logistical arrangements to attend hospital, for example those living in Western Isles, Orkney or Shetland NHS Board areas, tended to have access activities consolidated wherever possible to facilitate a shorter hospital admission.

When rural satellite dialysis units reported problems with AVFs it was common for telemedicine or similar services to be used to communicate with the base renal unit. No units reported logistical barriers to providing access due to patients' geography.

In contrast the provision of access appeared to be significantly hampered by the lack of co-location of nephrology, IR and vascular surgery services on one campus. This caused a variety

of problems in the creation of access, maintenance of access, and management of emergency procedures. The difficulties caused by non-co-location extend beyond the obvious logistical issues; this was seen to contribute negatively towards MDT working and ultimately frustrate attempts by individual clinicians to create and maintain vascular access for individual patients and the cohort as a whole.

"Obviously having everything on one site makes things geographically much easier, it'd be more challenging without that." (Nephrologist)

"The interventional radiologists providing a service are [radiologist] and [radiologist], but sadly that is an outside service down at [offsite] which is one of the issues." (Surgeon)

HOW DO TEAM DYNAMICS AND LINES OF CLINICAL RESPONSIBILITY INFLUENCE ACCESS SERVICES?

There were clear differences observed between centres in the engagement of clinicians, patient-centeredness of the services and general team dynamics.

Where particular individuals seemed to be more involved than their equivalents in other units this tended to reflect their specific interest in the role, rather than having had the role delegated to them. Engagement and involvement were not necessarily a function of simply having more allocated clinical time for VA, but it seemed more difficult for individual clinicians to become involved with VA when their time was already allocated to other clinical roles. This was particularly the case where nephrology, vascular surgery and IR were not co-located on the same hospital campus.

Clear clinical leadership was evident in most centres, where all interviewees could identify key individuals who facilitate the service and enable others to optimally fulfil their role to achieve the best outcome for the patient. In these centres the main challenges arose during out-of-hours periods, when clinicians with little VA involvement occasionally encounter patients with access problems and tend to be less aggressive in their efforts to intervene acutely. In some centres however this was more likely to be the experience at all times of day. In units with a more dislocated and misaligned VA service it was common for VA activities to be viewed in a task-oriented rather than patient-centred manner. Clinicians in these units tended to be less able to clearly articulate roles and responsibilities of their colleagues in providing VA.

"I supply the surgical service and then [VAN] and [VAN] are our vascular access nurses, so they presumably link between nephrology and surgery and they link between nephrology, surgery and IR as well" (Surgeon)

"I would imagine the process, generally, is it is discussed with [X} as the Vascular Surgeon who would then make a decision to do a fistuloplasty, so that is probably the pathway that is taken" (Radiologist)

"There is a whole bunch of people, if you like, doing the selection process, it seems to me, I think they outnumber the people doing the delivery process! Clearly the renal physicians are involved, we have got renal nurse practitioners who are often the interface between us and the competing priorities during the day." (Radiologist)

It seemed important that each member of the team could clearly identify the lead clinician from each element of the MDT, including nephrology, IR, vascular surgery and VAC. The centres that

featured an adequately resourced nephrology lead that could facilitate optimal access creation by vascular surgeons and access maintenance by IR, tended to report perceived better results for the patient. This often also involved a VAC. Some centres described a collegiate atmosphere in which colleagues felt comfortable enough with one another to display vulnerability and openly discuss challenging cases.

"I have full faith in that bunch round the corner… they're fine people and we get on really well and if they say it needs doing, then we will do it." (Surgeon)

"I think for places like yourselves who are doing 100 a year, having written protocols and all the rest of it, is probably quite important especially when there's so many other people involved. When it's just a small number of people, a relatively small number of patients with you know, we're a happy family, we talk to each other, it's I don't think the rules… we don't need quite so many rules because you know we've got more flexibility." (Surgeon)

"Here you know everybody has an input and everybody has a voice. Nobody has to fear about saying anything because everybody's inputting everything to that patient. Erm I think that attitude, I think that is the crux of why it works so well is that we have such a good set-up with the MDT and with the teamwork." (Radiologist)

"I feel just now there's no one person responsible and that causes issues… that causes delays that probably don't need to be there." (Nurse)

"I guess they're our patients aren't they… you could argue it's me. I don't have a session for it though. I am nominally the person that leads. Well I tell you what, I lead by default because I am the only one that ever…" (Nephrologist)

"Not sure we've ever thought that anyone in particular has ownership… bit of shared responsibility I mean…. I think the renal physicians feel overall they are in charge of the care of the patient. I think we essentially agree with that. So the final decision rests with the renal physicians." (Surgeon)

"It's because we all play a part. A small part, a large part of this and we work together. And we work quite well together." (Vascular Access Coordinator)

"You have to remember this is very much a team-based process. The patient comes in for the MDT, we're all there, we all discuss it and we decide what's going to be the next step forward and it doesn't matter. You just decide it between everybody that's there." (Radiologist)

In contrast some other centres tended to encounter frequent clinical uncertainty, difficulty scheduling clinical activities and barriers to getting things done. These centres tended to be notable for the inability of clinicians working in each area of the VA service to identify one another by name; in some cases the clinicians forming the VA team had never met in person.

"And then obviously we are fed in with the nephrologists, whose names I cannot give you because I don't know them…. I don't take any ownership of who requires priority from that point of view. I will let the nurses [prioritise patients for surgery] in conjunction with the nephrologist." (Surgeon)

"I think something of more ownership from the ground upwards probably would be very helpful. Right now I don't know who that patient belongs to; I don't know who the other patient belongs to, so it doesn't work" (Nephrologist)

"Our renal physicians are in regular contact with us. Whether some of my younger colleagues could put faces to the names I don't know." (Radiologist)

Surgeons and interventional radiologists tended to feel supported by one another when the VA team was well defined and when the individual clinicians met together on a regular basis. Each group felt this enabled them to tackle complex clinical cases where they might otherwise have been reluctant to do so.

"With the lines we have set up a list every week which is run by a nephrologist and that has only lines on it and that is the time of the week on Thursday morning when we don't have a regular IR list but we are around in the department so we give her a hand, [nephrologist], we give her a hand if she needs it if it's a complex line but mostly… you know, she has been doing it for years" (Radiologist)

"Because of how good our IR are, we've got a couple of AVFs that wouldn't have lasted weeks but have lasted one of them 6 years with about 2 interventions a year and in someone who is not anaesthetically fit for anything else so has survived against the odds and has an AVF which has amazingly survived against the odds and that is testament to the support we get." (Nephrologist)

A clear nephrology lead was considered important by all parties to identify the subtleties of the patient's condition, their declining renal function and the alternative RRT modalities practically available to them. Without strong ownership of the VA process individual clinicians seemed less likely to directly tackle impending clinical problems.

"It is difficult to know exactly who the responsible nephrologist is because they work in teams… you can look at the letters from the low clearance clinics and see 6 different consultant nephrologists have been seeing the patient and none more than anywhere else. So you never quite know who to write to." (Surgeon)

Collaboration is clearly necessary across any VA service, but it can only be realistically possible to engage clinical staff when they are resourced adequately and given an appropriate allocation of clinical time to devote to the service.

WHAT ARE CLINICIANS' ATTITUDES TOWARDS DIFFERENT VA MODALITIES?

Tunnelled CVCs

Opinions regarding AVFs, AVGs, CVCs and PD vary between units. The most polarised differences of opinion are seen in relation to CVC usage for prevalent patients.

Centres with very low rates of prevalent TCVC use tended to express very negative opinions towards TCVC whereas in other units there was an acceptance that CVCs and their complications were an unavoidable part of delivering HD. Centres with lower TCVC prevalence seemed to have a mindset that it was virtually always possible to provide dialysis without using a TCVC.

"I think the fewer lines they have, the fewer problems they have with central stenosis and problems later on, so we try and prevent them having lines really because we think that is the best, fewer sepsis and fewer central stenosis later on." (Nephrologist)

"We don't, as a rule I would think, any Nephrologist talks about lines with their patients, on the basis that we, I think, pretty much universally don't believe there is anyone who can't be dialysed in another fashion. … I have never had a conversation with somebody that needed to start on a line because no other access in my whole time here, you know as a first access." (Nephrologist)

"I don't think there's anybody, yes there's maybe one person at the moment who might, we might have given up on, in terms of native access." (Nephrologist)

Clinicians tended to associate SAB and infection-related complications with CVCs, but it was uncommon for central venous stenosis to be discussed as a TCVC complication.

In some areas TCVC were considered an appropriate means of VA for frail patients with limited life expectancy; other centres took an opposing view, that it was more appropriate to use an AVG in such patients or even create an AVF rather than using a CVC.

"If someone is dying of cancer we will put them in an AVG, you know if we think they are going to die within 6 months, to get a line out quick and give them a better quality of life we will put in an AVG." (Nephrologist)

"Very elderly, frail people who can't survive their line sepsis, so we don't see that as a reason not to try and get an AVF. You sometimes have a, patient… who prefers not to have an AVF, but not for comorbidity reasons." (Nephrologist)

It was apparent that TCVC use has become normal practice in some centres. While staff in some centres referred to NTCVC as "temporary" and TCVC as "permanent" CVCs, others were clear that all varieties of CVC were considered to be a bridge to alternative access.

"It is there as a temporary procedure, all lines are temporary, tunnelled or not! They are not allowed to call them anything other than temporary, until we get AVF." (Nephrologist)

In centres where TCVC usage was seen to be normal practice, it was also noted that the associated complications were viewed as being inevitable.

"Well we actually have a number of CVC patients that present problems when they come back for repeated CVCs…. Patients with central venous stenosis, they are actually quite difficult to manage, as I'm sure you are well aware. Clearly patients with recurrent stenosis despite repeated venoplasties, so just the problems that every unit will face." (Radiologist)

"Yeah, some patient's lines, they are always absolutely fine, we don't really have any problems with them and they've had them for a long time, other patients erm, their lines are, they just, they are problematic, difficult flows, sometimes they reverse the lines, get urokinase locks, get intra-dialytic urokinase, tends to be the same" (Nurse)

Ironically a key problem in centres with low TCVC usage was the difficulty in obtaining a TCVC for the occasional patient who did in fact require one. RDU unfamiliarity with accessing CVCs

was also noted to be a problem in these centres. The logistics of TCVC coordination seemed to occupy a disproportionate length of VAN time in some areas; this was attenuated where nephrology or nurse-led TCVC insertion was available, and this in turn did not seem to particularly drive excessive use of TCVC.

There was a recognition in centres with very high TCVC usage that a legacy of this approach will be the ongoing need to manage central venous stenosis in a large proportion of the patient cohort.

> *"There is a cohort of patients that we have looked at I mean obviously and said look we have got 50 central catheters and I am saying 20 I don't want to know anything about. I cannot do anything for these people who are burnt out." (Surgeon)*

Arteriovenous grafts

Most centres recognised the potential utility of using AVG as alternatives to CVCs. Their use is limited however by the technical difficulty associated with their insertion, the need for intense maintenance thereafter (with or without need for anticoagulation), and uncertainty around surveillance parameters. AVGs tended to be seen as a 'special' treatment and clinicians wanted more evidence before using them on a wider scale. VAN and RDU staff also voiced concern about the significant training need to optimally care for patients with AVG in-situ.

Peritoneal dialysis

PD is generally viewed as a favourable option that some centres considered to be under-utilised.

> *"If this is a patient just presenting and they've got a reasonably good chance of getting a transplant in the future, there's a strong case for pushing PD more and preserving their central veins." (Nephrologist)*

> *"And our default tends to be, in most places it tends to be HD. It shouldn't necessarily be so…. PD probably has more of a role in difficult vascular access then we use it for… A PD catheter is probably better than a TCVC." (Nephrologist)*

PD was usually considered a separate, alternative RRT modality to HD and transplantation, rather than being viewed as a potential VA strategy. Most VAN were not directly involved in PD catheter insertion, and there tended to be an informal referral mechanism in use to arrangement their placement. It was common for PD catheters to be inserted by surgeons who were not involved in AVF creation or maintenance.

Some concern was raised as to the timing of PD catheter insertion but there was an appetite for increasing its use, particularly in younger patients for whom PD would be an alternative to a TCVC.

Recommendation 64 **– Cases of central venous stenosis should be routinely audited and discussed at the VA morbidity and mortality meeting.**

Recommendation 65 **– All patients should have access to AVG if required. In some instances this may require the establishment of 'complex access centres' who provide this as a specialist service.**

WHAT HAS DRIVEN PRIOR CHANGE IN VASCULAR ACCESS SERVICES?

Vascular access services are conspicuous in their absence from formal corporate structures within NHS Boards. The service has actively and passively evolved over time with a number of overt and hidden influences.

Interaction of different specialty groups was seen as an important driver of positive change in many centres. In centres where vascular surgeons and nephrologists have a current or historical working relationship through renal transplantation it seemed easier to establish 'MDT working' as the model for providing the VA service.

Active involvement of the wider VA team in the processes around service delivery has also generally led to success in many centres. Several units considered the involvement of sonographers in the MDT as a key factor in increasing prevalent AVF usage while reducing the need for other clinical interventions. It is normal practice in some centres for sonographers to directly arrange emergency fistuloplasty based upon duplex imaging findings, rather than simply issuing a written report that then relies upon VAN or equivalent liaising with IR. Centres with particularly successful maintenance programmes commented on the utility of the 'AVF intervention history', which has credited to the active engagement of sonographers with the VA service.

Staff perspective was also viewed to be an important driver of change. Some units have introduced secondment programmes that enable RDU nurses to spend time working with the VAC. This is reported by the VAC to increase general RDU staff awareness of the importance of VA and provides insight as to the complexity of local access creation and maintenance pathways. While most VACs have a renal background some entered the service from other areas of clinical practice; this was considered advantageous in providing alternative perceptions of access in comparison with colleagues who have been embedded in the system for a number of years.

Newly appointed staff have also been utilised by services to drive change, with several units associating the introduction of an MDT meeting with the appointment of a new colleague. Elsewhere it has been noted that where an enthusiastic surgeon or radiologist has driven forward access creation or maintenance, this has tended to provide momentum to enable overall service development beyond their individual contributions.

Clinical audit is recognised in many centres as an effective means of bringing clinicians together, and increasing clinical buy-in to the service. Scrutiny of service bottlenecks has facilitated various improvements, ranging from the development of VAC-led duplex scans to nephrology-led TCVC lists and formal endovascular IR training for vascular surgeons.

Additional opportunities have also been identified within hospitals to enable more effective processing of patients within VA pathways. Centres reported reclassifying VA theatre lists as 'urgent' and utilising theatre lists that were cancelled by other surgeons to provide additional short-notice capacity to create more access. Some units report conducting a formal visit to each satellite RDU in turn to look for patients dialysing through TCVC who could potentially have AVF created; while this was said to be a relatively labour intensive approach, it was also considered highly effective in reducing unnecessary TCVC usage.

Recommendation 66 **– Vascular access service needs should be considered as part of any recruitment exercise into relevant clinical and non-clinical departments within NHS Boards.**

WHAT ARE THE EDUCATIONAL NEEDS FOR VASCULAR ACCESS SERVICES?

Several educational needs are identified across VA services. These can be broadly classified as technical (medical), technical (non-medical) and non-technical. The groups requiring education include the core VA team, the wider nephrology service, RDU staff, and patients receiving RRT.

It is common for members of the VA team to be generally unaware of the roles performed by colleagues who work in other areas of the service. This is likely to be the only area in which these clinical specialties overlap. While it is unnecessary to train every team member about every element of the service it would be useful for clinicians to achieve a greater understanding of one another's roles. This would be especially helpful in units where there is not currently a functioning MDT.

Many VANs already perform vascular imaging to some extent, as part of access surgery planning or to assess AVF health. It is uncommon at present for imaging skills to be formally taught and this may be helpful. In some centres surgical review of patients has been replaced by VAN-led imaging. This can also facilitate more rapid assessment and intervention in the event of an acute AVF or AVG problem arising in the RDU.

The wider nephrology service would benefit from a greater understanding of the VA team and some technical elements of the VA service. This might include aspects of AVF creation (for example the technical requirements to create an AVF or AVG), the causes of AVF problems and the potential routes for investigation and management. It is notable that these topics do not currently feature in the standard training curriculum for renal physicians, vascular surgeons or interventional radiologists who train in the United Kingdom. It would also be beneficial to place a greater emphasis on the significant burden of financial cost, morbidity and mortality that is brought about by inadequate VA arrangements within a renal unit. There remains reluctance among many nephrologists to discuss end-stage renal disease, RRT or vascular access with patients until they have reached an advance stage of illness. Some clinicians consider it more harmful to have this discussion and cause unnecessary worry to a patient who ultimately will not reach RRT, than to delay the discussion and ultimately cause the patient to commence RRT with a suboptimal VA modality.

> *"I think the reason we don't – maybe that's not such a good thing – but in general terms really we don't because you're going to have to embark on the discussion about RRT. Which is pretty time consuming and very upsetting for them." (Nephrologist)*

RDU staff would also benefit from an appreciation of the technical aspects of AVF creation and maintenance. Many VACs and RDU staff report a lack of basic knowledge among RDU colleagues in these areas. This may bring with it a lack of confidence discussing VA issues with patients, difficulty approaching patients whose AVF or AVG is technically difficult to use, and inability to recognise the earliest signs of access failure. One centre has developed a series of 'renal competences' for RDU nurses, which they must achieve before they can cannulate an AVF or AVG. Other centres offer opportunities for RDU staff to be seconded to VAN team for a brief period; this is seen as a highly beneficial training opportunity for RDU nurses, albeit it does require VAN to absorb this on top of an already busy workload.

Surgical ward staff, theatre staff and anaesthetics are a largely forgotten stakeholder group within the wider VA team. It is common in some centres for patients to stay on a vascular surgery or general surgery ward following access creation surgery. In some cases this happens without on-site nephrology involvement in the perioperative management. It may be that additional training

for nursing staff who work on such wards would optimise perioperative management, for example with blood pressure control. This might have the effect of increasing primary patency rates.

It is uncommon for any centre to provide formal training to patients or staff about the best ways to preserve AVF or veins. This could range from basic information about different access modalities to more complex instruction about AVF longevity, cannulation and self-care HD. One centre has already developed a curriculum for patients to support this process.

In addition to these clinical training needs there is also a requirement to improve general knowledge and ability relating to the use of computers, electronic health records and computer-based tools that facilitate clinical audit. This would incorporate general training in addition to more focused training in the use of specific software packages, including those required to request tests, to view imaging studies and to interrogate the renal electronic patient record.

Recommendation 67 **– Nephrology, Vascular Surgery and Interventional Radiology specialty training curricula should include a formalised Vascular Access training block as a core competency**

Recommendation 68 **– Training should be given to nurses and other clinical staff who provide peri-procedural care for patients undergoing access creation or maintenance procedures.**

HOW MUCH ACCESS-RELATED TIME IS JOB PLANNED, AND HOW MUCH WOULD BE NEEDED TO DO IT PROPERLY?

Across the country and between professions it is unusual for VA service delivery to be formally job planned. Where VA does feature in a job plan it typically includes MDT attendance and/or a commitment to a vascular access clinic, but does not usually include time for performing procedures. Surgeons and radiologists were more likely to have job planned time for vascular access than nephrologists.

It is most common for MDT meetings to be job planned but IR and surgery lists are not necessarily job planned specifically for VA. It's also common for MDT to be job planned in one but not all three specialties who actually have to attend. In one site the MDT start time is before the working day officially begins for the majority of attendees.

There is a common perception among clinicians that most of their colleagues are using their own time to perform vascular access creation, maintenance and service development activities. In most cases this is true, and in fact most clinicians have other competing priorities written into job plans that may ultimately reduce the time commitment given to VA. It is accepted that patients requiring VA work are 'slotted in' around other clinical activities, and there is a clear sense that colleagues are 'doing a favour' when VA procedures are required.

> *"The difficulty is that that's not what they're paid to do. So they go and ask and again it's a please, please, please. It can't run like that!" (Nephrologist)*

Key problems caused by the lack of formal job planning include:

- Lack of formal clinical time to attend to vascular access.
- Diary clashes preventing attendance at MDT meetings (e.g. outlying clinics).
- Difficulty with succession planning and lack of VA consideration during recruitment exercises.
- Lack of backfilling in the event of planned or prolonged absence from work.

- Limited visibility of vascular access during broader service reconfigurations.

Most clinicians gave estimates of their actual time commitment to VA that were at odds with the descriptions given by other team members in the course of their own interviews. Several VANs work part-time, and in some cases have additional clinical roles within the renal unit. It was common to report that VA work tended to occupy a larger part of the working week than was formally allocated, and working additional hours was considered a necessary part of the role.

Nephrologists commonly reported spending 'a few hours per week' attending to VA issues, often embedded within other activities such as a HD review or outpatient clinic. It was very uncommon for nephrologists to have formally allocated time to develop the VA service. In large centres the effective time commitment between all nephrologists equated almost to one whole time equivalent consultant nephrologist. Surgeons and radiologists had a clearer idea of how long was spent performing VA procedures but often reported informal mechanisms that effectively meant they added VA procedures to the routine scheduled clinical activities in order to avoid significant waits for patients. There appeared to be little organisational oversight of VA activity and limited insight as to the staff and other resource cost of providing the service in its current form.

Recommendation 69 **– All vascular access service delivery should be formally job planned. NHS Boards should backfill vascular access activity in periods of prolonged absence.**

WHAT ARE THE BARRIERS TO WORKING EFFECTIVELY?

The major barrier to progress in most units lay in the lack of sufficiently senior management involvement or awareness of the VA service. This was seen as a function of the distribution of clinical problems and interventions between the services, clinicians, wards and budgets of a number of departments. A series of organisational, logistical, interpersonal and clinical barriers to effective working were also identified. Many of these issues spanned multiple units.

At the organisational level there was a lack of administrative support for MDT in most centres, and a reliance on administrators to book procedure slots and issue appointments to patients. Administrators seemed dislocated from the clinical urgency, and a lot of prompting seemed necessary to get things done. This was exacerbated where staff worked part time, with their role being unfilled in their absence.

At times the number of theatre slots offered, and the advance notice given before the theatre date, seemed insufficient and impractical. It was uncommon for IR slots to be formally protected although some centres had introduced a system of informal protection of slots for VA, or at least informal protection of slots for generic emergency cases which would tend to ultimately be used for VA-related cases. Without protected slots there was uncertainty in the timing of interventions which led to prolonged inpatient admissions and difficulties in scheduling regular dialysis sessions.

> *"I've actually just done January's waiting list actually and I've only probably got about 10 slots which is unheard of. We've usually got about 18 or 20. But I've no general anaesthetic list and that's the ones I need to get the transpositions on and so… although I can change the day surgery ones into the general anaesthetic ones if I have to." (Vascular Access Coordinator)*

Logistical issues were a particular barrier in units where nephrology, surgery and IR were not co-located. In some cases the organisation of transport, booking beds and attempts to liaise with offsite departments would account for a large proportion of VAN time each week. Units with

large geographical catchment areas or large numbers of satellite units also reported difficulties in maintaining overview of each patient and still managing to attend the MDT and other centralised activities.

VAC workload seemed extremely high in most centres, and especially so where the MDT appeared to be less functional. In some units the VAC is the focal point of all service activity including routine surveillance, ad hoc RDU problems, access creation issues, clotted AVFs, TCVC requesting and coordination, and any other access issue. Some VACs additionally reported spending significant periods of time clarifying ambiguities about newly referred patients; it was common in some areas for a referral to contain only the patient's name with no other accompanying details. Late referrals were also common, with many cases reported to involve patients who could potentially have been referred earlier to the service.

> *"Honestly, it never stops. It never stops. Because it's like I tried to phone you and couldn't get you so I've emailed you. You know? I'll come in, and I've cleared my emails and when I go back there'll probably be about 30 emails and I'm not kidding." (Vascular Access Coordinator)*

In many cases VAN was not authorised to request investigations or procedures that formed a core aspect of the VAN role. In a few instances VAN was authorised to request a test but was not technically capable to do so using the electronic booking systems.

Where the MDT seemed dysfunctional a number of interpersonal barriers were encountered. With a lack of job planned time to fully attend to the VA service clinicians could be perceived as lacking interest or engagement with clinical problems. Without regular face-to-face contact clinicians tended to be less aggressive in managing VA problems. Less obviously, when the vascular lab (or equivalent) was organisationally or physically separate from the main radiology department, there tended to be more passive recording of AVF problems. In contrast, units with vascular labs integrated into radiology departments would frequently intervene within a few hours of a problem first being diagnosed. While some groups of clinicians were clearly very familiar with one another despite not having a regular, formal MDT meeting, it was apparent in some centres that the key clinicians in each area of the service rarely, if ever, met one another in person. Nephrologists and radiologists both expressed frustration about feeling unable to discuss challenging cases with one another. This frustration was echoed at times by surgeons, especially where units were organised such that patients attended a group of nephrologists rather than having a named consultant, with whom the surgeon could discuss the case.

Most access creation surgery is performed under local anaesthetic, but some centres routinely conduct anaesthetic pre-assessment for every patient. This commonly leads to delays or cancellations of access surgery, given the comorbidity typically encountered in this patient group. The best strategy for minimising cancellations appeared to be where a small group of vascular anaesthetists (or equivalent) dealt with these theatre lists.

Other surgical and radiological problems were often seen to usurp VA procedures. It was common for VA interventions to be considered 'routine' rather than 'emergency' where the patient could potentially have an NTCVC or TCVC placed as a stopgap. In many units it was common for patients and staff to become overly comfortable with TCVC, which then created a challenge in persuading patients of the benefits from AVF creation.

> *"I am very aware of vascular access theatre slots having to be postponed if emergencies happen. You know, because we are on the receiving end of that. That will be the one to go*

if a vascular emergency comes in, it will be vascular access that gets [cancelled]" (Vascular Access Coordinator)

Recommendation 70 – **The financial cost of haemodialysis vascular access services needs to be clearly visible to NHS Boards. This must be based on all nephrology, surgical AND radiological vascular access related activity. These data must be overseen by a named service manager and viewed as a whole by the board.**

WHAT DO CLINICIANS PERCEIVE AS THE STRENGTHS AND WEAKNESSES OF THEIR VASCULAR ACCESS SERVICE?

Every unit is seen to report its own perceived strengths and vulnerabilities. The majority of units credited MDT working with their overall ability to create and maintain access. This was especially successful where the team members met one another on a regular basis, trusted one another's clinical judgements and demonstrated a willingness to perform the necessary procedures when clinically indicated. In such centres it was normal to proactively create and maintain access before a clinical crisis emerged. These centres also tended to have a good working relationship with a vascular laboratory, with frequent formal and informal contact between the sonographers, interventional radiologists and the wider VA team.

"I think the main thing is you are quite comfortable with your colleagues of what….how they do things" (Surgeon)

While it was not essential to have one clinician in an overall service leadership position it seemed important to have strong clinical leadership and engagement from each specialty, coupled with an authoritative and adequately resourced VAC. Lack of buy-in from each specialty, particularly from nephrology, manifested as nihilism and hopelessness among other members of the team.

Where VACs considered the patient cohort to be of a manageable size this was associated with higher incident and prevalent AV access. In larger centres it was common for staff to consider strategic management of the whole cohort to be an unmanageable task, hence their focus on individual patients for whom they had responsibility.

Almost every unit experienced challenges in recruiting, retaining and training staff. This was especially difficult in areas requiring particular technical expertise. One centre had conducted an international recruitment exercise to appoint a sonographer. Enthusiastic staff were considered a strength in every unit, however in some areas this was seen to create a person-dependent service without resilience to continue in its current form in the absence of a particular individual. One centre reported a failure of the MDT process when an integral team member had a period of sickness absence and their specialty colleagues declined to attend the MDT or buy into the clinical urgency of the cases being discussed. VANs in centres with low SAB and other adverse event rates considered training to be the most significant challenge, in order to prevent complacency among junior colleagues who lacked personal experience of the sequelae of poor VA.

Succession planning was also listed as a concern in many centres. It was common in several units for one or two key individuals to provide the service, and in whose absence the MDT or clinical pathways failed to function. The lack of formally job planned time, informal or no protection of slots to perform procedures, and in places an absence of managerial oversight all hampered attempts to recruit into the service and provide cover in the event of prolonged absence.

Various attempts to build resilience into the service were encountered. In units where access creation was planned along with fall back options in the event of primary failure, this improved

efficiency of the service. Many units actively engaged patients in their care, with practices ranging from simple AVF education to a formal set of competences that ultimately led to patients being taught to self-cannulate and self-care on dialysis.

Out-of-hours care was cited as an area of vulnerability in many centres. While some units had sufficient IR and surgical capacity to manage AVF problems on the next working day, others relied upon out-of-hours action to salvage clotted or otherwise threatened AVFs. It was commonly reported that clinicians who were not directly involved in the VA service tended to be conservative in their approach to such problems, and this could at times result in the loss of an AVF. This was also seen in normal hours where the local IR service had limited engagement with the MDT and tended to view VA issues as routine referrals.

Recommendation 71 **– All patients should have access to an appropriately trained team (nephrologist, surgeon or interventional radiologist) irrespective of the geographical location, within a clinically appropriate timeframe when they develop a vascular access-related problem.**

MOVING FORWARD

This report contains a number of recommendations for action by front-line clinicians, service managers and NHS Boards. Most of the recommendations are self-explanatory, and many have already been mooted or formally proposed in previous such investigations[24]. For patients to genuinely benefit from the significant work that has gone into the research and preparation of this report it is necessary to take action in relation to most, if not all, of the recommendations at all levels of service provision including nursing, surgical and nephrology. As with most other areas of clinical practice it is necessary for Boards to work in partnership with front-line clinicians if these measures are to be truly successful. This section intends to facilitate the process and provide an auditable record of organisations' progress towards providing safer, more effective and more patient-centred vascular access care.

The pertinent questions for boards, based on the recommendations, are:-

GOVERNANCE

Question	Yes	No
Is the vascular access service formally integrated into the corporate structure of the NHS board through the presence of a nominated board-level stakeholder?		
Is there a named service manager who collates the financial cost data on all vascular access related activity from across nephrology, surgery and radiology?		
Are the roles and responsibilities of each member of the VA team clearly defined in a written description of the VA service, which is accessible to patients and members of the wider clinical team?		
Is there a clearly articulated, written pathway that describes and governs the referral mechanisms and patient flow through the access creation and maintenance pathways?		
Is there a written policy describing and governing the escalation of potential access problems?		
Is there a written policy that describes and governs the management of clotted arteriovenous fistulae or grafts?		
Does the NHS Board have a policy designed specifically to prevent inappropriate venepuncture and other such practices that create a hazard for patients who require or already have native arteriovenous fistula or graft vascular access?		

JOB PLANNING

Question	Yes	No
Do the lead VA clinicians from nephrology, vascular surgery and interventional radiology have job planned time to attend to strategic aspects of the VA service?		
Do all clinicians responsible for the care of patients receiving HD have job-planned time allocated to attending the vascular access MDT proportionate to their haemodialysis case load?		

SERVICE PERFORMANCE

Question	Yes	No
Do you know how many vascular access surgical procedures are conducted per year?		
Do you know how many vascular access interventional radiology procedures are conducted per year?		
Do you know how many vascular access ultrasound examinations are conducted per year?		
Do you know how many patients require an overnight inpatient hospital stay for an elective vascular access procedure?		
Are current waiting times for vascular access creation procedures available and accessible to the clinical team?		
Are all cases where patients require emergency access routinely audited or discussed in the setting of a vascular access morbidity and mortality meeting?		
Are vascular access procedures that are cancelled for non-clinical reasons routinely audited or discussed at a vascular access morbidity and mortality meeting?		
Are administrative delays routinely audited or discussed at the vascular access morbidity and mortality meeting?		
Are informal referrals for vascular access routinely audited or discussed at the vascular access morbidity and mortality meeting?		
Is primary and secondary arteriovenous access patency routinely audited or discussed at the vascular access morbidity and mortality meeting?		
Are all cases of clotted arteriovenous fistulae or grafts routinely audited or discussed at the vascular access morbidity and mortality meeting?		
Are all cases of central venous stenosis routinely audited and discussed at the vascular access morbidity and mortality meeting?		
Is there a regular meeting, separate to the discussion of individual patient cases, where strategic elements of the vascular access service are discussed?		

EDUCATION

Question	Yes	No
Are RDU staff formally trained in the basic assessment of fistulae, to identify potential fistula problems, and to cannulate arteriovenous fistulae and grafts?		
Are all members of the vascular access team trained in the optimal use of the electronic patient record and associated electronic health records?		
Has appropriate training been given to nurses and other clinical staff who provide peri-procedural care for patients undergoing access creation or maintenance procedures?		
How much clinical time is allocated to patient education about vascular access? (New patients)		
How much clinical time is allocated to patient education about vascular access? (Prevalent patients)		
Has education been provided to all clinicians who refer patients for vascular access creation to enable the clinical identification of vessels that are suitable for AVF creation?		
Is there an educational secondment programmes that enables RDU nurses to have protected time to working with the vascular access coordinator?		

PATIENT EXPERIENCE

Question	Yes	No
Are steps being taken to measure patient experience around the creation and maintenance of vascular access?		
Do patients have access to arteriovenous graft procedures as a potential access modality?		

PROCESSES

Question	Yes	No
Do all patients with eGFR <=15ml/min within the centre have a documented “personal access strategy”?		
Is the patient’s “personal access strategy” documented in the patient’s case record?		
Are electronic health records used to refer patients into the access creation and maintenance pathways?		
Are electronic health records used to tracking the patient journey through access pathways?		
Is there access to a suitably trained sonographer to perform ultrasound vein mapping?		
Is USS duplex vein mapping available for all patients within two weeks of referral?		
Is there a one-stop clinic (or equivalent) where ultrasound scanning, clinical review and a decision for theatre may all be undertaken at a single attendance?		
Do operation notes for all arteriovenous access procedures include a statement directing subsequent action in the event that the access does not mature?		
Are all patients who have arteriovenous access creation or revision surgery seen between two to four weeks postoperatively?		
Are there protected slots for interventional radiology and surgical vascular access procedures?		
Are slots for elective vascular access creation and maintenance procedures available to book with at least four weeks’ notice?		
Are slots for emergency interventional radiology maintenance procedures available with 48 hours’ notice?		
Are all vascular access procedures given ‘urgent’ or ‘emergency’ priority on waiting lists?		
Does the Vascular Access Coordinator have the clinical authority and technical / administrative ability to directly allocate specific surgery or interventional radiology slots to named patients for the creation or maintenance of vascular access?		
Can the Vascular Access Coordinator re-order existing vascular access surgery and radiology procedure lists?		
Are named administrative staff available during normal working hours to liaise with vascular access coordinators?		
Is there a regular vascular access MDT meeting at least every three weeks?		
Does the minimum time allocated to the vascular access MDT meeting per week equate to the same number, in minutes, as the number of patients in 10-15% of the prevalent HD population?		
Is an attendance register taken at the MDT meeting?		
Is it possible to directly book interventional radiology procedures at the MDT meeting?		

Question	Yes	No
Are MDT outcomes recorded on the electronic health record?		
Do sonographers have direct access to an interventional radiologist to discuss cases outwith the MDT meeting?		
Is a 'priority list' maintained, that identifies which patient is next in line to have a procedure performed?		
Do renal services have access to 'Day surgery' beds for elective/semi-elective arteriovenous access work?		
Are co-located nephrology, vascular and interventional radiology services available for patients undergoing complex access work or who require an overnight stay?		
Is there a proactive approach to identifying the failing arteriovenous access?		
Are 'threatened' arteriovenous fistulae or grafts considered medical emergencies and managed accordingly?		
Do patients have access to a combined surgical / interventional radiology declotting procedure within 48 hours of presentation with a clotted AVF or AVG?		
Is an 'intervention history' recorded in the patient's record for every arteriovenous access?		
Is there a tracking system that allows team members to determine where an individual patient is in their vascular access journey		
Is there a named lead vascular access nephrologist, vascular surgeon, interventional radiologist and service manager?		
Is there a vascular access coordinator role, staffed equivalent to a minimum of 0.75 WTE coordinators per 100 prevalent HD patients?		

CONCLUSION

This was a comprehensive exercise that was designed to map out the practice and processes that drive the delivery of haemodialysis vascular access provision in Scotland 2014-2015.

It was undertaken by a group of clinicians from nephrology, surgery and imaging backgrounds. This brought a degree of authenticity in investigation and a practical understanding of the issues. The group visited every unit, spoke to all the key players and asked people what they felt and what they wanted. The authors amalgamated all the gathered data in a coordinated and meaningful way, grouped into the key identified themes of;

(i) The Patient Experience;

(ii) Creation of vascular access;

(iii) Maintenance of access;

(iv) Service performance; and

(v) Development needs.

It is clear that the patient experience is often under-appreciated and under-recognised. In an area where much of the focus has been on hard endpoints such as *Staphylococcus aureus* bacteraemia and mortality, quality of life is an under-represented outcome of importance. Vascular access services that are oriented around patients' needs have a vein preservation ethos, timely access creation, proactive maintenance and aggressive action in the event that an AVF or AVG becomes unviable. Such services provide better clinical outcomes for their patients, appear to provide a less stressed working environment for clinicians, and are seen to provide optimal financial value.

The creation and maintenance of haemodialysis vascular access is dependent on a successful linkage across a network of different specialties, supported by an empowered coordinator. The greatest challenge with such complex multi-disciplinary working arises from the conspicuous absence of vascular access services from formal corporate structures within NHS Boards. A lack of overarching service planning has led to silo-working in many centres, which drives a disproportionate amount of inefficiency and at times quite phenomenal financial cost. This is most apparent when considering the near-universal experience of a lack of sufficient interventional radiology resource, causing renal services to shift away from a proactive management stance to a very expensive, reactive, crisis-driven stance.

Every renal service in Scotland was seen to have significant areas of vulnerability. Nearly all cite succession planning as a significant concern. Almost every centre depends upon one or two key individuals, without whom system performance would immediately deteriorate. It is common for vascular access services to operate on an informal basis, with discussion of cases and procedures slotted around other clinical work by individual clinicians who are inadequately resourced and poorly supported to deliver optimised care. This becomes most evident when considering out-of-hours working, where it remains common for access-related problems to be managed conservatively when more aggressive intervention may be appropriate.

A number of educational requirements are identified. The near-absence of vascular access-related competences from nephrology, vascular surgery and interventional radiology specialty training curricula seems absurd. Similarly there is a clear need for greater training and support for vascular access coordinators and RDU nursing staff, who ultimately spend the most time

attending to patients with active vascular access needs. The peri-procedural stages of access creation and maintenance appear particularly vulnerable, and again the nursing staff providing care for such patients require more formal education and support to properly fulfil their role. Finally a greater, ongoing educational engagement with patients and their relatives about the provision and care of vascular access seems likely to augment clinicians' efforts to improve the clinical processes for creating and maintaining patients' personal access solutions.

In a broader sense there is a need for vascular access to be taken more seriously and approached with a greater urgency than at present. Suboptimal vascular access brings with it a substantial burden of morbidity and mortality; patients deserve to have optimised clinical processes that can create and maintain their access within a clinically appropriate timeframe and to an acceptable standard. Threatened AVF or AVG should be considered as medical emergencies and afforded the same degree of urgent care and attention that is given to equivalent clinical presentations in other areas of medicine.

It is hoped that this report will provide new insights as to how vascular access services should be developed and governed. We anticipate the development of more formal pathways for education, research and joint clinical working within services and across the geographic health boards. Above all else we seek to improve our patients' experience and to reduce the vast burden of morbidity and mortality that is currently associated with vascular access and other aspects of end-stage kidney failure. Our recommendations provide a number of audit measures and quality improvement strategies that serve as a starting point for front line clinicians, service managers and NHS Boards who wish to engage with these goals.

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APPENDIX 1 INTERVIEW SCHEDULES

STAFF INTERVIEW

AN APPRAISAL OF VASCULAR ACCESS PROVISION FOR PATIENTS REQUIRING RRT IN SCOTLAND

1. Information for interviewee
    a. Purpose of study
    b. Format of interview
    c. Confidentiality
    d. Dissemination of results
    e. Agreement to participate
2. Study demographics
    a. Title, investigators, sponsor
    b. Date/time/location of interview
    c. Interviewee name/title/contact
    d. Interviewers present
3. Questions and probes
4. Closure

INFORMATION FOR INTERVIEWEE

Purpose of study

The purpose of this study is to describe and appraise the current state of vascular access provision for patients requiring RRT (RRT) in Scotland. A mixed-methods quantitative-qualitative approach is employed to gather:

1. Quantitative data that may explain / define / describe:
    a. The adequacy of vascular access provision
    b. The incidence / prevalence of complications
    c. The patient-centeredness of current service provision
2. Qualitative narrative that may explain / define / describe:
    a. Positive and negative vascular access practices across Scotland
    b. Rationale for adopting a particular approach over an alternative
    c. Variation between units and opportunities for improvement

Data collection

Quantitative data is being gathered using a questionnaire that has been supplied separately. This interview focuses upon collecting qualitative data that provides context, insight and meaning to the quantitative data.

Data analysis

A constructivist grounded theory epistemological approach is being utilised to conduct and analyse this study. This means we do not believe that any one vascular access setup represents a gold standard to which others should be compared; rather we acknowledge that real-world clinical systems exist within a complex, changing context and each system has its own strengths and weaknesses. We aim to gather quantitative and qualitative data from each renal unit in Scotland, and analyse the data in order to determine current practice and identify opportunities for improvement across the country.

Ethical approval

This project is being conducted under the auspices of the Scottish Renal Registry. No intervention is proposed during this study, which is categorised as a "service evaluation". Formal ethical approval has therefore not been sought.

Format of this interview

A semi-structured interview schedule will be followed. Notes will be taken during the interview, and the discussion will be audio-recorded for later transcription. The interview is intended to last between 20-30 minutes.

Confidentiality

All patient and participant data will be held confidentially, and will be destroyed securely once data analysis is complete. Audio is being directly recorded onto a password-protected NHS computer, and will be backed-up using a password-protected, encrypted, USB memory stick.

Dissemination of results

The results of this study will be disseminated nationally via the Scottish Renal Registry. The lead author (SO) intends to include this project in his forthcoming PhD thesis. It is also intended that the data will be presented at relevant scientific meetings and subsequently published in a peer-reviewed journal.

Agreement to participate

Please sign the attached consent form.

CONSENT TO PARTICIPATE IN SCOTTISH VASCULAR ACCESS APPRAISAL INTERVIEW

I understand:

- The purpose of the interview is to gather qualitative information about the current status of vascular access for patients who require RRT in Scotland;
- Interviews will last up to 20-30 minutes, and questions will focus upon the processes involved in obtaining and maintaining appropriate vascular access;
- To facilitate data analysis, notes will be taken and interviews will be audio-recorded for later transcription and the audio data destroyed once transcribed;
- I can refuse to answer any question at any time, or end the interview, without giving reasons;

- All patient data will be treated in strict confidence, and will be anonymised for analysis and/or publication;
- All unit-specific data will be anonymised for publication according to Scottish Renal Registry policy;
- Information disclosed during this interview will be used only for the purposes described above.

I have read and understand the above information, and have had the opportunity to ask any questions. I consent to participating in this interview.

Signature:

Print:

Date:

INTERVIEW RECORD

Date

Time

Hospital

Location

Interviewee name

Interviewee job title

Interviewee consent form?

Interviewers

Audio recorded?

Question 1

Who is involved in vascular access here, and what are their roles?

Nephrologist / Surgeon / Interventional radiologist / Sonographer / Vascular access coordinator

How much allocated time do they have?

Who is responsible for the process / for the individual patient?

Question 2

What's the process for obtaining vascular access pre-emptively?

How are patients identified?

How do you time referral?

What is the mechanism of referral?

What is the timescale for each part of the pathway?

Is there a means of documenting and keeping track of the process?

Question 3

What's the process for obtaining vascular access in patients who present late with end-stage renal failure?

What are the timescales?

Who are the operators performing the procedures? How available are they?

How are these patients upgraded to more permanent access?

Question 4

How do you identify problems with vascular access?

Is there routine surveillance of access?

Is there any communication with primary care/phlebotomy/ ward staff about preservation of access?

Is there any established patient or staff education programme?

Question 5

What could other units learn from the way things work here?

What changes have you made to the way things work?

What have your biggest challenges been?

Is there a memorable patient who stands out as a particular success story?

Question 6

What would you change about the current setup?

If money was no object, how would you make things better?

What would you change about current governance arrangements?

What do your patients think of the current setup?

Question 7

Is there anything else you would like to tell us?

CLOSURE

Thank you for taking part in the interview.

Could we contact you again for further information?

Contact phone

Contact email address

PATIENT SCENARIOS

1. CKD in low clearance clinic – no live donor

48 year old man with progressive IgA Nephropathy and no other comorbidity, diagnosed on biopsy 3 years ago. No potential live donors. eGFR 20ml/min/1.73m2 and declining at 10ml/min/1.73m2/year.

2. CKD in low clearance clinic with potential live donor

48 year old man with progressive IgA Nephropathy and no other comorbidity, diagnosed on biopsy 3 years ago. Live donor being actively worked-up. eGFR 12ml/min/1.73m2 and declining at 10ml/min/1.73m2/year.

3. Late presentation with end-stage renal failure

62 year old man, new patient, presenting with likely diabetic nephropathy, eGFR 10ml/min/1.73m2 and likely to need to start RRT within 4 weeks.

4. Failing transplant

39 year old female, ESRF end-stage renal failure secondary to autosomal dominant polycystic kidney disease, who received a cadaveric transplant 9 years ago. Several episodes of acute rejection treated with steroid / ATG / rituximab since transplantation, and eGFR declining by 8-10ml/min/1.73m2/year. Current eGFR 17ml/min/1.73m2. No potential live donors.

5. Difficult vascular access

64 year old man with end-stage renal failure secondary to diabetic nephropathy, who attends thrice weekly for hospital HD via right brachio-cephalic AVF. Transplantation contraindicated in view of comorbidity. Admitted as an emergency with clotted AVF.

PATIENT INTERVIEW

An appraisal of vascular access provision for patients requiring RRT in Scotland

1. Information for interviewee
    a. Purpose of study
    b. Format of interview
    c. Confidentiality
    d. Dissemination of results
    e. Agreement to participate
2. Study demographics
    f. Title, investigators, sponsor
    g. Date/time/location of interview
    h. Interviewee name/title/contact
    i. Interviewers present
3. Questions and probes
4. Closure

INFORMATION FOR INTERVIEWEE

Purpose of study

The aim of the study is to describe the provision of vascular access for patients requiring RRT across Scotland. This means we are investigating the ways in which different units organise for patients to have AVFs created, dialysis catheters (dialysis CVCs) inserted, and other related procedures.

This study is being conducted by a team of nephrologists, surgeons and radiologists, on behalf of the Scottish Renal Registry. We are interested in this topic because it is known that each renal unit organises its services differently, and we are searching for evidence of good practice to share across Scotland.

Methodology

A mixed-methods approach is being taken to data collection, meaning we are collecting both quantitative, numerical data and qualitative, narrative data. We would value your assistance in the second part of this process, by participating in a short 15-20 minute interview.

A semi-structured interview schedule will be followed. Notes will be taken during the interview, and the discussion will be audio-recorded for later transcription.

Confidentiality

All data will be held confidentially, and will be destroyed securely once data analysis is complete.

Audio is being directly recorded onto a password-protected NHS computer, and will be backed-up using a password-protected, encrypted, USB memory stick.

Anonymised quotes may be used to illustrate particular points about a named renal unit, but no data that individually identifies you will be placed in the public domain.

Ethical approval

This project is being conducted under the auspices of the Scottish Renal Registry, and is categorised as a "service evaluation", therefore formal ethical approval is not required.

Dissemination of results

The results of this study will be disseminated to all renal units in Scotland via the Scottish Renal Registry, and it will be included in a future Scottish Renal Registry annual report. The lead author (SO) intends to include this project in his forthcoming PhD thesis, and it is also intended that the data will be presented at relevant scientific meetings and subsequently published in a peer-reviewed journal. No information that could identify you individually will be presented publicly or submitted for publication.

Agreement to participate

Please sign the attached consent form.

PATIENT CONSENT TO PARTICIPATE IN SCOTTISH VASCULAR ACCESS APPRAISAL INTERVIEW

I understand that:

- Participation in this interview is entirely voluntary
- My decision to participate or not has no bearing whatsoever on my current or future medical care;
- I will not receive any payment or other incentive for taking part;
- This interview intends to seek my subjective opinion about my personal experience of vascular access and related processes;
- This interview is not intended to be (or to replace) a medical consultation, and a record of the interview will not therefore be logged within my medical records;
- The interviewers do not seek information about my medical history beyond that required to contextualise my opinions;
- This interview is not intended to provide me with medical opinion, advice or comment with regard to any of my diagnoses; past, present and future tests; previous, current or future treatments;
- No details of my medical history beyond those I provide will be made available to the researchers;
- Interviews will last up to 15-20 minutes, and the questions will focus upon my views about the processes involved in obtaining and maintaining vascular access;
- To facilitate data analysis, notes will be taken and interviews will be audio-recorded for later transcription and the audio data destroyed once transcribed;
- I can refuse to answer any question at any time, or end the interview, without giving reasons and without prejudice to my current and future care;

- All data will be treated in strict confidence, and will remain confidential to the research team;
- My opinions will not be shared directly with the doctors, nurses and other health professionals who look after my kidney problems;
- Only anonymised data will be used in any presentation or publication of project findings; unit-specific data will be anonymised for publication according to Scottish Renal Registry policy, which means units (eg “Aberdeen”, “Dundee”, “Glasgow”) will be identifiable but individual patients and staff within the units will not be identifiable;
- Information disclosed during this interview will be used only for the purposes described above.

I have read and understand the above information, and have had the opportunity to ask any questions. I consent to participating in this interview.

Signature:

Print:

Date:

INTERVIEW RECORD

Date

Time

Hospital

Location

Interviewee demographics:

Initials:

Age:

Current vascular access:

Interviewee consent form?

Interviewers

Audio recorded?

Question 1

I would like to talk about your experience of having vascular access created for dialysis (AVF, AVG, CVC). What was your experience of having your current vascular access created?

Who did you meet?

When did the process start?

How long did you have to wait?

Did you understand what the procedure was for?

Did you understand the reason for being offered this particular modality?

Question 2

Have you heard anything about how to look after your vascular access?

Is there routine surveillance of access? If so, how does that work?

Warnings about venesection and practicalities in primary care / clinic / ward?

Managing complications – clotted / aneurysmal AVF

Question 3

What would you change about your experience of vascular access?

If money was no object, how would you make things better?

Are there things you think other patients would find difficult?

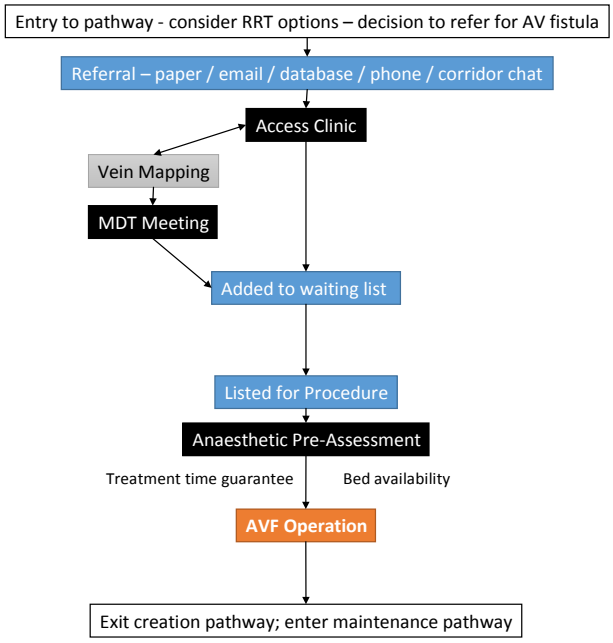
CLOSURE

Thank you for taking part in the interview.

APPENDIX 2 INTERVIEW DETAILS

23/09/2014	Ayr Hospital	Interviewers - SO, DK, PT, RK
23/09/2014	Crosshouse Hospital	Interviewers - SO, DK, PT, RK
10/11/2014	Raigmore Hospital	Interviewers - SO, DK, PT, RK
11/11/2014	Aberdeen Royal Infirmary	Interviewers - SO, DK, PT, RK
12/11/2014	Victoria Hospital Kirkcaldy	Interviewers - SO, DK, PT
12/11/2014	Ninewells Hospital	Interviewers - SO, DK, PT
13/11/2014	Dumfries & Galloway Royal Infirmary	Interviewers - SO, DK, PT
16/12/2014	Royal Infirmary of Edinburgh	Interviewers - SO, DK, PT, RK
23/12/2014	Western Infirmary Glasgow	Interviewers - SO, AH, SS
20/01/2015	Monklands Hospital	Interviewers - SO, DK
23/01/2015	Western Infirmary Glasgow	Interviewers - SO, SS
26/01/2015	Royal Hospital for Sick Children, Yorkhill	Interviewers - SO, PT
26/01/2015	Western Infirmary Glasgow	Interviewers - SO
20/02/2015	Dumfries & Galloway Royal Infirmary	Interviewers - SO, PT

APPENDIX 3 PROCESS DIAGRAMS FOR EACH ADULT RENAL SERVICE



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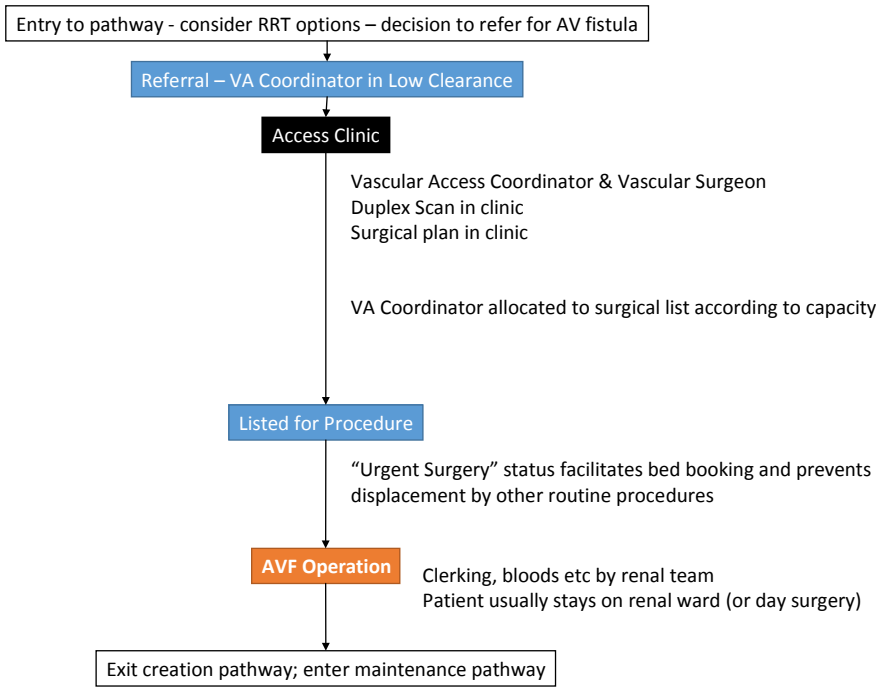
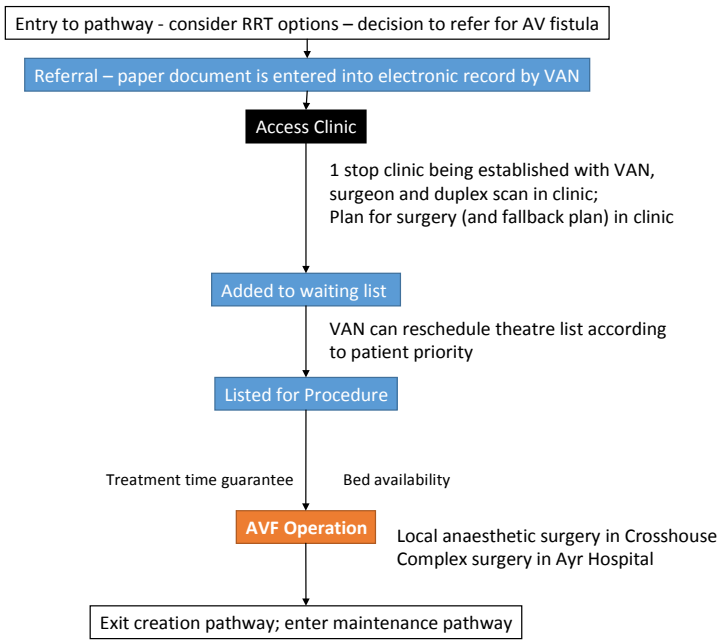
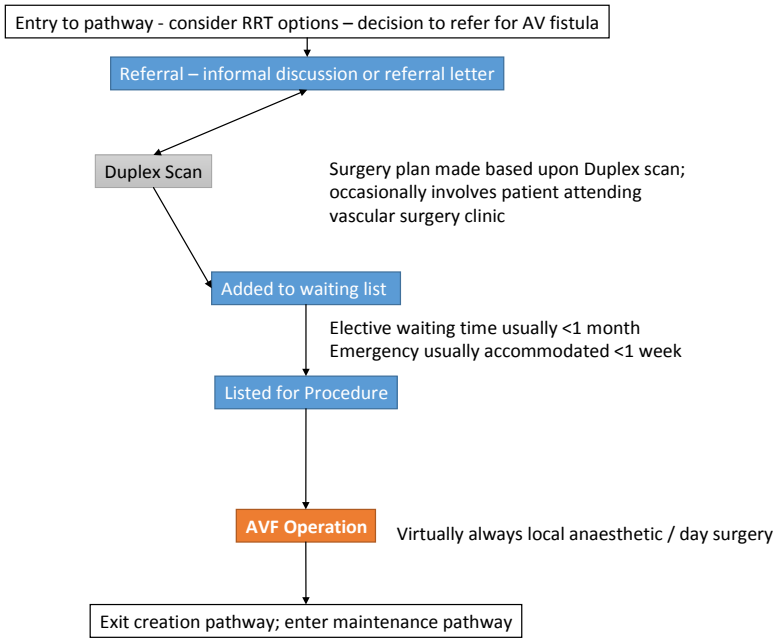


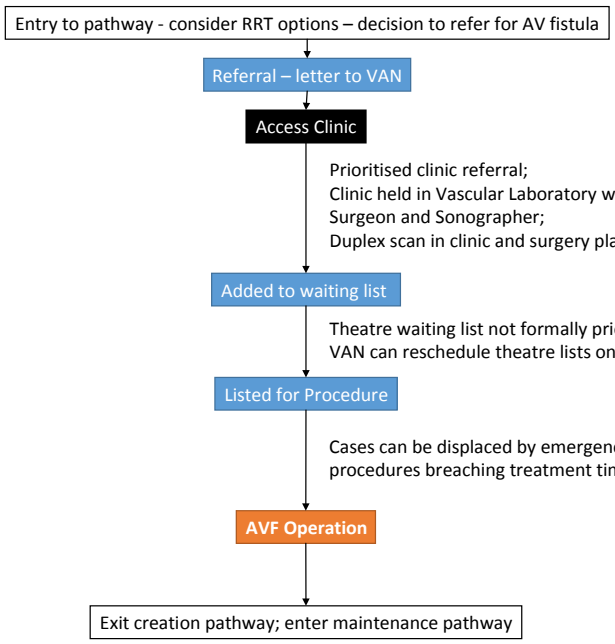
Aberdeen



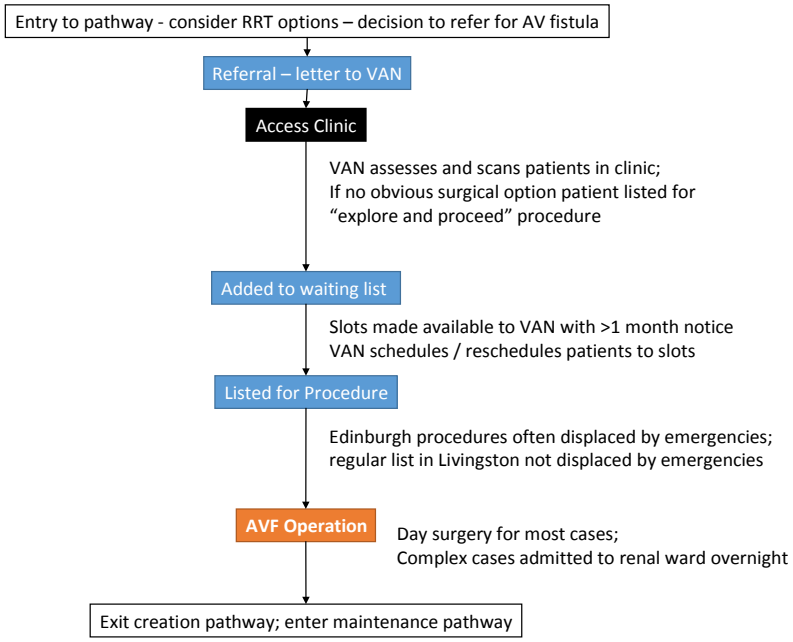
Crosshouse



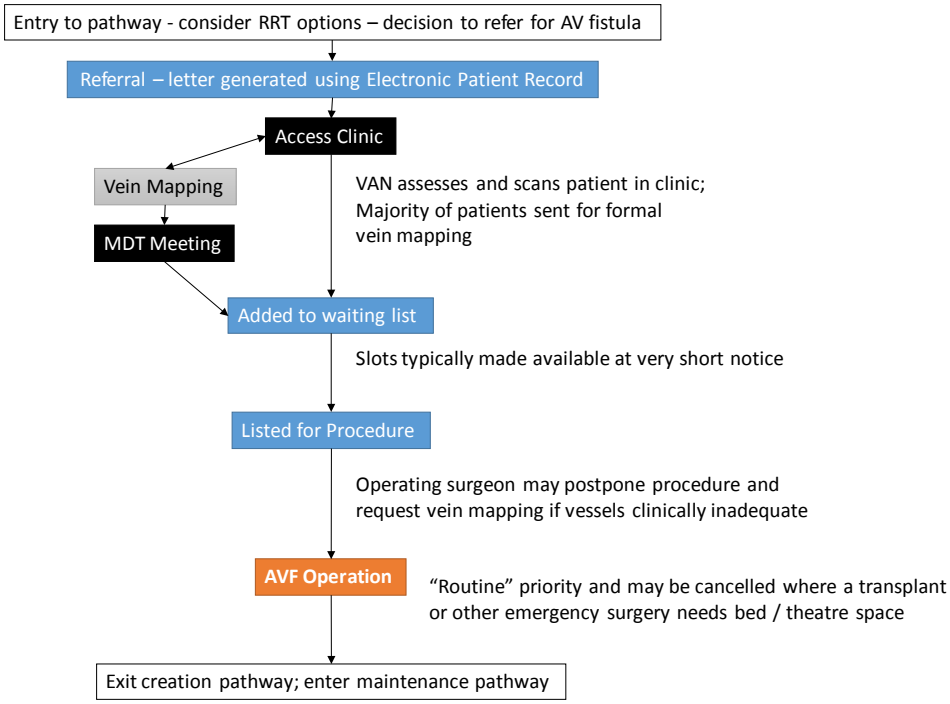
Dumfries



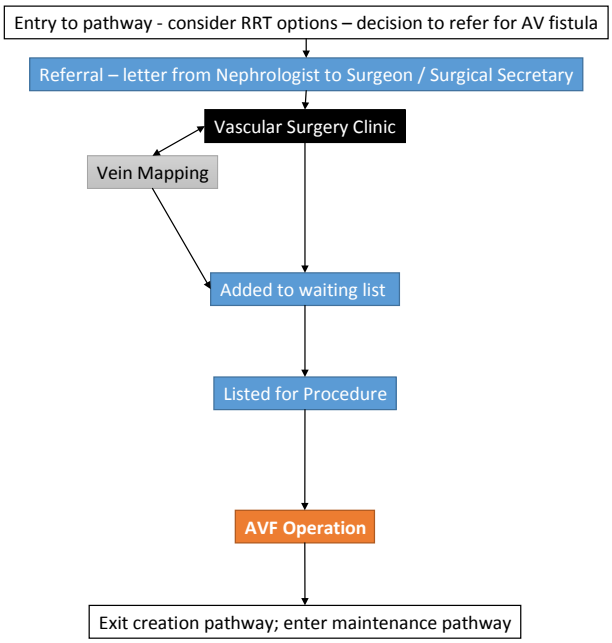
Dundee



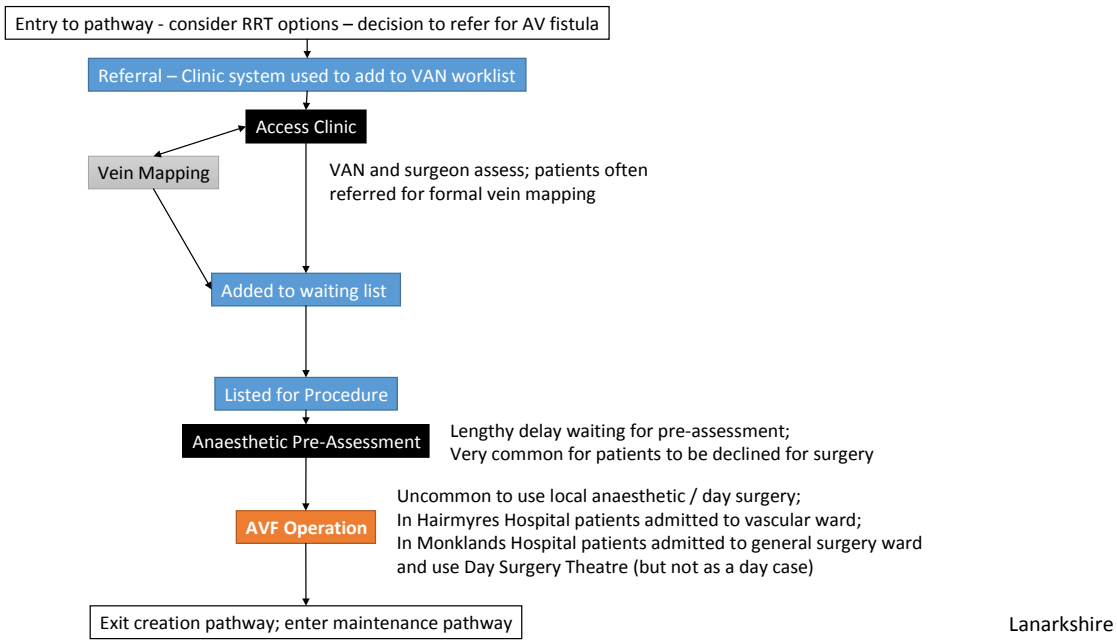
Edinburgh



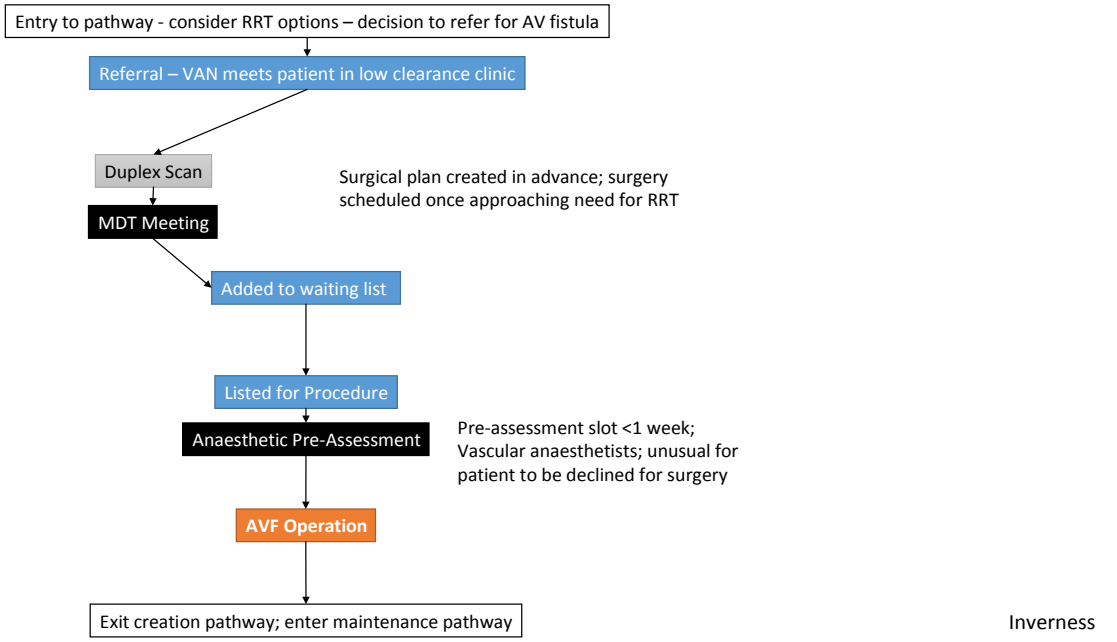
Glasgow



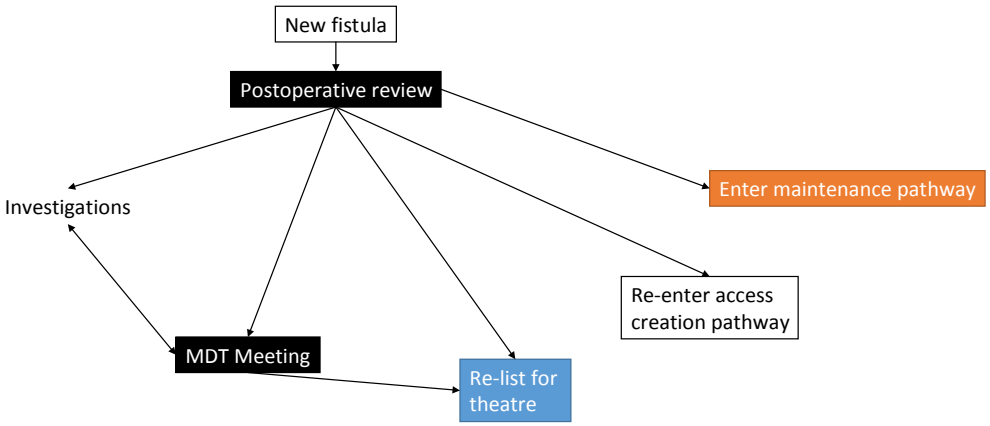
Fife



Lanarkshire



Inverness



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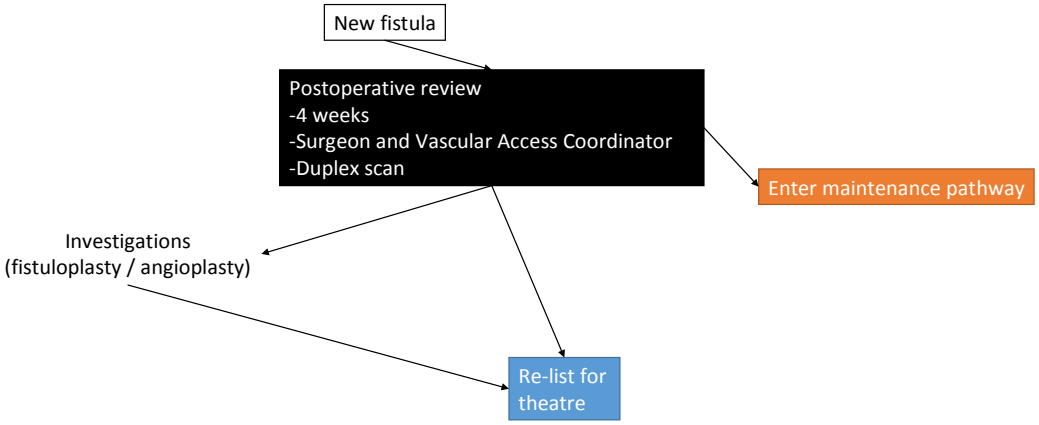
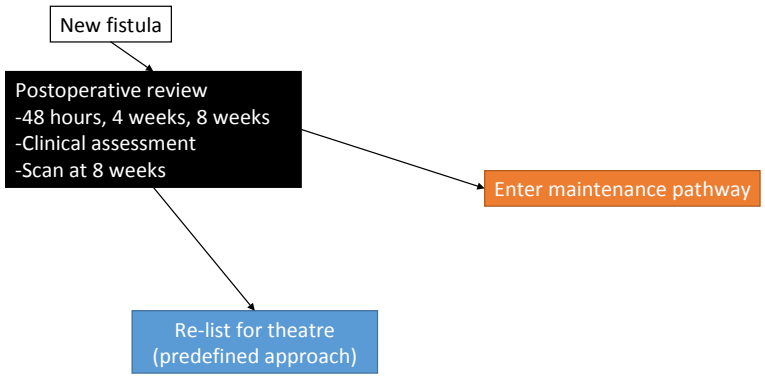
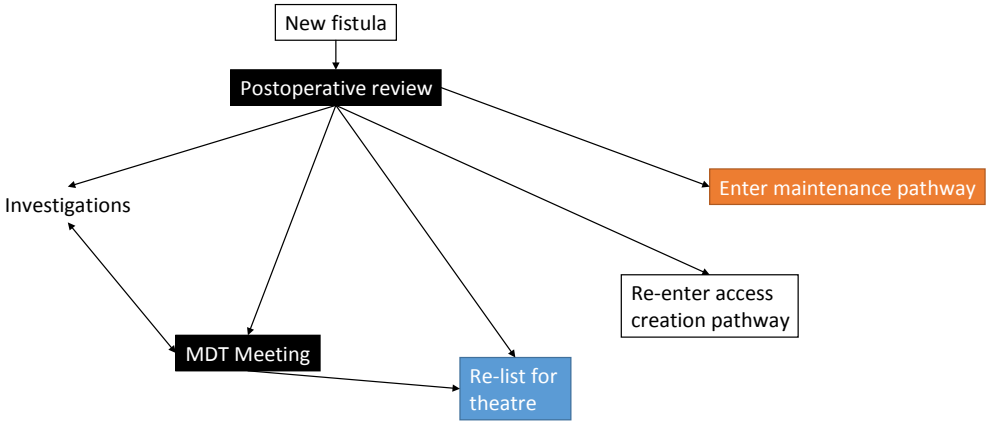


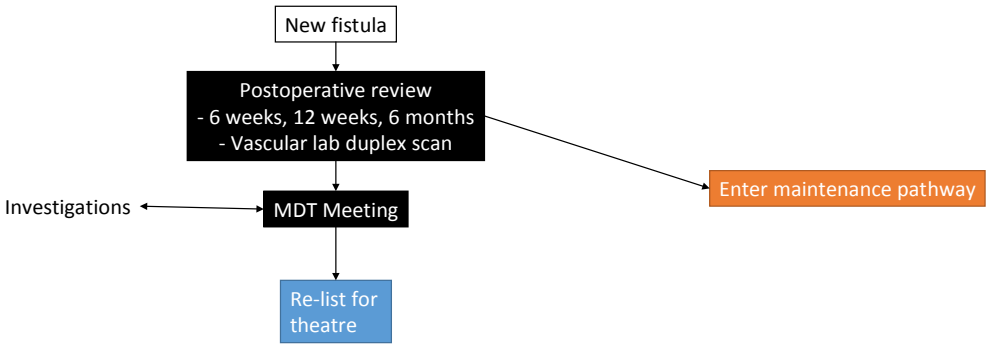
Aberdeen



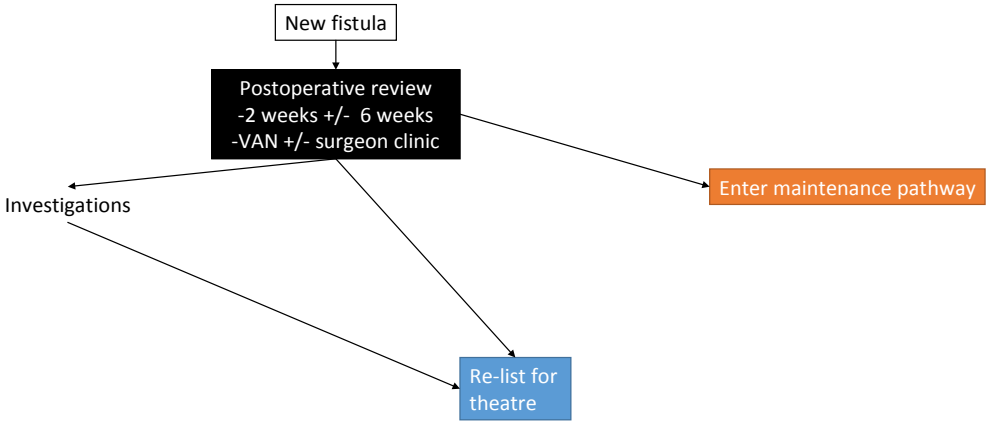
Crosshouse



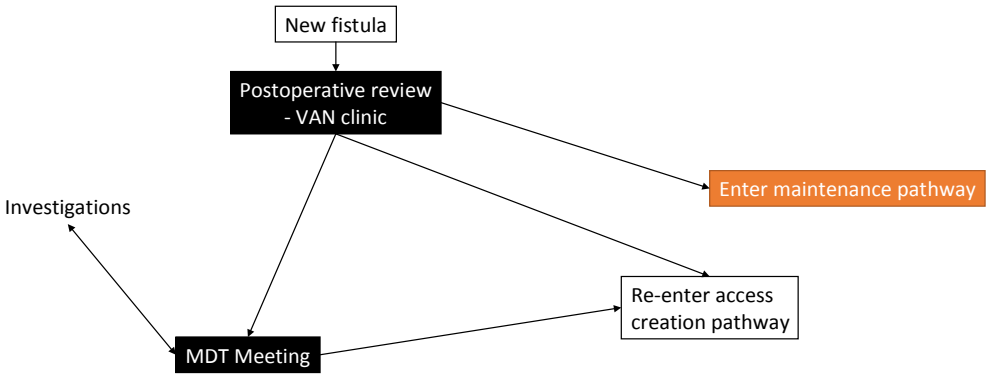
Dumfries



Dundee



Edinburgh



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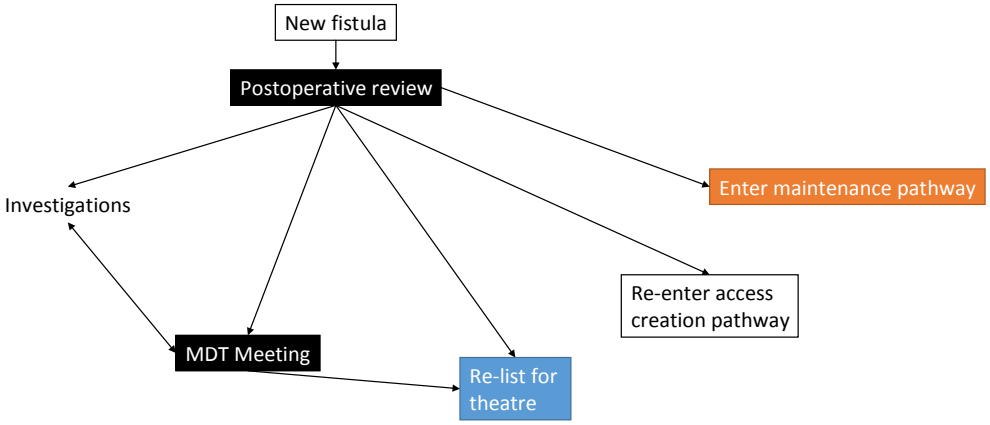

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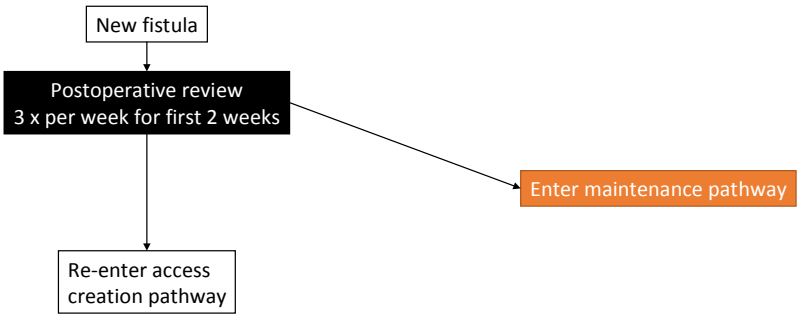
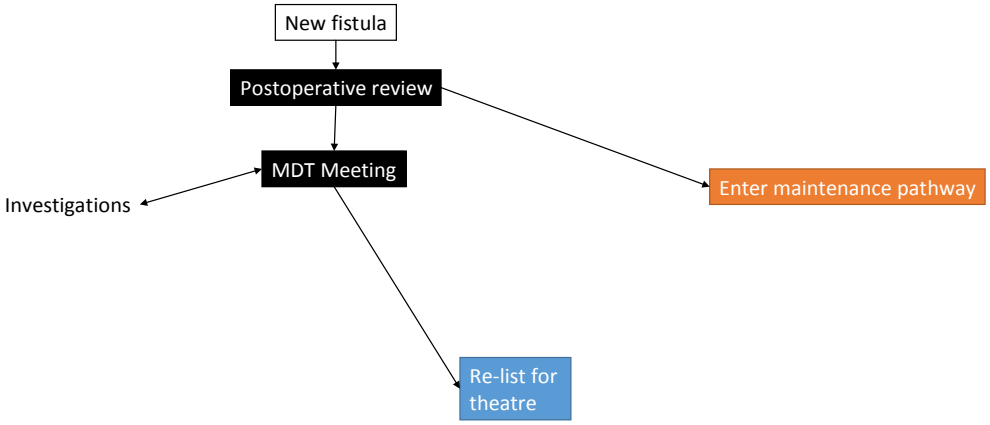


Lanarkshire



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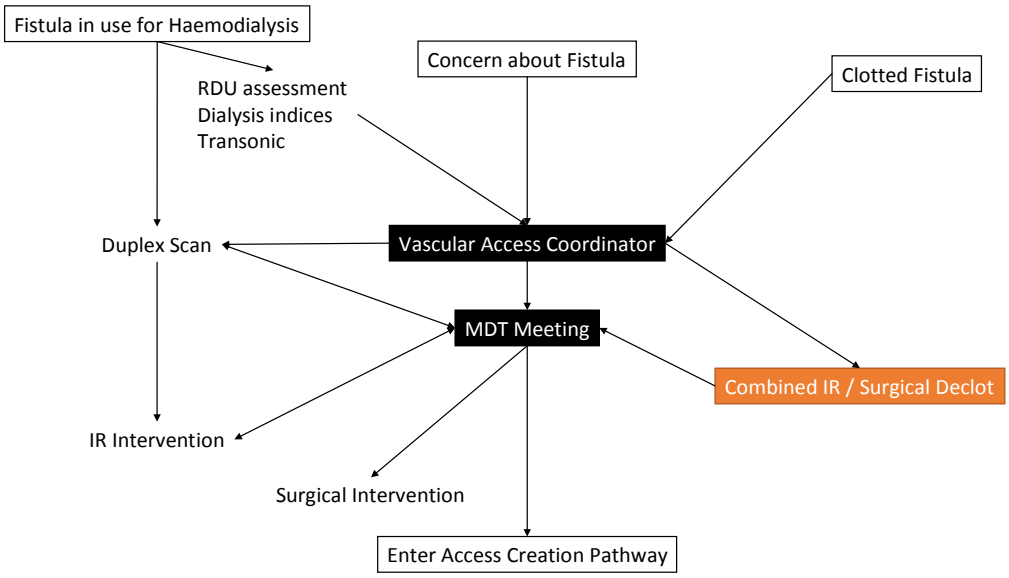

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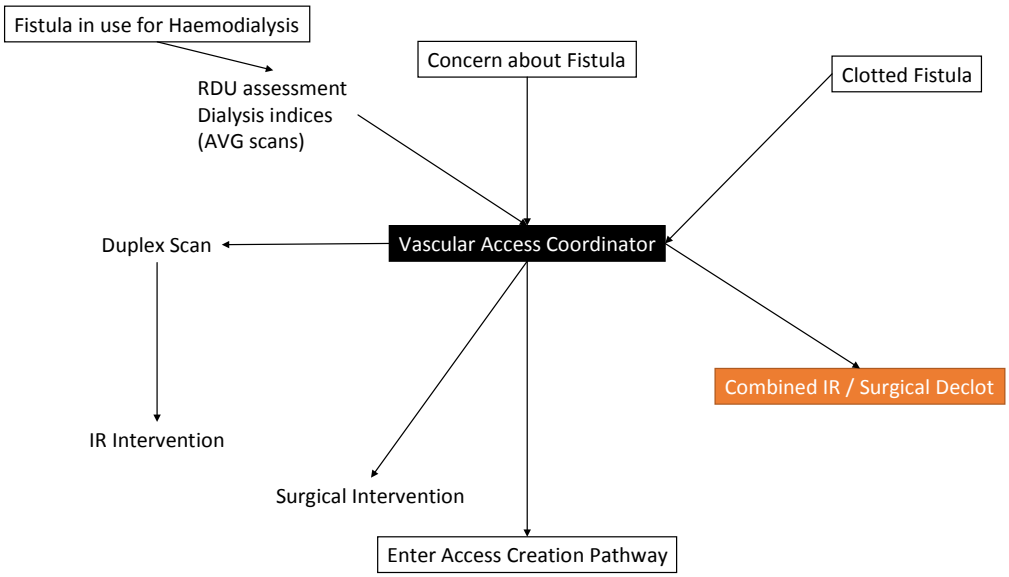

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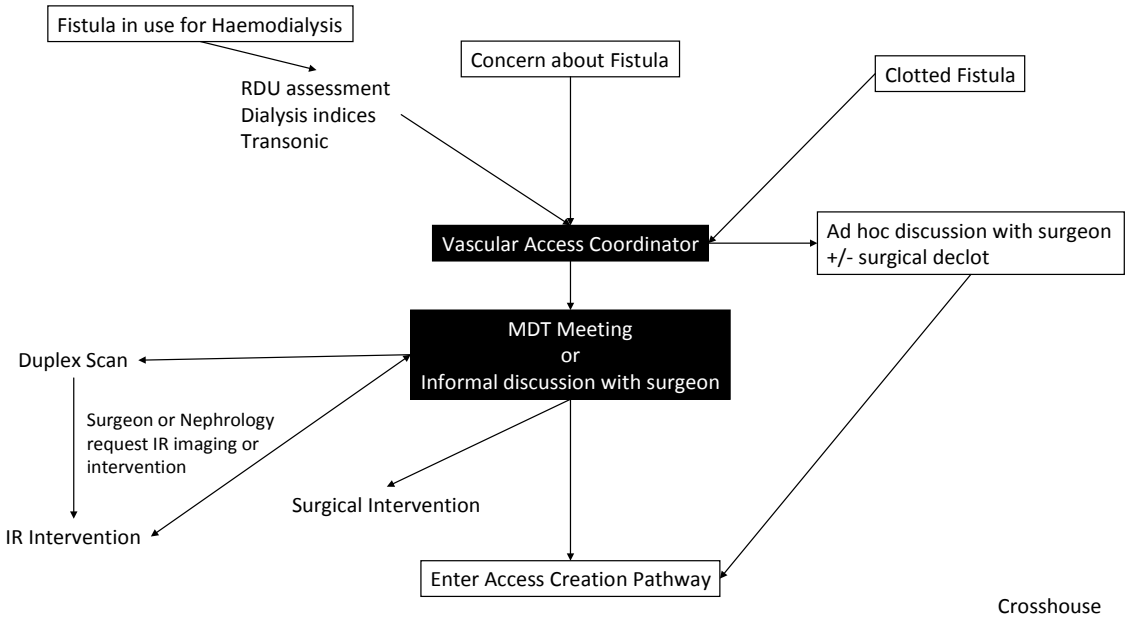

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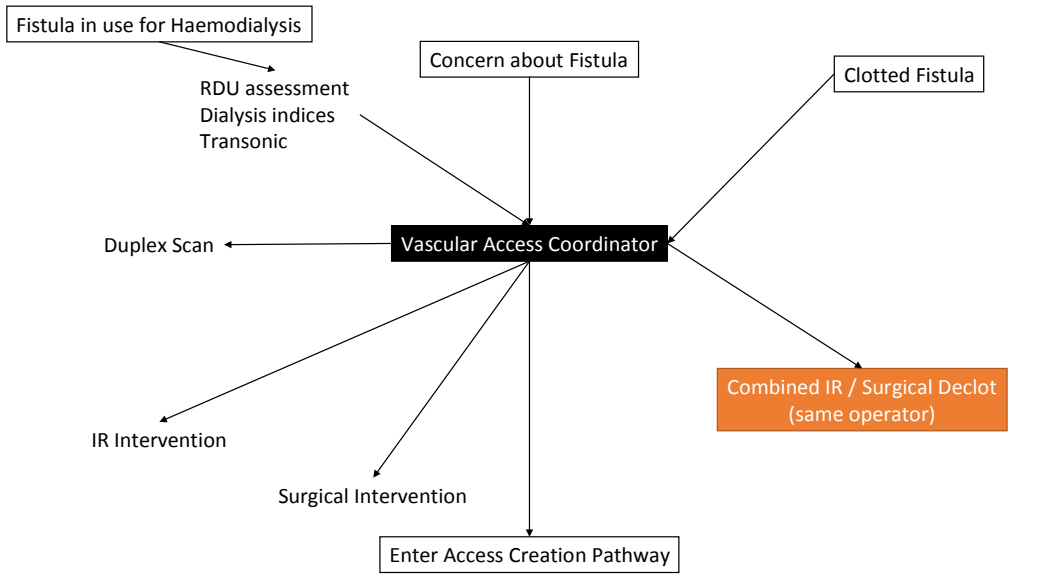

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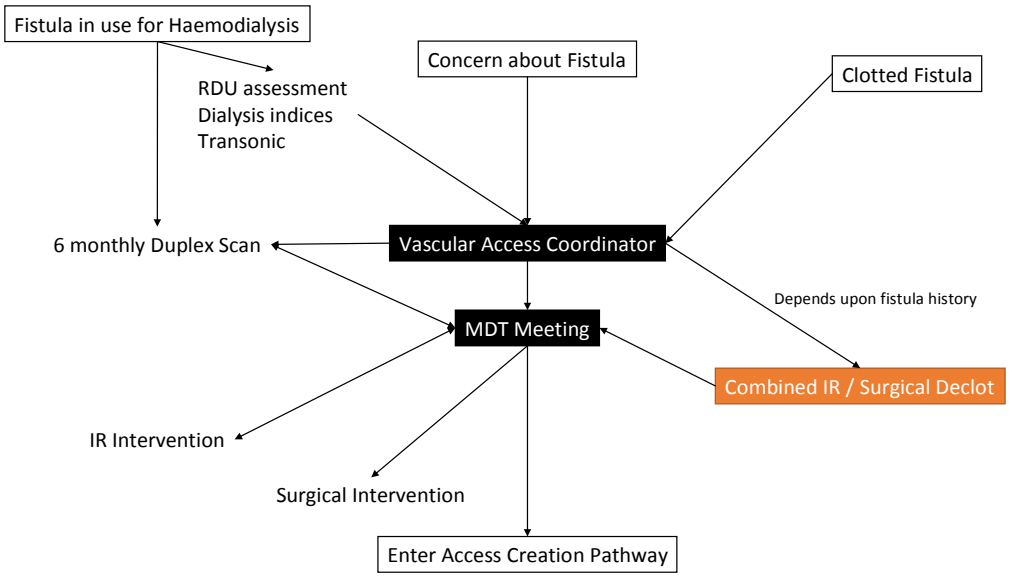

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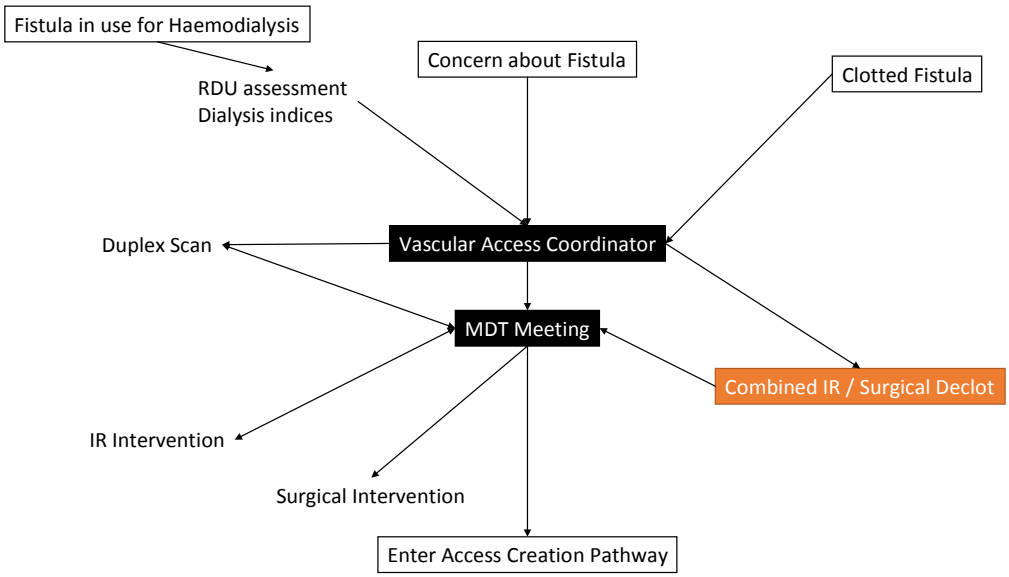

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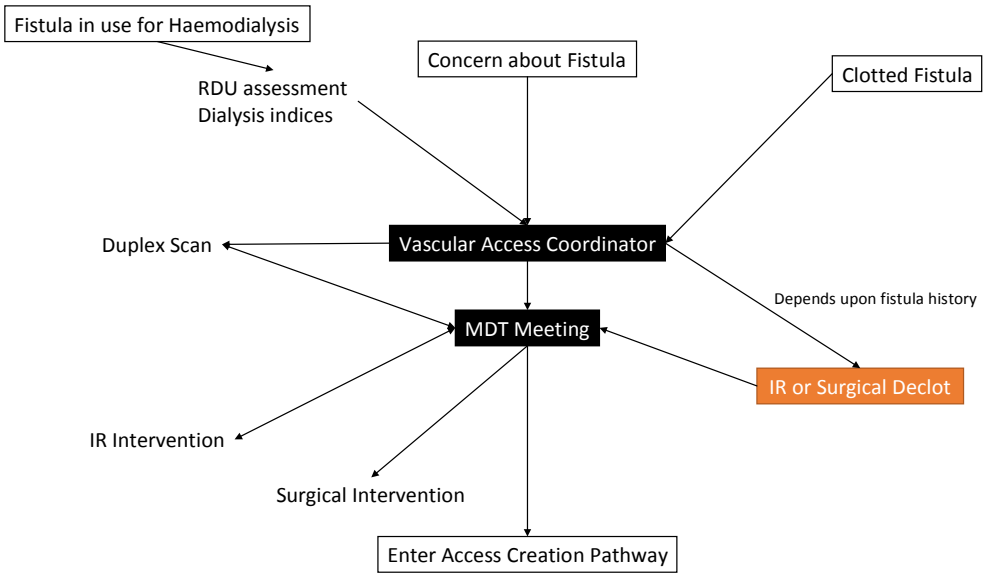

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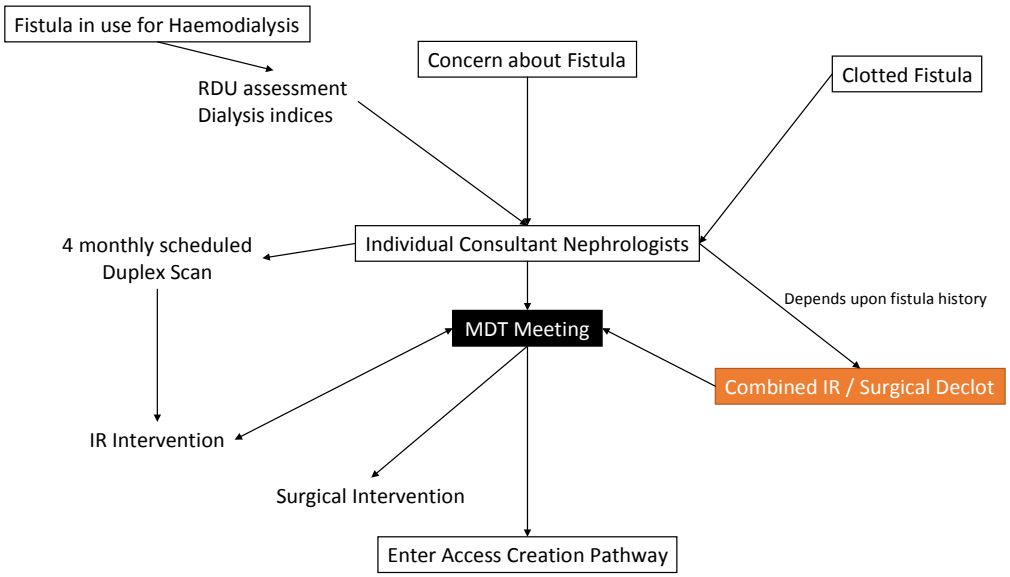

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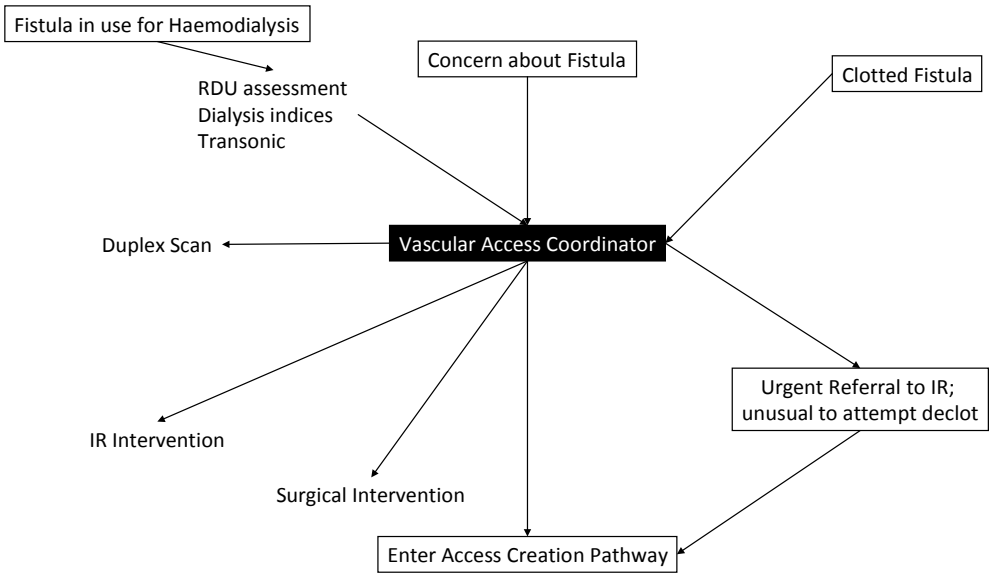

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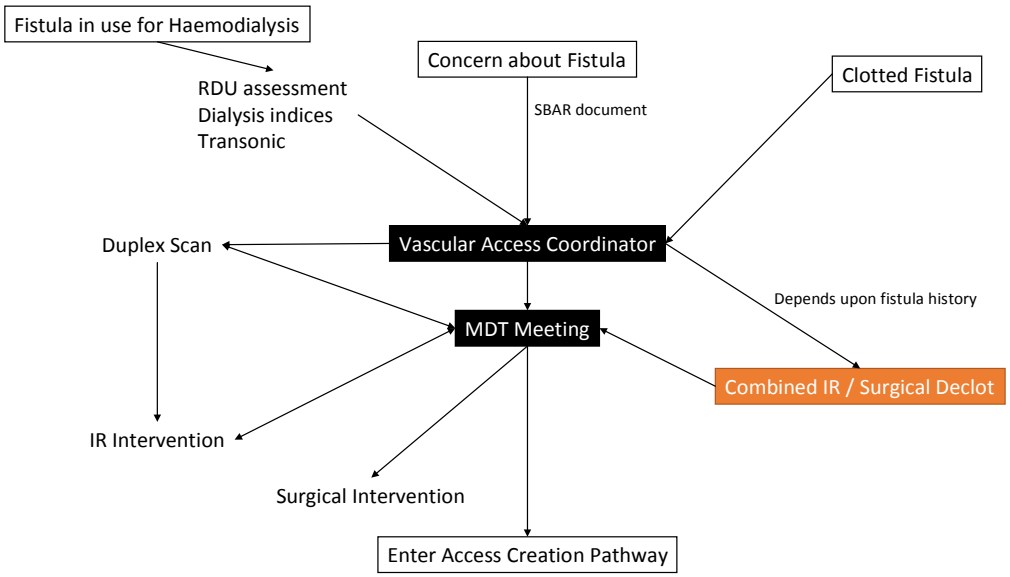
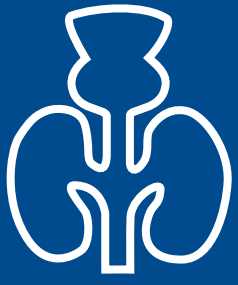


Inverness



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