Proposed Pan London Access Strategy to achieve appropriate native HD access in 80% of the HD population by 2026.

I find myself leading this initiative on an interim basis with little formal validation other than several of my current and past colleagues putting their trust in me. For most individuals supporting haemodialysis delivery across London this is meaningless because we have neither met, spoken nor worked together.

I was born in Zambia and went to school in England and New Zealand before finding myself in receipt of a British army scholarship. My medical degree was from UCL and house jobs done in London, after which I promised myself I would never return to the capital. My surgical training was in Devon, Cornwall and Gloucester leading to a CCT in vascular and general surgery. I then went to South Africa firstly on a transplant and then on a trauma fellowship before gaining a post as a singlehanded consultant general surgeon in a neglected hospital near Stellenbosch. Whilst there I was invited to apply for an RCS post-CCT fellowship in laparoscopic donor nephrectomy and found myself doing this between Guys and the Royal Free. I was appointed to the Free in 2009, moving to the Royal London in 2018. Along the way I have operated in Beirut, Jordan, Ghana, and Jamaica as well as taught surgical critical care in Singapore, the UAE, and India.

I am not sure that I was ever trained in vascular access surgery until I met Francis Calder at Guys, but after this it has been an exercise in applying general vascular principles and remembering what Francis said! Whilst at the Free I worked half time in transplantation and half time in general vascular surgery but participating in both full-time separate transplant and vascular on-call rotas. You could say that I gained 18 years of busy on call clinical experience in nine. I passionately believe that we achieved our sub-20% line rate at the Free because of Colin Forman, Neal Banga, Bimbi Fernando and myself together challenging resource limitations, institutional behaviours, and barriers to pathway refinement as we encountered them. Dr John Connolly, our nephrology CD at the time was also a key enabler. I am under no illusion however that the RFH had the smallest number of patients on HD compared to any of the other London centres. We did learn that as AVF/AVG access rates improve the increased burden on resources to maintain that increase is non-linear, it gets steeper!

When I moved from the Royal Free to the Royal London in 2018, I was leaving from the position of vascular CD, and it is no secret that my move was based on my strong personal belief in the principles of fairness, honesty, kindness, transparency, and pragmatism.

These are the values that I feel we need to promote on our journey to improve haemodialysis access across London. The recently published renal medicine GIRFT report has come at just the right time for the London Kidney Network. It has given us exactly the mandate we need as a group to identify and justify what resource we think we need to deliver a safe haemodialysis service. This will mean identifying variation between our units and understanding the reasons for these differences using Quality Improvement (QI) methodology. This initiative is not just about seeking the right amount of resource. There will be a requirement to set up several different projects, identified by us as a group, that will aim to optimise pathways, needling skills and patient experience, again using QI. We can then establish a haemodialysis service that will deliver the recommendations of the GIRFT report. In addition, I would hope that coming to work will be fulfilling and enjoyable instead of feeling like we are all individually trying to push a rock up a hill every single day.

I invite you to help our London haemodialysis population by engaging with the PLAN, the Pan London Access Network.

Ben Lindsey
Consultant General, Vascular & Renal Transplant Surgeon 22.06.2021

Background, context, and challenges

People with kidney failure can be kept alive by having a kidney transplant or dialysis. These are termed the renal replacement therapies (RRT). Renal Registry data from 2018 showed there were 24,577 people receiving dialysis of which 87.4 % were being sustained with haemodialysis (HD) and the remaining dialysis modality being peritoneal dialysis (PD).

HD generally requires three four-hour dialysis sessions every week for fifty-two weeks a year indefinitely. Blood is removed from the patient at a rate of about 300mls per minute, cleaned by the HD machine and returned to the body. It is accepted that life sustaining HD is best delivered by a native access in the form of an arteriovenous fistula (AVF) or arteriovenous graft (AVG) instead of a tunnelled venous catheter (TVC). This is because the rate of catheter related blood stream infections (CRBSI) is ten times more likely than infections related to either an AVF or AVG.

The healthcare costs associated with blood stream infections (bacteria in the blood or bacteraemia) are reflected in previous generous tariff incentives that reward healthcare providers who avoid delivering HD via a TVC for every session delivered. The human cost of bacteraemia is significant with a mortality rate approaching 25% in the RRT population. A national target of delivering HD via a native access in 80% of sessions has been proposed. In 2018 only 11 of 43 UK centres had achieved this. Of the London centres, only the Royal Free Hospital (RFH) had a TVC rate of less than 20%. It is worth noting that RFH has just over half the number of patients on HD compared to the other London centres.

London is unique, comprising several high-volume centres which between them deliver over a fifth (26.7%) of all HD in England as shown below. It is hoped that learning from attempts to improve access rates pan-London will be transferable to the rest of England and the UK.

Fig. 1 Adult patient dialysis prevalence on 31/12/2018 by detailed dialysis modality and centre *

centre	N on Dialysis	% < 65 yrs wait listed	% > 65 yrs wait listed	% All HD	N all HD	% All PD	N all PD
L Barts	1,341	36.1	7.7	82.3	1104	17.7	237
L Kings	704	29.7	6.1	87.2	614	12.8	90
L Guys	772	37	10.5	94.4	729	5.6	43
L Rfree	861	43.3	10	80.7	695	19.3	166
L St.G	340	41.6	12.8	88.2	300	11.8	40
Carsh	973	32.9	4.9	89.9	875	10.1	98
L West	1,583	48.6	13.7	91.5	1448	8.5	135
London total	6,574	40.4	10.2	87	5,764		810
England	24,577	34.3	7.2	87.4	21480	12.6	3,097
London % of England	26.7				26.8		26.2

* UK Renal Registry Data

Summary of the GIRFT report recommendations for vascular access

The recent publication of the GIRFT programme national specialty report for renal medicine has formed a series of recommendations that sit within 18 categories. One of these categories is vascular access and lists 10 areas for consideration. These are listed below and have then been repeated where relevant throughout the subsequent document, which was written before the author had sight of the GIRFT recommendations.

- 5a. NHS England and NHS Improvement to review differential pricing, and the effectiveness of the existing HD BPT.
- 5b. NHS England and NHS Improvement and professional societies to establish the surgical and IR capacity required to deliver an 80% prevalent definitive vascular access rate. (This will also require formal definition of the pathway urgency to be delivered by relevant teams.)
- 5c. Trusts with a renal service to ensure they have sufficient surgical and IR capacity to support their HD programmes.
- 5d. Trusts with a renal service to ensure their day case surgery rate for HD arteriovenous fistula/graft (AVF/G) formation is a minimum 70% of all cases.
- 5e. All renal centres to have a vascular access co-ordinator post or posts (depending on size).
- 5f. Accountable commissioners to explore network-based commissioning of HD vascular access, including commissioning of dedicated vascular access centres and IR support.
- 5g. Renal centres to optimise skill mix and competencies of clinical staff in the needling and monitoring of HD vascular access.
- 5h. Collaboration with regional vascular access QI initiative to identify local actions needed to implement effective pathways, to be agreed at network level.
- 5i. Intervention (+/- transfer where relevant) of failing or thrombosed vascular access to be sufficiently rapid to avoid central venous access (usually 24–48 hours).
- 5j. A curriculum, training, and qualification process to be developed for credentialing in vascular access intervention.

In addition to the above recommendations for vascular access, eight of the remaining 17 categories share key areas of renal service focus that are key to high quality vascular access delivery and are listed below.

- AKC
- OP / Diagnostics
- Patient experience / SDM
- Workforce
- Infection / IPC
- Hospitalisations / Admissions
- Data
- Procurement

The four proposed domains

Four domains have been identified that together cover 9 of the 10 GIRFT recommendations. 5a is excluded.

Information Technology and pathway design – 5f, 5h, 5i

Access needling skills and empowerment of dialysis nursing teams – 5g, 5j

Operating, radiological and human resource requirements – 5b, 5c, 5d, 5e

Challenging culture, dogma, and myth-busting – 5e, 5j,

Several proposed requisites and considerations are outlined for each domain below. This is not exhaustive, and some suggestions may appear unrealistic or irrelevant.

Information Technology

- 'Automated' pathways within each hospital electronic patient record (EPR).
- Referral for vascular access enabled - within a few mouse clicks.
- Creation of clinical notes that are primarily quantitative but can include a qualitative component.
- Identification of the minimum number of data fields that inform the service about efficiency and therefore areas for improvement.
- Achieve a real-time or weekly output from each centre into a single pan London access network data warehouse.
- A longer-term aspiration could be to use the relationship between data and outcomes to identify areas for change and inform clinical decision making. These data can be distributed to the group anonymously but available on a centre/individual basis also.

Access needling skills and empowerment of dialysis nursing teams

Implementation of Magic (Managing access by generating improvements in cannulation)

I am grateful to Rachel Gair for her aspiration to introduce and embed the practices that "Magic" represents.

Operating, radiological and human resource requirements

Identify the resources needed to maintain 80% access per 1000 patients on HD.

Much of the resource required to create a new working access is predictable whereas the support needed to maintain a haemodialysis access is harder to define. It may be that a snapshot audit is required across London to identify the burden that this represents as well as characterise similarities and differences in local practices.

The weekly number of elective hours of theatre and IR time need to be defined.

The amount of unplanned work resource needed.

Are the surgical instruments and radiology services fit for purpose and streamlined?

There is a large administrative requirement to look after these patients which ranges from non-clinical administration but also a significant amount of administration that requires clinical knowledge. Who currently delivers this could be characterised followed by discussions about how this can be streamlined, automated or may not be required at all?

Changing culture, challenging dogma, and myth-busting

Identify barriers to change.

Patients with renal disease represent a challenging cohort, primarily because of medical comorbidities and logistical challenges. There may be more challenges to getting these patients into the theatre or IR suite than many other specialty patients. For many of these patients however doing nothing is not an option so the procedure will need to be done and delay for another test may be treating the clinician and not the patient?

Is the vascular radiology resource being used appropriately? Does a surgeon need to use a skilled vascular technologist to measure the superficial veins?

What is the best surgical approach to salvaging a brachio-axillary graft that has had failed IR salvage? Some surgeons always open the arterial end – some the venous.

Is it true that attempting to create a RCAVFs in certain ethnic groups is futile?

Do clinicians delivering the access service (anaesthetists, radiologists) have access to and read/document medical notes on a bespoke renal software?

Should each patient on HD be issued with their own stethoscope when the fistula is made and they are taught to use this, as well as bring it with them to each HD session. They can be taught to offer the stethoscope to the cannulating nurse to reinforce the need to listen to it before every cannulation. The cost of a stethoscope is a tiny fraction of the cost of the initial basic AVF creation……

Areas of defined improvement for discussion

The common resources being competed for include:

Access to theatre
Inpatient beds
Day procedure beds
Access to interventional radiology (IR)
Access vascular scientists delivering duplex scans
Consultant nephrological, anaesthetic and surgical support

This interdependency could be perceived as negatively impacting the fulfilment of both objectives. Delivering these unpredictable services in a timely manner is perceived as a major challenge. Nobody knows who will be transplanted on any day nor when an access will fail. Furthermore, there is great variation in the approach by individual centres to managing a failing or failed access.

Access to IR support is very variable with some centres offering 24/7 services and having a weekly joint radiology/surgery MDT whilst others have limited weekday access and less collaborative working practices.

Delivering anaesthesia within the renal failure population is challenging. Many consultant anaesthetists are uncomfortable working in this area, which can act as an additional barrier to undertaking unplanned fistula salvage procedures in the emergency theatre environment. There is an increasing realisation that many patients undergoing access surgery would benefit from having regional anaesthetic, a modality that is not comfortably delivered by all renal anaesthetists.

Basic approaches to meeting the above challenges

There are several apparently simple measures that could be pursued to improve the safety of vascular access for the HD population. These include targeting the incident as well as the prevalent population groups by adopting clear time limited objectives in the access pathways. To external agencies and non-clinicians, the suggestions below appear simple however all members of the team are familiar with the multiple and persistent barriers to achieving them.

The incident access population

- **5d. Trusts with a renal service to ensure their day case surgery rate for HD arteriovenous fistula/graft (AVF/G) formation is a minimum 70% of all cases.**

1. **Creation of a new basic or complex surgical or radiological (endo-AVF) within two weeks of referral.**

2. **Creation of a new surgical or radiological vascular access during the same admission in all crash-landers where appropriate. Appropriate means that the patient has been able to process the need for native access and that their physiology has normalised sufficiently not to compromise the likelihood of access surgery success.**

The prevalent access population

- **5e. All renal centres to have a vascular access co-ordinator post or posts (depending on size).**

3. **Correction of an existing vascular access within 2 weeks of the decision that it is required. This includes radiological (fistuloplasty/stenting) as well as surgery for a failing access.**

4. **Creation of a working vascular access in all patients that have been on PD for more than 50 months - the concept of the back-up AVF.**

5. **Active management of a thrombosed AVF from the moment it is detected with the aim of restoring it, minimising the need for a bridging temporary line insertion.**

6. **Ensure that every patient with a vascular access has a "thought about" and documented plan describing a proposed next step when it fails. This may include the output from joint radiological and surgical MDT discussion.**

7. **Develop an acceptance and acknowledgement within the Low clearance and HD patient populations that acquiring and using a native vascular access is achievable with minimal fuss, discomfort, and inconvenience.**

- **5g. Renal centres to optimise skill mix and competencies of clinical staff in the needling and monitoring of HD vascular access.**

- **5j. A curriculum, training and qualification process to be developed for credentialling in vascular access intervention.**

8. **Educate dialysis unit staff about the anatomy, physiology, and pathology of vascular access to empower independent safe access troubleshooting and reduce needling injuries that result in the need for a salvage procedure.**

Quantifying predictable and unpredictable activity – vascular access

Running a vascular access service is like managing a fleet of cars. There are predictable requirements such as the purchase of new stock and its maintenance, as well as the unpredictable need for repairs and the scrapping of cars when these repairs are too costly or there is significant damage. This analogy may seem basic and patronising however it is a particularly useful tool when trying to explain to patients and operations managers why an individual needs to come to hospital yet again for another vascular access procedure. It also mirrors the need to service and fix a new problem definitively rather than waiting for a breakdown to happen and administering an apparently less costly and temporary repair. For example, investing in enough small ultrasound machines will allow the access cohort to be monitored and needled more safely despite the apparently large initial capital investment. Maybe every mobile mechanic should have their own set of tools, maybe every clinician delivering an access service should have their own pocket scanner?

There is a counter argument to the above. There will be a group of patients in whom an apparent abnormality has been detected but despite this good dialysis is being achieved and the fistula is being effortlessly needled and decannulated. A seasoned team will decide if this status quo can be permitted without intervention, but with a clear plan put in place so that should failure occur, salvage can be actioned immediately.

The magnitude of the resources required to deliver dialysis to over 6,500 patients pan London means that an initial data driven approach will inform the team about where the barriers to delivery are greatest. The very crude data presented below will act as a starting point. Resources required are expressed as units per 1000 patients on HD per annum or **1000pHDpa**.

Predictable – Basic access creation – SB, RC, BC & BB1 arteriovenous fistulae – 60 minutes op time, 30-minute turnaround time. 300 cases per 1000HDpa

Generally, the size of the haemodialysis population in the UK is stable or growing. The actual numbers of access cases generated per 1000 patients on haemodialysis is very predictable. There will be approximately a 20% - 25% turnover in this population per annum as a combined result of transplantation and death. In a steady state HD population approximately 300 new basic access procedures will need to be done per 1000 patients on HD annually. The figure of 300 is derived from the 250 first time cases undertaken of which about 20% will fail (conservative estimate) adding a further 50 to this number because of requiring a second attempt. Basic access procedures comprise snuffb0x, radio-cephalic, brachio-cephalic or first stage brachio-basilic AVF creation. These require 60 minutes of operating under local anaesthetic. ***Allowing for a 30-minute turnaround time between cases, 450 hours of full-time operating would be required per-annum per 1000 patients on HD to deliver basic AVF surgery.***

Predictable – Complex access creation and maintenance – superficialisation of BB1, brachio-axillary AVG, interposition graft, aneurysmraphy & others. Ninety minutes operating time, 45 mins anaesthetic time, 15-minute turnaround time.

The number of complex AVF procedures undertaken per 1000 patients on HD per annum may be more variable between units. Examples of the most common types of complex operation are superficialisation of a first stage brachio-basilic AVF, creation of a single stage brachio basilic AVF, placement of primary grafts, interposition grafts for radiologically resistant stenosis as well as the management of aneurysmal fistulas. ***It is suggested that these complex AVF procedures take an estimated average of 2.5 hours including anaesthesia time.*** The number of complex cases is estimated as ranging between 25% and 75% of the number of new basic access procedures described above – between 75 and 225 complex access procedures per 1000 HD patients per annum. True values can be obtained for each unit from theatre activity records. The range of number of cases is 75 to 225 requiring between 187 and 562.5 operating hours per 1000pHDpa.

Unpredictable - Repair and write-off, combined unplanned IR and theatre time for access salvage

Assuming a native access rate of 80%, based on the data in figure 1 above, this represents 800 fistulas or grafts being needled per 1000 patients on HD. Based on two needles being placed for every access session, a 100% successful cannulation rate requires 4,800 perfect cannulations per week (800 patients with an access x 2 cannulations per session x 3 sessions per week).

Fistula and graft cannulation teams are generally very skilled however even with a 99.95% success rate, this will result in 2.4 problematic cannulations per week per 1000 patients on HD because of "blown" access (4,800 x 0.0005). With erosion of needling skills, it is evident that the number of failed access because of cannulation failures will rise.

In addition, several access's will be discovered to be clotted at the time of dialysis attendance – an estimation has been made that these will equal the number of blown AVF/AVGs, resulting in a total of 4.8 failed access per week (2.4+2.4) or 250 failed fistulas per 1000 patients on HD per annum.

These may not have failed because of the current cannulation technique but be discovered to be clotted because of an adverse event on decannulation following the previous session. Fistulas can fail for other reasons too, which include concurrent sepsis or hypovolaemia (hot weather) both of which can lead to low blood pressure and therefore thrombosis. It is well recognised that access thrombosis can be a precursor to patient death.

Clotted fistula salvage management may be successful after a single IR or single surgical intervention or may need both modalities. For ease of initial calculations, it will be assumed that surgical salvage and IR salvage take the same amount of time as Complex access creation and maintenance – 2.5 hours.

Following an audit, it will become clear what the ratio between IR and surgery is for primary intervention by site and access and the number of patients undergoing both. It will be assumed that 25% of cases will need both modalities resulting in 312 interventions (250 plus 62) or 780 hours of combined unplanned theatre/IR time. Assessment of real-life practice will inform the project about the predictors and volume for the use of a hybrid theatre.

Fig 2 – estimation of resources required for planned and unplanned vascular access activity

Activity	Hours of activity per 1000 pts on HD per annum (1000pHDpa)
Planned basic new AVF Creation*	450 hrs 1000pHDpa
Planned Complex access creation and maintenance **	187.5 - 562.5 hrs 1000pHDpa
Unpredictable - combined unplanned IR and theatre time for access salvage	682.5 hrs 1000pHDpa
Total number of combined hours per 1000 pts on HD	1320 - 1695 hrs 1000pHDpa
Total number of elective weeks of resource assuming activity between 0800 and 1800 - Monday to Friday (50 hours)	12.75 - 20.25 wks 1000pHDpa
Number of unplanned weeks of resource (theatre plus IR) assuming activity between 0800 and 1800 - M to F (50 hours)	13.65 wks 1000pHDpa
Total number of weeks of resource assuming activity between 0800 and 1800 - Monday to Friday (50 hours)	26.4 - 33.9 wks 1000pHDpa

* **Could some or most of this activity be done outside a theatre suite?**

** **Based on the assumption that the number of complex AVF cases reflects a further 25% – 75% of the basic AVF programme.**

Quantifying predictable and unpredictable activity - renal transplant activity

Although the Pan London Access Network brief is to improve vascular access rates, the objective cannot be considered in isolation from the concurrent objective of delivering a high-quality renal transplant programme. This is because a significant proportion of people receiving dialysis are also waiting for a kidney transplant as outlined in Figure 1, 10% above 65 years and 40% below.

* NHSBT Annual report 2017/18

Broadly a live donor kidney transplant takes 8 hours of theatre time. Based on data from 2017/18 this means that 1864 hours of theatre time are required per annum (233 x 8). ***For this paper gross generalisations have been made to express this time as a proportion of patients on HD. This generates a figure of living kidney transplant operating requirements of 324 hours per 1000 patients on HD per annum.***

The same assumptions have been made for deceased kidney surgery if a deceased kidney transplant will consume four hours of theatre time. This totals 2,252 hours (563 x 4 hours), or 390 hours per 1000 patients on HD per annum.

Figure 3 Estimated amount of combined theatre and IR time needed to support an access and transplant population per 1000 individuals on HD.

Activity	(1000pHDpa)
Planned basic new AVF Creation	450 hrs
Planned Complex access creation and maintenance	187.5 - 562.5 hrs
Unpredictable - combined IR/OR time for access salvage	682.5 hrs
Unpredictable (deceased) kidney transplant activity	390 hrs
Planned live donor activity	324 hrs
Total activity (hrs)	2034 - 2409 hrs
Total activity (wks of OR/IR time-50 hrs/wk)	40.68 - 48.18 wks

One proposed solution

The above data have been generated using some very crude assumptions based on relatively recent validated UK renal registry and ODT UK data. The true requirements are often not acknowledged or simply under-estimated by institutions because when analysed objectively they appear burdensome from a theatre, anaesthesia, and IR resource perspective.

The mandate to definitively fix a failed dialysis access can be clouded by the issue of medical safety.

The risk of high potassium (hyperkalaemia) which will lead to cardiac arrest can understandably become the focus of urgency rather than getting on with an immediate intervention. Anaesthetists accustomed to managing renal patients will often be happy to get on with a definitive fix with the intention of the newly repaired access being safe to use straight away post operatively to correct hyperkalaemia and acidaemia. This working relationship relies on an established, mature relationship between the surgical and anaesthesia teams.

Nationally, transplant surgeons often feel fatigued because of the need to constantly argue the case to have timely access to emergency (CEEPOD) theatre. Activity is often pushed into the early hours of the morning which will not register as an issue on the radar of senior hospital management. The transplants are delivered at the cost of operating when the body should be resting, and instead of definitively fixing vascular access a line is placed instead. These challenges are further complicated by the need for separate green and amber Covid-19 pathways.

Kidney transplants often start in the early hours of the morning in the CEEPOD theatre because there is anxiety from the surgical team that waiting to start at 0800 hrs will not be guaranteed because of ongoing direct competition with life threatening emergencies – specifically head injuries (code black), exsanguination injuries (code red) and other life-threatening emergencies as well as competing organ (liver) transplants. A case could be made for not attempting vascular access salvage surgery between 2000 and 0800 because this patient group are medically complex. Actuarily the risk/benefit is in favour of placing a temporary dialysis line because again – there is no guarantee of being able to operate at 0800 hrs the following morning.

	Same site Trauma centre	Same site Liver transplant center
L Barts	√	x
L Kings	√	√
L Guys	x	x
L Rfree	x	√
L St.G	√	x
Carsh	x	x
L West	x	x

If a Monday to Friday dedicated renal theatre could be funded at each centre, then it may be possible to stop the renal transplant and access service from impacting the CEEPOD list with the exception the rare occasion when a DCD organ is delivered to the centre at 2300 hrs already having been explanted from the donor 20 hours previously. It should be possible model the theoretical impact on cold ischaemia time (CIT) by adopting a policy of having a funded transplant theatre available between the hours of 0800 and 2400 hrs. This would require planning NOT to put knife to skin any later than 2100 hrs and therefore maintaining the operating window within the 0800 to 2400hr envelope.

The total resource required to deliver the transplant and vascular access services per unit could be calculated and expressed using some of the assumptions made above.

Total adult kidney transplants 2017/18 *		**Theatre time in hours (theatre wks assuming 0800 - 1800 day)**	
centre	**All kidney transplants** (of which Live donors)	Deceased kidney programme - assuming 4 hours per case	Living kidney programme - assuming 8 hours per case
L Barts	128 (39)	356 (7.1 wks)	312 (6.24 wks)
L Kings			
L Guys	207 (77)	520 (10.4 wks)	616 (12.3 wks)
L Rfree	141 (30)	444 (8.8 wks)	240 (4.8 wks)
L St.G	141 (41)	400 (8 wks)	328 (6.56 wks)
Carsh			
L West	179 (46)	532 (10.64 wks)	368 (7.36 wks)
Ln total	796 (233)	2252 (45 wks)	1864 (37.3 wks)
England	3272 (952)	9280	7616
London % of England	24.3% (24.4%)		

From the above it can be appreciated how the provision of different amounts of theatre resource will allow the transplant and access services to be delivered. With intelligent management, if the last

option were trialled, offering a renal operating theatre from 0800 hrs to 2400 hrs then the "spare" capacity could be given back to other cases needing CEEPOD resource.

HD is dogmatically delivered using a very organised and structured regime throughout the UK out of necessity. Individuals will belong to one of six dialysis cohorts, receiving dialysis in either the morning, afternoon or evening on either Monday, Wednesday and Friday or Tuesday, Thursday and Saturday as shown below.

The structure of HD delivery in the UK.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
am	Patient A	Patient D	Patient A	Patient D	Patient A	Patient D
pm	Patient B	Patient E	Patient B	Patient E	Patient B	Patient E
evening	Patient C	Patient F	Patient C	Patient F	Patient C	Patient F

It is proposed that this dogma is extended to optimise the utilisation of a dedicated renal operating theatre. As shown just under half of the HD population are waitlisted on the deceased donor waiting list.

	% on HD &PD < 65 yrs wait listed	**% on HD &PD > 65 yrs wait listed**
London total	40.4	10.2

If elective access admissions for surgery are cohorted into am and pm admissions then when required, the pm cohort can be cancelled to allow for emergency cases. This is reasonable if the pm cohort comprises patients active on the transplant waiting list. This cohort is likely to benefit from this policy when they are called into the hospital to have a kidney transplant.

- **5c. Trusts with a renal service to ensure they have sufficient surgical and IR capacity to support their HD programmes.**

- **5b. NHS England and NHS Improvement and professional societies to establish the surgical and IR capacity required to deliver an 80% prevalent definitive vascular access rate. (This will also require formal definition of the pathway urgency to be delivered by relevant teams.)**

Initial approach to developing the pan London access strategy

A proposed way forward.

1) The document enclosed, ***PLAN V 1.5*** is an exceedingly early attempt to draw together some thoughts that I have had during my time working as a vascular access surgeon, as well as having had conversations with people from across the seven units in London. It is in no way exhaustive, but I wanted to set out some ideas that would act as a springboard for discussion.

   Please feel free to circulate this to members of your team. Please also encourage individuals to feedback, either in an e-mail, or by leaving reviewers comments in the document itself. Both types of feedback can be e-mailed to ben.lindsey@nhs.net.

2) ***It is proposed that there will be a separate "quick and dirty" survey monkey poll that will act sa a time and resource efficient tool to gain some early data about the current perceived priorities to improve the quality of haemodialysis services.***

3) An action to discuss within the group is to undertake **a two week "access snapshot"** at all London centres before the summer holidays – the provisional fields include:

   Number and type of elective vascular access operations done at each centre and associated length of stay for each case.

   Number and type of unplanned vascular access operations done at each centre and associated length of stay for each case.

   Number and type of elective IR vascular access procedure done at each centre and associated length of stay for each case.

   Number and type of unplanned IR vascular access procedures done at each centre and associated length of stay for each case.

   This needs to be done before the summer school holiday period to ensure representative extrapolation of a year's activity.

   In addition, we need o collate the nature and number of elective fistulas created per annum in each unit as well as the number of WTE nurses, surgeons, radiologists, CNS's, and administrators delivering vascular access per unit.

4) We will then write to each stake holder at each unit with a request that they return a list of specific questions that they would like to know the answer to from the wider group – examples are:

   Surgeons at Guys want to ask the nephrologists pan-London - "when do you think is the right time to refer a patient to have a first access created?"

   Access CNSs at Imperial want to ask the ops managers pan-London "How many hours of in house CPD do the dialysis nursing teams currently have per annum and how much is appropriate per annum?"

   Nephrologists at Royal Free want to ask the surgeons Pan-London "what are the reasons why you can't make a new basic AVF in a crash lander during the same admission?"

"Operations managers want to know why the surgeons pan-London keep overbooking their operating lists?"

Radiologists at Royal London want to know which side the surgeons want a tunnelled venous catheter placed following failed IR declot – the same side as the AVF or the other side?

Renal administrators want to know how the renal anaesthetists want their pre-op assessment clinics to be booked?

Heads of nursing at Royal London want to know from each unit what the dialysis staff turn-over rates, percentage of vacancies, and ratio of nurses to HD stations are.

Some of these examples clearly reflect specific clinical issues about which there is local sensitivity whilst others are more generalised. Both types of question are invited because for this project to succeed, individual departments need to express issues that they perceive represent barriers to improvement, or for which they would value the opinion from other centres.

Rachel Gair and I will then collate all the responses to these questions and send them out to the groups at each centre for responses over the summer.

We will meet the PLAN in early September with the output of:

A summary of the feedback from document 1.5 and specifically the Doodle poll.

Results from the 14-day snapshot view.

A breakdown of the questions asked by each stakeholder group.

A breakdown of the responses to the above.

I anticipate that very shortly we will be well on the way to identifying 5 - 8 projects that have leaders and teams that can be initiated, using QI methodology.

One or two of these will be Rachel's implementation of MAGIC!

I would also like to have movement in the background of a larger IT/pathway project that will deliver a unified, hassle-free real time data output to a haemodialysis data warehouse that will use machine learning to inform clinicians, managers, and administrators what works and what does not!

I would then propose monthly pan London meetings with specific workstreams reporting into the group and between these Rachel and I will meet monthly too. We will use an action log to drive progress.

We will also then set some medium- and longer-term goals for the PLAN to deliver agency/commissioner targets

Collate day/night operating ratios for London centres from NHSBT for kidney transplantation.

Model the effect of having access to protected theatre utilisation allowing transplants to start at the latest by 2100 hrs and at the earliest 0800 hrs the following day.

- **5h. Collaboration with regional vascular access QI initiative to identify local actions needed to implement effective pathways, to be agreed at network level.**

The power of Quality improvement methodology

There are many variations in practice with regards to decision making when delivering an elective and emergency vascular access service. Each of these can be expressed using one or more driver diagrams with an individual charged with leading the work and being coached to use QI methodologies. The large number of patients receiving HD pan London is globally unique. This means the number of individuals having access created or salvaged is exceptionally large. This will provide extremely powerful and quick PDSA cycles to be delivered, moving the quality improvement process forward very quickly.

Other areas for consideration/discussion

Patient information, education, and consent - managing expectations and ensuring good patient experience. Info, comms by clinicians, use of YouTube, minimal waiting time.

Administration. This is an underestimated challenge but essential to get right to stop DNAs. Minimising visits to hospital. Challenges in patient communication will be reduced by creating a virtual administrative hub. Between the seven units we would strive to recruit individuals to cover as many different languages as possible.

Referral pathway and validated accurate patient tracking list (PTL)

It is key to have a referral form within the EPR where possible, to enable a date and time stamped record of the milestones achieved on each patient's journey to achieve definitive access. This will also ensure a validated PTL.

Dialysis unit education designed to reduce discomfort and 'blown' access. Improvement in understanding the anatomy and physiology of a fistula. Empowerment to make decisions in needling sites.

Surgical excellence and efficiency. Appraise surgeon satisfaction with surgical instruments. Explore willingness to operate outside the operating theatre, with fewer staff and the right number of appropriate instruments. The use of "theatre packs".

Imaging resource and support - getting appropriate access to ultrasound at the coalface. Minimising the use of vascular labs for simple mapping affording more capacity for complex mapping/fistula evaluation by experienced vascular scientists. Rollout of Butterfly probes or similar with remote monitoring capability to improve ultrasound guided needling.

Pragmatism. Develop operating resource to improve opportunity to try more high risk (anatomically distal) procedures, reducing overall consumption of venous capital.

Collaborative and pragmatic working with the interventional radiology teams.

- **5i. Intervention (+/- transfer where relevant) of failing or thrombosed vascular access to be sufficiently rapid to avoid central venous access (usually 24–48 hours).**

Emergency pathway - active management of a thrombosed AVF from the moment it is detected with the aim of restoring it without the need for bridging temporary line insertion. This will include surgical, radiological or a hybrid approach.

Multidisciplinary team working will become embedded within the pan London group with both local (site specific MDTs) and pan-London (complex cases MDTs).

An aspiration to understand where endo-AVF procedures are best used in an individual's access career.

It is possible that Pan London collaboration may allow a more robust 'next day intervention' where 3 of the seven centres are designated as on call for IR and or surgical intervention, and the way this fits into weekend working could be examined.

Evolution of a hybrid service.

- **5f. Accountable commissioners to explore network-based commissioning of HD vascular access, including commissioning of dedicated vascular access centres and IR support.**

It is possible that pan London honorary contracts are created to facilitate hands on knowledge sharing between units, particularly with regards more complex access procedures.

It would be appropriate to include use the microbiology departments to ensure standardisation of sensitivity and reporting of catheter related sepsis.

Training, education, and CPD.

It is possible that a number of post-CCT access fellowships and access MSc's could be offered within the Pan London group for transplant and vascular surgeons.

An access diploma/module/MSc. could be offered to Nurses.

MSc's can be used to generate income to support the Pan London infrastructure.

A rolling online education programme could be set up to maintain skills/knowledge/understanding across the group. This would include presentations of access dilemmas - interesting cases.

Development of career pathways for physicians' associates interested in nephrology, dialysis and access could be explored. This group could become a significant part of the work force.

Access monitoring.

This is a challenging area that requires ongoing work. The sheer number of individuals receiving HD pan London can be used to understand this better. There may be opportunities to innovate how best this may be achieved.

Data acquisition and Reporting

An example of this might or could look something like the following:

Each of the seven units collect the same agreed dataset within their own EPR, but these are exportable as CSV files to a common database on a weekly basis. The data set is designed with minimal number of fields to deliver high value data. These data will deliver anonymised comparator data between and within units.

Subgroups of data might include.
Demographic
Comorbidities
Anatomical
Procedural (surgical or radiological)
Procedural outcomes including patency, patient experience and Surgical site infections.
Access function
MDT outcomes feeding into the current access plan.
Between the seven units a huge amount of data will be collected which will allow rapid learning about which factors are related to good outcome. Machine learning would be anticipated as helpful and would be considered in the design of the data sets. It is hoped that these data will allow an evidence-based approach to the management of planned and unplanned access interventions.

Ease of use. The mandate to collect data must be offset by the additional time required to collect it. Therefore, the type and number of fields need to be carefully thought about. The process of data collection needs to be built into forms within each hospital EPR. For example, a traditional operation note can be distilled into a few very simple fields and timings that convey the clinically relevant information. For a basic AVF (Radio-cephalic/Brachio-cephalic/1st stage Brachio-basilic the operation note would be created with 20 mouse clicks

Type of AVF
Side
Grade of surgeon
Grade of assistant
Type of skin prep
Type of LA
Total volume of LA used
Timing of LA administration
Time Knife to skin
Time artery clamped.
Time artery released.
Last stitch
Location of arteriotomy
Size of arteriotomy mm
Type of vein used.
Diameter of vein following distension mm
Anastomoses performed using x suture
Number of rescue sutures required

Subjective category of AVF
Free txt comments".....

The above principles can be transferred to all domains of data collection such as “assessment for AVF creation”

Reporting - it is anticipated there will be weekly reports of elective and emergency activity along with anonymised funnel plots reporting individual and unit outcomes. Percentage definitive access rates will also be reported weekly. Collaboration with local Infection Prevention and Control (IPC) teams will ensure that catheter related blood-born infections are also reported.

Additional data collation support. There will be an inevitable delay of 2 to 3 years delay before the work undertaken to achieve unified CSV data output is complete. This can be managed by employing a full-time data clerk. The salary for this individual will need to be contributed to by all seven centres.

Indirect benefits

A real opportunity exists to improve the overall health and well-being in the RRT population as well as the clinicians charged with delivering the service.

It would be great to use the opportunities whilst the patients are undergoing AVF surgery to further educate them where appropriate with the value of living kidney donation as well as deceased donor transplantation.

Development of a network with accurate and transparent site-specific reported outcomes will help individual trusts quantify the cost versus benefit of resource allocation.

A worked example

Unit A has invested in a bespoke funded renal theatre from 0800 to 2400, Monday to Friday. This means an allocated consultant renal anaesthetist and scrub team. This means that very few deceased donor kidney transplants are commenced between the hours of midnight and 0800 on the CEPOD lists. Instead of starting a deceased kidney transplant at 0400 hrs because the clock is ticking and there is no guarantee of accessing the CEPOD list at 0800, the case can be actively deferred to begin at 0800 in the designated renal theatre. This will ensure daytime operating with the renal anaesthetist and renal scrub team. Unit A can accommodate one or two surgical declots/emergency revisions per day. The elective renal caseload has staggered admissions and so the afternoon elective cohort can be deferred to the evening or another day allowing the surgical declots to progress. If there are no emergencies, then the resource can be used for additional CEPOD cases with the latest one being commenced at 2200 hrs. Unit A has an 80% native AVF rate.

Unit B has not invested in the above and has a 60% native access rate - currently the rate at the author’s hospital. This means that unit B has double the number of patients dialysing on a line (40% versus 20%) which means double the number of catheter related blood stream infections CRBSI’s. Unit B has more night-time operating and a more fatigued surgical workforce. Unit B is also not ready to seamlessly transition to accommodating the anticipated change in renal transplantation with the implementation of normothermic machine perfusion (NMP) as a standard of care. This means that no

renal transplants will be undertaken between 2400 hrs and 0800hrs, mandating an expansion of daytime theatre availability.

Unit A has spent money on a theatre team providing an additional 6 hours of cover. Probably the equivalent of 50% of an elective WTE operating theatre. They also have 200 less patients dialysing on a line per 1000 patients on HD. This represents or 73,000 fewer catheter days. The literature reports a rate of between 2 and 16 CRBSI's per 1000 catheter days which suggests unit A having between 146 and 1,168 fewer CRBS infections. At a conservative estimate, assuming a minimum 4 days of inpatient stay - time to remove the line, be line free, IV antibiotics and new interventional radiological procedure at the minimum incidence of 2 CRBSIs per 1000 catheter days this equates to 584 bed days or 1.6 WTE inpatient beds per annum. This does not include patient mortality.

Advanced approach to meeting the above challenges and horizon scanning

Develop a Pan London Renal anaesthesia group.

Explore the practicality (or not) of building access super centres to support the London population.

Consider the value of establishing a pan London renal scrub team flying squad – its not that there is a lack of theatres at night, or surgeons, it's about anaesthetic and scrub staff. The National Organ retrieval service is now an established and accepted model. If we can swoop to retrieve, we can swoop to put in!

Creation of the largest and most rapidly growing prospective access database in the world.

In which cases is IR the best first choice to de-clot an access and when is surgery the best. To what extent would access to a hybrid theatre reduce the number of serial interventions.

The group would aspire to gain a reputation for bringing sound evidence to NHS England as how to deliver HD access excellence most efficiently.

The group would like to change the perception held by theatre staff and anaesthetists that timeliness of transplant surgery is key.

Instillation of an understanding in senior hospital management that booking operating lists 4 to 6 weeks into the future (apart from live kidney transplants) is impractical and unrealistic. The NHS has prompted the 6-4-2 rule to "lock down" lists two weeks ahead of them happening. Centres that have attempted this find that administration time is doubled with no improvement in efficiency. This requires a "leap of faith" from the hospital senior management teams. Use of the CEEPOD overflow model described above will mitigate the situation of a theatre being unused. A factor contributing to length of stay in the emergency surgical patient cohort is the wait for access to emergency theatre.

There is no place for access zealots. There needs to be an appreciation that it is not in every patient's interest to have a native access. Frail patients or those who refuse to give up their TVC should not be hounded or coerced into undergoing procedures or operations that they do not want.

Define the best access career algorithm – adapted for age and ethnicity.

The comprehension of the basics of fistula creation, anatomy and flow dynamics can be significantly improved within the dialysis units. A culture of openness and empowerment would improve needling skills and reduce the number of needling related access loss.

Understanding when to intervene. There is a tendency for nephrologists to refer early because there is a long wait to have access creation. There is a tendency to have multiple pairs of dissecting scissors in an AVF set to ensure that at least one cuts. There is a tendency to intervene because there is a visible stenosis even though the access may be working very well with no technical problems for either the patient, cannulation team or nephrologists.