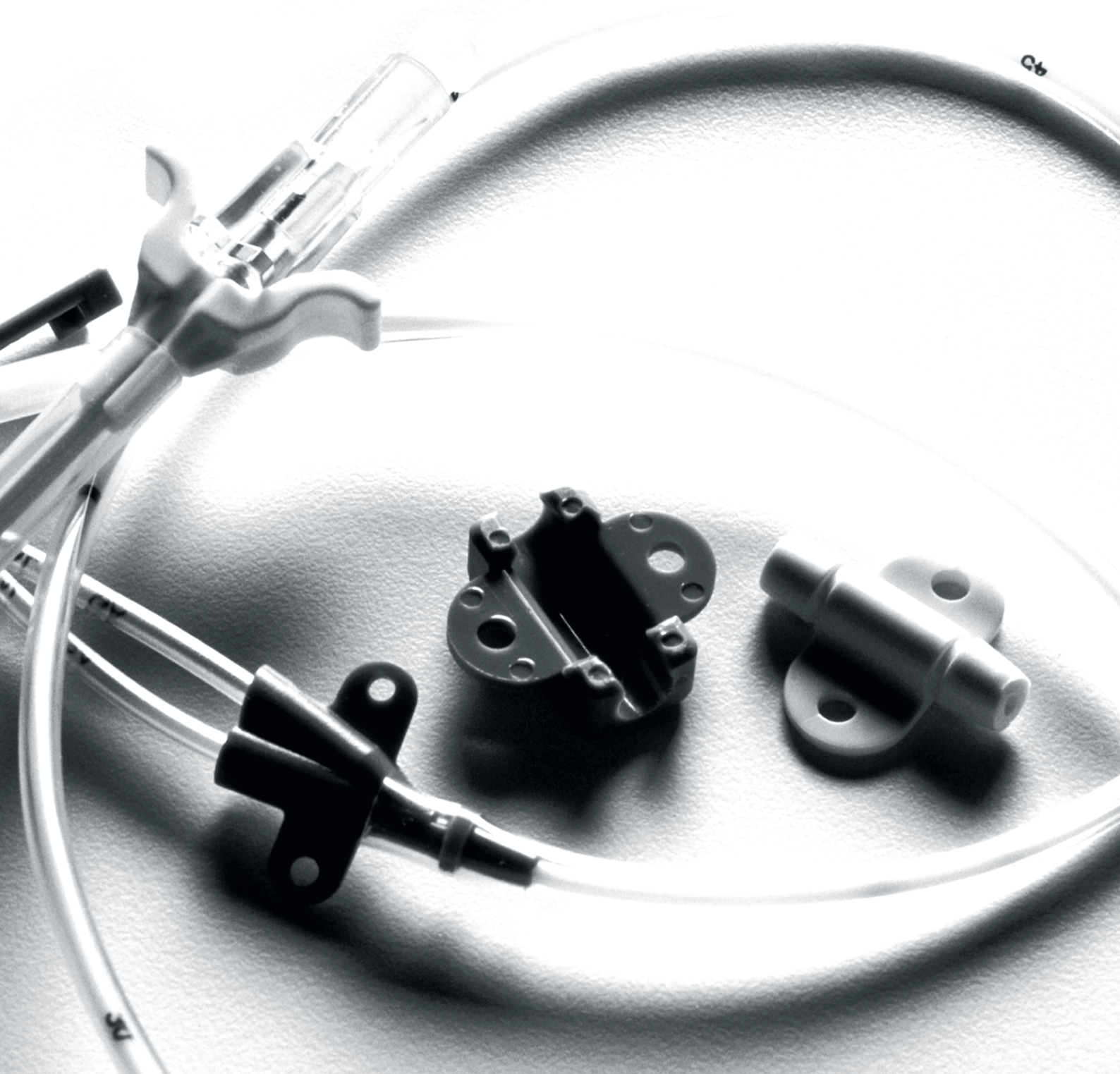
National Kidney Care Audit Vascular Access Report 2011



National Kidney Care Audit Vascular Access Report 2011

Reporting on the 2010 data collection period for patients starting dialysis between 1st January and 30th June 2010

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Prepared in partnership with:

The Healthcare Quality Improvement Partnership (HQIP) promotes quality in healthcare. HQIP holds commissioning and funding responsibility for the National Kidney Care Audit and other national clinical audits.

The NHS Information Centre for Health and Social Care (The NHS IC) is England's central authoritative source of essential data and statistical information for frontline decision makers in health and social care. The NHS IC managed the publication of the 2011 Report.

The UK Renal Registry (UKRR) was established by the Renal Association with support from the Department of Health, the British Association of Paediatric Nephrologists, and the British Transplant Society as a resource for the development of patient care in renal disease. The Registry provides a focus for the collection and analysis of standardised data relating to the incidence, clinical management and outcome of renal disease.

The National Kidney Federation (NKF) is the only national kidney charity actually run by "Kidney Patients for Kidney Patients". The NKF has a major role in campaigning for improvements to renal provision and treatment, and national patient support services.

National Kidney Care Audit Vascular Access Report 2011

Reporting on the 2010 incident patients

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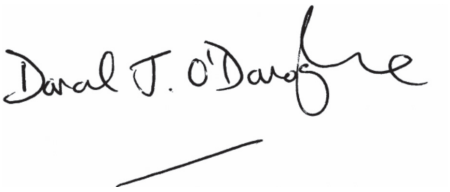
1 Foreword

Dr Donal O'Donoghue
National Clinical Director
for Kidney Care

This vascular access audit has not been easy to conduct. We had policy drivers and widely endorsed clinical audit measures developed by the Renal Association and Vascular Society of Great Britain and Ireland but, the way local systems are configured, how data is recorded and where it is held, differed between units. In addition, the way teams share responsibilities between disciplines and over time varies considerably. In total 60 of a possible 63 kidney units participated and the quality of the returns was high. This is testament to the leadership and skills of the audit team and the dedication and hard work of the individual kidney care teams in each of these units. They all recognise both the importance of best possible access as a modifiable factor that can improve patient experience and outcome and the central role national comparative audit plays in driving up quality and adding value to direct clinical care.

Creating vascular access for dialysis is a complex process. Planning for dialysis is both culturally and technically challenging. The timing of conversations, decisions, consent and surgery need to take into account the views, attitudes and aspirations of the individual with progressive kidney disease; the often unpredictable rate of decline of kidney function and the coordination of imaging, surgery and medical teams. Successful maturation of an arteriovenous fistula requires care and nurture. There is as yet no standard recipe for monitoring and fistula management to guarantee longevity of access. We do however increasingly recognise the importance of team work – patient, dialysis nurse, nephrologist, radiologist and surgeon, in achieving this goal. Good outcomes therefore require both reliable systems and attention to the human factors upon which success is based. No wonder the audit had been difficult to deliver.

But deliver it has. This report provides valuable insights for all participating kidney care teams and the results are the basis for continuing to involve local patients in quality improvement; small tests of change within units for discussion, debate and sharing best practice within and between kidney care networks providing a platform for future work including the routine collection of dialysis access information by the UK Renal Registry. Improving vascular access is an end in itself. Even more than that, a focus on preparation and choice in the 12 months before renal replacement therapy should also facilitate patient engagement in shared decision making and care planning and accelerated rehabilitation for those who commence dialysis as an emergency. It therefore has the potential to increase live donation and pre-emptive transplantation, promote patient preference in type and place of dialysis and support better conservative kidney care for those who choose the "no dialysis" option. It would be a perverse unit that did not capitalise on the added value opportunities all the hard work on vascular access presents. I look to the kidney services to use this knowledge now to improve care for your patients this year. Also to retain the audit's know-how so that future patients can benefit from all the efforts that have gone into it. For many people with end stage renal failure better vascular access is the single most important modifiable factor in improving outcomes. Better access leads to fewer infections and as this reporting shows directly correlates with a reduction in the burden of dialysis. This audit is a big step in the right direction. All involved should be congratulated. I am truly impressed by the coverage gained, but don't be complacent. Getting the best vascular access for every single haemodialysis patient remains a challenge but some teams have shown it is achievable.



Gateway Reference Number: 16229

Marion Higgins
Patient Representative

I very much welcome this third audit report of vascular access for haemodialysis patients. As a patient with a fistula that is now coming up to its twelfth year, I fully understand the importance of good access.

A working fistula should be the norm for all patients where physically possible. Good patient education right at the outset is of paramount importance, to enable an informed choice of treatment to be made. Those opting for haemodialysis need to be made fully aware of the long term implications of dialysing through lines and the benefits of having a fistula made in good time.

Neck lines should only be used in cases of emergency access or only when there is absolutely no alternative.

I was shocked to speak with a Kidney Patient Association (KPA) representative recently from an area where neck lines are more common than fistulas, and who really couldn't understand the difference. I can see that there is still an enormous gap in the education and information process – an area that requires much more work.

I urge all dialysis units to use this report to work towards achieving a higher number of patients commencing their treatments with a good working fistula, as well as continuing good aftercare and monitoring, which is just as important.

Marion Higgins

2 Acknowledgements

The National Kidney Care Audit is commissioned by the Healthcare Quality Improvement Partnership (HQIP). The Audit is managed by The NHS Information Centre for Health and Social Care (The NHS IC), who are working in partnership with the National Kidney Federation and the UK Renal Registry.

There are 2 distinct areas of audit; the provision of timely and appropriate surgery for permanent vascular access and patient transport for haemodialysis patients.

We would like to express our thanks for the invaluable support from patients and their representatives, clinical staff and allied health professionals, IT and operational staff within renal units and The NHS IC. We acknowledge how vital their input has been into ensuring that the Audit has been successful. In particular, we would like to express thanks to the renal units for their continued support in light of the changes made to the submission process and restricted timescales placed upon them.

We would also like to thank the Trusted Data Linkage team within The NHS IC for providing the Hospital Episodes Statistics (HES) data, the Patient Episodes Database for Wales (PEDW), the Department of Health Social Services and Public Safety for Northern Ireland (DHSSPSNI) Hospital Statistics and the Health Protection Agency (HPA) for the provision of infectious disease surveillance data.

Our thanks also go to the vascular access clinical lead, Dr Richard Fluck, who has written this report.

3 Executive Summary

- 60 out of 63 renal centres in England, Wales and Northern Ireland took part in the audit, submitting 2,404 records
- 2,078 haemodialysis patient records were included in the audit after the removal of 326 due to the inclusion of PD starters, recovery of renal function, acute patients or inconsistency in the records submitted
- The median age of the patients in the sample was 68 years old, and 62 per cent of the patients were male
- Late referrals (less than 90 days from seeing a renal physician to dialysis) accounted for around one quarter of patients nationally, although this varied across networks
- At first dialysis, 39 per cent of patients had a tunnelled line, 20 per cent had a non-tunnelled line, 1 per cent an arteriovenous graft (AVG) and 40 per cent an arteriovenous fistula (AVF)
- In units that submitted data about peritoneal dialysis (PD), these accounted for 17 per cent of patients in these units, but did not otherwise predate into the provision of preferred access in these units
- After three months, there was little change in the provisions of AVG and AVF. The majority were tunnelled lines at 42 per cent
- Late referrals (less than 90 days from seeing a renal physician to dialysis) were less likely to have had definitive access at first dialysis
- Late referrals were less likely to have been referred to a surgeon (7 per cent) compared to patients with longer waits for dialysis, although this may be linked to organisational factors and uncertainty around the need for dialysis
- Deprivation appeared to have no effect on access type
- The median bed day utilisation for haemodialysis patients within 3 months of the start of dialysis was 6 days overall. This ranged from 14 days for non-tunnelled line patients to 1 day for arteriovenous fistula patients
- 7 per cent of haemodialysis patients had a bacteraemic episode in the six months following first dialysis
- After adjusting for sample size, bloodstream infections were more common in patients with catheters compared to definitive access, 6 episodes/100 patients for an AVF, 13 for a non-tunnelled venous catheter and 8 for tunnelled catheters
- Whilst age is often associated with higher rates of infections in a healthcare setting, this did not appear to be a significant factor in dialysis patients
- When examining Hospital Episodes Statistics data for patients in the audit, patients on venous catheters have a higher rate of general infections and cardiovascular events.

4 Introduction

This is the third report of the National Kidney Care Audit for Vascular Access presenting the findings from the 2010 data collection period for patients starting dialysis between the 1st January and 30th June 2010.

The Vascular Access audit provides information on the timely and appropriate surgery for permanent vascular access based on the recommendations of the standards and quality requirements stated in the National Service Framework (NSF) for Renal Services[1].

The central aims of the audit are to determine the performance of renal centres across England, Wales and Northern Ireland in the use of optimal vascular access for haemodialysis, to measure the burden of vascular access and to explore operational issues in providing access.

The principle audit questions, analysed on a national, network and where appropriate individual unit level, were:

- Does the proportion of patients starting haemodialysis with functioning permanent access meet Renal Association and Vascular Society Guidelines for permanent vascular access?
- What are the health care associated infection (HCAI) rates associated with vascular access in an incident haemodialysis population and how does this compare with the national average and the best performance?

Haemodialysis is a valuable therapy for people with end stage renal disease. It can successfully replace kidney function, removing toxins and excess salt and water, when a person's own kidneys are unable to adequately do so. Without haemodialysis or other forms of renal replacement therapy (such as peritoneal dialysis or transplantation) life expectancy is markedly reduced.

The majority of prevalent patients in the United Kingdom undertaking dialysis do so in the form of haemodialysis. At the end of 2008, 20,972 patients undertook haemodialysis, out of a total of 25,225[2]. Within the same report, 67.7 per cent of 6,639 patients commencing renal replacement did so in the form of haemodialysis in 2008.

Increasingly, it is recognised that whilst dialysis is a life enhancing therapy, elements of dialysis care can increase a person's risk of harm or death. There is an increased focus on the role of the type of vascular access used in the process of haemodialysis.

What is meant by vascular access?

In the context of haemodialysis, it is the means by which the blood circulation of a patient may be accessed, to allow the removal and return of blood, which is then 'cleaned' via an artificial kidney within a dialysis monitor. Most patients have their treatment three times a week for four hours or more.

The ideal form of Vascular Access (VA) should be safe and efficient. It should be easy to use. It should provide effective therapy. It should minimise the risk of complications related to its use and presence. There are three broad categories of VA in use today.

1. Arteriovenous fistula (AVF): an artery and vein, usually in the arm above or below the elbow, are surgically joined, to create a fistula so that arterial pressure eventually enlarges the vein. The enlarged vein can then accommodate a cannula or large needle, so that blood may be removed and passed through an artificial kidney.

2. Arteriovenous graft (AVG): an artery and vein are joined surgically, using an artifical graft, usually Polytetrafluoroethylene (PTFE). The graft material itself is then used for the placement of cannulae or needles.

3. Venous catheters: a large plastic tube (catheter) is placed into a large vein, allowing a connection to be made to the dialysis circuit. The tube itself may be either passing directly from the vein through the skin to outside (non-tunnelled, NTC) or exit the vein, pass under the skin through a tunnel and then out (tunnelled, TC).

Whilst none of these fully meet the desired criteria it is recognised that an arteriovenous fistula (AVF) offers the best form of VA[4]. An AVF has a lower risk of infection due to the lack of non-biological material and the absence of an external device. An AVF also has a longer useable lifetime and requires fewer interventions. However, it does require prior planning, surgery and time for the fistula to develop.

The risks associated with the use of venous catheters are now well documented. Although no randomised controlled comparisons have been performed observational data are clear that the use of a venous catheter increases risk. Data from the Dialysis Outcomes and Practice Pattern Study (DOPPS) reported an increased risk of death of 32 per cent in patients in dialysis with a venous catheter[3]. Such data are only observational and indication bias means that causality may not be determined from such an analysis, but DOPPS also used centre based analysis to reduce the impact of indication bias. When analysis by country or by centre is performed, outcomes (death and infection risk) are still strongly associated with catheter use.

Given that vascular access is a key **modifiable** risk for patients on haemodialysis, it is therefore an important measure of clinical care. This audit was therefore configured to determine the type of access first used for dialysis, to match that access to important health events (admission, infection) and to explore operational effectiveness (surgical referral, conversion rates between access types).

5 Methodology

The Vascular Access Audit, managed by The NHS Information Centre (The NHS IC), began data collection in 2009 with 11 renal units contributing to the 2009 and 2010 published reports working in partnership with the UK Renal Registry (UKRR).

The UK Renal Registry, UK Transplant and the British Association of Paediatric Nephrologists have been key partners in the development of the National Renal Dataset (NRD). The data collected for the Vascular Access Audit 2009 and 2010 reports was based upon the data items within the NRD and was submitted using UKRR existing collection mechanisms.

Due to clinical system technical restrictions which renal units had to confront to be able to submit the requested audit data, the collection mechanism was revised for this report. The data items to be collected were refined and units were asked to complete an excel spreadsheet (Appendix 1) which was submitted directly to the NHS IC using secure data transfer procedures. These data items cover basic patient demographic information and specific facts about the patient's treatment which include:

- The type of access used at first dialysis
- The date of the patient's first dialysis session
- The date the patient was first seen by a renal physician
- The access type in use 3 months following the patient's first dialysis session
- Whether the patient was referred to a surgeon at least 3 months before the patient's first dialysis session.

For the audit to address the key audit questions data also flows from other sources to provide information on hospital episodes and Healthcare Associated Infections (HCAIs).

Hospital episode data was acquired from the Hospital Episodes Statistics (HES) database within the NHS IC, the Patient Episode Database for Wales (PEDW) and the Department of Health Social Services and Public Safety for Northern Ireland (DHSSPSNI) Hospital Statistics. The audit data was linked to the hospital episodes to investigate operations, interventions and the duration of time spent in hospital.

The Health Protection Agency (HPA) routinely collects information on Healthcare Associated Infections (HCAIs). Data was extracted from the HPA database and linked to the audit data to investigate the bacteremia and *Clostridium difficile* infection rates amongst haemodialysis patients.

6 Data Quality

6.1 Overview

Renal centres within England, Wales and Northern Ireland took part in the collection for Vascular Access and are listed in Figure 1.

60 of the 63 renal units in England, Wales and Northern Ireland provided information on 2,404 patients who commenced dialysis within the audit period 1st January to 30th June 2010. Three centres declined participation (University Hospital of Wales, Cardiff; St. Bart's Hospital, London; and the West London Renal and Transplant centre). The UK Renal Registry reported a total of 6,639 incident dialysis patients in 2008. This included Scotland (532), University Hospital of Wales, Cardiff (153), London and St Bart's hospital (201) and West London Renal and Transplant Centre (317). For the same census population there were therefore a total of 5,436 patients in a 12-month period or 2,718 in a 6 month period. These include all PD and pre-emptive transplant starts. As will be discussed some centres provided data on PD starters as well. However, the broad numbers suggest that a high proportion of all incident haemodialysis patients (in excess of 90 per cent) were provided to the audit.

Figure 1
Table of records by participating units

Unit Name	Total
Antrim Area Hospital	18
Bangor - Gwynedd Hospital	18
Basildon	10
Belfast - Ulster Hospital	13
Belfast City Hospital	48
Birkenhead - Arrowe Park Hospital	32
Birmingham - Heartlands Hospital	89
Birmingham - Queen Elizabeth Hospital	94
Bradford - St Lukes Hospital	26
Brighton - Royal Sussex County Hospital	44
Bristol - Southmead Hospital	84
Cambridge - Addenbrooke's Hospital	37
Carlisle - Cumberland Infirmary	7
Chelmsford - Broomfield Hospital	30
Colchester General Hospital	17
Coventry - Walsgrave Hospital	59
Derby City General Hospital	42
Derry/Londonderry - Altnagelvin Hospital	4
Doncaster Royal Infirmary	19
Dorchester - Dorset County Hospital	35
Dudley - Russells Hall Hospital	14
Exeter - Royal Devon and Exeter Hospital	72
Gloucester Royal Hospital	19
Hull Royal Infirmary	46
Ipswich Hospital	16
Kent & Canterbury Hospital	46
Leeds - St James's University Hospital - Ward 55	56
Leicester General Hospital	108
Liverpool - Aintree University Hospital	32
Liverpool - Royal Liverpool University Hospital	21
London - Guy's and St Thomas's Hospital	74
London - King's College Hospital	51
London - Royal Free Hospital	71
London - St George's Hospital	36
London - St Helier Hospital, Carshalton - South West Thames Renal & Transplantation Unit	143
Manchester Royal Infirmary	44
Middlesbrough - The James Cook University Hospital	50
Newcastle - Freeman Hospital	49
Newry - Daisy Hill Hospital	13
Norfolk & Norwich University Hospital	25
Nottingham City Hospital Renal and Transplant Unit	51
Omagh - Tyrone County Hospital	8
Oxford Radcliffe Hospital	56

Figure 1 (continued)
Table of records submitted by participating units

Unit Name	Total
Plymouth - Derriford Hospital	14
Portsmouth - Queen Alexandra Hospital	68
Preston - Royal Preston Hospital	76
Reading - Royal Berkshire Hospital	22
Rhyl - Glan Clwyd Hospital	12
Salford - Hope Hospital	54
Sheffield - Northern General Hospital	67
Shrewsbury - Royal Shrewsbury Hospital	15
Southend Hospital	15
Stevenage - The Lister Hospital	35
Stoke - University Hospital of North Staffordshire	55
Sunderland Royal Hospital	13
Swansea - Morriston Hospital	59
Truro - Royal Cornwall Hospital, Treliske	16
Wolverhampton - New Cross Hospital	26
Wrexham - Maelor Hospital	12
York District General Hospital	15
Grand Total	**2404***

*2404 includes 3 patients with an unknown treatment centre

6.2 Data completeness

The 2,404 records submitted to the audit generally had very high levels of completeness, as shown in Figure 2.

This high level of completeness was facilitated by:

1) simplifying the data collected to a smaller number of data items

2) carrying out preliminary data quality checks and offering units the opportunity to re-submit their results where completeness or quality was found to be poor

3) in some cases the data submitted was not in the format required, which then required clarification to allow for analysis. In this instance, the majority of data was clarified. For example, a common issue that could only be resolved by contacting each unit was where there was no differentiation between tunnelled catheters and non-tunnelled catheters.

Figure 2
Data completeness for the 2,404 patient records submitted

Data Field	Number of records completed	Percentage of records completed
NHS Number	2372	99%
Access First Dialysis	2356	98%
Access 3 Months	2257	94%
Date Physician	2276	95%
Date Dialysis	2364	98%
Assessed By Surgeon	2119	88%
Gender	2388	99%
Postcode	2382	99%

Note: All records as submitted by units

6.3 Datasets available for analysis

The data received goes through a series of validation stages to remove records that did not meet the requirements for inclusion in the audit. All records were then checked for suitability for inclusion in the audit and records excluded from analysis where appropriate.

- 15 records were duplicates, so the appropriate record was retained while the other deleted
- 55 patients were not incident in the time period covered by the audit, so were excluded
- 3 patients had a unit that was not known and date of first dialysis was not known, so were excluded
- 19 patients were either dead, had recovered renal function or transplant at the time of first dialysis so were excluded
- 55 patients recovered renal function within three months of first dialysis. These cases were likely to be cases of acute kidney injury and not relevant to the audit, so were removed.

A total of 2,257/2,404 patients submitted are included for further analysis, including all haemodialysis and peritoneal dialysis patients. For those patients who were not incident haemodialysis patient (unknown incident modality or peritoneal dialysis), data were excluded from access dependent analyses, but are included where explicitly stated. 168 patient records submitted started on peritoneal dialysis and for a further 11 the type of dialysis was not known. This leaves 2,078 incident haemodialysis patients.

Not all participating centres reported incident PD patients. This was in part due to a lack of clarity in signposting these data requirements. These units account for 1,001 patients in total. There are a number of analyses where these centres are analysed alone.

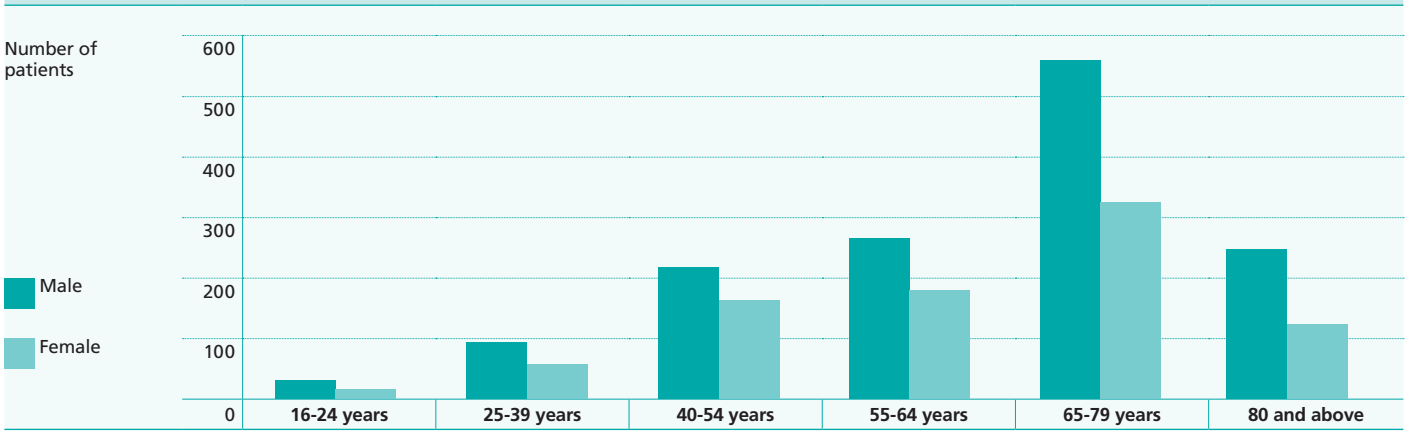
7 Demographics

The purpose of this report is to present the general trends and findings of the audit at a national level. Results are summarised for England, Wales and Northern Ireland combined, unless otherwise specified. Due to the variable size of patient lists and casemix at centres, results are not presented by centre routinely in the main part of this report, but are available in Appendix 2 of this report for reference.

7.1 Age and gender

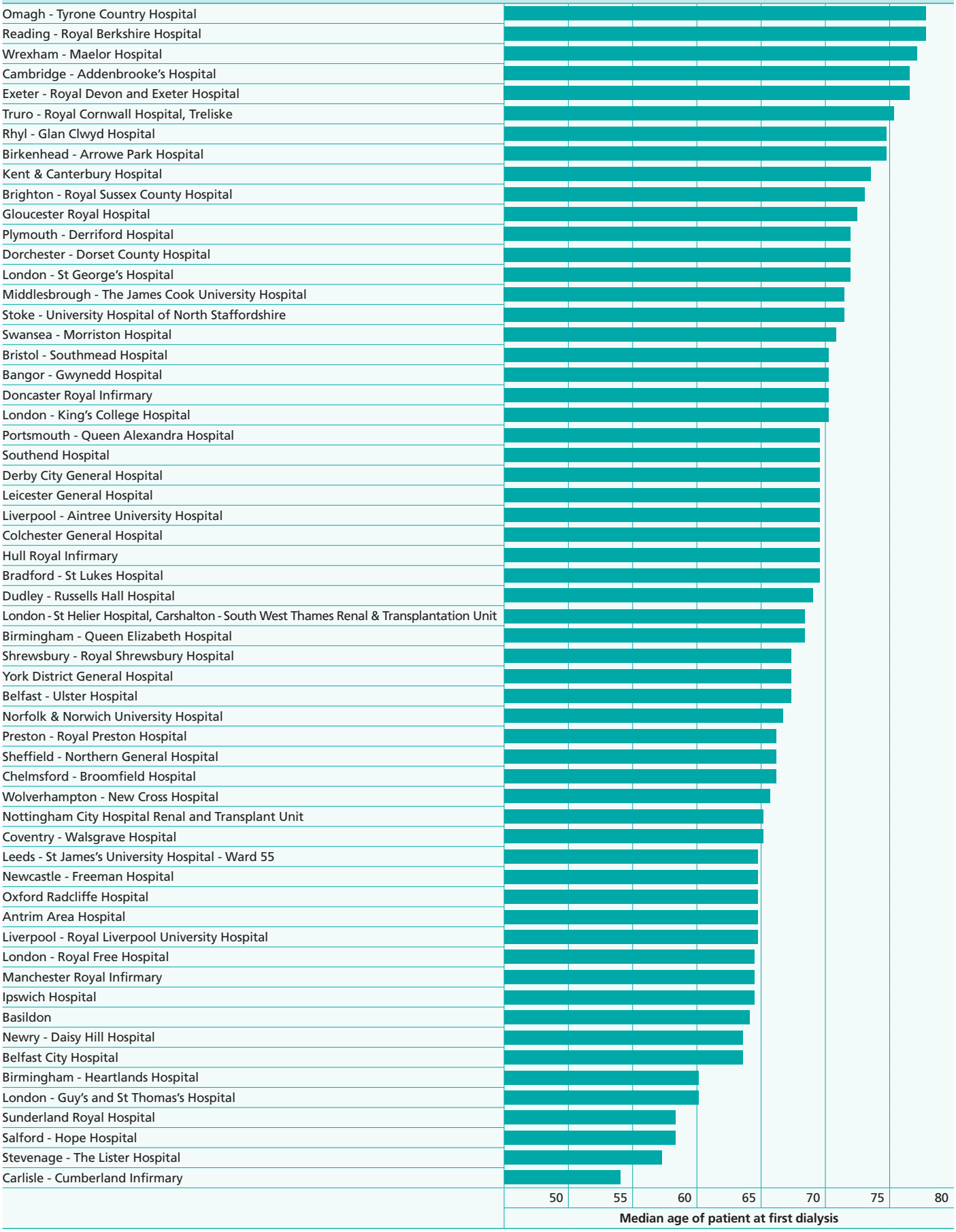
Figure 3 shows the age and gender of patient records submitted to the audit in 2010, and shows that more men than women require dialysis and that it is more common in patients aged 65 or older. The mean age was 64 ± 17 (range 17-100) years, the median 68 years. (Paediatric patients are not included in this audit). Male patients accounted for 1,409 of the 2,257 (62 per cent) unique records submitted. The UKRR 2009[2] report reported an incident patient median age of just over 64, 61 per cent males. Unit median age ranged from 54 to 77 (Figure 4).

Figure 3
Age and gender of patients submitted to audit



Notes: Results based on 2257 records (all haemodialysis and peritoneal dialysis patients)

Figure 4
Median age of HD patients at first dialysis, by renal centre



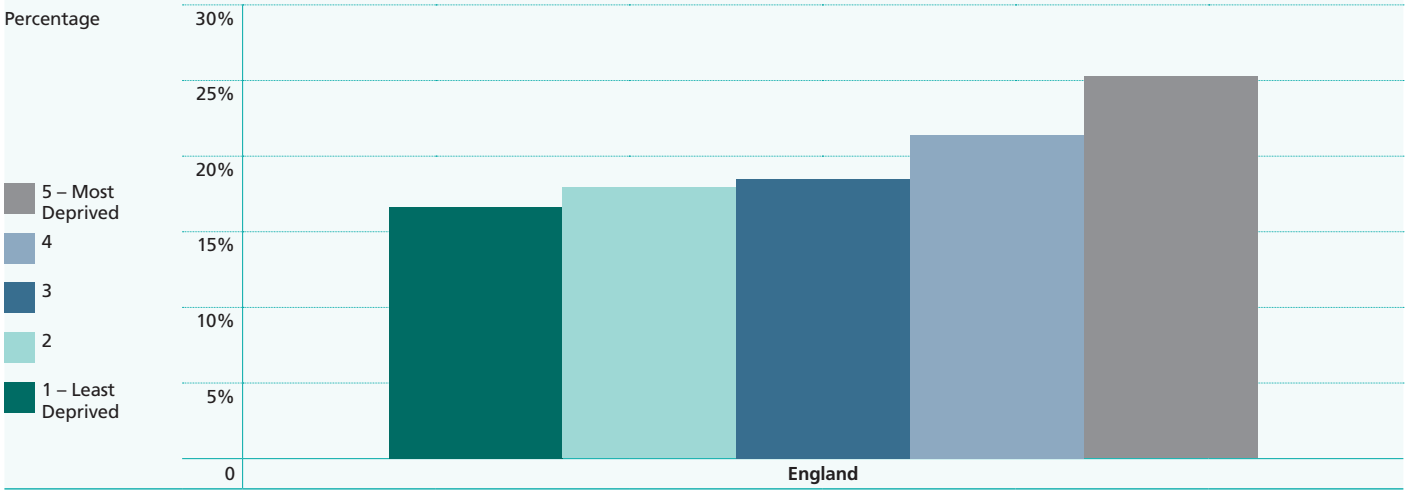
Note: Results based on 2074 records (all haemodialysis patients with Altnagevin Hospital in Derry/Londonderry not shown, as the unit only submitted 4 patient records).

7.2 Deprivation

The Index of Multiple Deprivation 2010 (IMD 2010) combines a number of indicators, chosen to cover a range of economic, health, social and housing issues, into a single deprivation score for each small area in England. Patient records with valid postcodes were mapped to the IMD 2010 file at Local Super Output Area (LSOA). All LSOAs in the IMD 2010 file were ranked in order of relative deprivation scores and split into five groups from most to least deprived (quintiles). Patient records from the audit were linked to this data and the quintiles for these patients were added. For the purpose of this audit, the combined overall indicator of deprivation has been used. IMD 2010 does not include Wales or Northern Ireland, so are excluded from these analyses.

For patients resident in England, 1,976 records with a postcode could be matched to the Index of Multiple Deprivation 2010. Figure 5 shows that there is a slight increase in the proportion of patients who are most deprived compared to those who are more affluent.

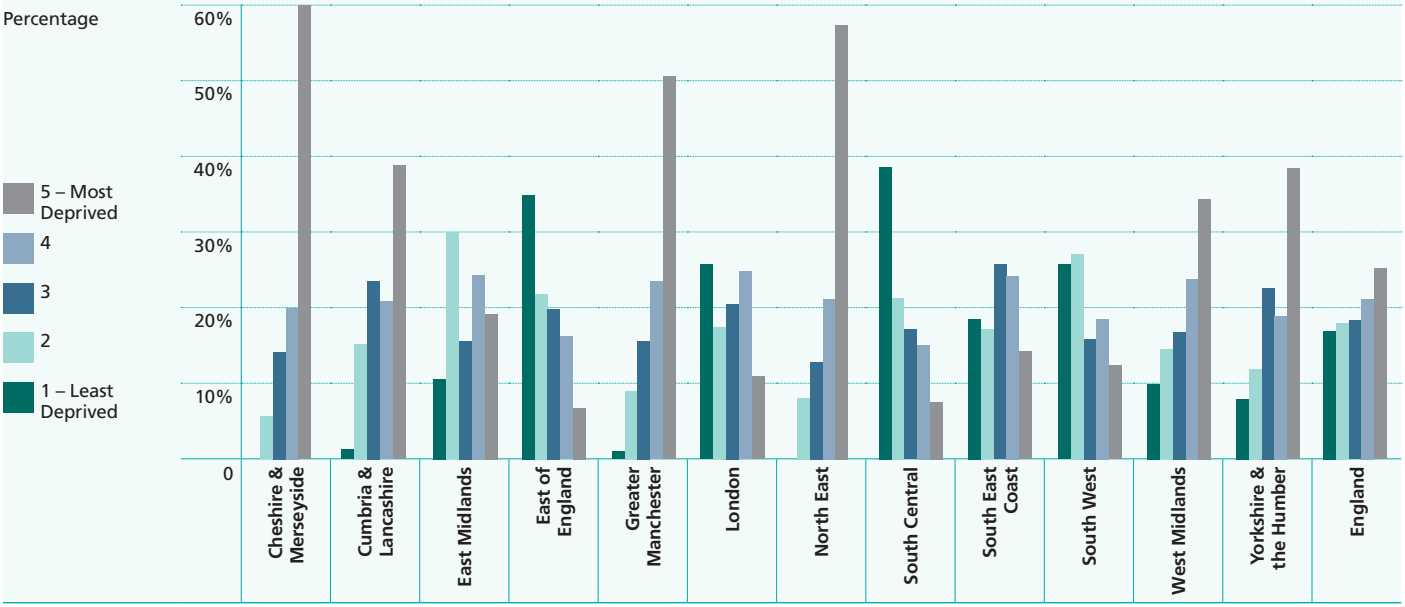
Figure 5
Deprivation quintile profile for patients residents in England



Note: Results based on 1976 patient records (patients resident in England with valid postcode)

Figure 6 demonstrates the same data as Figure 5, but broken down by renal network. While nationally the proportion of haemodialysis patients from deprived areas is slightly raised, renal networks show considerable variability. East of England, South Central and the South West have a less deprived casemix than the North (Cheshire and Merseyside, Greater Manchester and the North East). East Midlands suggests a mixed picture and London a relatively flat profile. However, the two largest centres in London (St Bart's and West London) did not furnish data and this may have had a considerable impact on this pattern.

Figure 6
Deprivation quintile profile for patients resident in England, by renal centre attended



Note: Results based on 1976 patient records (patients resident in England with a valid postcode)

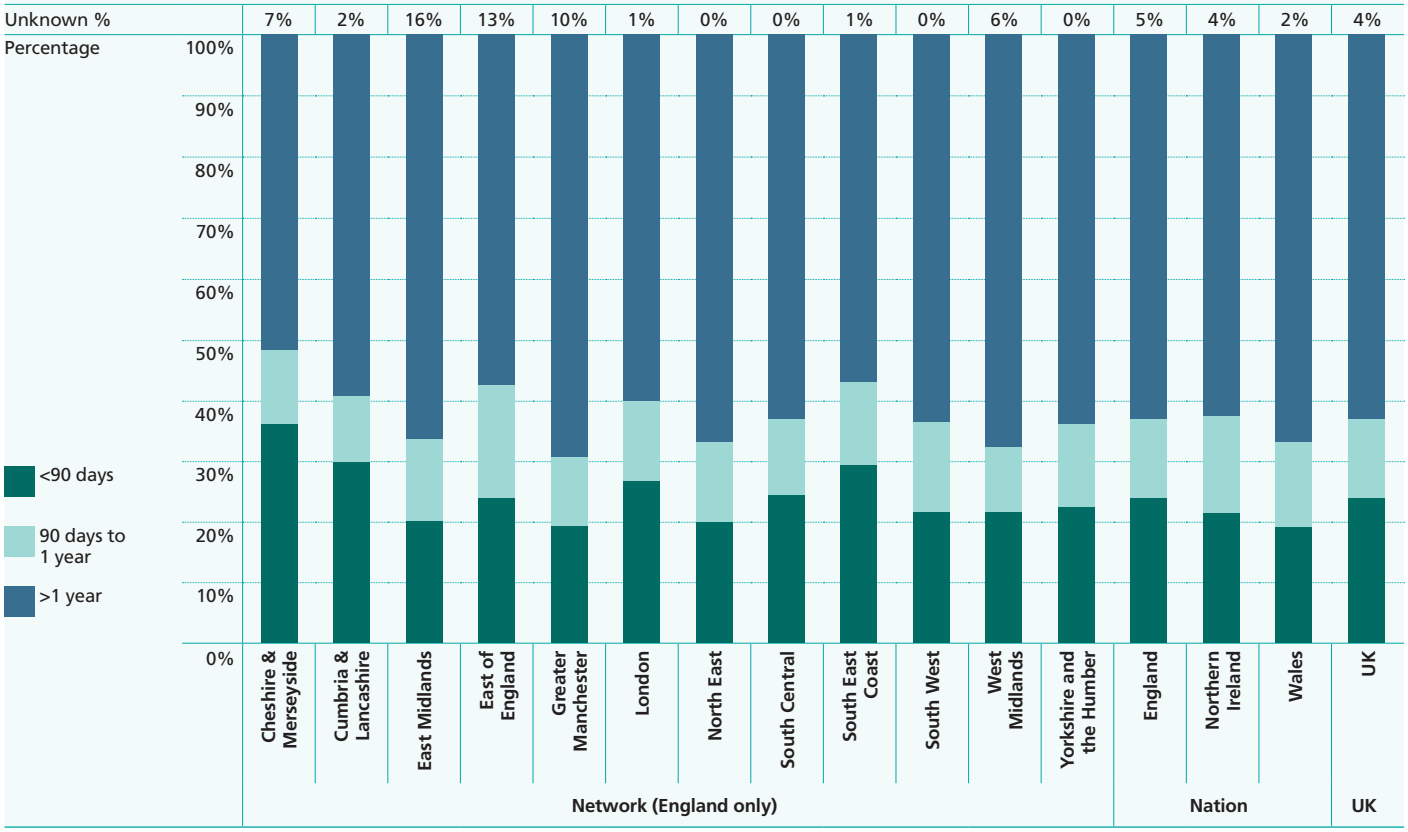
8 Referral Times

8.1 Time between referral and dialysis

Figure 7 shows the distribution of referral times from a patient first seeing a renal physician to the date of first dialysis by renal network. Referral 'interval' was banded into 0-90 days, 90 days to 1 year and 1 year or more.

Referral times of less than 90 days are generally considered to be 'late referrals', usually presenting as an emergency. In these cases there is felt to be insufficient time to provide definitive vascular access for those starting haemodialysis. Nationally, this accounts for between 17 per cent and 33 per cent of patients, although there is network variation – for example 17 per cent in Greater Manchester Renal Networks to 33 per cent in Cheshire and Merseyside. The reasons for this are not clear.

Figure 7
Referral time from physician to first dialysis, by renal network



Note: Results based on 2078 records (all haemodialysis patients)

Figure 8 shows the number of patients who were classified as late referral to dialysis (less than 90 days between first physician contact and first dialysis session) by renal centre. There is a degree of centre variation around an average late referral rate of 25 per cent. However, there is evidence of variation in referral patterns between centres.

Figure 8
Number of patients with late referral to dialysis (<90 days), by number of patients per renal centre

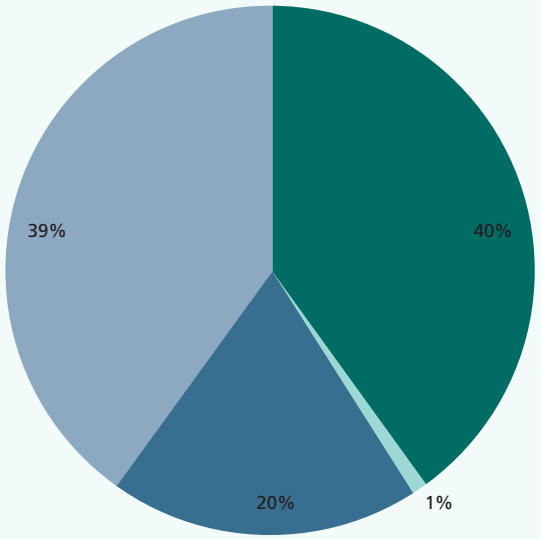
Note: Results based on 2078 records (all haemodialysis patients)

9 Access at dialysis

9.1 Type of access at first dialysis

Figure 9 shows that the majority of patients (59 per cent) across England, Wales and Northern Ireland have non-definitive access (tunnelled line or non-tunnelled line) at the time of first dialysis. Arteriovenous fistula accounted for only 40 per cent and arteriovenous grafts were uncommon at only 1 per cent. Appendix 2 shows these data broken down by renal network and centre, and shows that the distribution varies considerably. For example, 84 per cent of patients in Sunderland Royal Hospital had an Arteriovenous fistula, compared to 8 per cent of patients in Belfast City Hospital. The reasons for variation are not clear from these data.

Figure 9
Access at first dialysis



- Arteriovenous fistula 841 – 40%
- Arteriovenous graft 16 – 1%
- Non-tunnelled line 412 – 20%
- Tunnelled line 809 – 39%

Note: Results based on 2078 records (all haemodialysis patients)

Figure 10 shows the distribution for access at first dialysis by network and region. The highest rate for use of an AVF was seen in Wales (53 per cent), the lowest in Northern Ireland (25 per cent). Across the 12 renal networks in England, the highest rate was achieved in East Midlands (49 per cent) and lowest in London (32 per cent).

Figure 10
Access at first dialysis, by renal network for haemodialysis patients

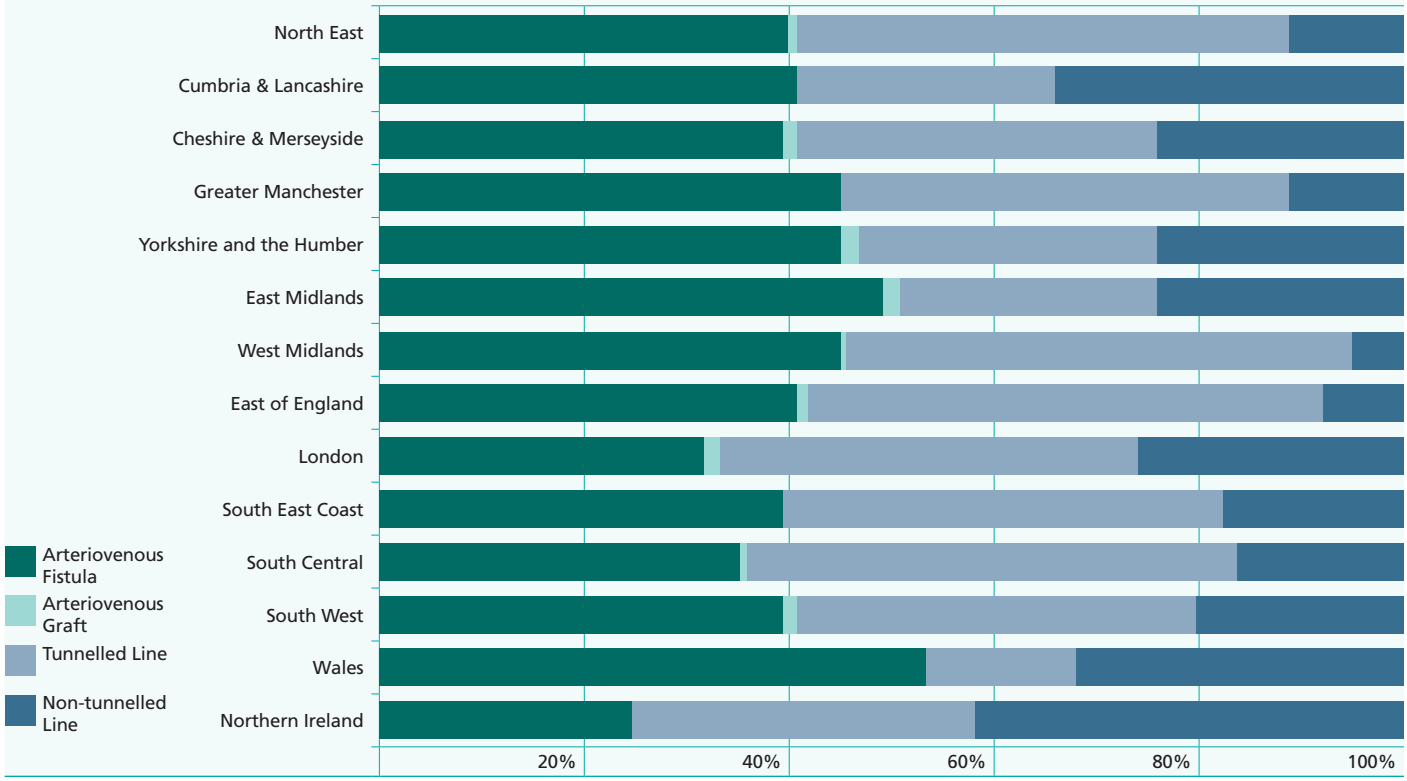


Figure 11 shows the same data for patients reported by units that submitted data on peritoneal dialysis. It shows that PD accounts for 17 per cent of patients who require dialysis and that otherwise the patterns for access in HD patients remains similar. Figure 12 shows regional and network level analysis. In East Midlands, the haemodialysis per cent falls to 30 per cent but with the highest PD start rate at over 24 per cent. This confirms the complexity of the casemix when analysing starting access for end stage renal failure.

Figure 11
Access at first dialysis for units reporting PD patients

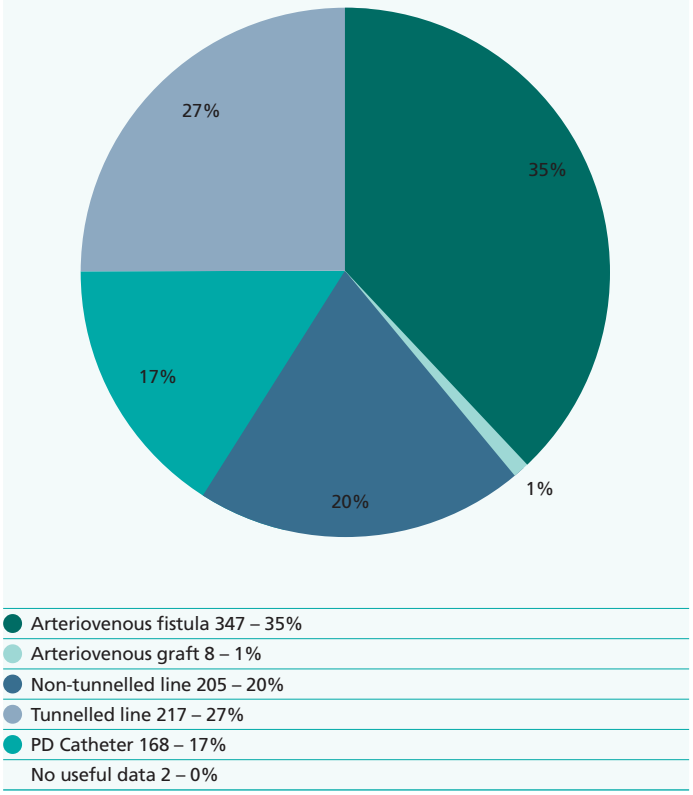
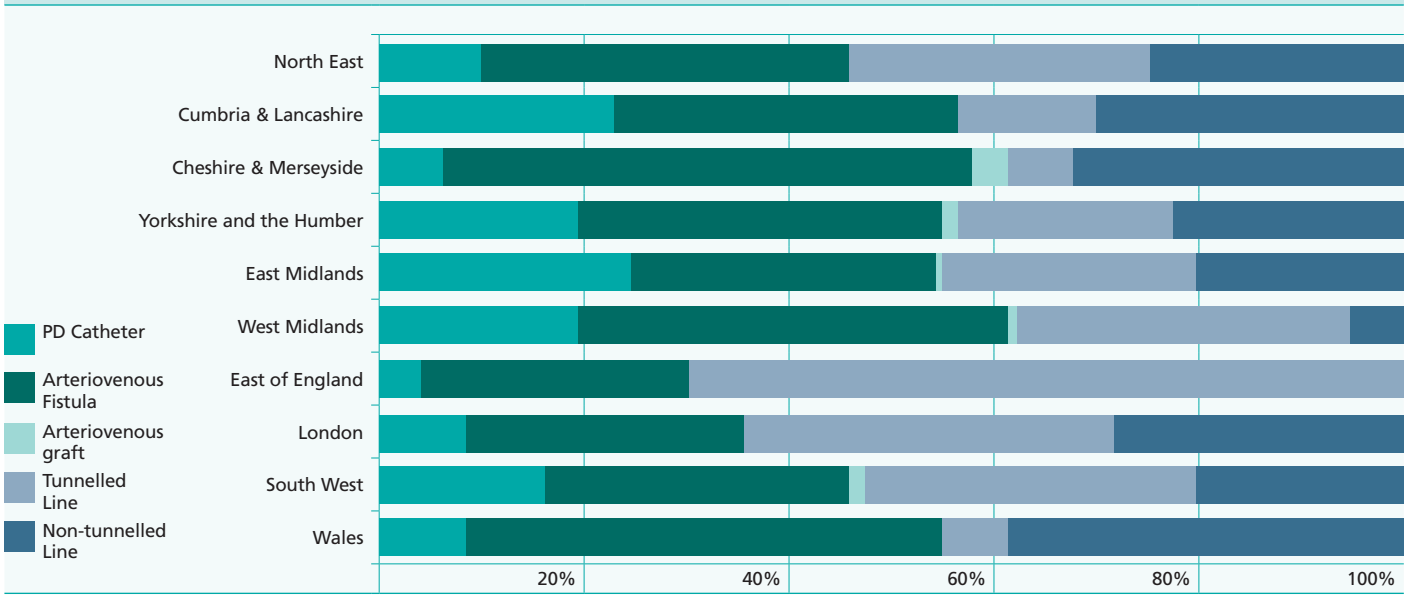


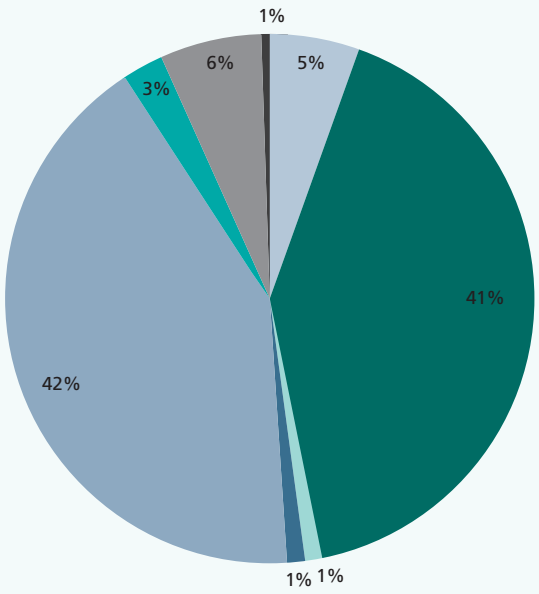
Figure 12
Access at first dialysis for units reporting PD patients, by renal network



9.2 Type of access after 3 months

Figure 13 shows the access or outcomes for the cohort after 3 months. Overall, there were no data on 5 per cent (n=114) of patients. At 3 months there was little evidence of increased provision of either an AVF or AVG. Only 1 per cent (n=23) of patients used non-tunnelled catheters, with 42 per cent using a tunnelled line. A small number of patients had been established on PD (3 per cent) and 6 per cent had died in the three month interval.

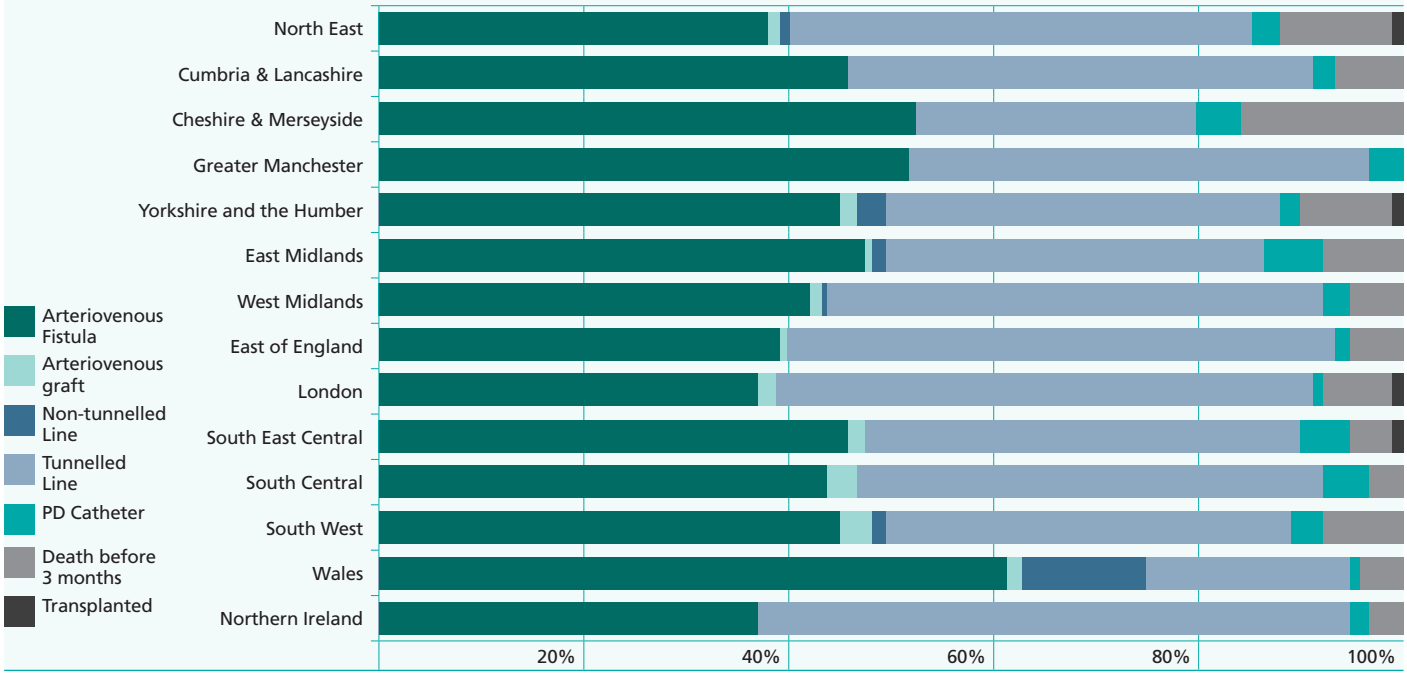
Figure 13
Access or outcome at 3 months for all patients who started on haemodialysis



- Arteriovenous fistula 858 – 41%
- Arteriovenous graft 24 – 1%
- Non-tunnelled line 23 – 1%
- Tunnelled line 870 – 42%
- PD Catheter 52 – 3%
- Death Before 3 Months 126 – 6%
- Transplanted 11 – 1%
- No useful Data 114 – 5%

Note: Results based on 2078 records (all haemodialysis patients)

Figure 14
Access or outcome at 3 months for all patients who started on haemodialysis, by renal network



9.3 Comparison of access at first dialysis and after three months

The outcome at 3 months can provide insight into the process of care around access. For example, if a patient commences dialysis with a venous catheter, what is the risk of death and how likely are they to use an AVF or PD catheter at 3 months? Is that pattern different for late referrals?

Figure 15, 16 and 17 summarise this organisational process, comparing the type of access at first dialysis and after three months. By three months, 38 per cent of patients are dialysing via an AVF with just 1 per cent via an AVG. 8 percent are on PD and 1 per cent have been transplanted. Overall, a little over half of patients are receiving renal replacement therapy in an optimal fashion and 5 per cent have died in the first 3 months. The vast majority of patients remaining receive dialysis via a tunnelled catheter (39 per cent), with an overall fall in 16 per cent receiving haemodialysis via a venous catheter.

The majority of patients with definitive VA at first dialysis remain on the same access three months later. Thirty patients (3.7 per cent) are using a catheter at 3 months and 28 are deceased (3.4 per cent). Very few patients have undergone a transplant or moved to PD.

For those who start on a venous catheter, the majority still have dialysis via a catheter. Only 110 have moved to an AVF, 10 to a graft and 49 onto PD out of a population of 1,136 where 3 month outcome was known. Including transplantation, only 15.6 per cent (177/1136) had moved to a preferred access or modality. The mortality rate within the catheter groups was 8.6 per cent (n=98) – twice the rate of the AVF starts. Finally 67 per cent of patients (246/366) who started via a non-tunnelled catheter were converted to a tunnelled catheter.

Data were available for 168 PD starts. Technique and patient survival was high within this group – technique survival 89 per cent and mortality 2.4 per cent. Five patients were on a venous catheter at 3 months.

Figure 15
Comparison of access at first dialysis and after three months for all patients (HD, PD unknown dialysis type at first dialysis)

	Access at 3 months								
Access at first dialysis	**Arteriovenous fistula**	**Arteriovenous graft**	**Tunnelled line**	**Non-tunnelled line**	**PD Catheter**	**Death before 3 months**	**Transplanted**	**No Useful data**	**Total**
Arteriovenous fistula	748	1	27	3	2	28	3	29	841
Arteriovenous graft		13	2		1				16
Tunnelled line	76	5	595	1	30	55	6	41	809
Non-tunnelled line	34	5	246	19	19	43	2	44	412
PD Catheter	4		4	1	148	4	5	2	168
No Useful data			4			2		5	11
Grand Total	**862**	**24**	**878**	**24**	**200**	**132**	**16**	**121**	**2257**

Figure 16
Comparison of access at first dialysis and after three months for all patients, where referral from physician to dialysis was less than 90 days

	Access at 3 months								
Access at first dialysis	**Arteriovenous fistula**	**Arteriovenous graft**	**Tunnelled line**	**Non-tunnelled line**	**PD Catheter**	**Death before 3 months**	**Transplanted**	**No Useful data**	**Total**
Arteriovenous fistula	22					1		2	25
Non-tunnelled line	14	1	122	9	9	20	1	18	194
Tunnelled line	17		194		11	17		9	248
PD Catheter			1		14	1	1		17
No Useful data			1						1
Grand Total	**53**	**1**	**318**	**9**	**34**	**39**	**2**	**29**	**485**

Figure 17
Comparison of access at first dialysis and after three months for all patients, where referral from physician to dialysis was more than 90 days

	Access at 3 months								
Access at first dialysis	**Arteriovenous fistula**	**Arteriovenous graft**	**Tunnelled line**	**Non-tunnelled line**	**PD Catheter**	**Death before 3 months**	**Transplanted**	**No Useful data**	**Total**
Arteriovenous fistula	699		25	3	2	25	3	20	777
Arteriovenous graft		13	1		1				15
Non-tunnelled line	20	4	120	9	10	21	1	21	206
Tunnelled line	55	4	375	1	17	36	4	29	521
PD Catheter	4		3	1	124	3	4	2	141
No Useful data			3			2		4	9
Grand Total	**778**	**21**	**527**	**14**	**154**	**87**	**12**	**76**	**1669**

Note: The data for figures 16 and 17 do not total those in figure 15 due to cases where the referral period between physician and dialysis is not known

10 Determinants of access – organisational factors

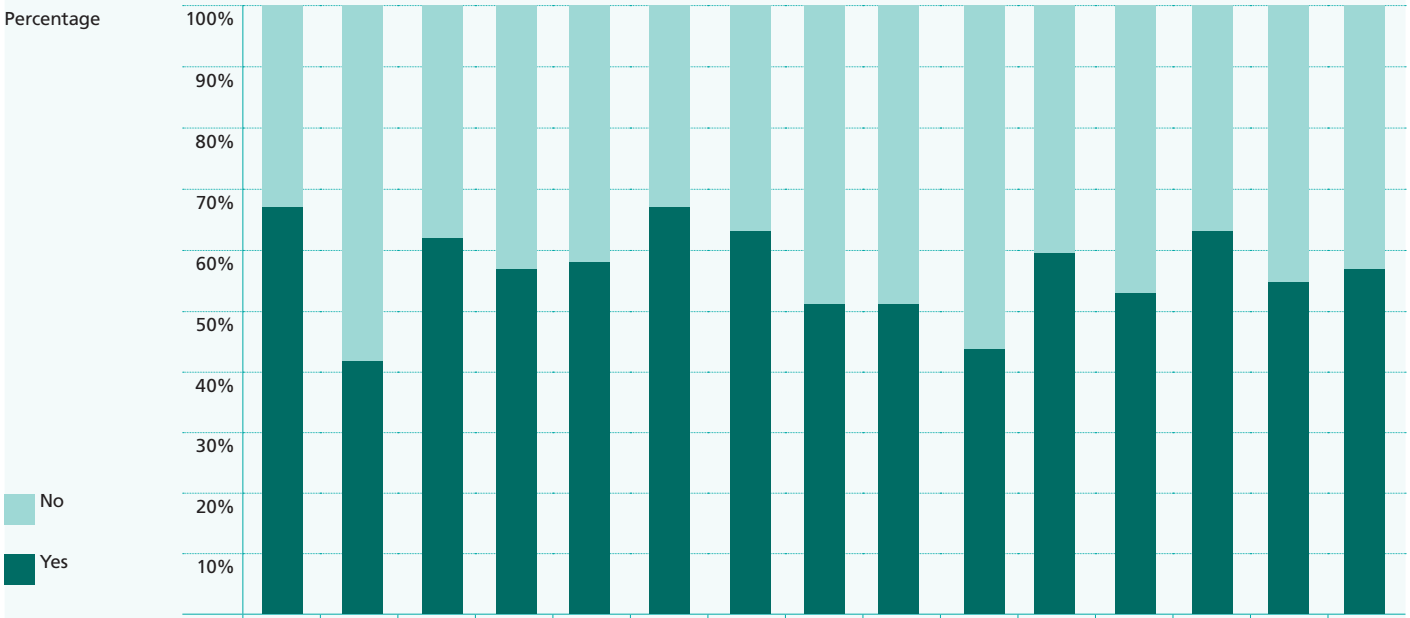
10.1 Referral to a surgeon

The clinical pathway includes the surgical creation of vascular access. The dataset included a question on whether an incident patient had been referred to a surgeon more than three months before the start of dialysis.

Figure 18 shows the proportion of all haemodialysis patients who were referred to a surgeon, by renal network and country. It is interesting to note that overall this question was not answered in 13 per cent of cases, but that there was considerable variation between networks. Data were available on 100 per cent of patients in the North East, Cumbria and Lancashire, South East Coast, South Central and South West with low reporting rates in East Midlands, Northern Ireland and Cheshire and Merseyside.

Overall, the proportion referred to surgeons was highest in the North East and East Midlands. Excluding unknown patients, about 50 per cent had been referred prior to dialysis start.

Figure 18
Referral time to surgeon, by renal network for HD patients



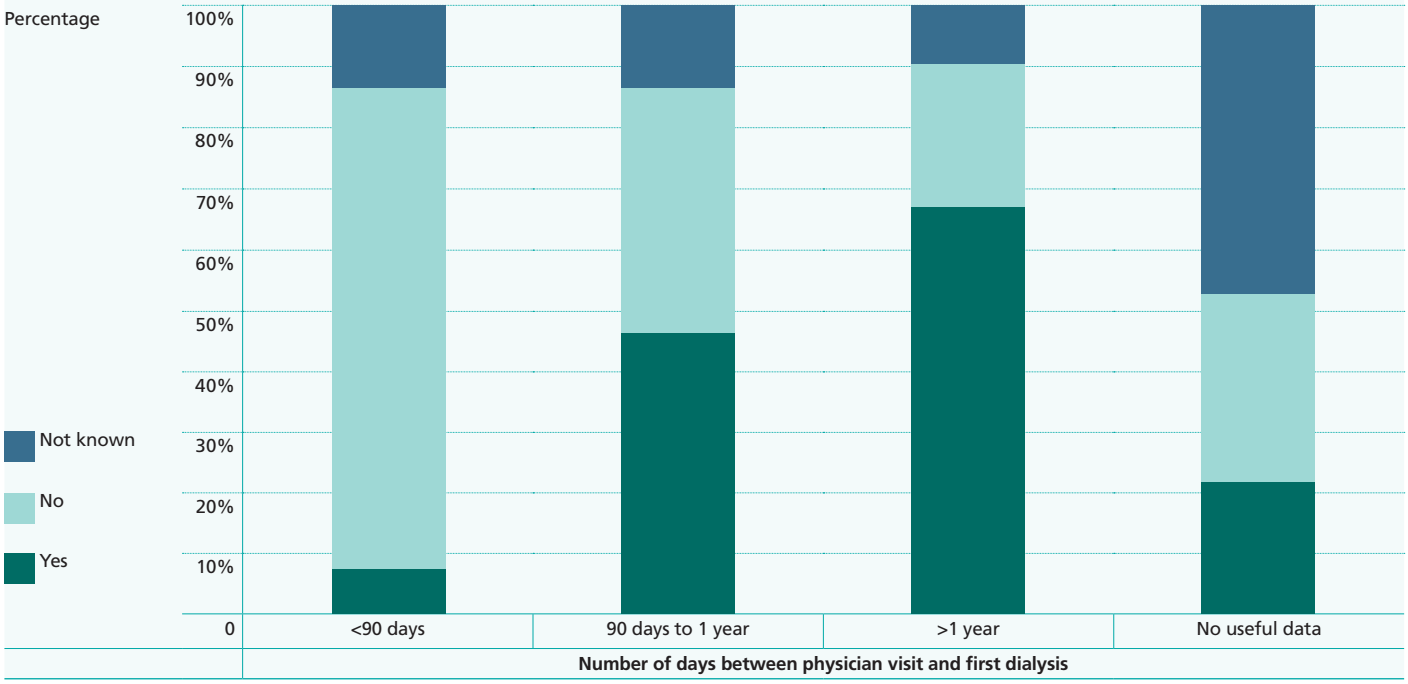
	North East	Cumbria & Lancashire	Cheshire & Merseyside	Greater Manchester	Yorkshire and the Humber	East Midlands	West Midlands	East of England	London	South East Coast	South Central	South West	Wales	Northern Ireland	UK
Unknown %	0%	0%	74%	1%	2%	55%	7%	22%	6%	0%	0%	0%	1%	40%	13%

Note: Results are based on 1944 records (HD starters. Excludes 134 records where referral to surgeon was not known)

Clearly a major determinant of the probability of a referral to the surgical team is that of time in the nephrological pathway. Figure 19 shows the relationship between referral to a surgeon and referral interval time (first renal consultation to start of dialysis). As expected late referrals had the lowest referral probability (32 of 467 or 7 per cent) but in fact it is surprising that so many had seen a surgeon more than 90 days before dialysis start, given they only saw a nephrologist at less than 90 days. This may not be real but reflect a systematic problem in how the questions were asked and interpreted.

In contrast, the longer time intervals were associated with a higher chance of surgical referral – for example two thirds of patients who had a referral period of a year or more had a referral (840 of 1257 or 67 per cent). Despite that, one might consider what factors mean that a patient is not referred despite being in the system for an adequate period of time. This may reflect organisational factors or clinical uncertainty around the need for dialysis.

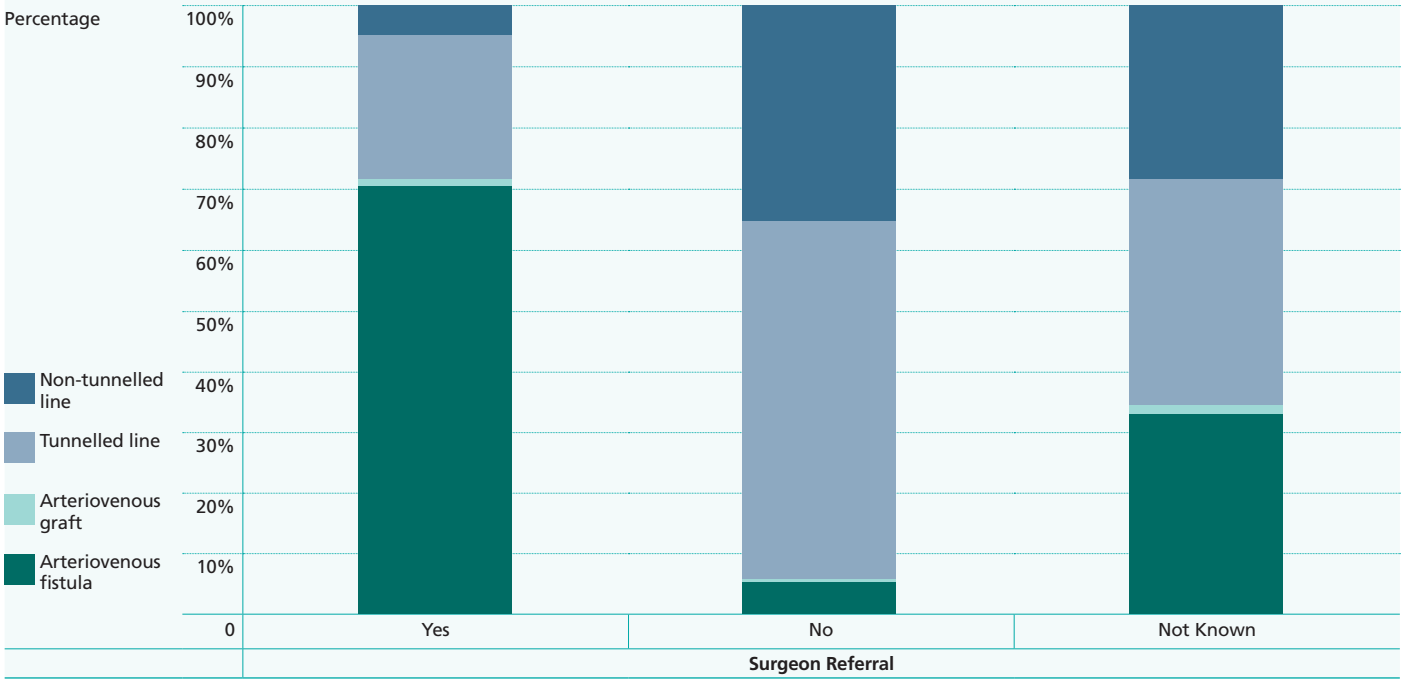
Figure 19
Referral to surgeon, by referral period for all patients



Note: Results based on 2078 patient records

Conversely, if a patient is referred into the surgical system, what is the probability of starting with definitive access? Figure 20 shows that the majority of patients with an AVF or AVG have had a surgical referral more than 3 months prior to the start of dialysis, which is not a surprise, but 30 per cent of patients starting with tunnelled access have had a referral and over 10 per cent of those with a non-tunnelled catheter. A small number without a surgical referral had an AVF in place at the start of dialysis – this group may represent people returning to haemodialysis from transplantation with a previous fistula still in place.

Figure 20
Referral to surgeon by type of access at first dialysis



Note: Results based on 2078 patient records

10.2 Referral times at the first dialysis

Linked to surgical referral is the referral time, which may or may not allow for time to see a surgeon. Figure 21 looks at this relationship. A much smaller proportion of patients on AVF or AVG were late referrals, reinforcing the implication that sufficient time is required for a surgical consultation and time for the surgery to take place before dialysis. However, those under renal care for a year or more still only had a 55 per cent chance of commencing dialysis with an AVF. This may be due to organisational factors, a lack of appreciation of renal decline and the need for dialysis or unpredictable clinical events.

10.3 Deprivation and access at first dialysis

Figure 22 shows deprivation by the type of access at first dialysis. Reassuringly, the trends reflect the national pattern and do not show any large differences between patients on definitive access and not on definitive access.

Figure 21
Referral time from physician to first dialysis by access type, HD starters

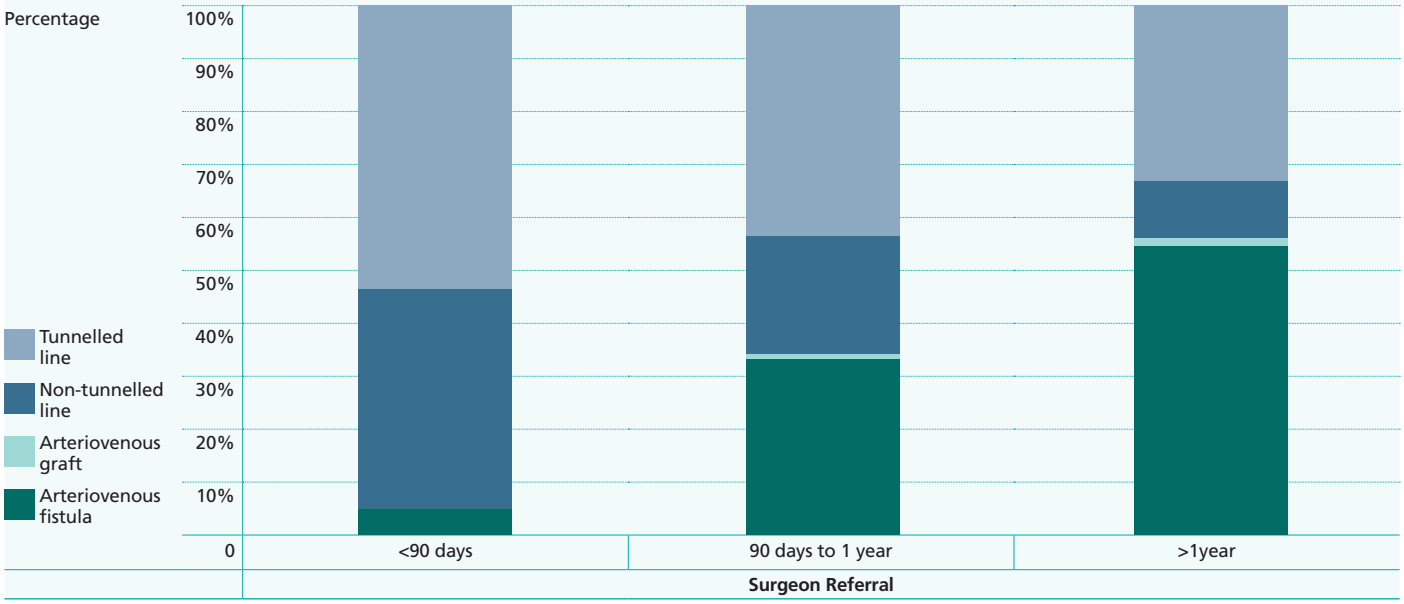
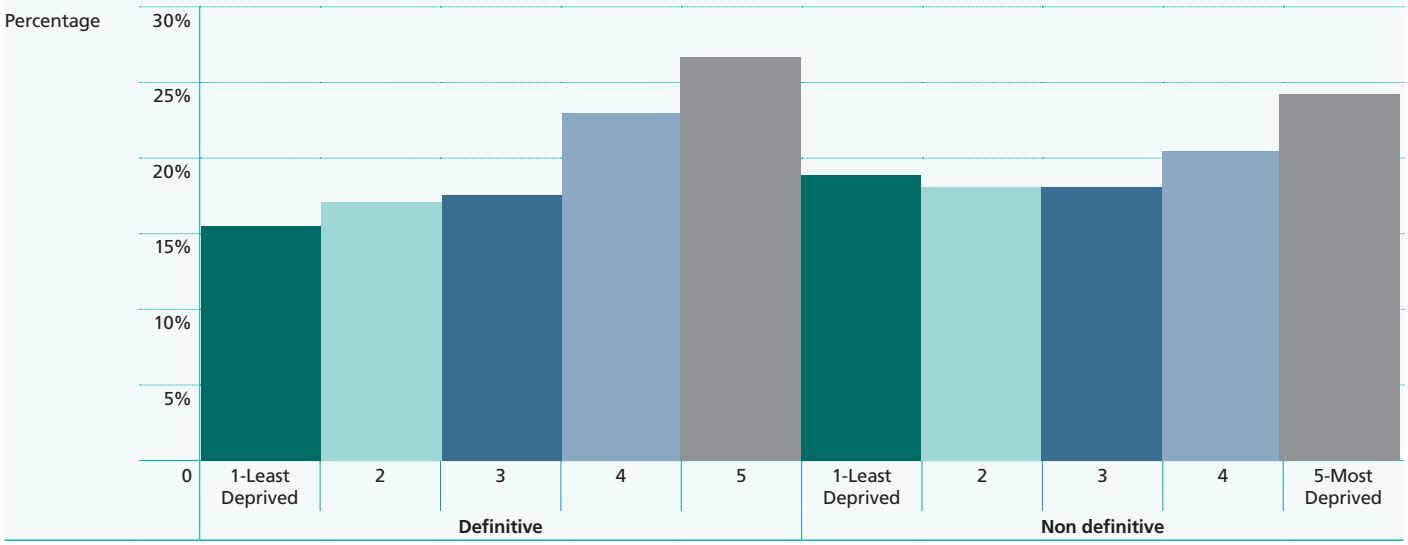


Figure 22
Deprivation by definitive/not definitive access at first dialysis



Note: Results based on 1976 patient records (patients resident in England with valid postcode)
Definitive = Ateriovenous graft or fistula
Non definitive = Non-tunnelled line or tunnelled line

11 Complications

Renal centres provided data that enabled patients to be identified via NHS number, together with a simple dataset on access provision. Further data relevant to the burden of vascular access was collected from other sources and linked to access. In particular, events related to infection, hospital admission and cardiovascular events were obtained from two principle sources.

Inpatient Hospital episode data were acquired from the Hospital Episodes Statistics (HES) database within the NHS IC, the Patient Episode Database for Wales (PEDW) and the Department of Health Social Services and Public Safety Northern Ireland (DHSSPSNI) Hospital Statistics. The audit data was linked to the hospital episodes to investigate the operations and interventions patients undergo and the amount of time spent in hospital. Second data on selected infections diagnosed by hospitals in England, Wales and Northern Ireland during 2010 were obtained from the Health Protection Agency. This gave information on bloodstream infections (all-cause) and *Clostridium difficile* infections.

Probabilistic linkage methods were used to link the vascular access records to the HPA LabBase which extracted all Bloodstream Infection and *Clostridium difficile* records and made pair-wise comparisons against all the renal patients.

Of the 2,078 patients who were HD starters, 2,026 had a hospital episode which was relevant to kidney care and 324 were matched to bloodstream infections or *Clostridium difficile* infection records reported to the HPA.

11.1 Bed days relating to kidney care

Figure 23 shows the number of relevant bed days for HD starters within 3 months of first dialysis. This included bed days that occurred outside the 3 month period, as long as the episode started or finished during that time. While the median for all patients is 6 days, patients with AVF have lower median bed days than patients on catheters. Data for AVG are presented but the number of patients are low (n=16).

Figure 23
Number and median number of bed days for all HD starters, for stays relating to kidney care where start or finish date is within 3 months of first dialysis

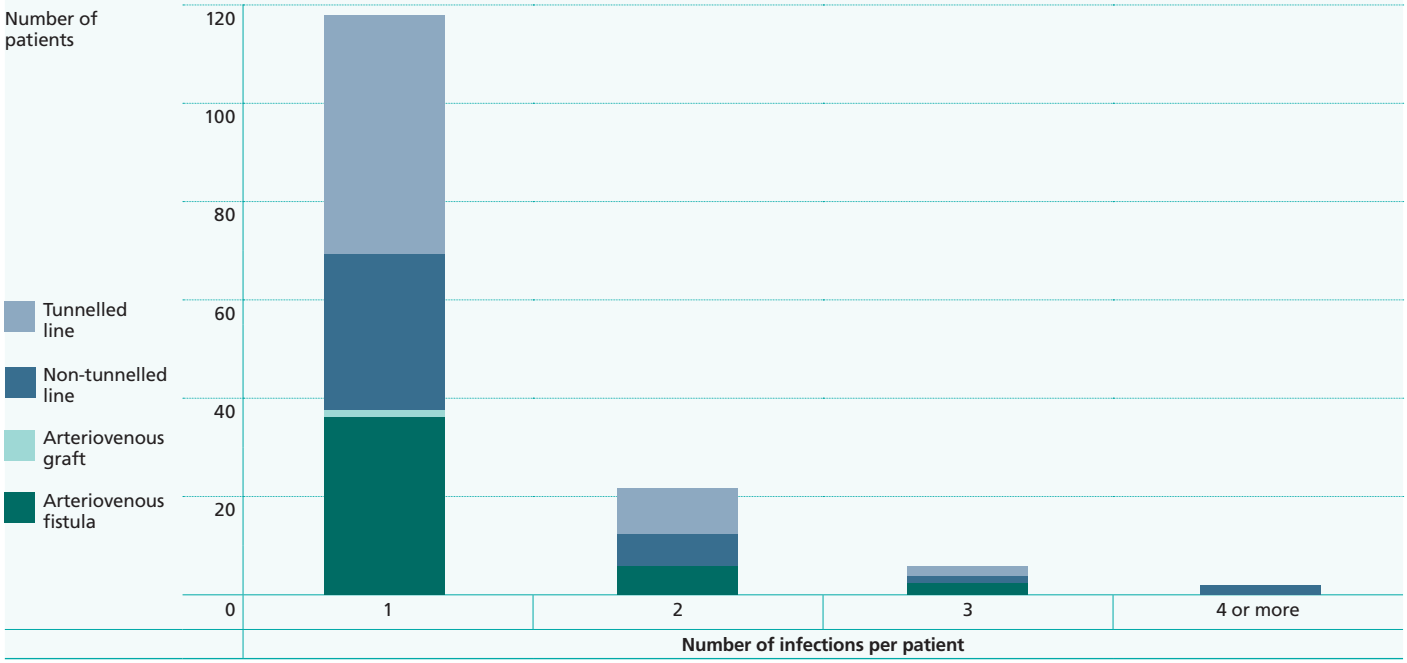
Access type	Days spent in hospital	All HD patients	Median days per patient
Non-tunnelled line	9103	412	14.0
Tunnelled line	13347	809	8.0
Arteriovenous fistula	6352	841	1.0
Arteriovenous graft	241	16	6.5
Grand Total	**29043**	**2078**	**6.0**

11.2 Bloodstream infections

Patients on dialysis are at risk of infection. The reasons for this are complex but reflect increased vulnerability as part of having kidney failure and as a consequence of therapy. Vascular access is a key component of this risk – access acting as a portal for infection to enter the circulation. It is well recognised that venous catheters increase dialysis associated infections due to the permanent nature of this portal and as a foreign body.

Figure 24 shows the frequency of infections per patient. Most patients (1,931) had no recorded episodes of bacteraemia following haemodialysis but 147 patients had 1 or more episodes in the 6 months after dialysis commenced. The majority of those (117 of 147 patients, 79 per cent) had only one bacteraemia in the six months following first dialysis and 30 individuals had two or more in the same period. The risk for recurrent infections would appear to be higher for individuals starting dialysis with a venous catheter, but numbers are too small to explore significance.

Figure 24
Frequency of infections per patient in the 6 months following first dialysis

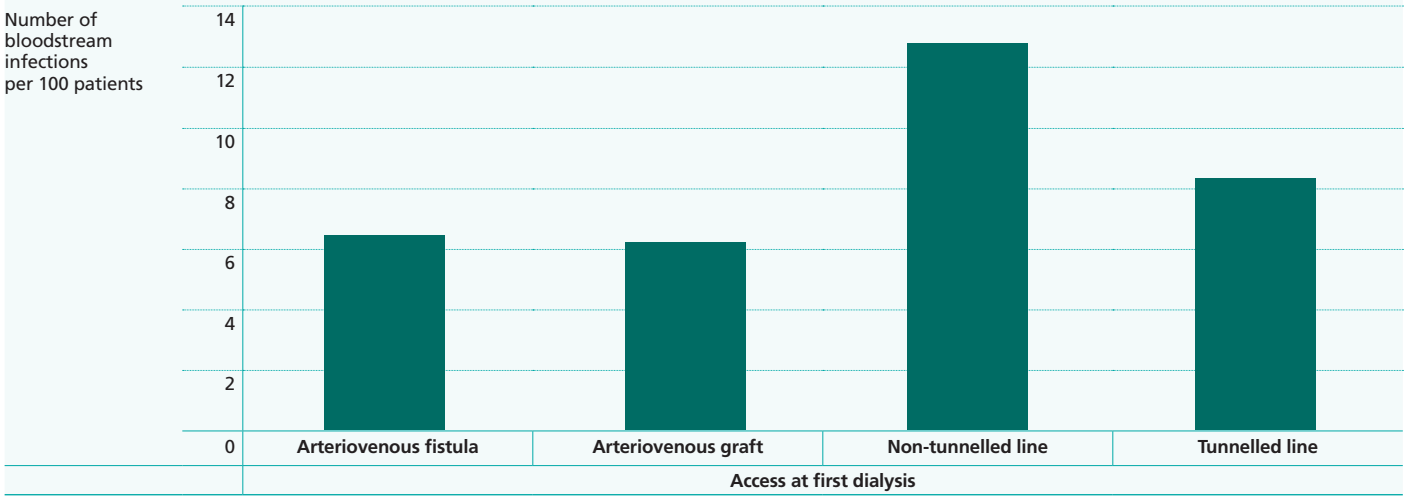


Source: HPA data for infections diagnosed within 6 months of start of dialysis

Figure 25 shows the rate of bloodstream infections in patients, which shows that the rate of infections in patients using temporary venous catheters is considerably higher than those on definitive access. Corrected for sample size, the 6 month infection rate was 6 episodes per 100 patients for an AVF, 13 for a non-tunnelled venous catheter and 8 for tunnelled catheters. In all groups of patients the risk is high, but magnified in the venous catheter populations.

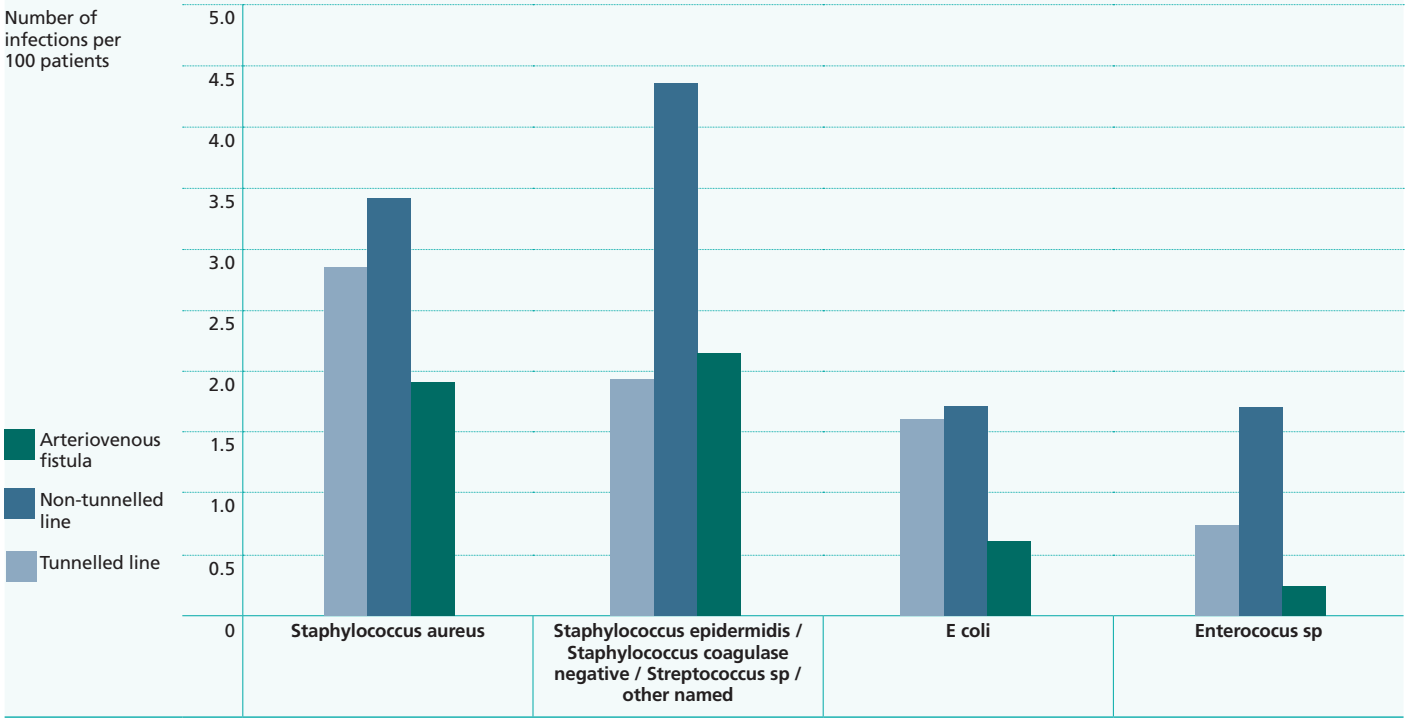
Figure 26 shows rates of bloodstream infection epsidoes within the first 6 months of starting haemodialysis for the four most commonly isolated pathogens. The rate of *staphylococcus aureus* bacteraemia was nearly doubled in the venous catheter group with higher rates of *E. coli* and *enterococcal* bacteraemia also observed. Whilst increased risk of *S.aureus* bacteraemia is well recognised, an increased risk of Gram-negative bacteraemia (such as *E.coli*) is less well documented and therefore of interest.

Figure 25
Number of bloodstream infections per 100 patients by access at first dialysis, HD starters



Source: HPA data for infections reported within 6 months of start of dialysis

Figure 26
Infections per 100 patients in 6 months following first dialysis, by access type at first dialysis and by top four infection types

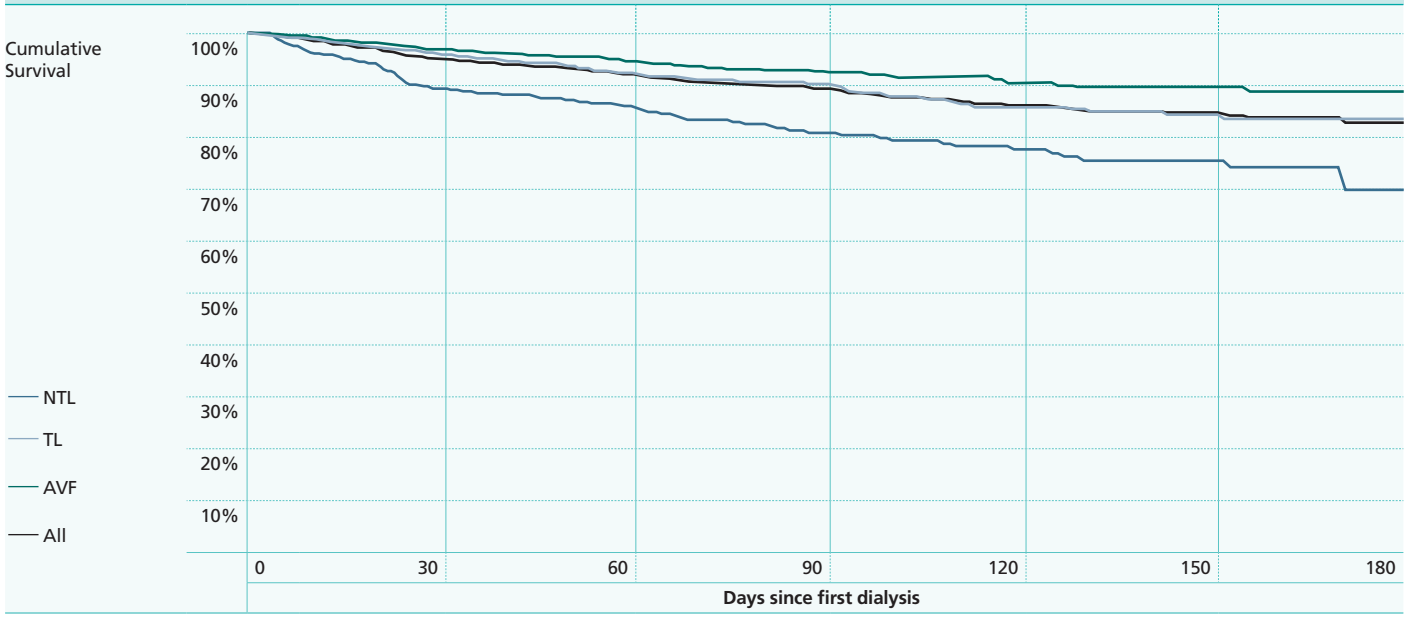


Source: HPA data for infections reported within 6 months of start of dialysis

Overall, 17 per cent of this cohort had either died or had at least one infection by the end of 6 months after dialysis start (Figure 27). However the 6 month risk was 11 per cent for AVF, 17 per cent for TC and 30 per cent for NTC.

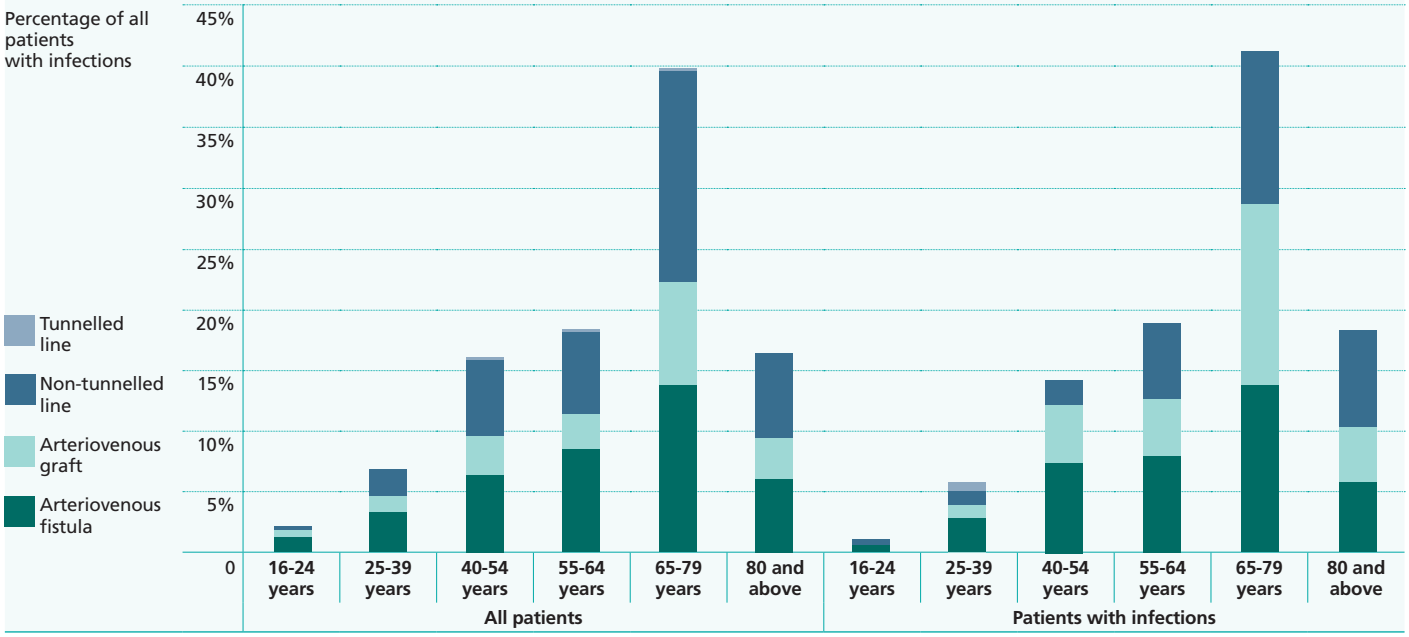
Age is often associated with higher rates of infections, particularly of those acquired in a healthcare setting. However, within this dialysis cohort this did not appear to be a significant factor (Figure 28).

Figure 27
Kaplan Meier Plot for all HD starters for first infection or death for 6 months following first dialysis



Note: AVF – Arteriovenous Fistula, NTL – Non-Tunnelled Line, TL Tunnelled Line
Arteriovenous Graft not shown due to small number of patients and events

Figure 28
Age profile of patients with and without infection by access at first dialysis



11.3 Complication relating to Vascular Access

Hospital episode statistics were correlated with the starting cohort to look at event rates. Essentially, events were divided into cardiovascular, infections directly related to access, other bacterial infections, atypical and viral infections and mechanical events related to access.

Unrelated events were not included in this analysis.

These events were mapped to starting access and event rate determined for the three months prior to the start of dialysis and three months after. Data for AVG are included in the figures but are not specifically commented on due to the small numbers and high variance.

Figure 29a details the event classifications by access type for the 3 months prior to the start of dialysis. It is clear that those patients starting dialysis with venous catheters had higher rates of general infections and cardiovascular events. In part, this might be part of the explanation for the use of venous catheters for vascular access. Infection directly related to access was equivalent between groups and there were few events related to access related mechanical diagnostic codes.

In the three months after dialysis commenced (Figure 29b), cardiovascular events rose in all access categories (82 to 151 AVF, 131 to 181 tunnelled and 181 to 280 events per 100 patients non tunnelled catheters). This absolute magnitude is similar in each group, but represents a very high overall burden.

There was no significant rise in access related infection events in the AVF group (7 to 15) but there was a doubling for catheter related access (NTL 8 to 37 and TL 13 to 21).

There was also no rise in AVF associated bacterial infections (32 to 38) but there was a small rise in tunnelled catheter events (88 to 97) and a substantial rise in the non tunnelled catheter group (140 to 206).

Figure 29a
Events per 100 patients, by access at first dialysis, 3 months before first dialysis

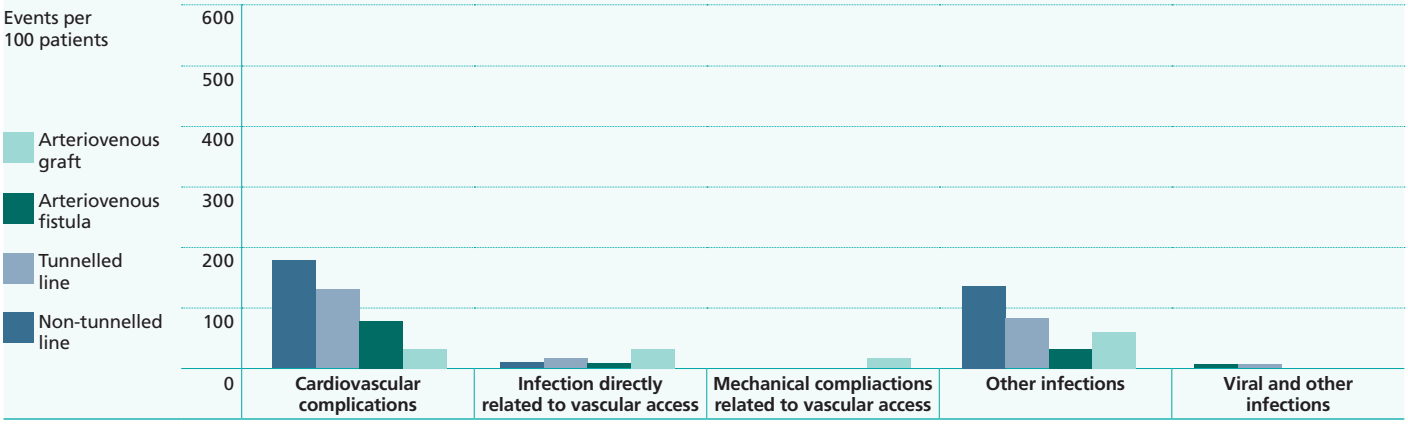
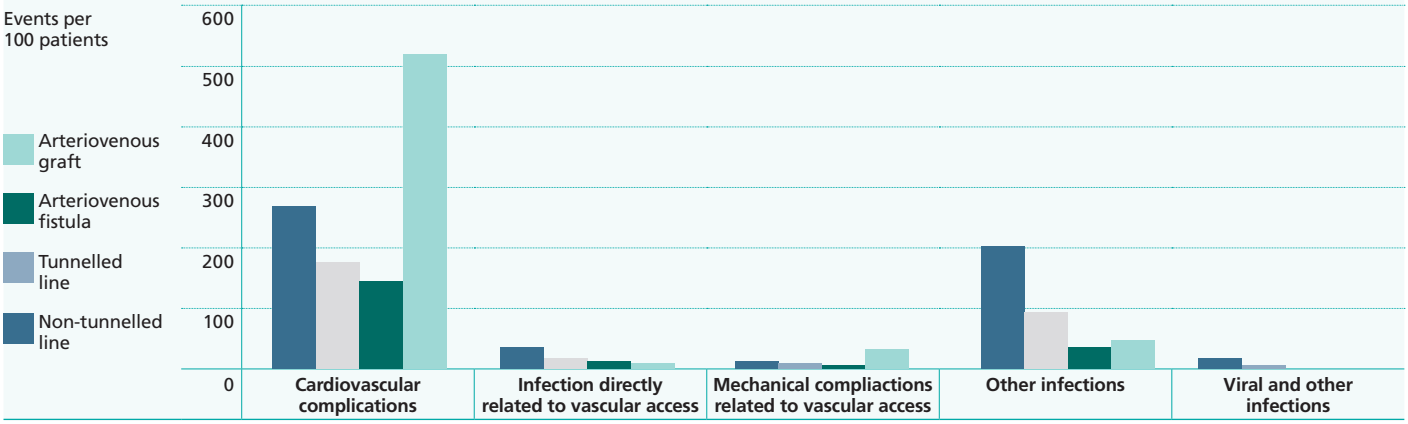


Figure 29b
Events per 100 patients, by access at first dialysis, 3 months after first dialysis



Cardiovascular events were subdivided between cardiac, cerebrovascular, peripheral vascular and salt and water overload. Baseline rates for cardiac and salt and water overload were higher in the catheter groups before commencement of dialysis, with a consistent rise across all access groups in cardiac events once dialysis commenced. Salt and water events fell in the AVF group, with small rises in the catheter groups.

Figure 30a
Cardiovascular events per 100 patients, by access at first dialysis, 3 months before first dialysis

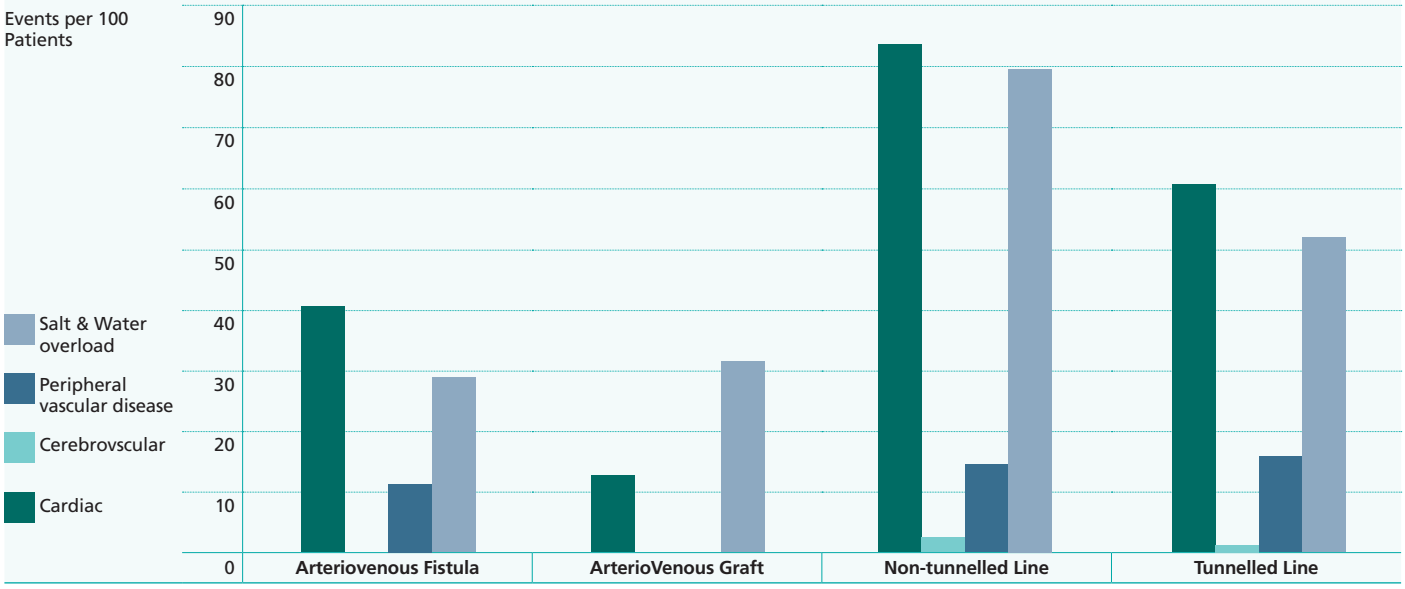
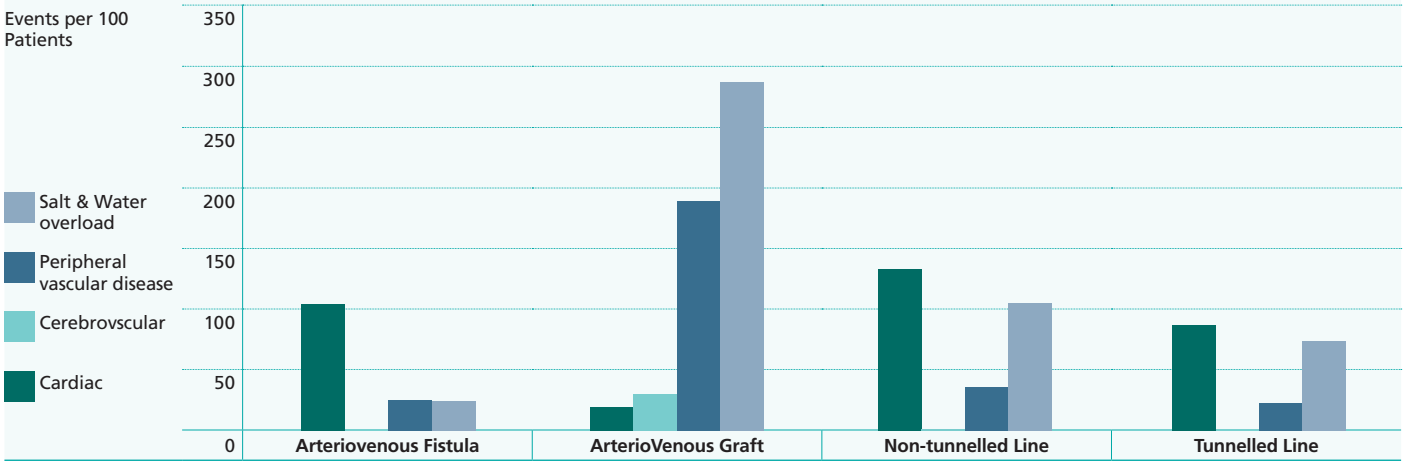


Figure 30b
Cardiovascular events per 100 patients, by access at first dialysis, 3 months after first dialysis



12 Discussion

12.1 Data Overview

To summarise this detailed dataset, 60 out of 63 renal units across England, Wales and Northern Ireland provided information on incident dialysis patients from 1st January to 30th June 2010. Based on previous UK Renal Registry returns this would appear to be a highly representative sample of all incident patients across the three countries. Data completion rates were very high with a lowest completion rate related to the surgical referral. Units returned the excel spreadsheet within a 2 month time frame and few queries were generated from this return back to centres.

A total of 2,404 patients were submitted. Of those, a number of patients were excluded due to being duplicate records, not incident, had recovered renal function or were deemed to have acute kidney injury. This provided the audit with a sample of 2,257 patients. This was reduced by a further 168 for patients who had commenced on peritoneal dialysis and 11 where the type of dialysis at start was not known or not recorded.

Of this cohort, 62 per cent were male with a median age of 68. Individual centre median age ranged from 54-77, the highest seen in Omagh - Tyrone County Hospital and the lowest in Carlisle - Cumberland Infirmary. Twenty five per cent of patients came from the most deprived quintile with large variations between the regions of England. The more deprived areas were Cheshire and Merseyside (60 per cent of patients were from the most deprived quintile) followed by the North East and Greater Manchester (57 per cent and 51 per cent). In contrast more affluent populations were seen in the East of England and South Central regions where the most deprived quintile formed less than 10 per cent of the sample size.

Across the United Kingdom 22 per cent of patients were referred within 90 days of dialysis start, with significant variation between networks. Greater Manchester had a 17 per cent late referral rate rising to 33 per cent in Cheshire and Merseyside.

Forty per cent of haemodialysis patients commenced dialysis with an arteriovenous fistula and just 1 per cent with an arteriovenous graft. Centres and countries varied with the lowest percentage on an arteriovenous fistula seen in Northern Ireland, just over 20 per cent and Wales having the highest percentage at just over 50 per cent. The percentage at three months who were dialysing with an arteriovenous fistula had not significantly changed. Tunnelled venous catheters were in use in 42 per cent of patients, 3 per cent were on peritoneal dialysis and 6 per cent were deceased. Small numbers had been transplanted or were still using non-tunnelled catheters. For those patients who started with an arteriovenous fistula there was a low mortality risk at three months and high technique survival. The majority of patients with non-tunnelled catheters had been converted to tunnelled lines but just over 10 per cent were using arteriovenous fistula or had been converted to a peritoneal dialysis. For those patients who presented within 90 days mortality risk was higher in those patients who commenced with a venous catheter but there are only a small number of patients with arteriovenous fistula for comparison.

Overall just over 50 per cent of patients had been referred to a surgeon for vascular access more than three months before they started dialysis. Northern Ireland with low fistula starting rates still referred more than 50 per cent of patients to surgeons suggesting capacity issues within the system. This was in contrast to Wales that had referred just over 60 per cent of patients to a surgeon with a starting rate on fistulas of over 50 per cent, suggesting that the surgical pathway is relatively well resourced and organised. Within England rates of referral varied from 40 per cent in Cumbria and Lancashire up to over 65 per cent in the East Midlands. For those patients who had been referred to a surgeon there was a greater chance of commencing dialysis with an arteriovenous fistula going from 7 per cent for less than 90 days up to 45 per cent in a 90 day to 1 year period and more than 65 per cent when they had been known to the renal system by more than 1 year. Those patients who had been referred to a surgeon prior to first dialysis clearly had a much higher probability of commencing dialysis with a fistula.

HES and HPA data were interrogated to provide additional information around the burden associated with vascular access. Three months after commencing dialysis median bed days per patient were 6 but were lower in the arteriovenous fistula group at 1 median days per patient, 8 in the tunnelled catheter group and 14 in non-tunnelled catheter group. Approximately 7 per cent of patients had at least one episode of bacteraemia following the start of dialysis with 30 patients having more than one episode. Arteriovenous fistulas were associated with 6 bacteraemic episodes per 100 patients in the first three months compared to 13 for non-tunnelled catheters and 8 in tunnelled catheters. HPA confirmed *s. aureus* bacteraemia as being a particularly important pathogen but there were higher rates of Gram-negative organisms in those patients with non-tunnelled catheters. *Clostridium Difficile* infection rates were also higher in those patients with non-tunnelled catheters.

From HES data sources there was a particular finding of higher rate of non-access associated infection in the venous catheter groups. Cardiovascular complications were elevated in all groups mainly due to an excess of cardiac events but issues with salt and water overload improved in the arteriovenous fistula group after the commencement of dialysis compared to the catheter related groups.

12.2 Data Collection

The main issue for the audit has been the challenge of data collection. The previous plan had been to extract data directly from centre IT systems, accessing data items from the National Renal Dataset. This proved unworkable in the lifetime of this project and therefore the strategy around acquiring data from dialysis units was changed for this last round of data collection. A simple excel spreadsheet with defined data items was sent to dialysis centres. In a relatively

short period of time thanks to the support and hard work of collaborating centres, 60 out of 63 centres returned high quality data on a large number of incident patients. Three centres did not return data. In 2 out of 3 cases this was related to data issues. In one centre's case there were concerns about data security despite the measures the NHS Information Centre had put in place and in another a local IT system was unable to deliver the appropriate data in the timeframe allotted. The final centre declined participation on the audit on the basis of criticisms of the structure of the audit itself. Once data was acquired there were some issues around data validation as opposed to data completeness. The majority of these were due either to a lack of clarity in definitions around some of the data items or to data entry errors that were easily rectified with liaison with the centres.

Data completeness was high overall, exceeding 90 per cent completion and a comparison with previous UK Renal Registry returns suggest that the majority of incident haemodialysis patients were reported on. Only one data item had a completion rate below 90 per cent – that related to surgical referral.

Despite that it is clear that centres already have a large proportion of the data close to hand. The speed at which returns were sent into the NHS Information Centre and the high rate of completeness suggests that the data largely exists in information centres and does not require paper note based extraction. This therefore supports the notion that a regular electronic extraction of data around a limited number of data items would be possible on an on-going basis as part of the UK Renal Registry regular data returns. It was also clear that by refining the data items and utilising other data bases such as HES and HPA (and their equivalent in Northern Ireland and Wales), complex issues can be explored on a national, regional and centre basis.

One issue highlighted by the data item clarification was that of the inclusion by some centres of patients commencing dialysis on peritoneal dialysis. This has demonstrated that a more strategic analysis of patients commencing renal replacement therapy should include those patients who commence peritoneal dialysis or have pre-emptive renal transplant as part of that pathway. The wide variation in PD utilisation for incident patients may have a bearing on the casemix of patients commencing haemodialysis and hence their suitability for an arteriovenous fistula.

12.3 Complications

Infection is known to be a major consequence and risk of vascular access. Patients requiring venous catheter are particularly prone to bacteraemic infections particularly those of *staphylococcus aureus* species. This audit has highlighted that *staphylococcus aureus* bacteraemia (SAB) is a common problem in all incident dialysis patients. The HPA linkage data suggested high rates of SAB in the first six months after commencing dialysis in arteriovenous fistula patients or those utilising venous catheters. The rate is higher in those with venous catheters but is still equivalent to 8 bacteraemic episodes related to *s. aureus* for every 100 patients per year for those patients with an AVF. These data do not tell us whether that risk is attenuated as patients spend more time on dialysis but is an area of significant concern to patients and health care provision due to the associated morbidity, mortality, cost and resource utilisation.

The most common causes of mortality within a dialysis population are those related to cardiovascular events, particularly myocardial and cerebral vascular disease. Patients entering dialysis have an increased risk of cardiovascular events prior to commencing dialysis. This audit and these data do not tell us whether that is part of the uraemic milieu but once dialysis commences these risks remain high and for some diagnostic categories are increased. The one exception is related to episodes of salt and water overload (i.e., pulmonary oedema) in patients who commence dialysis on an arteriovenous fistula. This may reflect a direct consequence of the arteriovenous fistula upon dialysis adequacy and volume control. Alternatively, it may reflect a protective effect of arteriovenous fistulae upon some aspects of cardiac disease for which there are some data now available. It may also reflect a more controlled start to the initiation of dialysis with more timely initiation driven by the need to control fluid rather than those patients who commence renal replacement therapy via catheter being those who present as an emergency.

12.4 Referral Times

Turning to the central issue of provision of good quality vascular access it is clear that these results are disappointing. The most recent edition of the Renal Association standards have suggested for those patients presenting more than 90 days from referral to first dialysis, 65 per cent of patients should commence dialysis with an arteriovenous fistula. For those patients under 90 days the suggested standard is 35 per cent. The overall performance of 41 per cent is considerably below that level. There are suggestions from looking at the disparity between regions that some of this may reflect higher late referral rates whereas in other regions surgical capacity maybe an issue. However, nearly a third of patients known to nephrologists for more than a year and just under half of patients known to nephrologists for 90 days to a year had not been referred to a surgeon. This may reflect upon organisational issues such as capacity, education and support to individual but equally it may reflect a lack of certainty about the potential need for commencing dialysis. In other words, a patient with moderate kidney disease may have very stable renal function with no evidence of decline but a crisis precipitate a profound and prolonged decline in function requiring the commencement of dialysis. Similar clinical scenarios may be generated around this area but at the heart of it is the need to have better methodology for the assessment of the prediction of timing of dialysis start and then to be able to act upon it in a timely and appropriate way.

Equally for those patients presenting late and requiring dialysis it may be that the current Renal Association target is too optimistic. However there is little evidence that patients

who present late or present in an unplanned way requiring haemodialysis with a venous catheter are moved quickly through the system to deliver a functioning fistula or graft. Less than 10 per cent of patients commencing dialysis with non-tunnelled or tunnelled catheters who had presented at less than 90 days were using an AVF by day 90 post starting dialysis. The proportion was little better in those patients who had been known for more than 90 days. Of 727 patients who started with a catheter only 75 were using an arteriovenous fistula and 8 were using an arteriovenous graft at three months.

12.5 Summary

The principles of service improvement remain to collect appropriate data, analyse that data, effect change and continue to collect data in an iterative process. Six years after the publication of the first UK Renal Registry report on Vascular Access and with the advent of best practice tariff in England based around vascular access, it is clear that data collection is somewhat easier than before but is still not yet on a robust footing. This audit has also not measured prevalent dialysis access but there is evidence from other data sources such as DOPPS that the situation may have improved in the United Kingdom in comparison to other developed countries (personal communication unpublished data Ann Arbor Research, 2011). There has also been recognition that vascular access is a crucial component of therapy, as evidenced by its incorporation into the best practice tariff in England. What still needs to be done in a sustainable way is to provide robust information in a sustainable fashion to inform patients and commissioners.

Overall this has been a successful period from the National Vascular Access Audit in developing the methodology for a focused audit process to measure and thereby drive systemic improvement in the provision of vascular access across the United Kingdom. The burden of vascular access remains high for patients requiring haemodialysis. It remains the single most important and modifiable risk factor for death and illness in the haemodialysis population. This report highlights a low provision of definitive vascular access in patients commencing haemodialysis and points to the issues of organisation, resourcing and clinical understanding within this topic.

13 Recommendations

The 2010 Vascular Access Report included recommendations across 3 domains – data collection, access provision and morbidity and mortality. Where those recommendations have been revised, the wording is shown in italics.

Data collection

1. Data items relevant to the audit of vascular access in haemodialysis should be reviewed with a view to simplification. The key mandatory item should be access type in use at each dialysis session.
2. Individual dialysis centres should review data collection and extraction to the renal registry.
3. The UK Renal Registry should collect data on vascular access and return data quality reports to centres prior to analysis. Correction and improvement of data quality should remain the responsibility of the provider centre.
4. Centres *and commissioners* should develop data items to enable local and regional audit of process and outcomes related to vascular access.
5. A unified standard for patients commencing all forms of renal replacement therapy, including peritoneal dialysis and transplantation should be developed in collaboration with the Renal Association, the British Renal Society and the British Transplantation Society. This would provide a better measure of clinical care when assessing centre performance.

Access provision

1. Late referral should be minimised by joint working with primary and secondary care to identify *progressive* chronic kidney disease.
2. When patients present late, requiring renal replacement therapy, alternative therapies should be considered to allow time for the formation of vascular access.
3. When patients commence dialysis with a venous catheter, a root cause analysis should be undertaken to determine the reasons and to improve the process.
4. Research and development into the prediction of dialysis start dates and the optimal timing of access placement is urgently required.

Morbidity and mortality

1. Renal providers should record and audit episodes of infection. Key markers should be episodes of bacteraemia, pneumonia and metastatic infection such as endocarditis.
2. Infection rates should be reduced by improving the rate of AV fistula use at the start of dialysis.
3. Research into the role of vascular access and cardiovascular events is urgently required and should be addressed.
4. *Overall strategies to reduce global infection risk in dialysis populations should be supported through research investment.*
5. *Overall strategies to reduce cardiovascular burden in dialysis populations should be supported through research investment.*

14 Further Information

This report presents the key findings from the National Kidney Care Audit Vascular Access Report 2011.

To facilitate units in identifying success and weakness against the recommendations, unit level reports will be available following the publication of this report.

For more information please visit the NKCA webpage at:

http://www.ic.nhs.uk/services/national-clinical-audit-support-programme-ncasp/kidney-care/vascular-access

For further information about this report please contact The NHS Information Centre's Contact Centre on 0845 300 6016 or email: enquiries@ic.nhs.uk.

For more details of the Index Multiple Deprivation 2010 data source please visit:

http://www.communities.gov.uk/communities/research/indicesdeprivation/deprivation10/

15 References

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4. Fluck, R., and Kumwenda, M., Vascular Access for Haemodialysis Guidelines, Renal Association Clinical Practice Guidelies, 5th Edition, 2011: http://www.renal.org/Clinical/GuidelinesSection/VascularAccess.aspx

Appendix 1 – 2010 Data Submission proforma

The data collection spreadsheet can be accessed and viewed in full on the audit website at:

http://www.ic.nhs.uk/services/national-clinical-audit-support-programme-ncasp/kidney-care/vascular-access

Audit data item number	Audit data item	Mandatory/Optional	Definition	UKRR dataset specification code
VAA1	ID	O	Unique identifier, local to the data provider, e.g. automatically assigned by their clinical system	IDN04
VAA2	NHS Number	M	Unique identifier	PAT12
VAA3	Surname	M	The Patient's Surname	IDN01
VAA4	Forename	M	The Patient's Forename	IDN02
VAA5	DoB	M	The date on which a PERSON (the renal patient) was born or is officially deemed to have been born	IDN03
VAA6	Gender	M	The classification is phenotypical rather than genotypical, i.e. it does not provide codes for medical or scientific purposes	PAT00
VAA7	Post Code	M	The postcode of the patient's usual address	PAT23
VAA8	Treatment Centre Code for dialysis	M	Identifying code of the centre where the patient dialyses. Needed to establish renal centre where patient first dialyses	PAT01
VAA9	First Dialysis Access	M	Access in use at first dialysis.	ERF12
VAA10	Date First Dialysis	M	Date first dialysis in this audit cycle	ERF00 (Date 1st ERF treatment)
VAA11	Date first seen by Renal Physician	M	The date the patient is first seen by a renal physician. Outpatient or Inpatient nephrology	PAT33
VAA12	Access in use at 3 months	M	The Access in use 3 months after the access used for first dialysis	Not defined: derived
VAA13	Referred to Surgeon for an AVF or AVG at least 3 months before dialysis	O	Was the patient seen by a surgeon re-garding vascular access at least 3 months before their first dialysis date	

Appendix 2 – Results Reported by Renal Centres

Results based on 2078 records (all haemodialysis patients)

			Access type at first dialysis				Access type or outcome 3 months later							Referral time from physician & dialysis				
Kidney Care Network Name	**Patients**	**Median Age**	**AVG**	**AVF**	**NTL**	**TL**	**AVG**	**AVF**	**NTL**	**TL**	**PD Catheter**	**Death Before 3 Months**	**Transplant**	**>1 Yr**	**90 days to 1 Yr**	**<90 days**	**Patient referred to a surgeon**	**Patients**
UK Total	**2078**	**68**	**0.8%**	**40.5%**	**19.8%**	**38.9%**	**1.2%**	**41.3%**	**1.1%**	**41.9%**	**2.5%**	**6.1%**	**0.5%**	**60.5%**	**12.6%**	**22.5%**	**48.7%**	**2078**
North East	**100**	**68**	**1.0%**	**40.0%**	**12.0%**	**47.0%**	**1.0%**	**38.0%**	**1.0%**	**45.0%**	**3.0%**	**11.0%**	**1.0%**	**67.0%**	**13.0%**	**20.0%**	**66.0%**	**100**
Middlesbrough - The James Cook University Hospital	43	71	0.0%	39.5%	27.9%	32.6%	0.0%	34.9%	0.0%	46.5%	4.7%	11.6%	2.3%	62.8%	11.6%	25.6%	62.8%	43
Newcastle - Freeman Hospital	44	64.5	2.3%	27.3%	0.0%	70.5%	2.3%	25.0%	2.3%	54.5%	2.3%	13.6%	0.0%	70.5%	9.1%	20.5%	59.1%	44
Sunderland Royal Hospital	13	58	0.0%	84.6%	0.0%	15.4%	0.0%	92.3%	0.0%	7.7%	0.0%	0.0%	0.0%	69.2%	30.8%	0.0%	100.0%	13
Cumbria and Lancashire	**58**	**66**	**0.0%**	**41.4%**	**34.5%**	**24.1%**	**0.0%**	**44.8%**	**0.0%**	**44.8%**	**1.7%**	**6.9%**	**0.0%**	**58.6%**	**10.3%**	**29.3%**	**41.4%**	**58**
Carlisle - Cumberland Infirmary	6	54	0.0%	16.7%	0.0%	83.3%	0.0%	16.7%	0.0%	66.7%	16.7%	0.0%	0.0%	66.7%	16.7%	16.7%	16.7%	6
Preston - Royal Preston Hospital	52	66	0.0%	44.2%	38.5%	17.3%	0.0%	48.1%	0.0%	42.3%	0.0%	7.7%	0.0%	57.7%	9.6%	30.8%	44.2%	52
Cheshire and Merseyside	**81**	**70**	**1.2%**	**39.5%**	**24.7%**	**34.6%**	**0.0%**	**29.6%**	**0.0%**	**16.0%**	**2.5%**	**8.6%**	**0.0%**	**48.1%**	**11.1%**	**33.3%**	**16.0%**	**81**
Birkenhead - Arrowe Park Hospital	32	74.5	0.0%	31.3%	21.9%	46.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	6.3%	31.3%	0.0%	32
Liverpool - Aintree University Hospital	29	69	3.4%	55.2%	34.5%	6.9%	0.0%	58.6%	0.0%	0.0%	6.9%	24.1%	0.0%	51.7%	6.9%	34.5%	44.8%	29
Liverpool - Royal Liverpool University Hospital	20	64.5	0.0%	30.0%	15.0%	55.0%	0.0%	35.0%	0.0%	65.0%	0.0%	0.0%	0.0%	40.0%	25.0%	35.0%	0.0%	20
Greater Manchester	**88**	**62.5**	**0.0%**	**45.5%**	**11.4%**	**43.2%**	**0.0%**	**51.1%**	**0.0%**	**44.3%**	**3.4%**	**0.0%**	**0.0%**	**62.5%**	**10.2%**	**17.0%**	**55.7%**	**88**
Manchester Royal Infirmary	44	64	0.0%	45.5%	22.7%	31.8%	0.0%	54.5%	0.0%	38.6%	6.8%	0.0%	0.0%	68.2%	6.8%	9.1%	63.6%	44
Salford - Hope Hospital	44	58	0.0%	45.5%	0.0%	54.5%	0.0%	47.7%	0.0%	50.0%	0.0%	0.0%	0.0%	56.8%	13.6%	25.0%	47.7%	44
Yorkshire and the Humber	**196**	**67**	**1.0%**	**45.4%**	**24.0%**	**29.6%**	**1.5%**	**44.9%**	**2.6%**	**38.3%**	**1.5%**	**9.7%**	**1.0%**	**64.3%**	**13.3%**	**22.4%**	**55.6%**	**196**
Bradford - St Lukes Hospital	19	69	0.0%	52.6%	0.0%	47.4%	0.0%	36.8%	0.0%	42.1%	0.0%	15.8%	5.3%	78.9%	15.8%	5.3%	63.2%	19
Doncaster Royal Infirmary	19	70	0.0%	31.6%	36.8%	31.6%	0.0%	36.8%	0.0%	47.4%	5.3%	10.5%	0.0%	78.9%	5.3%	15.8%	47.4%	19
Hull Royal Infirmary	34	69	0.0%	32.4%	44.1%	23.5%	0.0%	35.3%	14.7%	32.4%	0.0%	14.7%	2.9%	47.1%	14.7%	38.2%	35.3%	34
Leeds - St James's University Hospital - Ward 55	54	64.5	0.0%	42.6%	18.5%	38.9%	0.0%	40.7%	0.0%	50.0%	1.9%	5.6%	0.0%	63.0%	14.8%	22.2%	59.3%	54
Sheffield - Northern General Hospital	55	66	3.6%	49.1%	27.3%	20.0%	5.5%	49.1%	0.0%	36.4%	1.8%	7.3%	0.0%	61.8%	14.5%	23.6%	56.4%	55
York District General Hospital	15	67	0.0%	80.0%	0.0%	20.0%	0.0%	86.7%	0.0%	0.0%	0.0%	13.3%	0.0%	80.0%	6.7%	13.3%	86.7%	15
East Midlands	**161**	**68**	**1.2%**	**49.1%**	**24.8%**	**24.8%**	**0.6%**	**46.6%**	**1.2%**	**36.0%**	**5.6%**	**7.5%**	**0.6%**	**55.9%**	**11.2%**	**16.8%**	**29.8%**	**161**
Derby City General Hospital	22	69	0.0%	45.5%	31.8%	22.7%	0.0%	45.5%	0.0%	27.3%	13.6%	13.6%	0.0%	54.5%	13.6%	31.8%	63.6%	22
Leicester General Hospital	89	69	1.1%	38.2%	25.8%	34.8%	0.0%	36.0%	2.2%	51.7%	2.2%	6.7%	1.1%	47.2%	10.1%	13.5%	0.0%	89
Nottingham City Hospital Renal and Transplant Unit	50	65	2.0%	70.0%	20.0%	8.0%	2.0%	66.0%	0.0%	12.0%	8.0%	6.0%	0.0%	72.0%	12.0%	16.0%	68.0%	50
West Midlands	**295**	**67**	**0.3%**	**45.1%**	**5.4%**	**49.2%**	**0.7%**	**39.7%**	**0.3%**	**45.4%**	**2.0%**	**5.1%**	**0.3%**	**64.1%**	**9.5%**	**20.3%**	**58.3%**	**295**
Birmingham - Heartlands Hospital	61	60	0.0%	59.0%	0.0%	41.0%	1.6%	47.5%	0.0%	31.1%	3.3%	3.3%	1.6%	52.5%	8.2%	11.5%	72.1%	61
Birmingham - Queen Elizabeth Hospital	94	68	0.0%	45.7%	0.0%	54.3%	0.0%	40.4%	0.0%	54.3%	0.0%	5.3%	0.0%	59.6%	7.4%	33.0%	51.1%	94
Coventry - Walsgrave Hospital	42	65	0.0%	31.0%	23.8%	45.2%	0.0%	35.7%	2.4%	52.4%	0.0%	9.5%	0.0%	69.0%	16.7%	11.9%	57.1%	42
Dudley - Russells Hall Hospital	14	68.5	0.0%	28.6%	28.6%	42.9%	0.0%	14.3%	0.0%	85.7%	0.0%	0.0%	0.0%	92.9%	0.0%	7.1%	64.3%	14
Shrewsbury - Royal Shrewsbury Hospital	13	67	0.0%	46.2%	15.4%	38.5%	0.0%	0.0%	0.0%	0.0%	7.7%	0.0%	0.0%	84.6%	15.4%	0.0%	0.0%	13
Stoke - University Hospital of North Staffordshire	45	71	2.2%	62.2%	0.0%	35.6%	2.2%	66.7%	0.0%	24.4%	2.2%	4.4%	0.0%	73.3%	11.1%	15.6%	80.0%	45
Wolverhampton - New Cross Hospital	26	65.5	0.0%	11.5%	0.0%	88.5%	0.0%	11.5%	0.0%	73.1%	7.7%	7.7%	0.0%	57.7%	7.7%	34.6%	42.3%	26
East of England	**161**	**66**	**0.6%**	**41.0%**	**8.1%**	**50.3%**	**0.6%**	**37.3%**	**0.0%**	**50.9%**	**1.9%**	**4.3%**	**0.6%**	**50.3%**	**16.1%**	**20.5%**	**39.8%**	**161**
Basildon	10	63.5	0.0%	60.0%	20.0%	20.0%	0.0%	40.0%	0.0%	30.0%	10.0%	10.0%	0.0%	60.0%	20.0%	10.0%	100.0%	10
Cambridge - Addenbrooke's Hospital	31	76	0.0%	61.3%	22.6%	16.1%	0.0%	54.8%	0.0%	41.9%	0.0%	3.2%	0.0%	38.7%	25.8%	35.5%	0.0%	31
Chelmsford - Broomfield Hospital	17	66	0.0%	35.3%	0.0%	64.7%	0.0%	29.4%	0.0%	52.9%	0.0%	0.0%	5.9%	52.9%	17.6%	29.4%	41.2%	17
Colchester General Hospital	17	69	5.9%	52.9%	0.0%	41.2%	5.9%	52.9%	0.0%	35.3%	0.0%	5.9%	0.0%	70.6%	0.0%	23.5%	58.8%	17
Ipswich Hospital	15	64	0.0%	13.3%	0.0%	86.7%	0.0%	13.3%	0.0%	46.7%	0.0%	20.0%	0.0%	53.3%	20.0%	0.0%	13.3%	15
Norfolk & Norwich University Hospital	22	66.5	0.0%	27.3%	0.0%	72.7%	0.0%	27.3%	0.0%	72.7%	0.0%	0.0%	0.0%	22.7%	4.5%	4.5%	31.8%	22
Southend Hospital	15	69	0.0%	46.7%	0.0%	53.3%	0.0%	46.7%	0.0%	40.0%	0.0%	6.7%	0.0%	66.7%	20.0%	13.3%	60.0%	15
Stevenage - The Lister Hospital	34	57	0.0%	32.4%	11.8%	55.9%	0.0%	29.4%	0.0%	64.7%	5.9%	0.0%	0.0%	55.9%	17.6%	26.5%	55.9%	34
London	**326**	**65**	**1.2%**	**31.9%**	**26.4%**	**40.5%**	**1.5%**	**36.5%**	**0.0%**	**52.1%**	**0.9%**	**6.7%**	**0.9%**	**59.5%**	**13.2%**	**26.1%**	**47.5%**	**326**
London - Guy's and St Thomas's Hospital	74	60	4.1%	37.8%	0.0%	58.1%	4.1%	44.6%	0.0%	43.2%	1.4%	6.8%	0.0%	73.0%	10.8%	16.2%	67.6%	74
London - King's College Hospital	50	70	2.0%	32.0%	48.0%	18.0%	2.0%	32.0%	0.0%	62.0%	0.0%	2.0%	0.0%	56.0%	20.0%	24.0%	38.0%	50
London - Royal Free Hospital	69	64	0.0%	34.8%	23.2%	42.0%	0.0%	43.5%	0.0%	56.5%	0.0%	0.0%	0.0%	60.9%	13.0%	26.1%	43.5%	69
London - St George's Hospital	36	71.5	0.0%	19.4%	44.4%	36.1%	2.8%	25.0%	0.0%	47.2%	2.8%	13.9%	2.8%	36.1%	16.7%	36.1%	33.3%	36
London - St Helier Hospital, Carshalton - South West Thames Renal & Transplantation Unit	97	68	0.0%	29.9%	30.9%	39.2%	0.0%	32.0%	0.0%	52.6%	1.0%	11.3%	2.1%	58.8%	10.3%	30.9%	45.4%	97
South East Coast	**90**	**73**	**0.0%**	**40.0%**	**17.8%**	**42.2%**	**1.1%**	**45.6%**	**0.0%**	**41.1%**	**5.6%**	**4.4%**	**1.1%**	**56.7%**	**13.3%**	**28.9%**	**43.3%**	**90**
Brighton - Royal Sussex County Hospital	44	72.5	0.0%	34.1%	36.4%	29.5%	2.3%	45.5%	0.0%	45.5%	2.3%	4.5%	0.0%	54.5%	18.2%	25.0%	38.6%	44
Kent & Canterbury Hospital	46	73	0.0%	45.7%	0.0%	54.3%	0.0%	45.7%	0.0%	37.0%	8.7%	4.3%	2.2%	58.7%	8.7%	32.6%	47.8%	46
South Central	**145**	**68**	**0.7%**	**35.2%**	**16.6%**	**47.6%**	**2.8%**	**42.8%**	**0.0%**	**44.1%**	**4.8%**	**2.8%**	**0.0%**	**63.4%**	**12.4%**	**24.1%**	**59.3%**	**145**
Oxford Radcliffe Hospital	56	64.5	0.0%	39.3%	12.5%	48.2%	0.0%	37.5%	0.0%	41.1%	8.9%	5.4%	0.0%	69.6%	12.5%	17.9%	46.4%	56
Portsmouth - Queen Alexandra Hospital	67	69	1.5%	29.9%	9.0%	59.7%	6.0%	44.8%	0.0%	49.3%	0.0%	0.0%	0.0%	65.7%	9.0%	25.4%	73.1%	67
Reading - Royal Berkshire Hospital	22	77	0.0%	40.9%	50.0%	9.1%	0.0%	50.0%	0.0%	36.4%	9.1%	4.5%	0.0%	40.9%	22.7%	36.4%	50.0%	22
South West	**194**	**73**	**1.5%**	**39.2%**	**20.6%**	**38.7%**	**2.6%**	**44.8%**	**1.0%**	**40.2%**	**2.6%**	**7.7%**	**0.5%**	**63.9%**	**14.4%**	**21.6%**	**52.1%**	**194**
Bristol - Southmead Hospital	72	70	1.4%	38.9%	23.6%	36.1%	2.8%	44.4%	0.0%	41.7%	2.8%	6.9%	1.4%	69.4%	9.7%	20.8%	48.6%	72
Dorchester - Dorset County Hospital	26	71.5	0.0%	42.3%	30.8%	26.9%	7.7%	57.7%	3.8%	23.1%	0.0%	7.7%	0.0%	57.7%	15.4%	26.9%	46.2%	26
Exeter - Royal Devon and Exeter Hospital	50	76	4.0%	26.0%	20.0%	50.0%	2.0%	24.0%	0.0%	62.0%	4.0%	8.0%	0.0%	54.0%	20.0%	26.0%	50.0%	50
Gloucester Royal Hospital	19	72	0.0%	63.2%	10.5%	26.3%	0.0%	63.2%	5.3%	21.1%	0.0%	10.5%	0.0%	63.2%	21.1%	15.8%	68.4%	19
Plymouth - Derriford Hospital	14	71.5	0.0%	50.0%	0.0%	50.0%	0.0%	71.4%	0.0%	21.4%	7.1%	0.0%	0.0%	78.6%	7.1%	14.3%	57.1%	14
Truro - Royal Cornwall Hospital, Treliske	13	75	0.0%	38.5%	23.1%	38.5%	0.0%	46.2%	0.0%	30.8%	0.0%	15.4%	0.0%	69.2%	15.4%	15.4%	61.5%	13
Wales	**90**	**71**	**0.0%**	**53.3%**	**32.2%**	**14.4%**	**1.1%**	**61.1%**	**13.3%**	**18.9%**	**1.1%**	**4.4%**	**0.0%**	**65.6%**	**13.3%**	**18.9%**	**62.2%**	**90**
Bangor - Gwynedd Hospital	18	70	0.0%	61.1%	5.6%	33.3%	5.6%	61.1%	0.0%	33.3%	0.0%	0.0%	0.0%	77.8%	11.1%	5.6%	66.7%	18
Rhyl - Glan Clwyd Hospital	8	74.5	0.0%	50.0%	0.0%	50.0%	0.0%	50.0%	0.0%	50.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	8
Swansea - Morriston Hospital	52	70.5	0.0%	50.0%	48.1%	1.9%	0.0%	63.5%	23.1%	5.8%	1.9%	5.8%	0.0%	53.8%	17.3%	28.8%	53.8%	52
Wrexham - Maelor Hospital	12	76.5	0.0%	58.3%	25.0%	16.7%	0.0%	58.3%	0.0%	33.3%	0.0%	8.3%	0.0%	75.0%	8.3%	8.3%	66.7%	12
Northern Ireland	**93**	**65**	**0.0%**	**24.7%**	**41.9%**	**33.3%**	**0.0%**	**22.6%**	**0.0%**	**34.4%**	**1.1%**	**2.2%**	**0.0%**	**60.2%**	**15.1%**	**20.4%**	**33.3%**	**93**
Antrim Area Hospital	18	64.5	0.0%	22.2%	44.4%	33.3%	0.0%	27.8%	0.0%	66.7%	0.0%	5.6%	0.0%	55.6%	27.8%	16.7%	50.0%	18
Belfast - Ulster Hospital	13	67	0.0%	53.8%	0.0%	46.2%	0.0%	53.8%	0.0%	38.5%	0.0%	0.0%	0.0%	53.8%	23.1%	23.1%	61.5%	13
Belfast City Hospital	37	63	0.0%	8.1%	67.6%	24.3%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%	54.1%	10.8%	24.3%	2.7%	37
Derry/Londonderry - Altnagelvin Hospital	4	56	0.0%	75.0%	25.0%	0.0%	0.0%	75.0%	0.0%	0.0%	25.0%	0.0%	0.0%	100.0%	0.0%	0.0%	75.0%	4
Newry - Daisy Hill Hospital	13	63	0.0%	23.1%	30.8%	46.2%	0.0%	23.1%	0.0%	69.2%	0.0%	7.7%	0.0%	69.2%	7.7%	23.1%	53.8%	13
Omagh - Tyrone County Hospital	8	77	0.0%	37.5%	12.5%	50.0%	0.0%	37.5%	0.0%	62.5%	0.0%	0.0%	0.0%	75.0%	12.5%	12.5%	37.5%	8

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