NSS Information and Intelligence

NHS National Services Scotland

Scottish Renal Registry Annual Report 2016.

With demographic data to 2016 and audit data to 2017.

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CONTENTS

RENAL UNITS AND SATELLITE DIALYSIS UNITS IN SCOTLAND ON 31 DECEMBER 2016

ACKNOWLEDGEMENTS

The steering group of the Scottish Renal Registry and the report editors would like to thank the staff in all renal units in Scotland for their immense efforts with data collection and checking. Jackie McDonald of ISD runs the SRR office with energy, skill and dedication and is integral to the work of the Registry; she is ably assisted by Stephanie Lang.

The SRR website is skilfully managed by the web and publications team at ISD and the report has once again been expertly published by Chris Dunn and the publications team at ISD.

Our statistical advice and much of the core data analysis is adeptly provided by Jacqueline Campbell and colleagues of ISD.

The quality and completeness of the data within this report represents the concerted efforts of many members of staff in each renal unit and would not be possible without them. Their dedication and diligence is greatly appreciated.

The analysis and presentation of the data is the result of hard work by many contributing chapter authors:

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** Members of the Scottish Renal Biopsy Registry steering group are listed at: http://www.srr.scot.nhs.uk/Contacts/Biopsy-registry-steering-group.html

We have benefitted greatly from collaborative working with colleagues from Health Protection Scotland and present data about bacteraemia occurring in patients receiving renal replacement therapy as a result of that work.

We very much value our collaboration with NHS Blood and Transplant (NHSBT) who through data linkage provide us with transplant listing status and donor details for patients on the SRR who are registered with them on the UK national transplant waiting list. We thank them for their support of the SRR.

We thank the National Records of Scotland for allowing us to use and report data from the population census.

Our computer hardware is supported by Greater Glasgow and Clyde IT department and our software by VitalPulse. The database software is Proton from Clinical Computing plc. The Information Technology staff of the hospitals and NHS Scotland support our use of the NHS computer network.

We are indebted to patients attending all renal units in Scotland and to their friends, families and carers for their brave and unwavering support and for their continuing encouragement to obtain and publish hard facts about the quality of the service, quality of life and outcomes. Patients are full members of the SRR Steering group, they vote on all major decisions and have organised major projects.

The report has been edited by Jamie Traynor, Bruce Mackinnon and Wendy Metcalfe. As editors we remain responsible for the content.

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EXECUTIVE SUMMARY

The first patient was dialysed for established renal failure (ERF) in Scotland in 1960. Up to 31 December 2016, 17337 patients had started renal replacement therapy (RRT) for ERF in Scotland. On 31 December 2016 there were 9 adult and one paediatric renal units in Scotland with 25 satellite dialysis units between them. All units contribute fully to the Scottish Renal Registry (SRR) and all patients receiving RRT for ERF are registered.

106 people per million population (pmp) started RRT for ERF in 2016. However 250 people pmp aged 65 and older started RRT for ERF 2012-2016. There were no significant differences in incidence of all people, nor of those aged 65 and older between NHS Board areas in the 5 years 2012-2016 when incidence was standardised for age, sex and Scottish Index of Multiple Deprivation (SIMD).

The median age of people starting RRT in 2016 across Scotland was 61 years.

There is a continued increased in the proportion of people starting RRT with ERF due to diabetic nephropathy. 28% of those starting RRT in the 5 years 2012-2016 had a primary renal diagnosis (PRD) recorded as diabetic nephropathy, this compares with 22% in the preceding 5 year period 2007-2011.

On 31 December 2016 there were 5026 prevalent patients receiving RRT. Of these 57% of patients had a functioning kidney transplant, 37% were being treated with haemodialysis (HD) and 4% with peritoneal dialysis (PD). In contrast to numbers of new patients starting RRT, the numbers of prevalent patients is still rising.

There are significant differences in the age, sex and SIMD standardised prevalence of patients receiving RRT on 31 December 2016 between NHS Board areas with NHS Lothian having prevalence more than 3 standard deviations lower than the mean and NHS Greater Glasgow and Clyde more than 3 standard deviations (SD) above the mean.

The prevalence per million age specific population of patients receiving RRT in 2016 was highest in those aged 64-74 years at 1810 people pmp (age specific) although 46% of the prevalent RRT population were in the age bracket 45-64 on 31 December 2016 and the median age of patients receiving RRT on 31 December 2016 was 55 years.

There is a significant trend of improving survival up to two years for patients starting RRT in the 10 years 2007-2016. Of those patients who started RRT between 1992-2011 when aged 45 to 64 years there is a significant trend of improving survival for each primary renal diagnosis group.

There are differences between NHS Board areas in the mortality of patients one year after starting RRT 2006-2015 when standardised for age, sex and SIMD and PRD. NHS Borders has mortality more than 3 SD below the mean. There are no significant differences between NHS Board areas in mortality at 90 days or at 5 years after starting RRT.

8.4% of patients who were receiving RRT on 31 December 2015 or who started RRT in 2016 died in 2016. The most common cause of death among patients on RRT is cardiovascular disease accounting for 32% of deaths over the period 2008-2016, infections were the main cause of death in 22% of cases and malignancy 11% overall, but 24% of those patients dying with a functioning kidney transplant.

65% of RRT patients who died in 2016 did so in hospital.

248 patients resident in Scotland received a kidney transplant in Scotland in 2016, 33 (13%) of those transplants were pre-emptive meaning they were performed before the patient had required any other form of RRT. 30% of kidney transplants performed 2012-2016 were from living donors.

There is a significant trend of improving survival of function of transplanted kidneys from 1960 – 2015 and also patient survival following kidney transplantation up to 10 years post transplant.

The Renal Association (UKRA) is the professional body for United Kingdom Nephrologists and produces clinical practice guidelines for management of patients with renal disease, a process accredited by the National Institute for Health and Care Excellence (NICE). Measures of quality of care are compared against the UKRA guidelines facilitating nationwide comparative audit and identification of areas of concern and of excellence in practice. This is one of the mechanisms through which the SRR contributes to continued efforts to improve standards of delivered care for renal patients across Scotland.

For UKRA clinical practice guidelines refer to website: http://www.renal.org/guidelines/.

The incidence of PD related peritonitis across Scotland was 15.8 months between episodes in 2016, this fails to attain the UKRA guideline.

Vascular access describes the connection between a patient's circulation and a haemodialysis machine. 44% of patients started HD via AV access in the first six months of 2017, 47% started HD via AV access in 2016. There were significant differences between renal units. No renal unit achieved the guideline rate of 60%.

In May 2017 73% of prevalent HD patients had a form of arteriovenous (AV) fistula which is the best form of access. 27% were using central venous catheters which are prone to infection. Significant differences persist between renal units.

Data linkage with Health Protection Scotland reveals significant differences between renal units in rates of bacteraemia occurring in patients treated by haemodialysis including significantly differing rates of Staphylococcus aureus bacteraemia (SAB) episodes.

84% of patients treated three times weekly by HD in May 2017 achieved the guideline urea reduction ratio (URR) of >65%.

56% of patients (excluding those not treated with an erythropoiesis stimulating agent (ESA)) treated by HD had blood haemoglobin concentration in the guideline range 100-120 g/L in May 2017.

In May 2017 45% of patients treated by HD had pre-dialysis phosphate in the recommended range; 85% had corrected calcium within their local laboratories normal range; 53% had PTH concentration within international guidelines target range when assay specific ranges were taken into account.

Data from the Scottish renal biopsy registry show that the rate of transplanted kidney biopsy in 2016 equated to a rate of 0.12 biopsies per transplant per year. The rate of native kidney biopsy for a new indication in 2016 was 127 biopsies per million population. There are significant differences in biopsy rates and practice between renal units across Scotland with units serving larger populations performing more biopsies per population. 1.9% of native kidney biopsies performed in 2016 had a significant complication.

Extensive information about the conduct of the audits and the quality assurance and validation methods used and much background information are available on the SRR website. A list of publications and a copy of the SRR reports are also available:

http://www.srr.scot.nhs.uk

INTRODUCTION

The Scottish Renal Registry aims to improve the care of patients with established renal failure (ERF) treated with renal replacement therapy (RRT) by systematic and comprehensive analysis including audits, of service provision, patient reported measures, clinical management and outcomes.

This thirteenth report from the Scottish Renal Registry (SRR) presents information about the causes, incidence, prevalence, distribution, methods of treatment and outcome of patients receiving RRT for established renal failure ERF in Scotland between 1960 and 31 December 2016.

It also presents audit data relating to the quality of treatment delivered up until 30 June 2017 measured against national quality indicators/ guidelines.

In addition we present national data from the Scottish renal biopsy registry relating to both native and transplanted kidney biopsies performed in Scotland in 2016.

Report readers will see the icon  at the start of some sections. This indicates that on the web version of this report data are available in a Tableau format which enables interaction with the data. The web version of this report is available at:

http://www.srr.scot.nhs.uk/Publications/Main.html

Funding

The Information Services Division (ISD) of NHS Scotland assumed overall responsibility and funding for the SRR in April 1999. In the period covered by this report, no financial assistance was received from commercial organisations.

Other background information

Detailed information about our computer hardware, software, analytic tools, the SRR office, staff, steering group, projects, data quality assurance, publications, security and confidentiality and details of how data are provided to external bodies is published on the SRR website.

http://www.srr.scot.nhs.uk

Renal unit anonymity has been progressively removed since 1998.

Patient anonymity is rigorously protected.

Conflict of interest

The SRR Chair, steering group and report editorial group do not have any conflicting interests.

SUMMARY OF DATA AND METHODS

Patients

17338 patients have been registered with the SRR from its inception in 1991 until 31 December 2016 when the data for this report were collated. 11834 of the patients registered with the SRR are known to have died by 31 December 2016. The total number of patients receiving RRT for ERF who died in 2016 was 469.

Inclusions and exclusions from analyses

Incident patients
All patients starting RRT in Scotland are included in incidence figures. Patients who have moved into Scotland already receiving RRT, either dialysis or with a functioning kidney transplant are excluded. This Report does not contain information about RRT for acute kidney injury.

Prevalent patients
All patients whose treatment started on or before 31 December 2016 and who were still alive and resident in Scotland on that date are included. Patients who have moved outside of Scotland, those who are lost to follow-up and those who have recovered renal function (within 90 days of starting RRT) are excluded.

Survival analyses
The start date for the survival analyses is the first date of RRT. The end date is the date of death or the censor date of 31 December 2016. Also censored are those patients moving outside of Scotland and those lost to follow-up, both groups are censored on the date that the SRR received the last laboratory or treatment information about them. Patients who were lost to follow up or moved, but later came back to have RRT in Scotland had their entire period of RRT included for survival analyses.

Cause of death analyses
Patients who die in Scotland whilst being treated by RRT are included. Some patients stop RRT with no expectation of recovery of renal function. If death does not occur within 90 days of stopping RRT such patients are excluded from cause of death analyses.

Patients who recover native renal function

Patients who recovered renal function within 90 days of starting RRT and have not yet needed to restart RRT were excluded from the analyses. Patients who recovered, but required more than 90 days RRT remain in the data set.

If a patient had to restart RRT within a 90 day period after initial recovery, the date of first starting RRT is considered as the beginning of the first period of treatment. If however the initial period of treatment is less than 90 days, and the period of recovery greater than 90 days, the date of first RRT is recorded as that on which they restart treatment that lasts for at least 90 days.

Where a patient started RRT and then died before the 91st day or if they recovered before the 91st day but then died within the next 90 days, their nephrologist was asked to decide whether they had been treated for acute or established renal failure. Only those with ERF are included in this report.

Primary renal diagnoses

A diagnosis code for the primary renal disease (PRD) has been chosen by the nephrologists responsible for the care of the patient from the code list published by the ERA-EDTA. In 2012 the ERA-EDTA published an updated primary renal diagnosis code list and since 01 January 2014 that revised code list has been used exclusively. To simplify analysis of the data ERA-EDTA PRD codes have been grouped into five categories: glomerulonephritis, interstitial nephritis, diabetic nephropathy, multi-system disorders and unknown diagnosis. It is often not possible to make a precise diagnosis for patients presenting with ERF because the subtle signs of the original disease may have been obscured. The PRD groupings of both old and new ERA-EDTA PRD codes as used in all SRR publications are listed on the SRR website:

http://www.srr.scot.nhs.uk/Projects/Methods.html

31 patients have no PRD recorded on the SRR, 1 has moved outside of Scotland. The remaining 30 patients are deceased and their clinical notes have been destroyed. They started RRT in 4 units: ARI (10), MONK (5), NINE (14), RIE (1).

Renal units in Scotland

All renal units in Scotland contribute fully to the SRR. A complete list of units is given in Appendix 2.

Health Board Areas

On 01 April 2014 Scottish Health Board area boundaries were changed to align with those of local authorities. In line with guidance issued all analyses in this report use population data defined by the new health board boundaries. More information is available at:

http://www.isdscotland.org/Products-and-Services/GPD-Support/Geography/NHS-Board-Boundary-Changes/

Presentation of the data

Throughout the report numeric data are shown either in charts or in a separate table. In many charts the data are shown in five year bands, in order to present all the available data, the first time band represents a different number of years.

Where data are reported using funnel plots the 2SD and 3SD lines represent 95% and 99.7% of data respectively.

Abbreviations

Throughout this report for brevity and ease of reading some abbreviations are used. These are listed in full in Appendix 1 and on the SRR website.

Extensive information about the conduct of SRR audits, the quality assurance and validation methods used and background information is available on the SRR website. A list of publications and copies of SRR reports are also available:

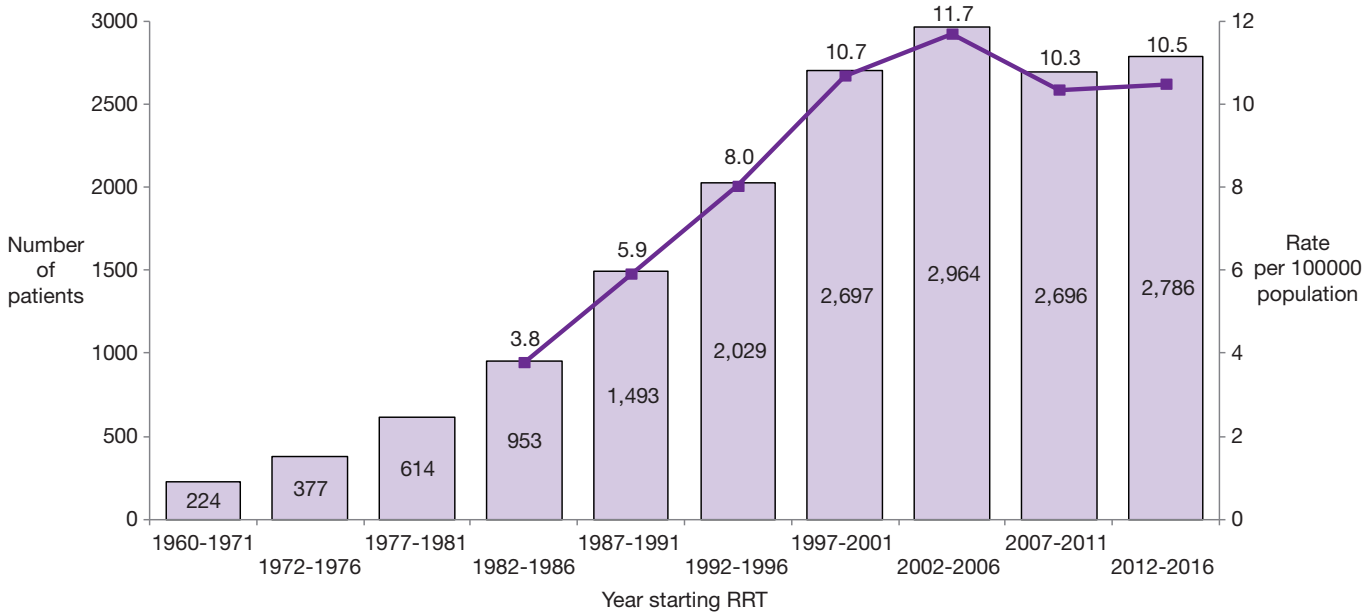
http://www.srr.scot.nhs.uk

SECTION A INCIDENCE

This section's data is available in Tableau format which enables interaction with the data.

A1 Incidence of new patients starting RRT

A1.1 Incidence of new patients starting RRT 1960-2016



A1.2 Annual incidence per 100000 population of new patients starting RRT 1982-2016

Year	Number starting RRT	Population of Scotland	Incidence per 100000
1982-1986	953	5138238*	3.7
1987-1991	1493	5083850*	5.9
1992-1996	2029	5095234*	8.0
1997-2001	2697	5071900*	10.6
2002-2006	2964	5092420*	11.6
2007	578	5,170,000	11.2
2008	549	5,202,900	10.6
2009	544	5,231,900	10.4
2010	519	5,262,200	9.9
2011	506	5,299,900	9.5
2012	529	5,313,600	10.0
2013	511	5,327,700	9.6
2014	556	5,347,600	10.4
2015	617	5,373,000	11.5
2016	573	5,404,700	10.6

* The population estimates shown for the five year bands between 1982 and 2006 are the arithmetical mean of the mid-year population estimates for each of the five years in question, the annual incidence of new patients is averaged over the five year periods.

A1.3 Incidence of patients starting RRT 2012-2016 by NHS Board area of residence standardised for age, sex and social deprivation

NHS Board	Number starting RRT	Incidence per 100000 population	Standardised incidence per 100000 population
A&A	235	12.6	11.1
BORD	42	7.4	6.5
D&G	80	10.7	9.5
FIFE	205	11.1	10.7
FV	156	10.4	10.4
GRAM	283	9.7	11.5
GG&C	667	11.6	11.5
HIGH	143	8.9	9.3
LAN	375	11.5	11.5
LOTH	335	7.8	8.8
ORKN	12	11.1	8.4
SHET	10	8.6	8.1
TAY	221	10.7	10.3
WI	20	14.7	8.3
SCOT	**2784**	**10.4**	**10.4**

Note: Two patients lived outwith Scotland when they started RRT.
Population figures are from National Records for Scotland. They are population estimates for the 30 June each year.
http://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-estimates/mid-year-population-estimates

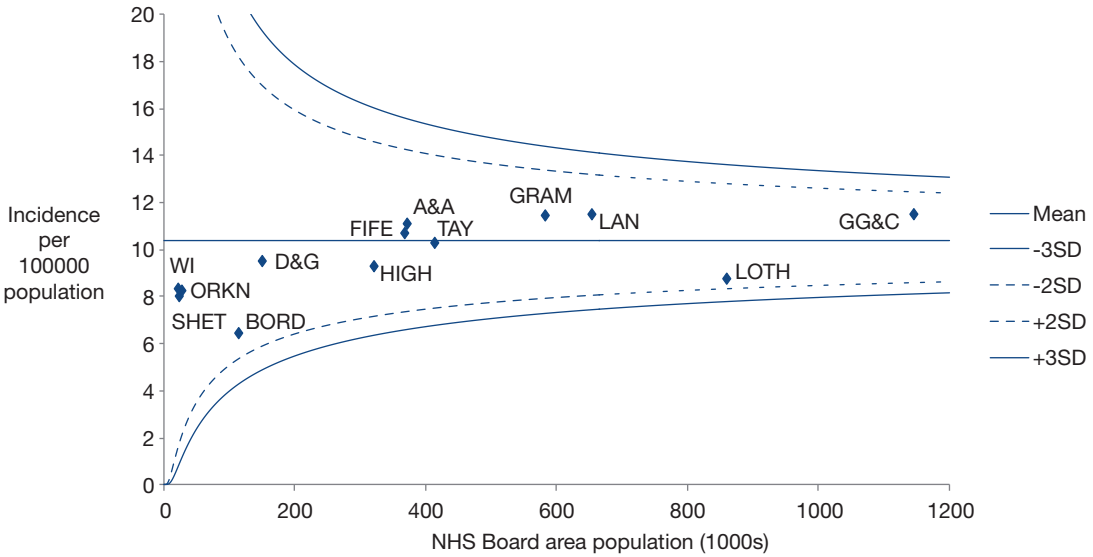
The incidence of new patients starting RRT in each NHS Board area of residence has been standardised to take into account differences in the age, sex and multiple deprivation distribution of residents to allow direct comparison between areas. Patients' postcode of residence when starting RRT was used to derive a Scottish Index of Multiple Deprivation (SIMD) score. The Scottish Index of Multiple Deprivation (SIMD) identifies small area concentrations of multiple deprivation across all of Scotland in a consistent way and ranks small areas (datazones) from most deprived (ranked 1) to least deprived (ranked 6505). SRR data have previously shown an association between SIMD and RRT use:

http://www.srr.scot.nhs.uk/Projects/Projects3.html#simd

The age, sex, SIMD standardised incidence is the total number of residents who would be expected to start RRT in an NHS Board area population, if the age, sex, SIMD structure of the Board area was the same as that of Scotland as a whole.

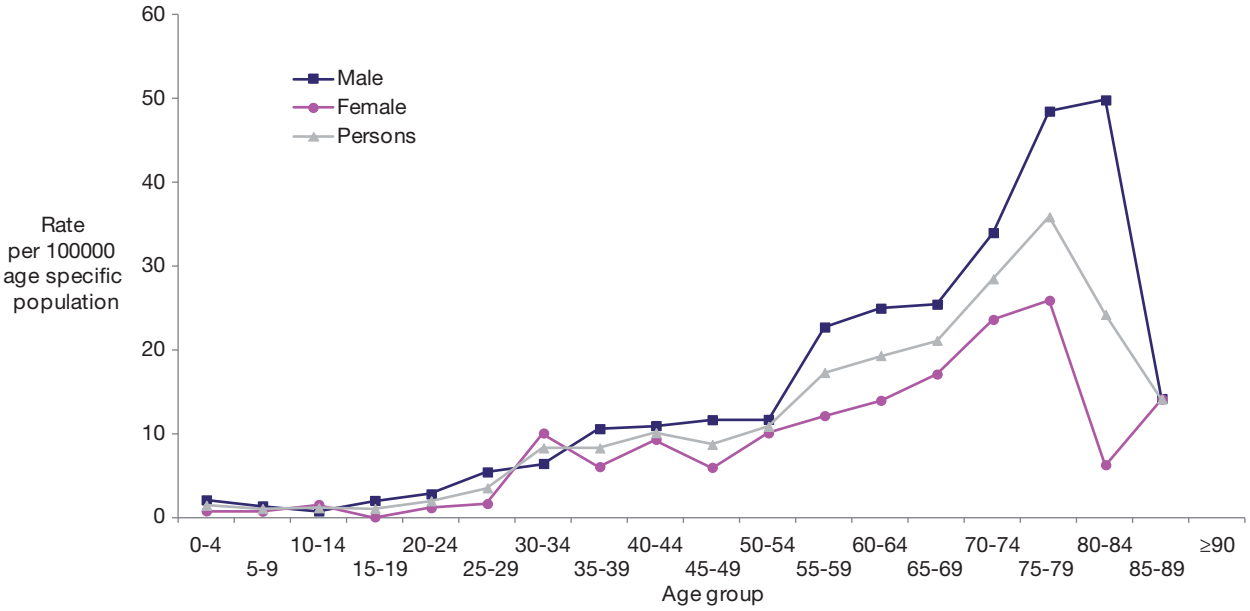
A five year incident period from 2012 to 2016 has been used to minimise the impact of year to year fluctuations in numbers of patients.

A1.4 Incidence of new patients starting RRT 2012-2016 by NHS Board area of residence standardised for age, sex and social deprivation

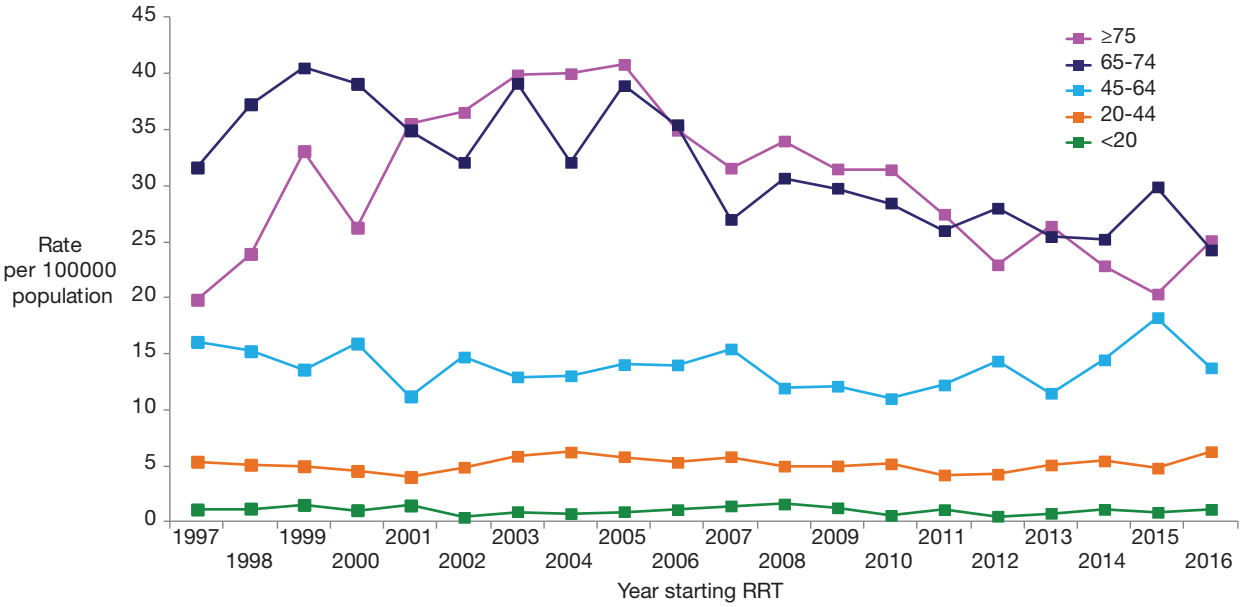


A2 General population and incident RRT population 2016

A2.1 Age specific incidence of new patients starting RRT 2016 per 100000 population



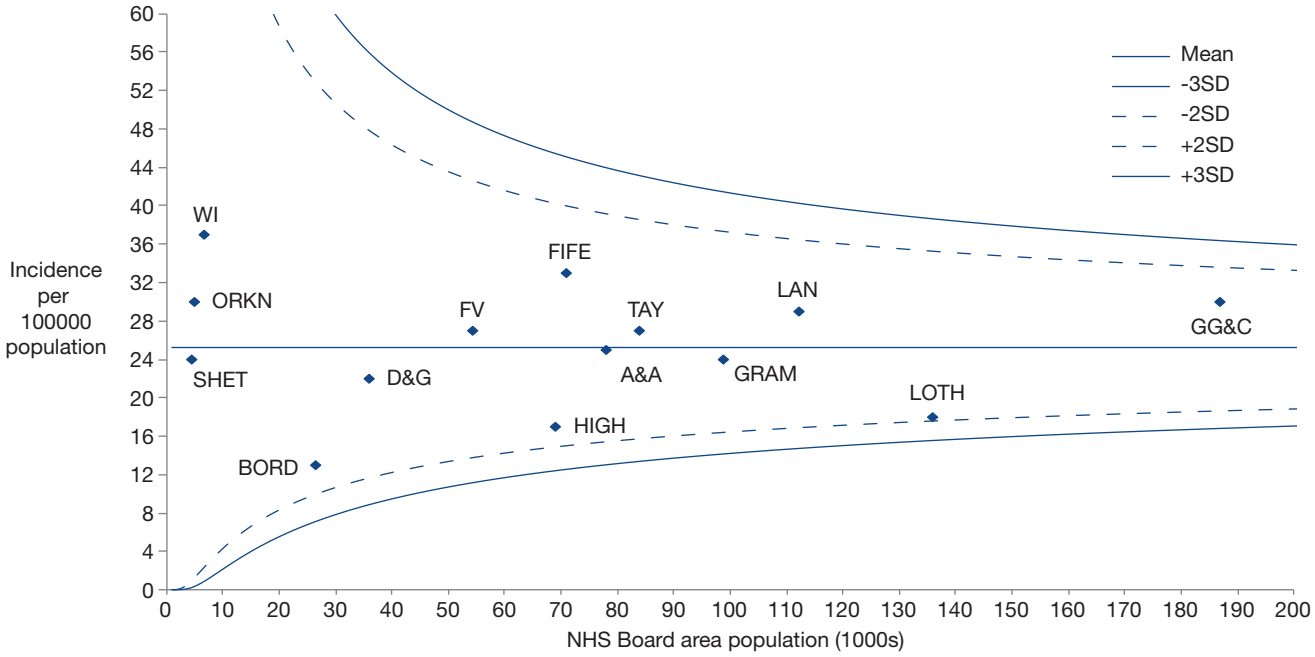
A2.2 Age specific incident RRT population 1997 to 2016 per 100000 population



A2.3 Incidence per 100000 population of patients aged 65 and over starting RRT 2012-2016 by NHS Board: standardised for age, sex and social deprivation

NHS Board	2012	2013	2014	2015	2016	Standardised incidence per 100000 population 2012-2016	95% Confidence Intervals
A&A	31	31	19	24	29	25	(20,31)
BORD	12	4	11	26	11	13	(8,21)
D&G	35	9	34	11	22	22	(16,30)
FIFE	31	38	39	32	26	33	(27,40)
FV	29	40	33	25	9	27	(21,34)
GRAM	24	28	17	27	22	24	(20,28)
GG&C	29	28	28	30	36	30	(27,34)
HIGH	18	16	10	21	17	17	(13,21)
LAN	32	35	20	30	28	29	(24,34)
LOTH	20	14	19	14	21	18	(15,21)
ORKN	67	44	-	42	-	30	(12,61)
SHET	-	49	47	23	-	24	(8,55)
TAY	25	22	32	31	24	27	(22,32)
WI	-	32	78	61	15	37	(19,65)
SCOTLAND	**26**	**26**	**24**	**26**	**25**	**25**	**(24,27)**

A2.4 Incidence per 100000 population of patients aged 65 and over starting RRT 2012-2016 by NHS Board: standardised for age, sex and social deprivation



A3 Age distribution of patients when starting RRT

A3.1 Number of patients in each age group and median age when starting RRT 1960-2016

Year starting RRT	<20		20-44		45-64		65-74		≥75		Median age
	n	%	n	%	n	%	n	%	n	%	
1960-1971	36	**16**	161	**72**	27	**12**	0	**0**	0	**0**	32
1972-1976	56	**15**	211	**56**	107	**28**	3	**1**	0	**0**	36
1977-1981	75	**12**	263	**43**	260	**42**	15	**2**	1	**0**	42
1982-1986	85	**9**	320	**34**	432	**45**	106	**11**	10	**1**	48
1987-1991	96	**6**	401	**27**	618	**41**	315	**21**	63	**4**	54
1992-1996	66	**3**	468	**23**	759	**37**	535	**26**	201	**10**	59
1997-2001	79	**3**	436	**16**	874	**32**	817	**30**	491	**18**	64
2002-2006	50	**2**	500	**17**	893	**30**	808	**27**	713	**24**	65
2007-2011	71	**3**	446	**17**	888	**33**	670	**25**	621	**23**	63
2012-2016	51	**2**	453	**16**	1,064	**38**	708	**25**	510	**18**	62
Total	**665**	**4**	**3659**	**22**	**5922**	**35**	**3977**	**24**	**2610**	**16**	**59**

A3.2 Number and median age of patients starting RRT 2012-2016 by renal unit

Renal unit	Number starting RRT 2012-2016	Median Age 2012-2016	Number starting RRT 2016	Median Age 2016
ARI	280	63	52	63
XH	205	63	54	62
DGRI	74	65	12	69
GLAS	952	61	198	61
MONK	290	62	64	59
NINE	220	66	44	64
RAIG	112	63	18	65
RHC	44	8	11	8
RIE	429	58	87	59
VHK	180	68	33	66
SCOTLAND	**2786**	**62**	**573**	**61**

A3.3 Number of patients in each age group and median age when starting RRT 2012-2016 by NHS Board area of residence

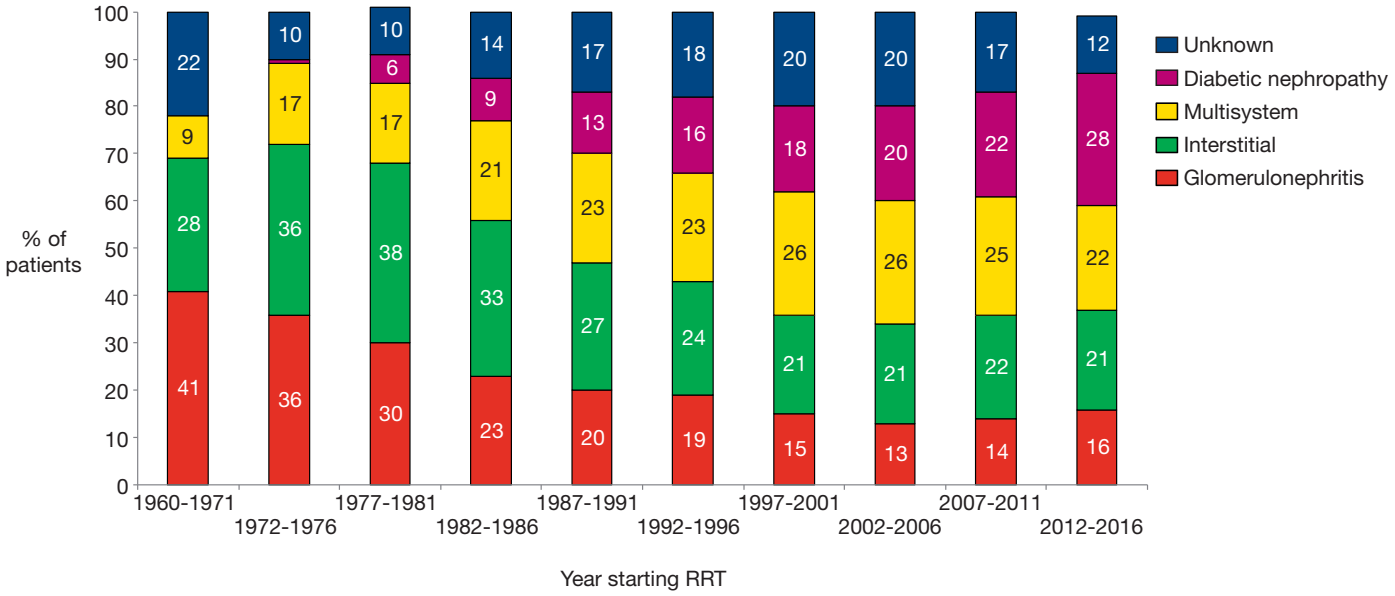
NHS Board area	<20	20-44	45-64	65-74	≥75	Number starting RRT 2012-2016	Median Age
A&A	4	37	96	52	46	235	61
BORD	1	7	17	13	4	42	59
D&G	1	13	27	20	19	80	64
FIFE	4	19	65	68	49	205	67
FV	3	18	62	44	29	156	63
GRAM	5	52	109	73	44	283	61
GG&C	13	114	257	159	124	667	61
HIGH	2	29	55	41	16	143	60
LAN	11	66	137	85	76	375	61
LOTH	6	61	149	79	40	335	59
ORKN	0	0	5	4	3	12	68
SHET	0	1	4	3	2	10	65
TAY	1	31	77	58	54	221	65
WI	0	4	4	9	3	20	67
SCOTLAND	**51**	**452**	**1064**	**708**	**509**	**2784**	**62**

Note: Two patients lived outwith Scotland when they started RRT.

A4 Primary renal diagnosis of patients starting RRT

ERA-EDTA Primary Renal Diagnoses (PRD) codes and groupings used in SRR reports are available on the SRR website: http://www.srr.scot.nhs.uk/Projects/Methods.html

A4.1 Percentage of patients in each diagnosis group starting RRT 1960-2016



Since 2015, the SRR records only the updated (2012) EDTA-ERA codes for primary renal diagnosis. These codes differentiate between type I and type II diabetes within the Diabetic nephropathy diagnosis group.

Of those patients who started RRT with a primary diagnosis of Diabetic nephropathy in 2015 and 2016 (n=345), 66% are attributed to type II diabetes.

A4.2 Number of patients in each diagnosis group starting RRT 1960-2016

Year starting RRT	Glomerulo-nephritis		Interstitial		Multisystem		Diabetic nephropathy		Unknown		Missing		Total
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n
1960-1971	90	**40**	63	**28**	20	**9**	1	**0**	48	**21**	2	1	224
1972-1976	137	**36**	136	**36**	64	**17**	3	**1**	37	**10**	0	0	377
1977-1981	182	**30**	232	**38**	102	**17**	36	**6**	61	**10**	1	0	614
1982-1986	218	**23**	315	**33**	197	**21**	86	**9**	131	**14**	6	1	953
1987-1991	293	**20**	409	**27**	340	**23**	189	**13**	257	**17**	5	0	1493
1992-1996	381	**19**	480	**24**	470	**23**	332	**16**	361	**18**	5	0	2029
1997-2001	391	**14**	562	**21**	713	**26**	477	**18**	551	**20**	3	0	2697
2002-2006	381	**13**	630	**21**	767	**26**	592	**20**	588	**20**	6	0	2964
2007-2011	385	**14**	593	**22**	663	**25**	603	**22**	450	**17**	2	0	2696
2012-2016	447	**16**	599	**22**	623	**22**	777	**28**	340	**12**	0	0	2786
TOTAL	2905	**17**	4019	**24**	3959	**24**	3097	**18**	2824	**17**	31	0	16835

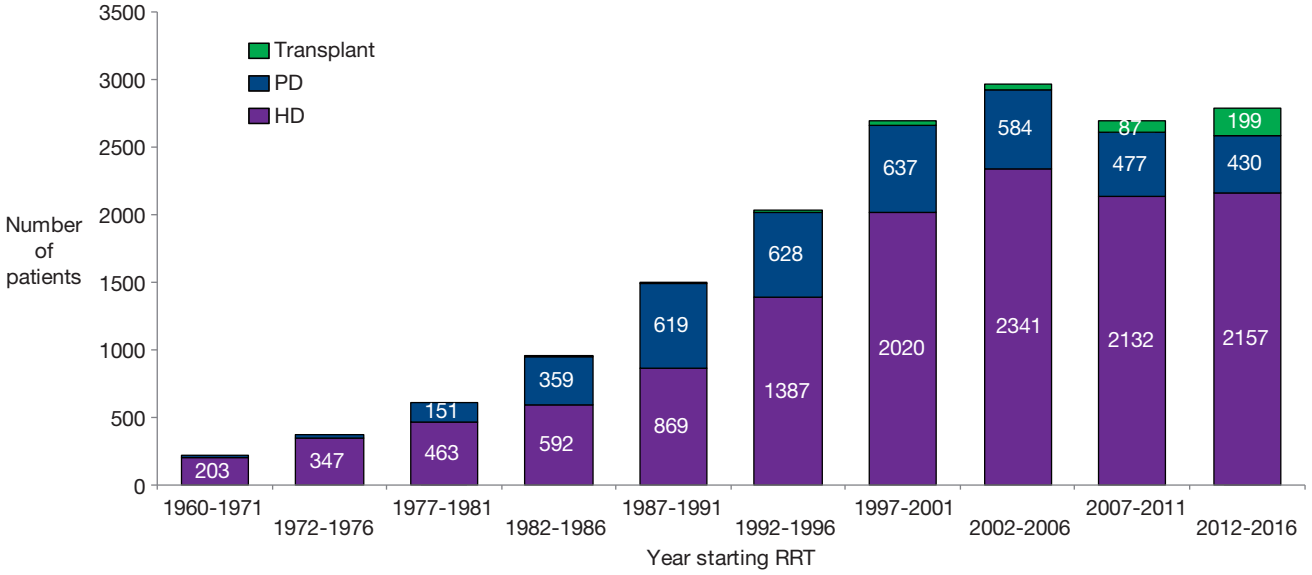
Please see primary renal diagnoses section on page xi for details of the missing diagnoses.

A5 Modality of RRT

There are three principal types of RRT: Haemodialysis (HD); Peritoneal dialysis (PD); Kidney Transplantation.

Patients who have received a kidney transplant as their first mode of RRT are termed as receiving a pre-emptive transplant.

A5.1 Mode of first RRT 1960-2016



A5.2 Mode of first RRT 1960-2016

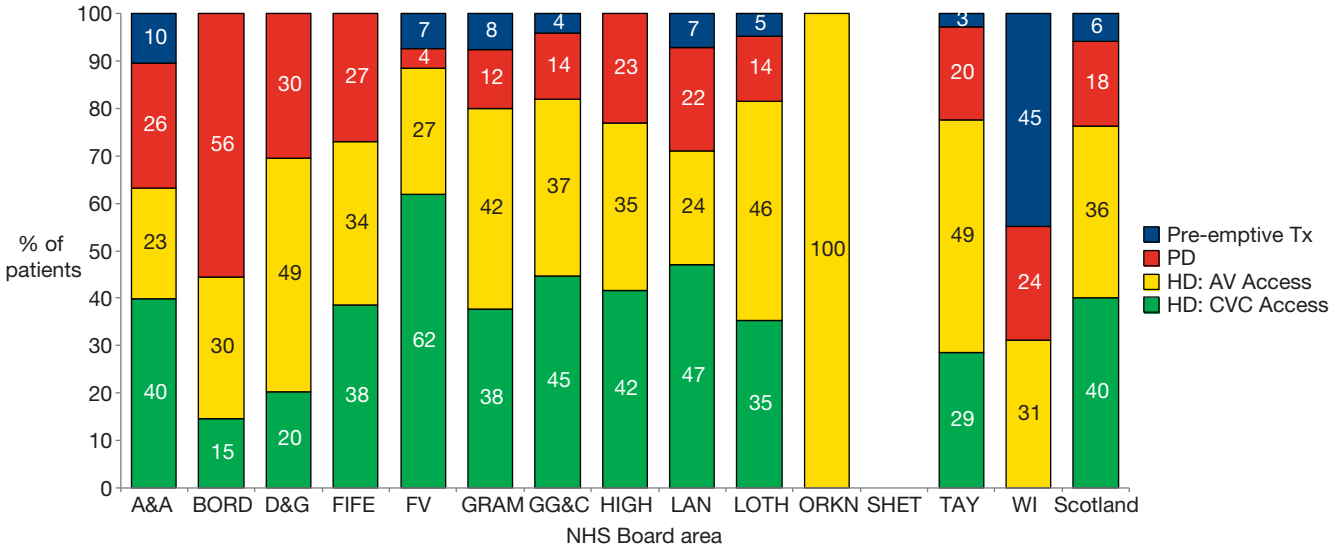
Year starting RRT	HD		PD		Transplant		Total
	n	%	n	%	n	%	
1960-1971	203	**91**	21	**9**	0	**0**	224
1972-1976	347	**92**	30	**8**	0	**0**	377
1977-1981	463	**75**	151	**25**	0	**0**	614
1982-1986	592	**62**	359	**38**	2	**0**	953
1987-1991	869	**58**	619	**41**	5	**0**	1493
1992-1996	1387	**68**	628	**31**	14	**1**	2029
1997-2001	2020	**75**	637	**24**	40	**1**	2697
2002-2006	2341	**79**	584	**20**	39	**1**	2964
2007	435	**75**	123	**21**	20	**3**	578
2008	436	**79**	93	**17**	20	**4**	549
2009	447	**82**	83	**15**	14	**3**	544
2010	418	**81**	89	**17**	12	**2**	519
2011	396	**78**	89	**18**	21	**4**	506
2012	417	**79**	76	**14**	36	**7**	529
2013	399	**78**	74	**14**	38	**7**	511
2014	431	**78**	84	**15**	41	**7**	556
2015	473	**77**	93	**15**	51	**8**	617
2016	437	**76**	103	**18**	33	**6**	573

A5.3 First mode of RRT and haemodialysis vascular access type, incident patient 2016 by NHS Board of residence

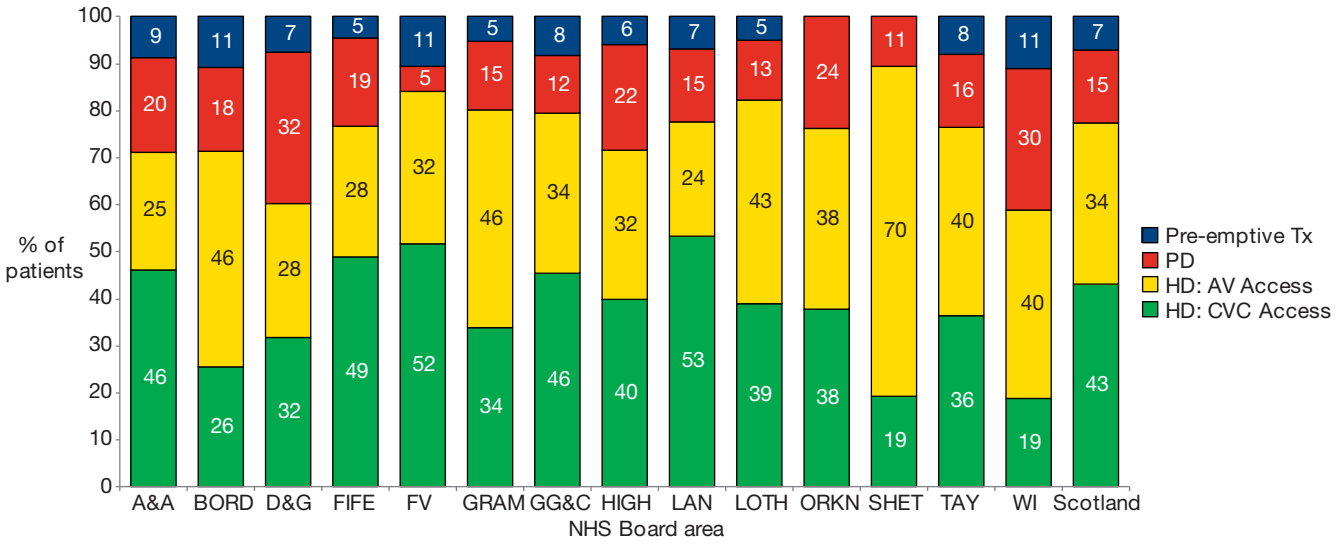
NHS Board	HD: AV Access		HD: CVC Access		PD		Pre-emptive Tx		Total
	n	%	n	%	n	%	n	%	
A&A	14	**23**	25	**40**	16	**26**	7	**11**	62
BORD	2	**40**	1	**20**	2	**40**	0	**0**	5
D&G	6	**50**	2	**17**	4	**33**	0	**0**	12
FIFE	12	**33**	15	**42**	9	**25**	0	**0**	36
FV	6	**25**	15	**63**	1	**4**	2	**8**	24
GRAM	24	**42**	20	**35**	7	**12**	6	**11**	57
GG&C	56	**38**	64	**44**	21	**14**	6	**4**	147
HIGH	10	**40**	11	**44**	4	**16**	0	**0**	25
LAN	18	**22**	39	**48**	19	**23**	6	**7**	82
LOTH	34	**48**	24	**34**	10	**14**	3	**4**	71
ORKN	2	-	0	-	0	-	0	-	2
SHET	-	-	0	-	0	-	0	-	-
TAY	22	**48**	14	**30**	9	**20**	1	**2**	46
WI	1	**25**	0	-	1	**25**	2	**50**	4
SCOTLAND	**207**	**36**	**230**	**40**	**103**	**18**	**33**	**6**	**573**

Note: Two patients lived outwith Scotland when they started RRT.

A5.4 First mode of RRT and haemodialysis vascular access type, incident patients 2016 by NHS Board of residence. Standardised for age, sex and PRD group.



A5.5 First mode of RRT and haemodialysis vascular access type incident patients 2012-2016 by NHS Board of residence. Standardised for age, sex and PRD group.



The UK Renal Association guideline on initiation of RRT suggests that patients known to nephrology services for 3 months or more and who are planned to have renal support should start RRT using an established access (arteriovenous fistula [AVF], arteriovenous graft [AVG], PD catheter) or by pre-emptive renal transplantation.

Analyses of SRR data have previously demonstrated that the attainment of AV access for haemodialysis is influenced by patients' age, sex and primary renal diagnosis.

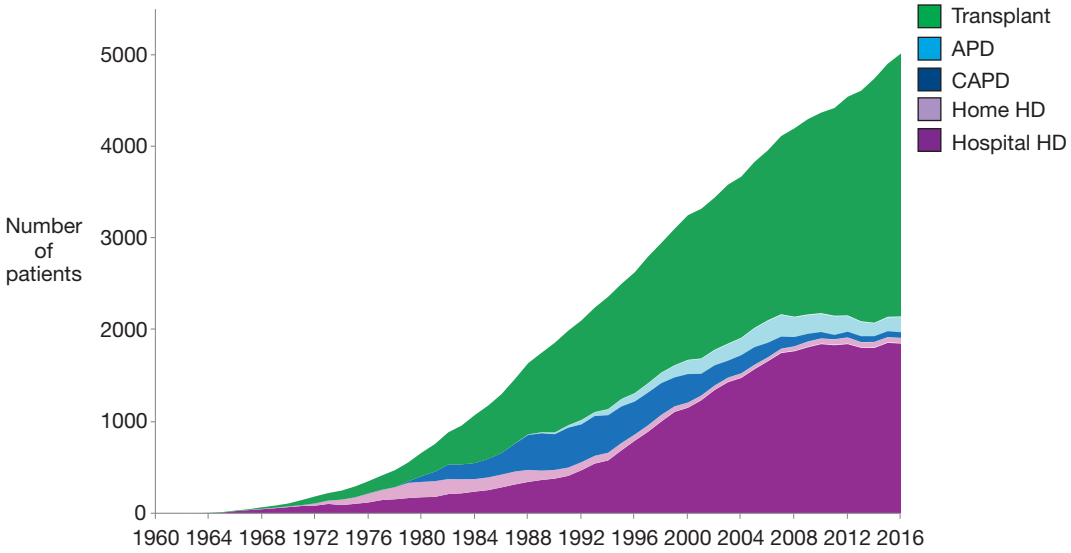
To take account of differing case mix of incident patients in each NHS Board area the data in A5.4 and A5.5 are adjusted for these variables by an indirect standardisation using the Scottish incident population as the standard.

For each NHS Board area the standardised incidence ratios for each modality are then multiplied by the respective Scotland counts to obtain the standardised distribution of incident patients across modalities.

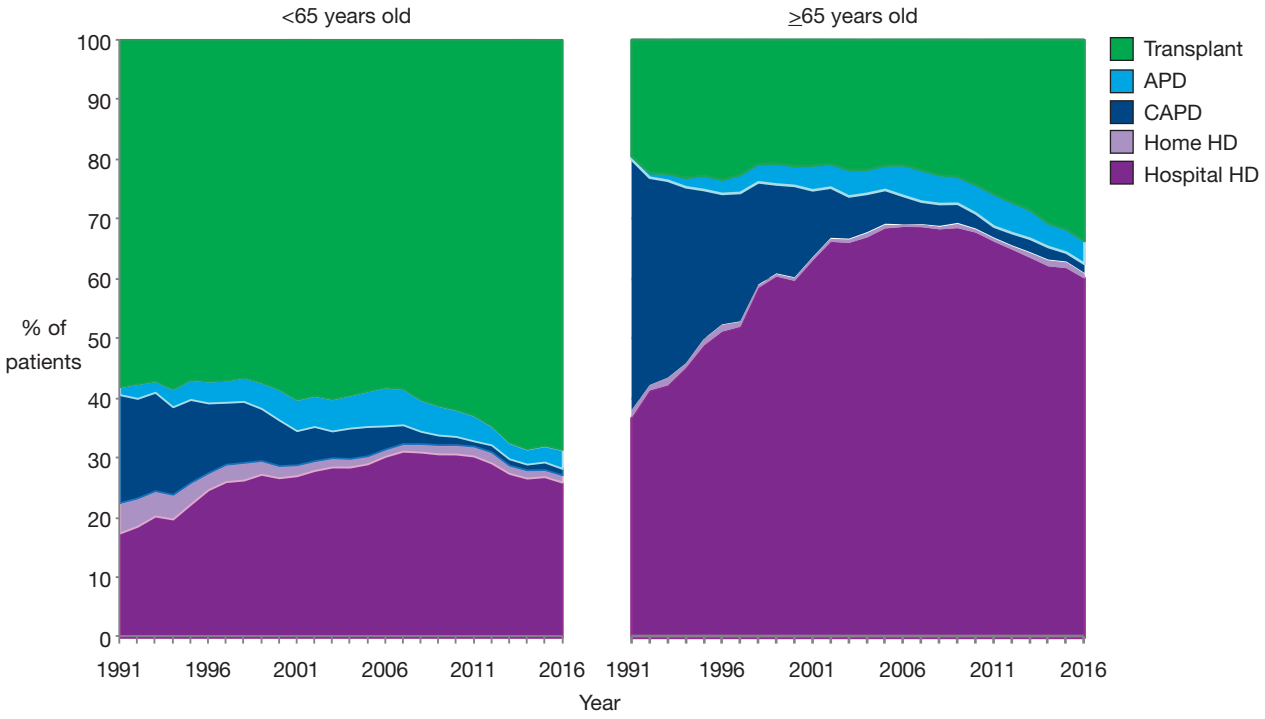
SECTION B PREVALENCE

B1 Patients receiving RRT in Scotland according to modality of treatment on 31 December

B1.1 Prevalent patients every year between 1960-2016



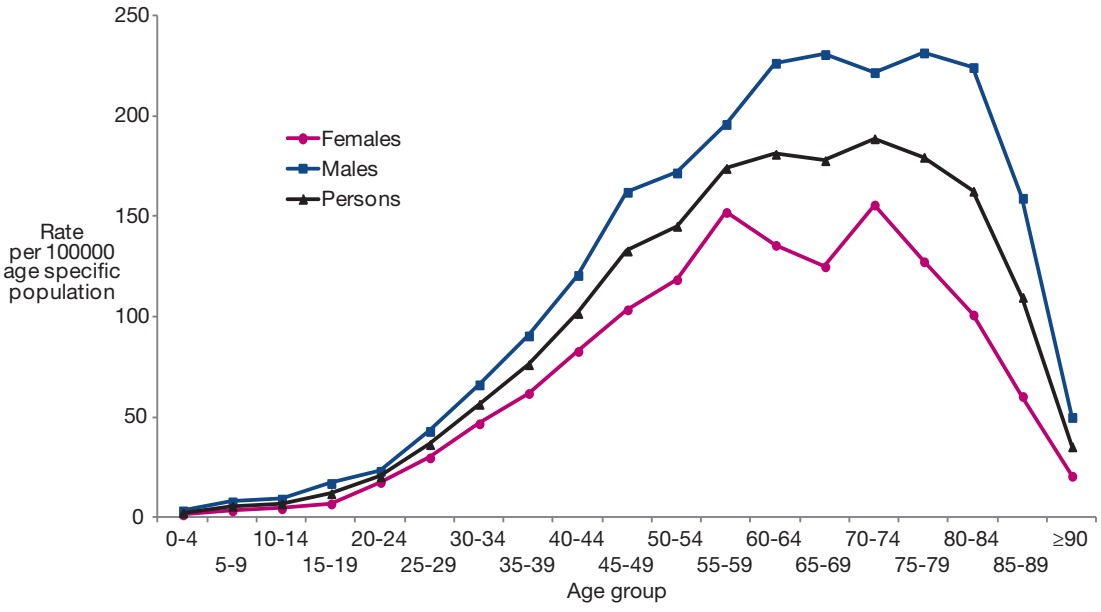
B1.2 Prevalent patients by modality and age group on 31 December each year 1991-2016



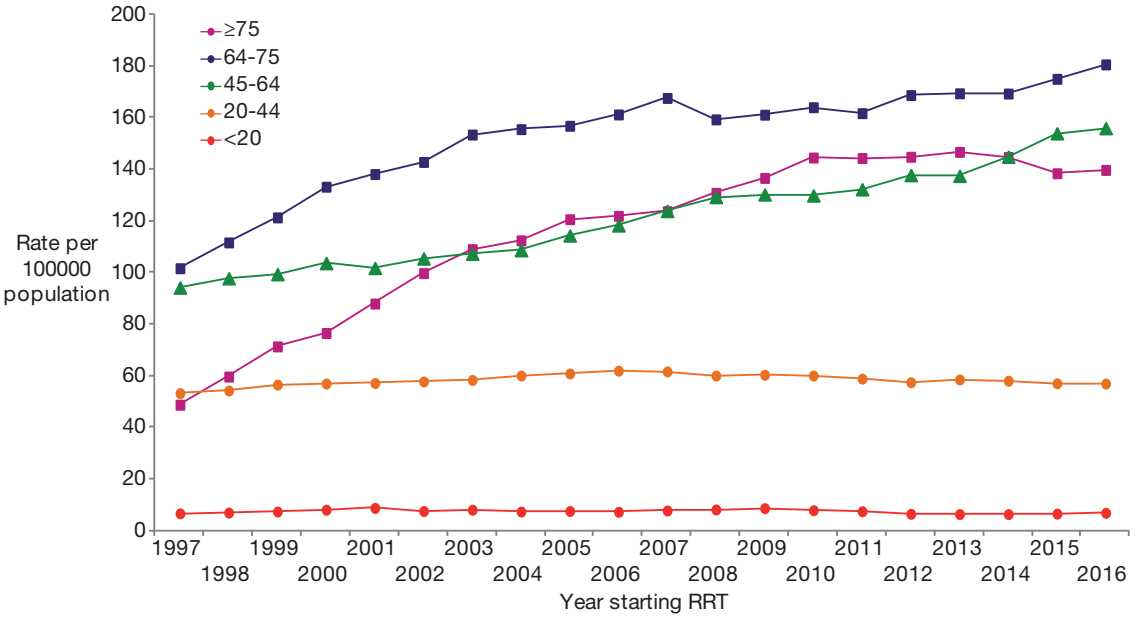
B1.3 Prevalent patients between 1960-2016

Year	Hospital HD		Home HD		CAPD		APD		Transplant		Total
	n	%	n	%	n	%	n	%	n	%	
1960	1	**50**	0	-	0	-	0	-	1	**50**	2
1965	7	**58**	0	-	0	-	0	-	5	**42**	12
1970	67	**63**	7	**7**	1	**1**	0	-	32	**30**	107
1975	103	**35**	69	**24**	2	**1**	0	-	119	**41**	293
1980	175	**26**	167	**25**	64	**10**	0	-	256	**39**	662
1985	253	**22**	138	**12**	202	**17**	0	-	584	**50**	1177
1990	379	**20**	94	**5**	393	**21**	17	**1**	980	**53**	1863
1995	688	**27**	78	**3**	404	**16**	79	**3**	1257	**50**	2506
2000	1156	**35**	52	**2**	318	**10**	151	**5**	1580	**49**	3257
2005	1579	**41**	42	**1**	200	**5**	206	**5**	1813	**47**	3840
2012	1854	**41**	65	**1**	71	**2**	172	**4**	2390	**53**	4552
2013	1814	**39**	54	**1**	73	**2**	157	**3**	2519	**55**	4617
2014	1812	**38**	58	**1**	71	**1**	141	**3**	2668	**56**	4750
2015	1868	**38**	54	**1**	73	**1**	152	**3**	2765	**56**	4912
2016	1860	**37**	54	**1**	70	**1**	168	**3**	2874	**57**	5026

B1.4 Age specific prevalence of RRT patients on 31 December 2016 per 100000 population



B1.5 Age specific prevalent RRT population 1997-2016 per 100000 population



The graph shows the age specific prevalence of RRT patients on 31 December of each of the years shown.

B1.6 Number and percentage of patients, median age and age range on each mode of RRT by age group on 31 December 2016

Age	Hospital HD		Home HD		CAPD		APD		Transplant		Total
	n	%	n	%	n	%	n	%	n	%	
≥75	465	**25**	2	**4**	13	**19**	32	**19**	106	**4**	**618**
65-74	512	**28**	11	**20**	15	**21**	31	**18**	436	**15**	**1005**
45-64	673	**36**	29	**54**	31	**44**	65	**39**	1527	**53**	**2325**
20-44	202	**11**	10	**19**	10	**14**	29	**17**	748	**26**	**999**
<20	8	**0**	2	**4**	1	**1**	11	**7**	57	**2**	**79**
Total	**1860**		**54**		**70**		**168**		**2874**		**5026**
Median age	56		54		55		55		54		**55**
Age range	1-96		7-80		18-86		1-87		5-88		**1-96**

B2 Prevalent patients at each renal unit

The number of patients treated at each renal unit differs considerably. Detailed information about each renal unit is given on the SRR website: http://www.srr.scot.nhs.uk/Renal_Units/clinics.htm

B2.1 Number and percentage of patients in each age group receiving RRT at each renal unit on 31 December 2016

		ARI	XH	DGRI	GLAS	MONK	NINE	RAIG	RHC	RIE	VHK
≥75	Number	60	40	22	200	64	76	34	0	73	49
	%	**11**	**13**	**17**	**11**	**14**	**18**	**13**	**-**	**9**	**17**
65-74	Number	119	62	36	340	80	95	56	0	147	70
	%	**21**	**20**	**27**	**19**	**18**	**23**	**22**	**-**	**19**	**24**
45-64	Number	238	161	52	844	203	186	117	0	400	124
	%	**43**	**51**	**39**	**48**	**46**	**44**	**45**	**-**	**51**	**42**
20-44	Number	135	54	22	369	95	63	53	0	157	51
	%	**24**	**17**	**17**	**21**	**21**	**15**	**20**	**-**	**20**	**17**
<20	Number	5	1	0	3	1	1	0	64	4	0
	%	**1**	**0**	**-**	**0**	**0**	**0**	**-**	**1**	**1**	**-**
Total		**557**	**318**	**132**	**1756**	**443**	**421**	**260**	**64**	**781**	**294**
Median age		57	58	59	57	56	60	57	11	56	61
IQR		44-67	48-68	50-70	46-67	46-69	48-71	47-68	8-16	47-66	48-71

B2.2 Number and percentage of patients on each mode of RRT and renal unit providing treatment on 31 December 2016

		ARI	XH	DGRI	GLAS	MONK	NINE	RAIG	RHC	RIE	VHK
Hospital HD	Number	226	133	47	573	186	174	86	8	284	143
	%	**41**	**42**	**36**	**33**	**42**	**41**	**33**	**13**	**36**	**49**
Home HD	Number	4	8	3	22	0	2	7	2	6	0
	%	**1**	**3**	**2**	**1**	**-**	**0**	**3**	**3**	**1**	**-**
CAPD	Number	10	3	5	13	8	18	8	0	4	1
	%	**2**	**1**	**4**	**1**	**2**	**4**	**3**	**-**	**1**	**1**
APD	Number	11	30	6	41	16	3	3	8	33	17
	%	**2**	**9**	**5**	**2**	**4**	**1**	**1**	**13**	**4**	**6**
Transplant	Number	306	144	71	1107	233	224	156	46	454	133
	%	**55**	**45**	**54**	**63**	**53**	**53**	**60**	**72**	**58**	**45**
Total		**557**	**318**	**132**	**1756**	**443**	**421**	**260**	**64**	**781**	**294**

B3 Prevalent patients in each NHS Board area

Abbreviations for NHS boards are given in Appendix 1.

B3.1 Number of patients in each age group, median age and inter-quartile range by NHS Board area of residence on 31 December 2016

NHS Board	<20	20-44	45-64	65-74	≥75	Total	Median age	IQR
A&A	6	71	195	80	43	395	58	47-67
BORD	1	22	43	23	15	104	58	48-70
D&G	1	24	52	37	22	136	59	50-70
FIFE	7	59	138	84	52	340	60	47-71
FV	5	46	134	46	32	263	58	46-68
GRAM	9	130	224	115	60	538	57	44-68
GG&C	19	246	561	224	140	1190	57	46-67
HIGH	2	64	143	61	38	308	56	46-68
LAN	16	138	293	116	78	641	56	45-67
LOTH	9	129	343	120	57	658	56	46-65
ORKN	1	1	9	1	3	15	53	50-71
SHET	0	4	6	6	0	16	63	45-70
TAY	3	57	178	85	72	395	60	49-72
WI	0	7	5	7	6	25	68	44-73
Total	**79**	**998**	**2324**	**1005**	**618**	**5024**	**57**	**46-68**

Two patients live outside of Scotland and were receiving treatment within Scottish renal units on 31 December 2016.

B3.2 Number of patients on each mode of RRT in each NHS Board area of residence on 31 December 2016

NHS Board	Hospital HD		Home HD		PD		Transplant		Total
	n	%	n	%	n	%	n	%	
A&A	139	**35**	8	**2**	34	**9**	214	**54**	**395**
BORD	34	**33**	0	**-**	4	**4**	66	**63**	**104**
D&G	47	**35**	3	**2**	11	**8**	75	**55**	**136**
FIFE	148	**44**	1	**0**	22	**6**	169	**50**	**340**
FV	89	**34**	4	**2**	4	**2**	166	**63**	**263**
GRAM	217	**40**	4	**1**	20	**4**	297	**55**	**538**
GG&C	428	**36**	7	**1**	45	**4**	710	**60**	**1190**
HIGH	95	**31**	12	**4**	8	**3**	193	**63**	**308**
LAN	221	**34**	6	**1**	29	**5**	385	**60**	**641**
LOTH	248	**38**	6	**1**	33	**5**	371	**56**	**658**
ORKN	6	**40**	0	**-**	3	**2**	6	**40**	**15**
SHET	7	**44**	0	**-**	1	**6**	8	**50**	**16**
TAY	172	**44**	2	**1**	19	**5**	202	**51**	**395**
WI	9	**36**	1	**4**	5	**2**	10	**40**	**25**
SCOTLAND	**1860**	**37**	**54**	**1**	**238**	**5**	**2872**	**57**	**5024**

Two patients live outside of Scotland and were receiving treatment within Scottish renal units on 31 December 2016.

B3.3 RRT modality and haemodialysis vascular access type by NHS Board area of residence on 1st May 2016

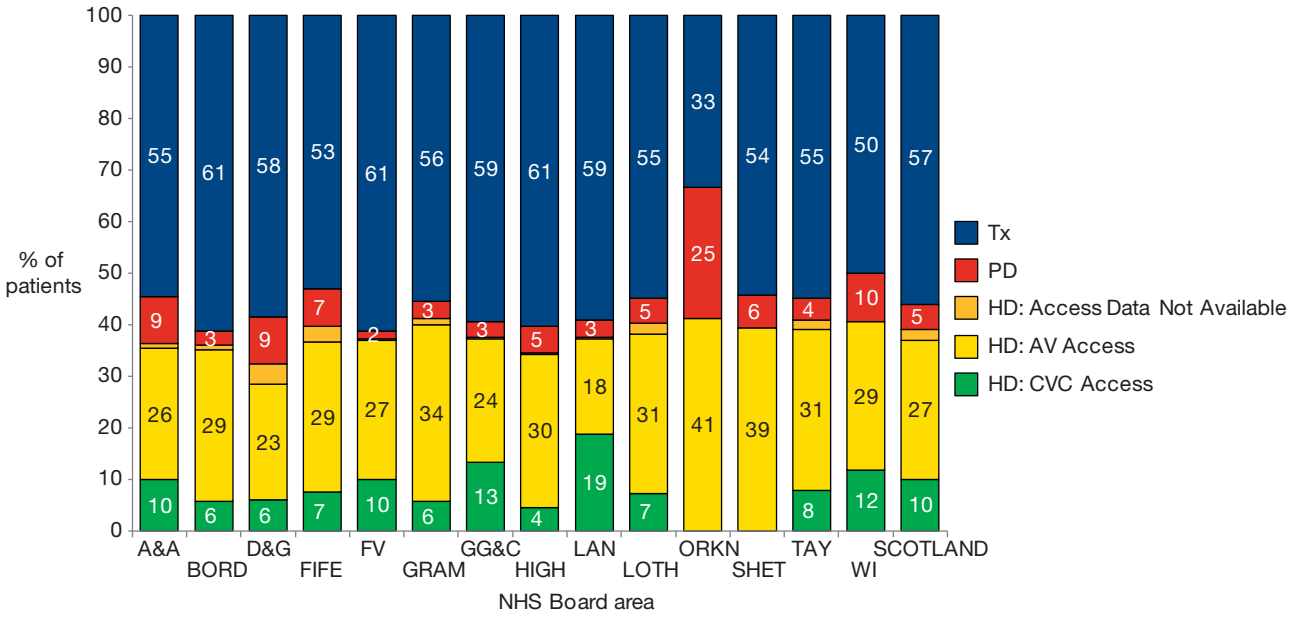
NHS Board	HD: AV Access		HD: CVC Access		HD: Access Data Missing		PD		Transplant		Total
	n	%	n	%	n	%	n	%	n	%	
A&A	96	**25**	36	**10**	3	**1**	34	**9**	202	**54**	**371**
BORD	29	**28**	6	**6**	2	**2**	3	**3**	62	**61**	**102**
D&G	36	**26**	9	**6**	6	**6**	13	**10**	74	**52**	**141**
FIFE	104	**30**	27	**8**	17	**6**	26	**7**	171	**49**	**348**
FV	71	**27**	28	**11**	1	**0**	4	**2**	157	**60**	**260**
GRAM	178	**34**	28	**5**	7	**2**	18	**3**	287	**56**	**517**
GG&C	268	**23**	152	**13**	7	**2**	36	**3**	692	**60**	**1161**
HIGH	86	**27**	13	**4**	1	**1**	15	**5**	191	**63**	**308**
LAN	112	**17**	119	**18**	3	**1**	19	**3**	377	**60**	**633**
LOTH	184	**28**	39	**6**	20	**3**	30	**5**	366	**58**	**638**
ORKN	7	**44**	0	**0**	0	**0**	4	**25**	5	**31**	**16**
SHET	6	**38**	0	**0**	0	**6**	1	**6**	8	**50**	**16**
TAY	136	**33**	34	**9**	8	**3**	17	**4**	202	**51**	**400**
WI	8	**32**	3	**12**	0	**4**	3	**12**	10	**40**	**25**
SCOTLAND	**1321**	**27**	**494**	**10**	**75**	**2**	**223**	**5**	**2804**	**57**	**4917**

One patient lived outside of Scotland and were receiving treatment within Scottish renal units on 01 May 2016.

Prevalent numbers are correct as of 01 May 2016. Details of the vascular access used for haemodialysis are dervived from the May 2016 census.

Where the access data is not available this may be for several reasons; the patient started RRT after the census for the unit had taken place, the vascular access details were not recorded at the time the census took place or the patient did not attend when the unit where undertaking the cenus e.g. on holiday or in hospital.

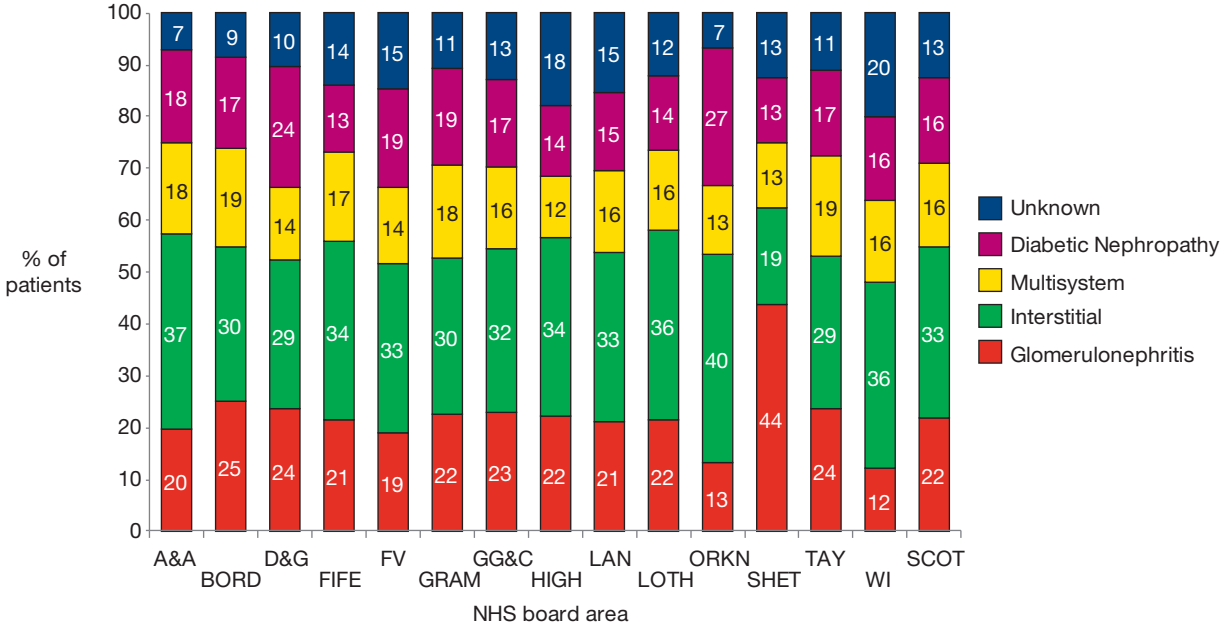
B3.4 RRT modality and vascular access type by NHS Board area of residence on 1st May 2016 standardised for age, sex and PRD group



Analyses of SRR data have previously demonstrated that the attainment of AV access for haemodialysis is influenced by patients' age, sex and primary renal diagnosis.

To take account of differing case mix of prevalent patients in each NHS Board area the data in B3.4 are adjusted for these variables by an indirect standardisation using the Scottish prevalent RRT population as the standard. For each NHS Board area the standardised prevalence ratios for each modality are then multiplied by the respective Scotland counts to obtain the standardised distribution of prevalent patients across modalities.

B3.5 Percentage of patients in each PRD group and their NHS board area of residence 31 December 2016

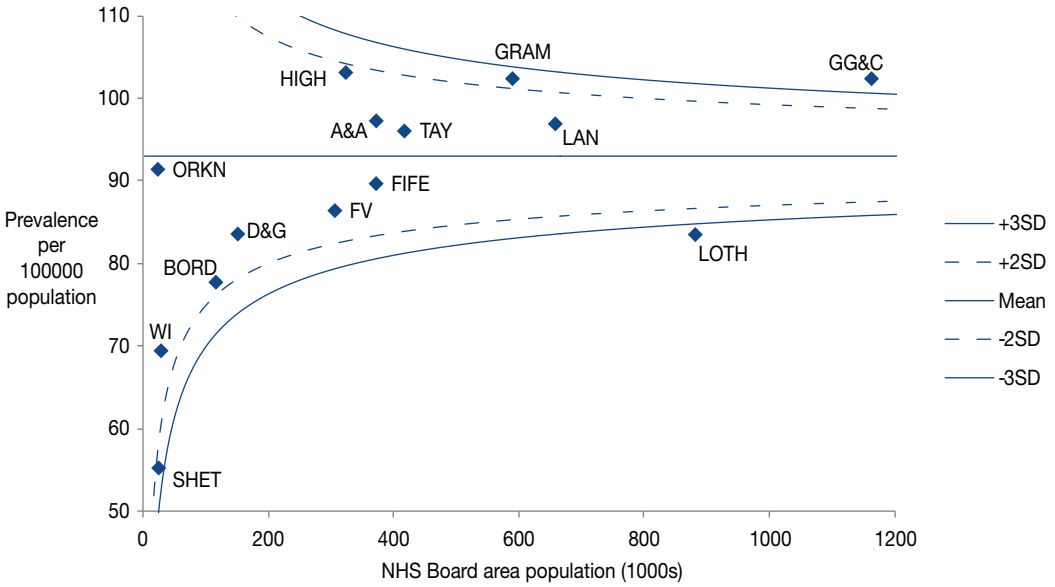


B3.6 Prevalence of patients receiving RRT on 31 December 2016 by NHS Board: standardised for age, sex and social deprivation

NHS Board	Population on 30 June 2016*	RRT population 31 December 2016	Prevalence per 100000 population	Standardised prevalence per 100000 population
A&A	370560	395	106.6	97.3
BORD	114530	104	90.8	77.8
D&G	149520	136	91.0	83.6
FIFE	370330	340	91.8	89.7
FV	304480	263	86.4	86.4
GRAM	588100	538	91.5	102.4
GG&C	1161370	1190	102.5	102.4
HIGH	321900	308	95.7	103.2
LAN	656490	641	97.6	96.9
LOTH	880000	658	74.8	83.5
ORKN	21850	15	68.6	91.4
SHET	23200	16	69.0	55.3
TAY	415470	395	95.1	96.1
WI	26900	25	92.9	69.5
Scotland	**5404700**	**5024**	**93.0**	**93.0**

* National Records of Scotland Mid-year estimates
Two patients live outside of Scotland and were receiving treatment within Scottish renal units on 31 December 2016.

B3.7 Prevalence of patients receiving RRT on 31 December 2016 by NHS Board: standardised for age, sex and social deprivation



SECTION C SURVIVAL

C1 Survival analyses

C1.1 Proportion of patients starting RRT 1996 - 2015 surviving at one, two, five and ten years by age and primary renal diagnosis group

Age group (years)	Diagnosis group	1 year survival			2 year survival			5 year survival			10 year survival		
		Number starting RRT (1996-2015)	n	%	Number starting RRT (1996-2014)	n	%	Number starting RRT (1996-2011)	n	%	Number starting RRT (1996-2006)	n	%
≥75	Unknown	680	439	**65**	663	298	**45**	582	95	**16**	401	8	**2**
	Diabetic nephropathy	291	188	**65**	280	132	**47**	223	27	**12**	140	2	**1**
	Multisystem	794	468	**59**	751	307	**41**	653	73	**11**	431	2	**0**
	Interstitial	280	199	**71**	269	142	**53**	237	52	**22**	159	3	**2**
	Glomerulonephritis	218	138	**63**	205	93	**45**	165	27	**16**	110	6	**5**
	All Diagnoses	2263	1432	**63**	2168	972	**45**	1860	274	**15**	1241	21	**2**
65-74	Unknown	579	430	**74**	556	331	**60**	500	155	**31**	382	27	**7**
	Diabetic nephropathy	635	468	**74**	594	333	**56**	481	94	**20**	321	6	**2**
	Multisystem	973	611	**63**	919	431	**47**	796	159	**20**	585	21	**4**
	Interstitial	438	362	**83**	413	288	**70**	342	134	**39**	240	26	**11**
	Glomerulonephritis	331	275	**83**	305	209	**69**	254	97	**38**	179	21	**12**
	All Diagnoses	2956	2146	**73**	2787	1592	**57**	2373	639	**27**	1707	101	**6**
45-64	Unknown	412	345	**84**	384	279	**73**	331	178	**54**	239	71	**30**
	Diabetic nephropathy	1000	845	**85**	907	635	**70**	708	224	**32**	470	50	**11**
	Multisystem	704	533	**76**	656	424	**65**	564	237	**42**	403	85	**21**
	Interstitial	939	873	**93**	873	762	**87**	713	520	**73**	486	244	**50**
	Glomerulonephritis	584	540	**92**	539	464	**86**	449	302	**67**	296	132	**45**
	All Diagnoses	3639	3136	**86**	3359	2564	**76**	2765	1461	**53**	1894	582	**31**
20-44	Unknown	222	210	**95**	215	194	**90**	194	161	**83**	145	106	**73**
	Diabetic nephropathy	432	394	**91**	401	328	**82**	339	216	**64**	224	101	**45**
	Multisystem	205	188	**92**	198	174	**88**	166	132	**80**	115	78	**68**
	Interstitial	546	533	**98**	515	493	**96**	434	383	**88**	305	237	**78**
	Glomerulonephritis	395	388	**98**	378	366	**97**	303	281	**93**	213	182	**85**
	All Diagnoses	1800	1713	**95**	1707	1555	**91**	1436	1173	**82**	1002	704	**70**
<20	Unknown	24	23	**96**	24	23	**96**	23	22	**96**	15	14	**93**
	Diabetic nephropathy	1	0	**0**	1	0	**0**	1	0	**0**	1	0	**0**
	Multisystem	30	29	**97**	28	27	**96**	26	22	**85**	18	14	**78**
	Interstitial	155	151	**97**	150	146	**97**	128	120	**94**	79	69	**87**
	Glomerulonephritis	35	34	**97**	32	31	**97**	28	26	**93**	21	18	**86**
	All Diagnoses	245	237	**97**	235	227	**97**	206	190	**92**	134	115	**86**
All ages	**Unknown**	**1917**	**1447**	**75**	**1842**	**1125**	**61**	**1630**	**611**	**37**	**1182**	**226**	**19**
	Diabetic nephropathy	**2359**	**1895**	**80**	**2183**	**1428**	**65**	**1752**	**561**	**32**	**1156**	**159**	**14**
	Multisystem	**2706**	**1829**	**68**	**2552**	**1363**	**53**	**2205**	**623**	**28**	**1552**	**200**	**13**
	Interstitial	**2358**	**2118**	**90**	**2220**	**1831**	**82**	**1854**	**1209**	**65**	**1269**	**579**	**46**
	Glomerulonephritis	**1563**	**1375**	**88**	**1459**	**1163**	**80**	**1199**	**733**	**61**	**819**	**359**	**44**
	All Diagnoses	**10903**	**8664**	**79**	**10256**	**6910**	**67**	**8640**	**3737**	**43**	**5978**	**1523**	**25**

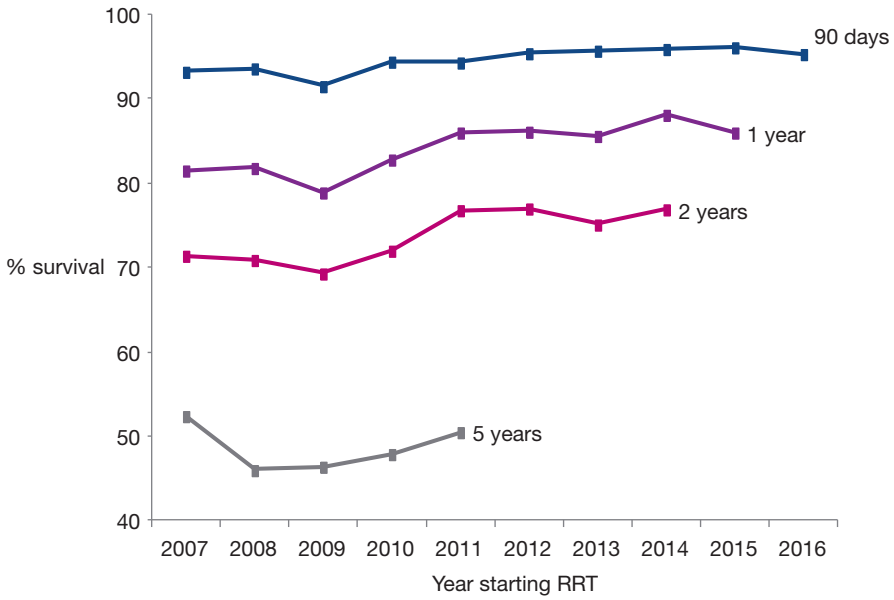
C1.2 Survival of patients by year of start of RRT 2007-2016

Year starting RRT	% surviving 90 days	% surviving 1 year	% surviving 1 year + 90 days	% surviving 2 years	% surviving 2 years + 90 days	% surviving 5 years	% surviving 5 years+ 90 days
2007	93.2	81.5	78.3	71.4	69.4	52.4	50.6
2008	93.6	81.8	78.9	70.9	67.4	46.0	45.3
2009	91.5	78.9	77.3	69.3	66.6	46.4	44.5
2010	94.4	82.8	79.3	72.0	68.8	47.9	47.5
2011	94.3	86.0	83.6	76.8	73.7	50.5	48.7
2012	95.4	86.1	83.7	77.0	74.9		
2013	95.7	85.6	82.4	75.1	72.5		
2014	95.9	88.1	86.1	76.9	75.0		
2015	96.1	86.0	83.1				
2016	95.3						

Note: Censored patients are excluded from this table.

Patients with insufficient follow-up and those who recovered within 90 days or who were lost to follow-up within the relevant period have been excluded.

C1.3 Trends in survival of patients starting RRT 2006-2016



Trend in 90 days survival: year to year OR is 1.07 (95% CI 1.03 -1.12).

Trend in 1 year survival: year to year OR is 1.07 (95% CI is 1.04 - 1.10).

Trend in 2 years survival: year to year OR is 1.06 (95% CI is 1.02 -1.09).

Trend in 5 years survival: year to year OR is 0.9 (95% CI is 0.94 -1.05).

There is a statistically significant trend of improving survival at 90 days, 1 year and 2 years after starting RRT.

C1.4 Proportion of patients starting RRT 2007-2015 surviving at 90 days and 1 year, by NHS Board area of residence

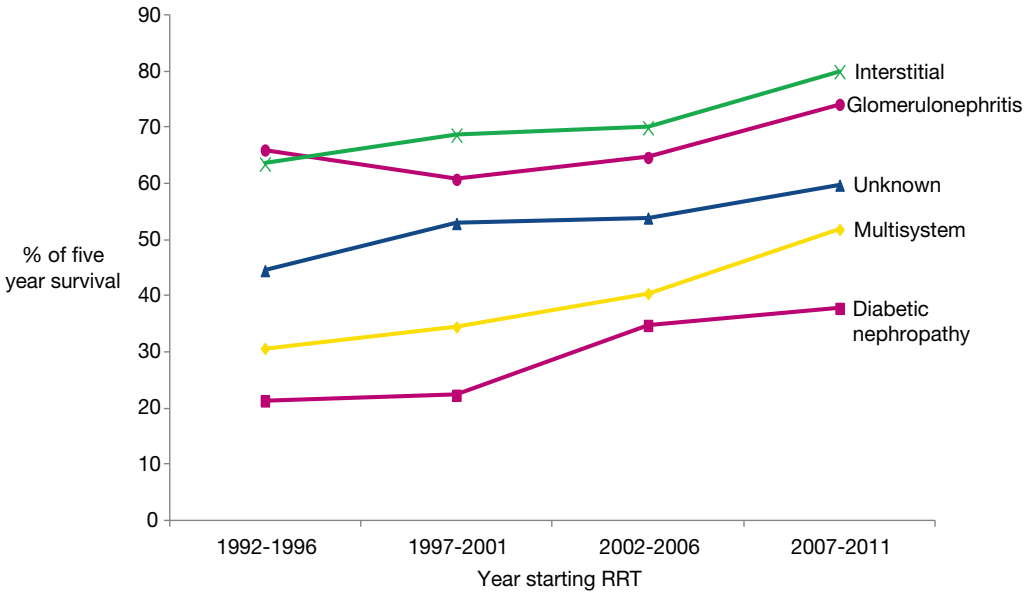
NHS Board	Number of patients	90 day survival		1 year survival	
		n	%	n	%
A&A	434	404	**93**	356	**82**
BORD	113	109	**96**	106	**94**
D&G	163	153	**94**	139	**85**
FIFE	446	415	**93**	369	**83**
FV	325	306	**94**	269	**83**
GRAM	552	528	**96**	472	**86**
GG&C	1237	1155	**93**	1020	**82**
HIGH	290	277	**96**	246	**85**
LAN	664	639	**96**	565	**85**
LOTH	704	651	**92**	552	**78**
ORKN	23	21	**91**	20	**87**
SHET	17	16	**94**	13	**76**
TAY	490	459	**94**	397	**81**
WI	35	34	**97**	30	**86**
SCOTLAND	**5493**	**5167**	**94**	**4554**	**83**

C2 Survival analyses

The trend in survival was calculated to investigate whether survival has improved over time for patients who started RRT aged between 45 and 64 years old.

Data relating to patients starting RRT after 2011 are excluded to ensure a minimum available follow up period of 5 years.

C2.1 Trend in 5 year survival from starting RRT 1992-2011 for patients aged 45-64 for each primary renal diagnosis group



There is a statistically significant trend of improving 5 year survival for all primary renal diagnosis groups except Glomerulonephritis.

	Odds Ratio	95% Confidence Interval	p-value
Glomerulonephritis	1.14	(0.98,1.33)	0.10
Interstitial	1.28	(1.12,1.48)	p<0.001
Multisystem	1.34	(1.17,1.56)	p<0.001
Diabetic Nephropathy	1.36	(1.18,1.58)	p<0.001
Unknown	1.21	(1.02,1.44)	0.04

C3 Survival by NHS Board area of residence

The standardised mortality ratio (SMR) is the number of deaths in every health board or unit divided by the number of expected deaths in that health board or unit.

This makes the SMR a measure of case-mix adjusted mortality (hence the label 'standardised').

The expected number of deaths is based on a logistic regression comprising patient's age, sex, SIMD and primary renal diagnosis group.

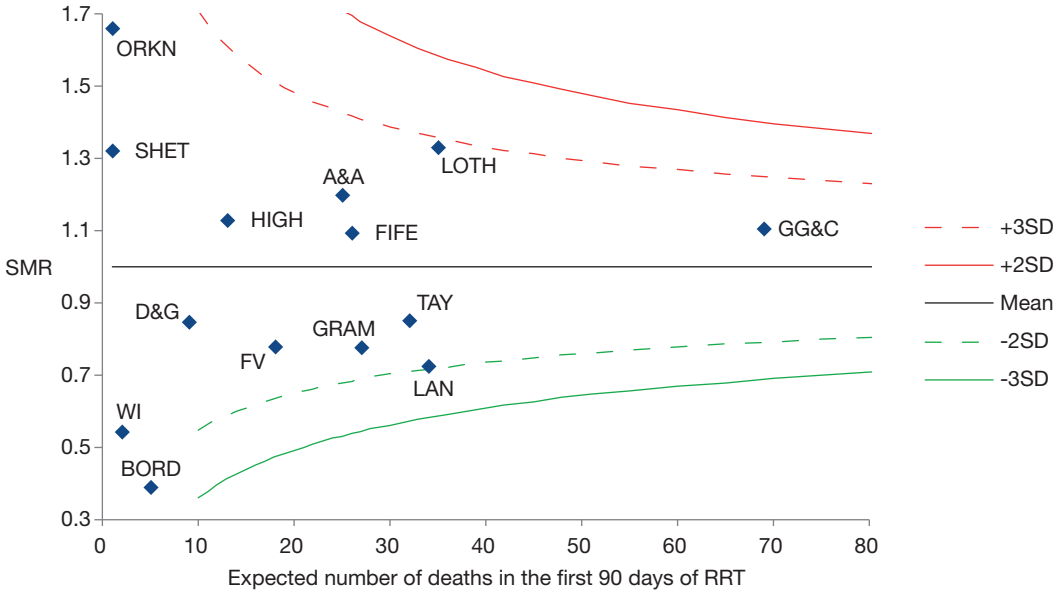
A SMR close to one means that the observed number of deaths is close to the expected number.

A SMR higher than one means that the observed number of deaths is higher than the expected number.

The units within the outer control limits (-3SD, +3SD) are considered equivalent and different only by chance.

The control limits are calculated via the Poisson probability distribution.

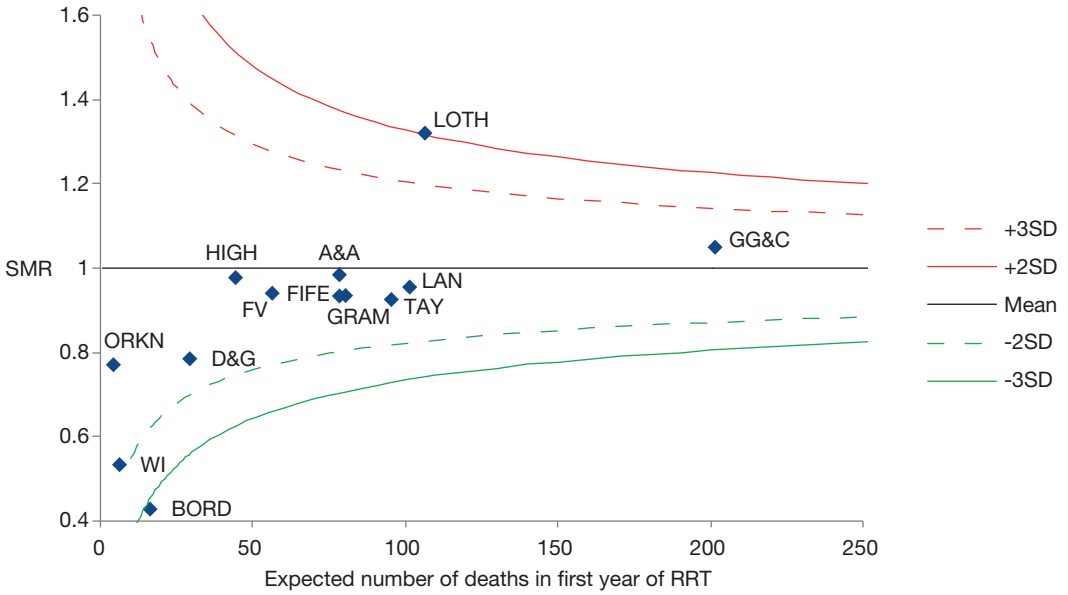
C3.1 90 day standardised mortality ratio for patients starting RRT 2007-2016 by NHS Board area of residence



All NHS Board areas fall within 3 standard deviations of the mean.

The mortality in the first 90 days of RRT for patients starting RRT in the ten years 2007-2016 was 5.6%.

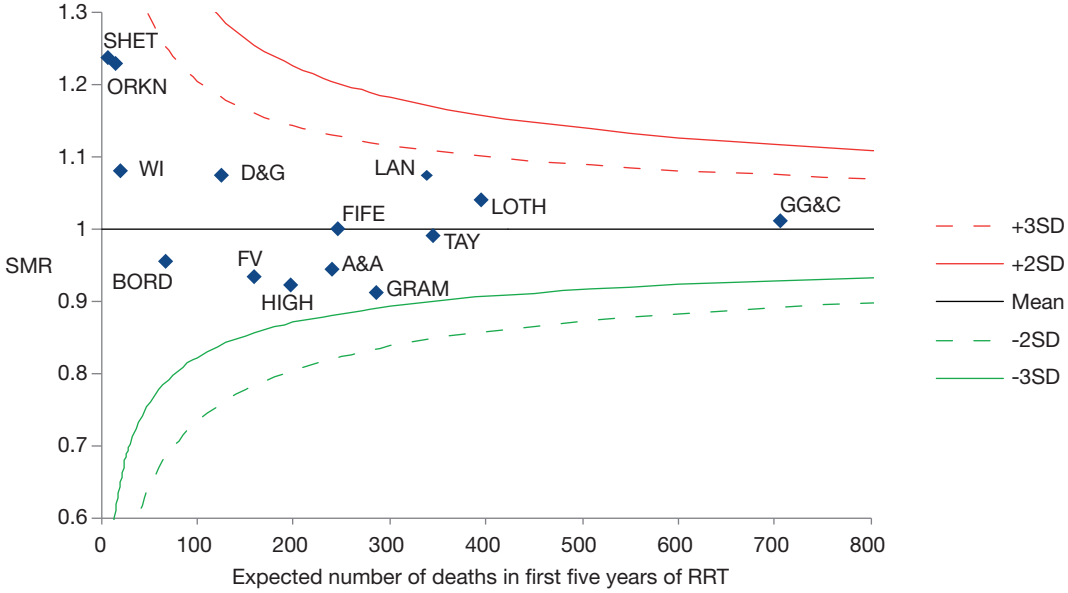
C3.2 One year standardised mortality ratio for patients starting RRT 2006-2015 by NHS Board area of residence



All boards fall within 3 standard deviations of the mean with the exception of BORD.

The mortality in first year of RRT for patients starting RRT in the ten years 2006-2015 was 17.1%.

C3.3 Five year standardised mortality ratio for patients starting RRT 2002-2011 by NHS Board area of residence

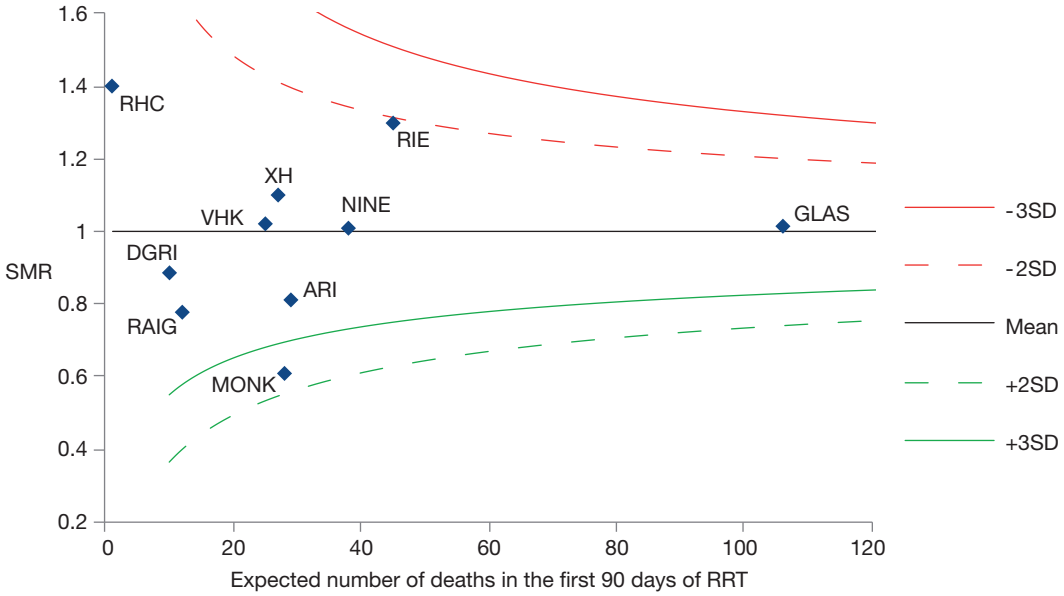


All NHS Board areas fall within 3 standard deviations of the mean.

The mortality in first five years of RRT for patients starting RRT in the ten years 2001 - 2010 was 55.6%.

C4 Survival by renal unit providing first RRT

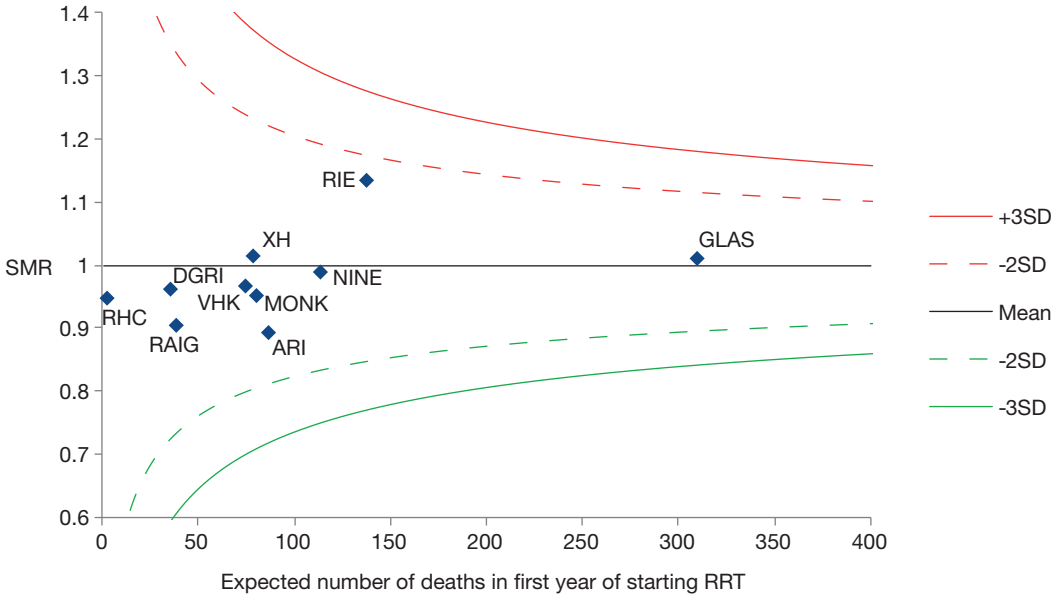
C4.1 90 day standardised mortality ratio by renal unit providing first RRT for patients starting RRT 2007-2016



Expected mortality is based on sex, age group, SIMD and primary renal diagnosis group.

The mortality in the first 90 days of RRT for patients starting RRT in the ten years 2007-2016 was 5.6%.

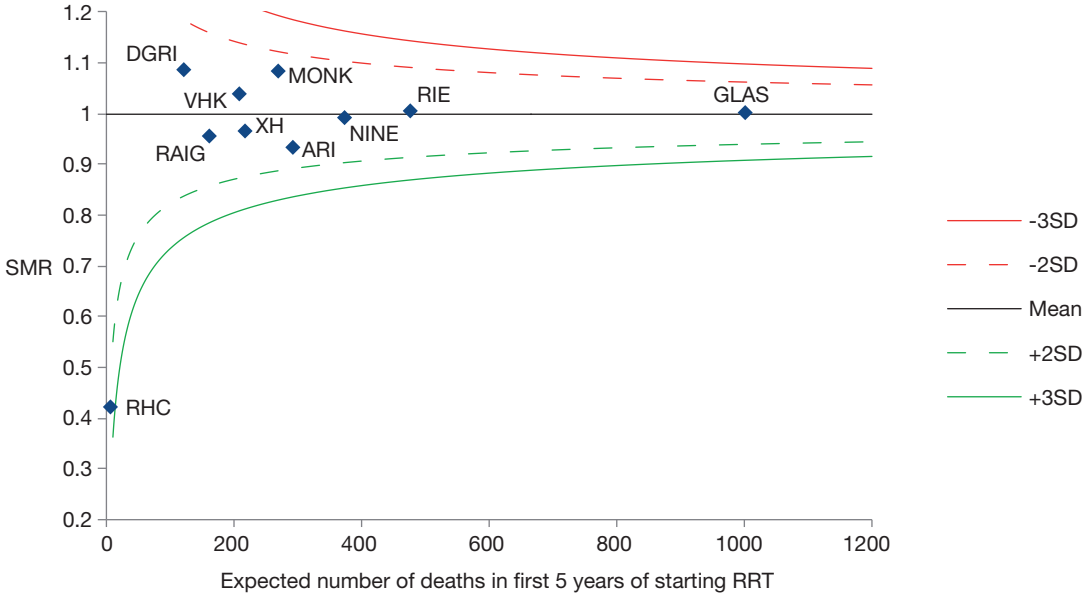
C4.2 One year standardised mortality ratio by renal unit providing first RRT for patients starting RRT 2006-2015



All units fall within three standard deviations of the mean.
Expected mortality is based on sex, age group, SIMD and primary renal diagnosis group.

The mortality in first year of RRT for patients starting RRT in the ten years 2006-2015 was 17.1%.

C4.3 Five year standardised mortality ratio by renal unit providing first RRT for patients starting RRT 2002-2011



All units fall within 3 standard deviations of the mean.
Expected mortality is based on sex, age group, SIMD and primary renal diagnosis group.

The mortality in first five years of RRT for patients starting RRT in the ten years 2002 - 2011 was 55.6%.

SECTION D CAUSE OF DEATH

Please see Summary of Data section of the report for details on the inclusion/exclusion of patients.

D1 Death in the prevalent RRT population 2008-2016

Year of death	Number of deaths	% of deaths in RRT population*	Age at death	
			Median	IQR
2008-2011**	1768	**9.1**	71	(63,78)
2012	396	**7.8**	71	(61,78)
2013	446	**8.7**	71	(61,79)
2014	429	**8.1**	72	(63,78)
2015	461	**8.3**	71	(61,78)
2016	469	**8.4**	70	(59,77)

* Percentage of deaths is expressed as: number of deaths in given year/number of patients starting RRT in given year + number prevalent on 31 December of previous year.
** Average taken over 4 year period.

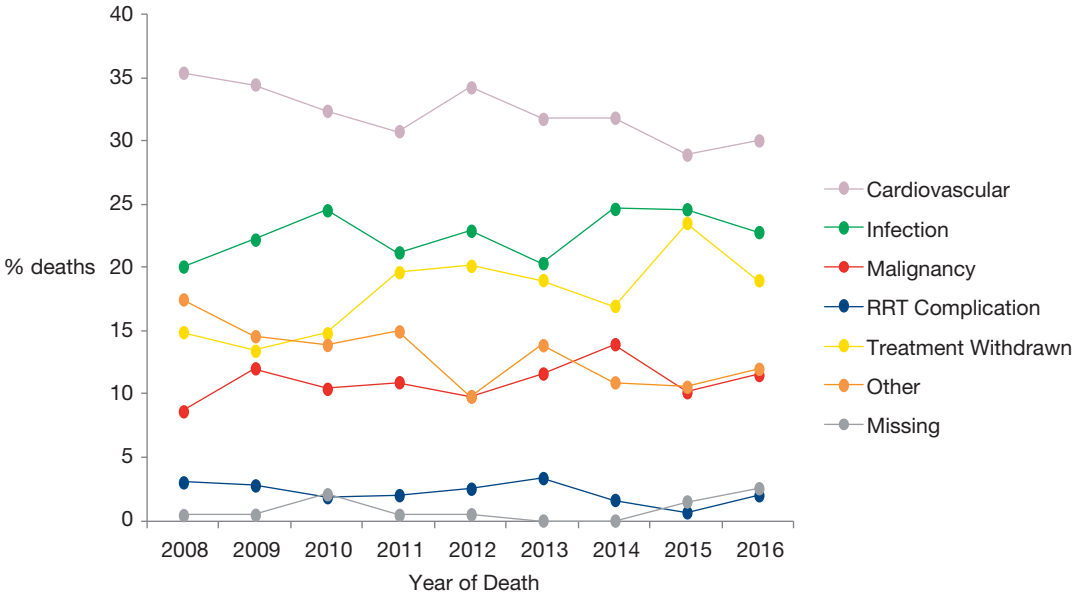
D2 Cause of death group by year 2008-2016

	2008-2011		2012		2013		2014		2015		2016		Total	
Year of death	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Cardiovascular	591	**33**	136	**34**	142	**32**	137	**32**	134	**29**	141	**30**	1281	**32**
Infection	389	**22**	91	**23**	91	**20**	106	**25**	113	**25**	107	**23**	897	**22**
Malignancy	186	**11**	39	**10**	51	**11**	60	**14**	47	**10**	54	**12**	437	**11**
Other	271	**15**	39	**10**	62	**14**	47	**11**	48	**10**	56	**12**	523	**13**
RRT Complication	43	**2**	10	**3**	15	**3**	7	**2**	3	**1**	8	**2**	86	**2**
Treatment Withdrawn	276	**16**	79	**20**	85	**19**	72	**17**	109	**24**	91	**19**	712	**18**
Missing	12	**1**	2	**1**	0	**0**	0	**0**	7	**2**	12	**3**	33	**2**
Total	**1768**		**396**		**446**		**429**		**461**		**469**		**3969**	

Cause of death has been collected as part of the Scottish Mortality Audit of Renal Replacement Therapy (SMARRT) since January 2008. Cause of death was available for just 72% of those dying between 1990 and 1999, 51% between 2000 and 2007 and 98% since 2008 and the creation of SMARRT.

ERA-EDTA Cause of death codes and the groupings used in SRR reports are available on the SRR website: http://www.srr.scot.nhs.uk/Projects/Methods.html.

D3 Trends in cause of death group by year 2008-2016



D4 Cause of death group and modality of RRT at death 2008-2016

Cause of death	Modality									
	HD		PD		Tx		RRT stopped*		All	
	n	%	n	%	n	%	n	%	n	%
Cardiovascular	1016	**36**	92	**38**	149	**25**	24	**8**	1281	**32**
Infection	663	**23**	39	**16**	165	**28**	30	**10**	897	**23**
Malignancy	226	**8**	20	**8**	143	**24**	48	**15**	437	**11**
RRT Complication	56	**2**	18	**7**	7	**1**	5	**2**	86	**2**
Treatment Withdrawn	482	**17**	29	**12**	18	**3**	183	**58**	712	**18**
Other	362	**13**	43	**18**	97	**17**	21	**7**	523	**13**
Missing	23	**1**	1	**0**	7	**1**	2	**1**	33	**1**
Total	**2428**		**242**		**586**		**313**		**3969**	

* This group were recorded on the SRR as having stopped RRT with no recovery of renal function, prior to death.

Of those patients who died within 90 days after stopping RRT between 2008-2016 the median, IQR and range between stopping RRT and death was 7 days, 3-12 days and 0-88 days respectively.

Over the time period 2008-2016 13 patients stopped RRT and then survived for more than 90 days. They had received RRT for a median of 84 days, range 5-2734 days before stopping RRT.

D5 Cause of death by age group 2008-2016

Cause of death	Age group										Total	Median Age
	<20		20-44		45-64		65-74		≥75			
	n	%	n	%	n	%	n	%	n	%		
Cardiovascular	1	**17**	70	**34**	406	**38**	379	**33**	425	**28**	**1281**	**69**
Infection	0	**0**	39	**19**	232	**22**	283	**24**	343	**22**	**897**	**71**
Malignancy	0	**0**	19	**9**	136	**13**	149	**13**	133	**9**	**437**	**69**
RRT Complication	2	**33**	17	**8**	19	**2**	26	**2**	22	**1**	**86**	**67**
Treatment Withdrawn	1	**17**	11	**5**	109	**10**	173	**15**	418	**27**	**712**	**76**
Other	1	**17**	43	**21**	158	**15**	148	**13**	173	**11**	**523**	**69**
Missing	1	**17**	4	**2**	8	**1**	5	**0**	15	**1**	**33**	**69**
Total	**6**		**203**		**1068**		**1163**		**1529**		**3969**	**71**

D6 Cause of death by primary renal diagnosis 2008-2016

Cause of death	PRD Group										Total
	Glomerulo-nephritis		Interstitial		Multisystem		Diabetic nephropathy		Unknown		
	n	%	n	%	n	%	n	%	n	%	
Cardiovascular	168	**31**	235	**30**	295	**30**	411	**43**	172	**25**	**1281**
Infection	126	**23**	204	**26**	210	**21**	190	**20**	166	**24**	**896**
Malignancy	75	**14**	122	**15**	146	**15**	30	**3**	64	**9**	**437**
RRT Complication	12	**2**	19	**2**	20	**2**	14	**1**	21	**3**	**86**
Treatment Withdrawn	84	**15**	96	**12**	200	**20**	170	**18**	162	**24**	**712**
Other	80	**15**	112	**14**	104	**11**	131	**14**	96	**14**	**523**
Missing	5	**1**	8	**1**	5	**1**	11	**1**	4	**1**	**33**
Total	**550**		**796**		**980**		**957**		**685**		**3968**

There is one patient with a missing PRD code.

SECTION E SCOTTISH MORTALITY AUDIT RENAL REPLACEMENT THERAPY (SMARRT)

Data on all deaths in adult patients receiving RRT in Scotland are submitted to the SRR via the Scottish Mortality Audit of Renal Replacement Therapy (SMARRT). Cause and contributors to death as well as location of death are recorded. In addition, the clinicians responsible for a patient's care are asked to comment on the presence or absence of areas of clinical concern in patient management prior to death.

A five point scale is used:

1. **There were no areas of concern or for consideration in the management of this patient**
2. **There were areas for consideration but they made no difference to the eventual outcome**
3. **There were areas of concern but they made no difference to the eventual outcome**
4. **There were areas of concern which may have contributed to this patient's death**
5. **There were areas of concern which CAUSED the death of this patient who would have been expected to survive**

Those deaths classed as category 4 or 5 are further assessed through a process which may include a review of case note records, discussion at local morbidity and mortality meetings, critical incident review reports or procurator fiscal reports. From analysis of this additional information several recurring themes have emerged.

These themes are:

- **Hyperkalaemia**

Death due to hyperkalaemic arrest. Patient non-concordance with treatment is noted to contribute in >50% of cases.

- **Prescribing**

Death attributed to adverse drug effects - inappropriate drug choices, combinations or monitoring. Most cases involve the use of common drugs including antiplatelet agents/ anticoagulants, opioid analgesics or immunosuppressant medication.

- **Systems of care**

Deaths attributed to failures of communication, inadequate out of hours cover, delays in specialist renal input or inadequate staff training.

- **Infection**

Deaths attributed to severe infection due to delays in its recognition or management, sepsis in the context of immunosuppressive drugs or due to vascular access related infection.

- **Vascular Access**

Deaths attributed to complications of vascular access. Examples include fatal blood loss (intentional and accidental), inadequate dialysis following failure to address poor vascular access or cardiovascular compromise from AVF formation.

- **Interventions**

Deaths attributed as a direct consequence of an operation or procedure. Examples include recognised bleeding complications of angiography and viscus perforation during endoscopic procedures.

- **Other**

Deaths following a fall-related fracture, unexpected deterioration during dialysis or noncompliance.

E1 Categories of deaths by year 2008-2016

Year	Cat 1		Cat 2		Cat 3		Cat 4		Cat 5		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%
2008-2011*	1486	**84.0**	176	**10.0**	31	**1.8**	58	**3.3**	10	**0.6**	7	**0.4**
2012	318	**79.9**	52	**13.1**	7	**1.8**	13	**3.3**	2	**0.5**	6	**1.5**
2013	349	**77.9**	56	**12.5**	20	**4.5**	15	**3.3**	6	**1.3**	2	**0.4**
2014	336	**77.8**	42	**9.7**	21	**4.9**	23	**5.3**	6	**1.4**	4	**0.9**
2015	353	**76.6**	61	**13.2**	25	**5.4**	15	**3.3**	3	**0.7**	4	**0.9**
2016	363	**77.2**	61	**13.0**	22	**4.7**	12	**2.6**	1	**0.2**	11	**2.3**
Total	**3205**	**80.6**	**448**	**11.3**	**126**	**3.2**	**136**	**3.4**	**28**	**0.7**	**34**	**0.9**

* Number and percentage over four year period 2008-2011

E2 Themes of category 4 and 5 deaths by year 2008-2016

Year	Hyper-kalaemia		Prescrib-ing		Systems of Care		Infection		Vascular Access		Interven-tion		Other		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
2008-2011*	2	**2.9**	12	**17.6**	15	**22.1**	25	**36.8**	7	**10.3**	5	**7.4**	2	**2.9**	**68**
2012	2	**13.3**	1	**6.7**	4	**26.7**	3	**20.0**	3	**20.0**	2	**13.3**	0	**0.0**	**15**
2013	2	**9.5**	0	**0.0**	9	**42.9**	3	**14.3**	1	**4.8**	4	**19.0**	2	**9.5**	**21**
2014	0	**0.0**	0	**0.0**	7	**24.1**	11	**37.9**	5	**17.2**	2	**6.9**	4	**13.8**	**29**
2015	0	**0.0**	4	**22.2**	6	**33.3**	5	**27.8**	0	**0.0**	1	**5.6**	2	**11.1**	**18**
2016	1	**7.7**	1	**7.7**	3	**23.1**	6	**46.2**	0	**0.0**	0	**0**	2	**15.4**	**13**
Total	7	**4.3**	18	**11.0**	44	**26.8**	53	**32.3**	16	**9.8**	14	**8.5**	12	**7.3**	**164**

* Number and percentage over four year period 2008-2011

E3 Location of death by year 2008-2016

Year	Usual Residence		Hospital		Hospice		Community Hospital		Other		Unknown		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
2008-2011*	375	**21.2**	1218	**68.9**	33	**1.9**	43	**2.4**	27	**1.5**	19	**1.1**	53	**3.0**
2012	93	**23.4**	270	**67.8**	12	**3.0**	6	**1.5**	8	**2.0**	0	**0.0**	9	**2.3**
2013	98	**21.9**	317	**70.8**	11	**2.5**	13	**2.9**	5	**1.1**	2	**0.4**	2	**0.4**
2014	85	**19.7**	303	**70.1**	17	**3.9**	10	**2.3**	3	**0.7**	0	**0.0**	14	**3.2**
2015	105	**22.8**	300	**65.1**	17	**3.7**	16	**3.5**	3	**0.7**	1	**0.2**	19	**4.1**
2016	99	**21.1**	308	**65.5**	21	**4.5**	11	**2.3**	4	**0.9**	1	**0.2**	26	**5.5**
Total	**855**	**21.5**	**2716**	**68.3**	**111**	**2.8**	**99**	**2.5**	**50**	**1.3**	**23**	**0.6**	**123**	**3.1**

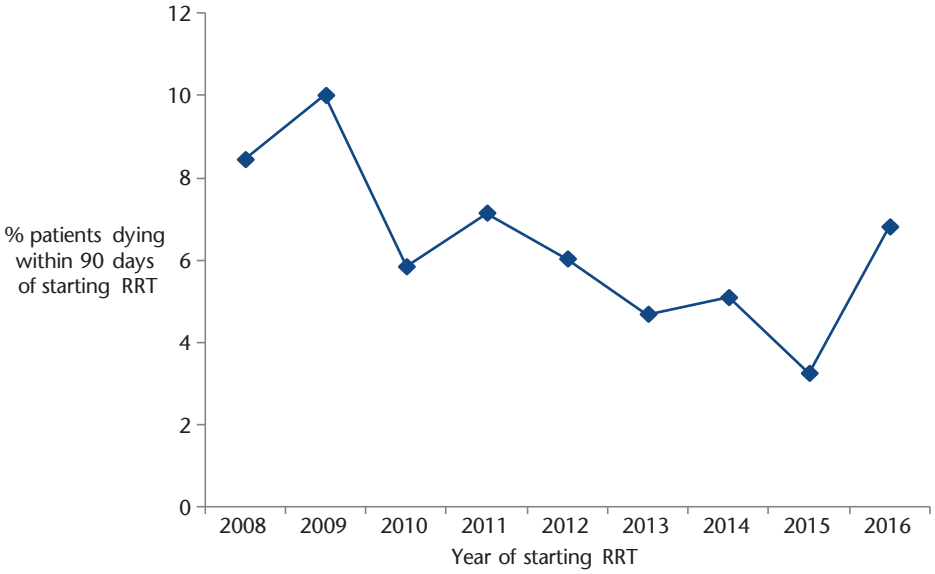
* Number and percentage over four year period 2008-2011

E4 Factors contributing to death 2008-2016

Year	With-drawal		Access failure/ infection		Dialysis compli-cations		Non-compli-ance		Peritoneal Infection		Trans-plant Complica-tion		Health-care As-sociated Infection		Malig-nancy		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
2008-2011*	548	**31.0**	161	**9.1**	96	**5.4**	65	**3.7**	52	**2.9**	98	**5.5**	148	**8.4**	287	**16.2**	25	**1.4**
2012	127	**31.9**	30	**7.5**	21	**5.3**	23	**5.8**	7	**1.8**	28	**7.0**	21	**5.3**	61	**15.3**	11	**2.8**
2013	161	**35.9**	24	**5.4**	23	**5.1**	21	**4.7**	13	**2.9**	32	**7.1**	30	**6.7**	77	**17.2**	5	**1.1**
2014	147	**34.0**	32	**7.4**	19	**4.4**	24	**5.6**	11	**2.5**	35	**8.1**	28	**6.5**	80	**18.5**	10	**2.3**
2015	171	**37.1**	37	**8.0**	18	**3.9**	10	**2.2**	9	**2.0**	40	**8.7**	26	**5.6**	88	**19.1**	9	**2.0**
2016	159	**33.8**	20	**4.3**	23	**4.9**	21	**4.5**	8	**1.7**	22	**4.7**	20	**4.3**	80	**17.0**	11	**2.3**
Total	**1313**	**33.0**	**304**	**7.6**	**200**	**5.0**	**164**	**4.1**	**100**	**2.5**	**255**	**6.4**	**273**	**6.9**	**673**	**16.9**	**71**	**1.8**

* Number and percentage over four year period 2008-2011

E5 Proportion of patients who died within 90 days of starting RRT 2008-2016



The percentage of patients who die at ≤90 days after commencing RRT is decreasing.

Comparing each era 2008-2011 and 2012-2016 demonstrates a significant decline over time, p=0.001.

Hyperkalaemia related deaths 2008-2015 – 'Are we doing enough?'

We analysed all data relating to all death 2008-2015 where hyperkalaemia was the primary cause of death, or felt to be a significant contributor to death from clinician comments contributed to SMARRT.

Patient demographics were compared between groups, including analyses of last available serum potassium results. A directed case note analysis was performed by SMARRT representatives to investigate efforts taken to reduce hyperkalaemia prior to death.

In the 8 years 2008-2015 there were 3,501 deaths; 79% HD, 6.3% PD and 14.7% in patients with a renal transplant.

In 28 deaths (0.8%) hyperkalaemia was either a primary cause (n=16) or significant contributor to death. Those who died from hyperkalaemia were younger when starting RRT (median age 44.4 vs 66.5 years, p<0.001), more likely to have non-concordance identified in SMARRT as a contributor to death (50 vs 3.7%, p<0.001) and a shorter than average duration of final hospital admission (median 1 vs 5 days, p=0.002). Serum phosphate was significantly higher in those who died from hyperkalaemia (1.66 vs 1.28mmol/L, p=0.002), possibly acting as a further surrogate marker of poor concordance with treatment goals.

Case note review was possible in 26 of 28 cases (93%). In 16 cases, hyperkalaemia was a recognised issue prior to death, with the remaining cases being unexpected or a complication of other illness.

In all 16 cases attempts were made to reduce serum potassium; dietician input in 81.3%, review of dialysis access in 62.5% and alteration of dialysis prescription in 25%.

At case note review, patient non-concordance was described in 11 (68.8%) cases. Of these 11, 4 were referred to psychiatric services and a further 3 were known to psychiatric services for other reasons. Only 1 unit had access to renal-specific psychiatric liaison during the study period. No unit has access to a renal-specific psychologist.

Our review has confirmed that hyperkalaemia related deaths are rare in people with end-stage renal disease on RRT when recognised measures are taken to reduce serum potassium. However those patients at risk are often young and have recognised poor concordance with treatment.

Strategies to support such patients and minimise this risk must be prioritised.

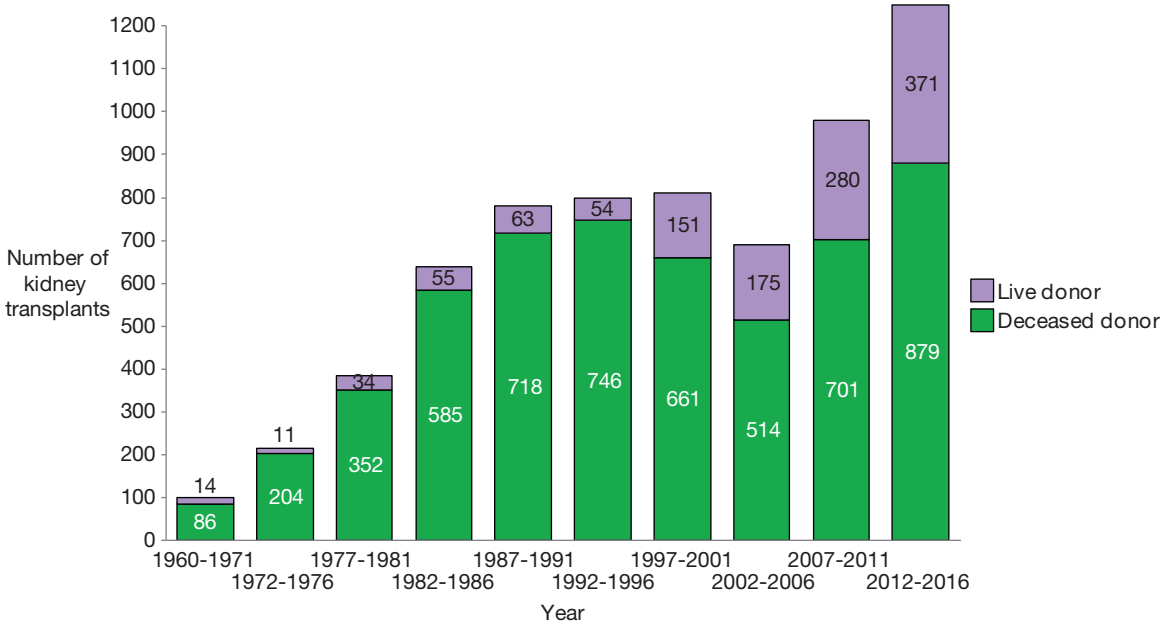
Data on hyperkalaemia related deaths between 01 January 2008 and 31 December 2015 using SMARRT data were presented to the European Renal Association meeting in Madrid, June 2017.

Reference: HYPERKALAEMIA ASSOCIATED DEATHS IN RRT - ARE WE DOING ENOUGH? Nephrology Dialysis Transplantation, Volume 32, Issue supplement 3, May 2017, Pages ii34, https://doi.org/10.1093/ndt/gfx111.SO060

SECTION F KIDNEY TRANSPLANTATION

F1 Frequency of kidney transplantation in Scotland

F1.1 Frequency and donor type, kidney transplants performed in Scotland 1960-2016



Between 1960 and 31 December 2016, 6654 kidney transplants were performed in Scotland in 5631 patients with postcode of residence in Scotland at the time of transplantation.

The kidney donor was deceased for 5446 (82%) transplants, 1208 (18%) of transplanted kidneys were donated by live donors.

5601 first kidney transplants were performed, 863 second transplants, 163 third transplants and 27 fourth or subsequent kidney transplants.

213 individuals resident in Scotland have received a simultaneous kidney and pancreas transplant, 16 individuals have received a simultaneous kidney and liver transplant.

Kidney transplants performed outside of Scotland are excluded. Transplants performed in Scotland for patients not resident in Scotland are also excluded.

F1.2 Frequency, transplant type and donor type, kidney transplants performed in Scotland 2007-2016

Year of transplant	Deceased donor kidney alone		Live donor kidney		Kidney and pancreas		Kidney and Liver		Total kidney transplants
	n	%	n	%	n	%	n	%	
2007-2011	630	**64.2**	280	**28.5**	68	**6.9**	4	**0.4**	**982**
2012	146	**64.6**	63	**27.9**	15	**6.6**	2	**0.9**	**226**
2013	166	**62.4**	84	**31.6**	16	**6.0**	0	**-**	**266**
2014	172	**65.6**	74	**28.2**	15	**5.7**	1	**0.4**	**262**
2015	159	**64.1**	77	**31.0**	11	**4.4**	1	**0.4**	**248**
2016	158	**63.7**	73	**29.4**	16	**6.5**	1	**0.4**	**248**

F1.3a Frequency and donor type of adult kidney transplants performed in Scotland 2007-2016 by transplanting centre

Year	GLASGOW								Total
	DBD		DCD		DD		LD		
	n	%	n	%	n	%	n	%	
2007	1	**1.3**	0	**-**	52	**67.5**	24	**31.2**	**77**
2008	0	**-**	3	**3.3**	51	**55.4**	38	**41.3**	**92**
2009	6	**6.6**	3	**3.3**	67	**73.6**	15	**16.5**	**91**
2010	41	**48.8**	11	**13.1**	14	**16.7**	18	**21.4**	**84**
2011	53	**54.6**	14	**14.4**	2	**2.1**	28	**28.8**	**97**
2012	59	**48.4**	33	**27.0**	0	**-**	30	**24.6**	**122**
2013	56	**39.4**	41	**28.9**	0	**-**	45	**31.7**	**142**
2014	65	**46.4**	39	**27.9**	0	**-**	36	**25.8**	**140**
2015	59	**44.0**	35	**26.1**	0	**-**	40	**29.9**	**134**
2016	56	**39.4**	48	**33.8**	0	**-**	38	**26.8**	**142**

DBD - Deceased after brain death; DCD - Deceased after circulatory death;
DD - Deceased donor unspecified; LD - Living donor.

F1.3b Frequency and donor type of adult kidney transplants performed in Scotland 2007-2016 by transplanting centre

Year	RIE								Total
	DBD*		DCD*		DD*		LD		
	n	%	n	%	n	%	n	%	
2007	56	**56.6**	12	**12.1**	0	-	31	**31.3**	**99**
2008	63	**60.0**	19	**18.1**	0	-	23	**21.9**	**105**
2009	71	**63.4**	13	**11.6**	0	-	28	**25.0**	**112**
2010	49	**52.1**	17	**18.1**	0	-	28	**29.8**	**94**
2011	52	**55.3**	17	**18.1**	0	-	25	**26.6**	**94**
2012	45	**46.4**	24	**24.7**	0	-	28	**28.9**	**97**
2013	48	**41.0**	33	**28.2**	0	-	36	**30.8**	**117**
2014	50	**45.5**	29	**26.4**	0	-	31	**28.2**	**110**
2015	45	**41.7**	28	**25.9**	0	-	35	**32.4**	**108**
2016	38	**37.6**	32	**31.7**	0	-	31	**30.7**	**101**

* Includes combined kidney + pancreas and kidney + liver transplants.
DBD - Deceased after brain death; DCD - Deceased after circulatory death;
DD - Deceased donor unspecified; LD - Living donor.

Since 2005 kidney transplantation for adult patients in Scotland has been undertaken in two units the Glasgow renal and transplant unit (GLAS) and the transplant unit of the Royal Infirmary of Edinburgh (RIE).

Kidney transplants for patients under the care of RHC are not shown in table F1.3.

F1.4 Age of patients at the time of kidney transplantation

Year of transplant	First kidney transplants				Second and subsequent transplants			
	n	Mean Age	SD	Age Range	n	Mean Age	SD	Age Range
1960-1971	95	30.2	11.8	(8 - 64.8)	5	21.2	3.9	(15.7 - 24.9)
1972-1976	194	33.9	11.8	(10.1 - 64.2)	21	33.2	10.8	(11.6 - 55.1)
1977-1981	322	36.8	12.8	(8.5 - 66.9)	64	33.0	9.8	(13.5 - 56.3)
1982-1986	521	38.8	15.1	(2.3 - 77.5)	119	35.8	12.1	(3.4 - 68.8)
1987-1991	652	40.8	15.8	(0.3 - 75.1)	129	36.4	13.9	(5.1 - 69.4)
1992-1996	670	42.4	15.8	(2.1 - 76.1)	130	36.7	12.6	(3.9 - 66.1)
1997-2001	672	41.5	15.4	(4 - 78.3)	140	38.8	11.9	(5.2 - 71.2)
2002-2006	569	43.2	15.1	(4.2 - 78)	120	39.0	11.1	(16.4 - 64.9)
2007-2011	836	45.9	15.3	(2.4 - 78.5)	145	43.5	11.5	(18.2 - 69.2)
2012-2016	1070	48.4	14.6	(3.6 - 79.2)	180	44.5	12.1	(14.4 - 75.4)

F1.5 Year of first kidney transplant and diagnosis group

Year of transplant	Glomerulo-nephritis		Interstitial		Multisystem		Diabetes		Unknown	
	n	%	n	%	n	%	n	%	n	%
1960-1971*	39	**41.5**	27	**28.7**	9	**9.6**	0	**-**	19	**20.2**
1972-1976	83	**42.8**	69	**35.6**	19	**9.8**	0	**-**	23	**11.9**
1977-1981	121	**37.6**	136	**42.2**	37	**11.5**	5	**1.6**	23	**7.1**
1982-1986	140	**26.9**	208	**39.9**	71	**13.6**	39	**7.5**	63	**12.1**
1987-1991	188	**28.8**	240	**36.8**	99	**15.2**	46	**7.1**	79	**12.1**
1992-1996	189	**28.2**	237	**35.4**	95	**14.2**	80	**11.9**	69	**10.3**
1997-2001	178	**26.5**	255	**37.9**	85	**12.6**	63	**9.4**	91	**13.5**
2002-2006	138	**24.3**	209	**36.7**	68	**12.0**	82	**14.4**	72	**12.7**
2007-2011	182	**21.8**	329	**39.4**	102	**12.2**	106	**12.7**	117	**14.0**
2012-2016	261	**24.4**	403	**37.7**	131	**12.2**	164	**15.3**	111	**10.4**

* One patient who received a first kidney transplant between 1960-1971 has missing PRD

F2 Transplanted Kidney Survival

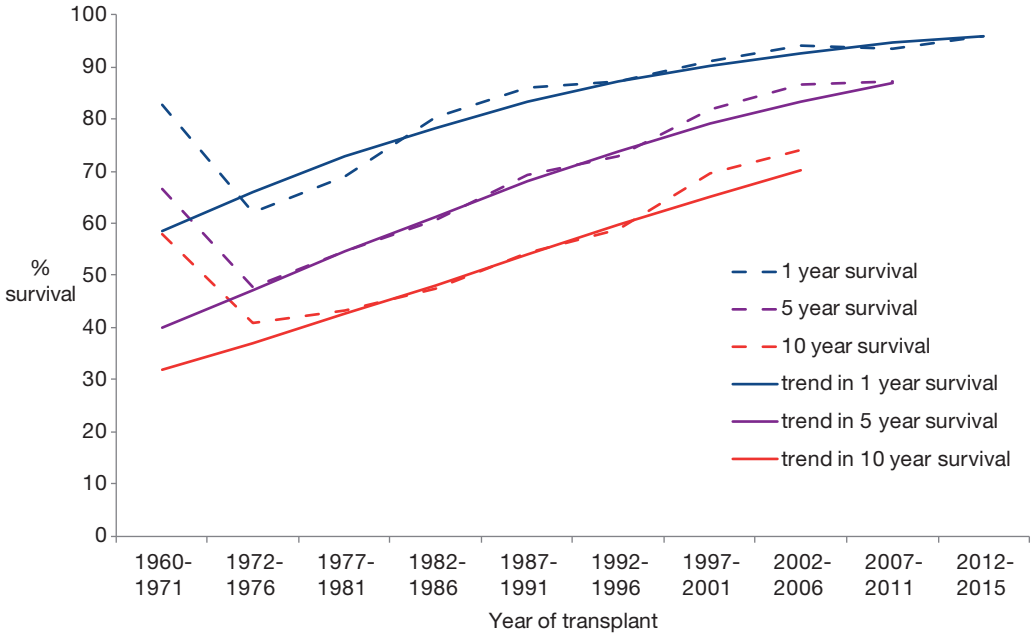
F2.1 Graft survival of first kidney transplants by year of transplantation 1960 - 2015

Year of transplant	Grafts surviving 1 year		Grafts surviving 5 years		Grafts surviving 10 years	
	n	%	n	%	n	%
1960-1971	62	**83**	38	**67**	29	**58**
1972-1976	101	**62**	70	**48**	55	**41**
1977-1981	205	**69**	156	**55**	114	**43**
1982-1986	401	**80**	279	**61**	196	**48**
1987-1991	531	**86**	396	**69**	279	**54**
1992-1996	559	**87**	437	**73**	315	**59**
1997-2001	592	**91**	508	**82**	400	**70**
2002-2006	523	**94**	443	**87**	345	**74**
2007-2011	762	**94**	674	**87**		
2012	183	**97**				
2013	212	**97**				
2014	218	**96**				
2015	190	**95**				

Survival of first kidney transplants only, for transplants performed in Scotland, are shown in the table.

Grafts with insufficient follow-up and those that did not fail in patients dying within the relevant period have been excluded from the table.

F2.2 Trends in first graft survival by year of transplantation 1960-2015



Trend in 1 year survival: year to year OR 1.07 (95% CI 1.06-1.07)

Trend in 5 year survival: year to year OR 1.06 (95% CI 1.05-1.07)

Trend in 10 year survival: year to year OR 1.05 (95% CI 1.04-1.06)

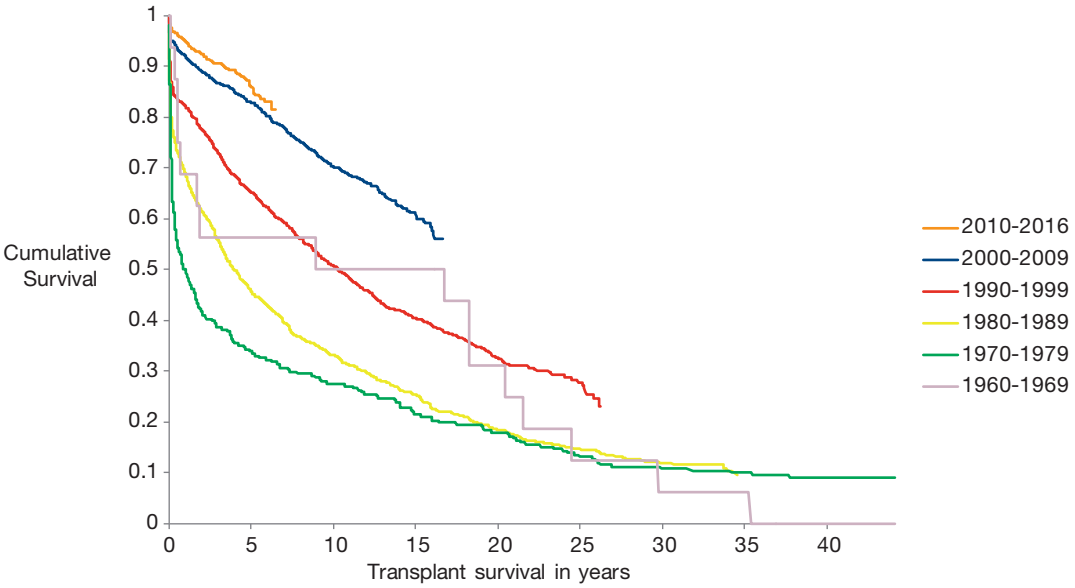
The trends in 1 year, 5 year and 10 year graft survival are all statistically significant. (Wald-statistic, df=1,p<0.001)

F2.3 Graft survival by Health Board of residence at transplantation 2006-2015

	Grafts surviving 1 year			Grafts surviving 2 years			Grafts surviving 5 years		
	Number of first kidney transplants 2006-2015	n	%	Number of first kidney transplants 2006-2014	n	%	Number of first kidney transplants 2006-2011	n	%
A&A	115	109	**94.8**	101	92	**91.1**	53	44	**83.0**
BORD	41	39	**95.1**	36	34	**94.4**	16	15	**93.8**
D&G	49	47	**95.9**	42	39	**92.9**	23	21	**95.5**
FIFE	123	114	**92.7**	110	97	**88.2**	70	56	**83.6**
FV	101	97	**96.0**	83	78	**94.0**	45	40	**93.0**
GRAM	183	176	**96.2**	167	156	**93.4**	95	84	**91.3**
GG&C	410	386	**94.1**	360	331	**91.9**	186	164	**90.1**
HIGH	115	111	**96.5**	102	96	**94.1**	68	62	**92.5**
LAN	243	233	**95.9**	208	192	**92.3**	110	98	**89.1**
LOTH	246	233	**94.7**	217	202	**93.1**	135	116	**87.9**
ORKN	4	4	**100.0**	3	3	**100.0**	3	3	**100.0**
SHET	4	4	**100.0**	4	4	**100.0**	3	3	**100.0**
TAY	111	105	**94.6**	94	89	**94.7**	56	46	**82.1**
WI	5	5	**100.0**	4	4	**100.0**	3	3	**100.0**
Scotland	1750	1663	**95.0**	1531	1417	**92.6**	866	755	**87.2**

Grafts with insufficient follow-up and those that did not fail in patients dying within the relevant period have been excluded from the table.

F2.4 Transplanted kidney survival by decade of transplantation 1960-2016



The survival curves demonstrate the transplanted organ survival, so called ‘graft survival’ not the survival of the patients receiving the transplant.

Patients are censored in the analysis if they died with a functioning kidney transplant, and on 31 December 2016.

All kidney transplants undertaken in Scotland between 1960-2016 are included within the analysis.

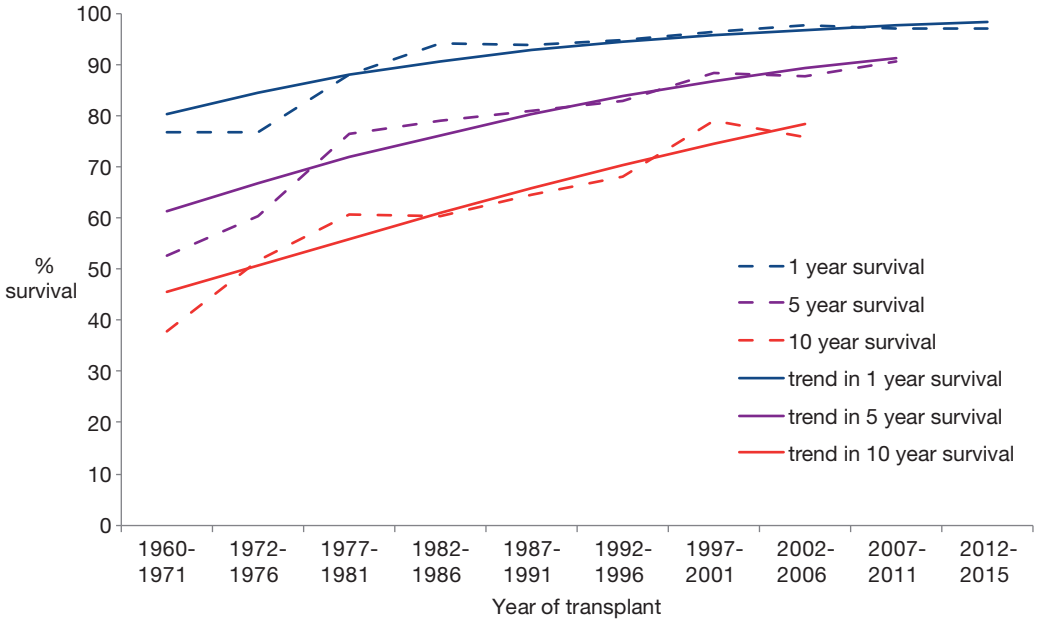
F3 Patient survival after Kidney Transplantation

F3.1 Patient survival after first kidney transplant by year of transplantation 1960-2015

Year of transplant	Patients surviving 1 year		Patients surviving 5 years		Patients surviving 10 years	
	n	%	n	%	n	%
1960-1971	73	**76.8**	50	**52.6**	36	**37.9**
1972-1976	149	**76.8**	117	**60.3**	100	**51.5**
1977-1981	283	**87.9**	246	**76.4**	195	**60.6**
1982-1986	491	**94.2**	411	**78.9**	314	**60.3**
1987-1991	611	**93.7**	527	**80.8**	421	**64.6**
1992-1996	634	**94.6**	555	**82.8**	457	**68.2**
1997-2001	647	**96.3**	594	**88.4**	531	**79.0**
2002-2006	555	**97.5**	498	**87.5**	431	**75.7**
2007-2011	811	**97.0**	757	**90.6**		
2012	188	**96.4**				
2013	217	**96.4**				
2014	227	**98.3**				
2015	201	**97.1**				

Patient survival is reported from the time of first kidney transplant for transplants performed in Scotland. Patients with insufficient follow-up are excluded.

F3.2 Trends in patient survival by year of first kidney transplantation 1960-2015



Trend in 1 year survival: year to year OR 1.06 (95% CI 1.04-1.07)

Trend in 5 year survival: year to year OR 1.05 (95% CI 1.04-1.06)

Trend in 10 year survival: year to year OR 1.04 (95% CI 1.04-1.05)

The trends in 1 year, 5 year and 10 year patient survival are all statistically significant. (Wald-statistic, df=1,p<0.001)

F4 Transplant Kidney Function

F4.1 Transplanted kidney function at one year in adult recipients after first kidney transplant performed 2006-2015

Year	Transplants performed	Surviving patients with functioning graft at 1 year		Patients with creatinine result	Serum creatinine (micromole/L)		eGFR (ml/min)	
		n	%	n	Median	IQR	Median	IQR
2006-2010	708	669	**94.5**	635	119	100-148	54.5	42.3-66.8
2011	153	143	**93.5**	128	119	102-152	52.6	42.3-67.4
2012	181	176	**97.2**	165	119	94-143	55.5	45.3-72.6
2013	211	206	**97.6**	169	111	88-135	58.4	47.0-73.0
2014	215	206	**95.8**	186	119	95-151	54.4	41.6-67.5
2015	195	184	**94.4**	173	113	96-151	55.4	42.4-70.8

Patients dying within the first year post transplant are excluded.

Patients aged under 18 years at the time of transplantation are excluded.

Kidney transplants performed outside of Scotland are excluded. Transplants performed in Scotland for patients not resident in Scotland are also excluded.

F4.2 Transplanted kidney function one year in adult recipients after first kidney transplant performed 2006-2015 by primary renal diagnosis group

Recipient primary renal diagnosis group	Transplants performed	Surviving patients with functioning graft at 1 year		Patients with creatinine result	Serum creatinine (micromole/L)		eGFR (ml/min)	
		n	%	n	Median	IQR	Median	IQR
Glomerulone-phritis	400	377	**92.4**	335	125	105-162	51.5	40.1-67.0
Interstitial	622	600	**94.2**	552	115	95-144	54.5	41.8-67.5
Multisystem	199	188	**90.4**	171	118	93-142	56.6	44.9-68.0
Diabetic nephropathy*	242	233	**92.5**	226	111	90-138	60.1	46.5-73.8
Unknown	200	186	**89.0**	172	116	98-146	55.4	44.3-69.3

* Includes patients receiving simultaneous kidney and pancreas transplant

F4.3 Transplanted kidney function one year in adult recipients after first kidney transplant performed 2011-2015 by donor type

Donor type	Transplants performed	Surviving patients with functioning graft at 1 year		Patients with creatinine result	Serum creatinine (micromole/L)		eGFR (ml/min)	
		n	%	n	Median	IQR	Median	IQR
Deceased - DBD	413	395	**91.9**	361	115	92-140	55.5	44.1-72.8
Deceased - DCD	250	235	**90.4**	216	126	103-169	47.2	35-65
Live donor	291	284	**97.3**	243	111	91-135	58.7	49.2-71.5

1 patient with Deceased Donor (DD) unspecified transplants within the time period has been excluded.

F4.4 Transplanted kidney function one year in adult recipients after first kidney transplant performed 2006-2015 by transplanting unit

Transplant renal unit	Transplants performed	Surviving patients with functioning graft at 1 year		Patients with creatinine result	Serum creatinine (micromole/L)		eGFR (ml/min)	
		n	%	n	Median	IQR	Median	IQR
GLAS	840	797	**94.9**	700	117	97-144	55.0	42.5-69.5
RIE	823	787	**92.8**	754	117	97-147	54.9	42.6-67.6

F5 Listing for kidney transplantation

F5.1 Percentage and prevalence per 100000 population of RRT patients with functioning kidney transplant or on transplant waiting list 31 December 2016 by NHS Board area of residence

	All RRT patients 31/12/2016	Patients with kidney transplant		Transplant or transplant listed		NHS Board population	Prevalence per 100000 population
		n	%	n	%		
A&A	395	214	54	261	66	370560	70.4
BORD	104	66	63	76	73	114530	66.4
D&G	136	75	55	101	74	149520	67.5
FIFE	340	169	50	207	61	370330	55.9
FV	263	166	63	205	78	304480	67.3
GRAM	538	297	55	352	65	588100	59.9
GG&C	1190	710	60	885	74	1161370	76.2
HIGH	308	193	63	233	76	321900	72.4
LAN	641	385	60	493	77	656490	75.1
LOTH	658	371	56	459	70	880000	52.2
ORKN	15	6	40	9	60	21850	41.2
SHET	16	8	50	8	50	23200	34.5
TAY	395	202	51	250	63	415470	60.2
WI	25	10	40	13	52	26900	48.3
Scotland	**5024**	**2872**	**57**	**3552**	**71**	**5404700**	**65.7**

The percentage of patients in each NHS Board area treated by all forms of RRT (PD, HD, Transplant) who are either on the transplant waiting list or have a functioning transplant are shown.

Patients who were on the transplant waiting list but had suspended rather than active status are included.

Two patients live outside of Scotland and were receiving treatment within Scottish renal units on 31 December 2016.

F5.2 Frequency of first kidney transplants and time from start of RRT to activation on transplant waiting list, by NHS Board area of residence at transplantation 2012-2016

	First Tx 2012-2016 (n)	Pre-emptive transplants (DD)		LD Tx in first year of RRT*	Patients with listing date**	Days from start of RRT to listing ***	
		Total Number	Number from DD			Median	IQR
A&A	85	20	10	15	66	52	-133-458
BORD	29	5	2	4	22	84	-62-370
D&G	28	5	2	7	23	40	-164-202
FIFE	60	7	2	8	50	128	-95-347
FV	69	15	7	14	51	87	-58-321
GRAM	105	17	4	16	85	65	-65-304
GG&C	273	57	24	53	219	15	-182-238
HIGH	59	10	4	13	43	-35	-147-220
LAN	162	28	13	25	132	177	-153-392
LOTH	122	19	10	21	101	168	-76-461
ORKN	2	-	-	1	2	-	-
SHET	3	-	-	0	3	-	-
TAY	69	14	3	18	55	98	-182-342
WI	4	2	1	1	3	-	-
Scotland	**1070**	**199**	**82**	**196**	**855**	**70**	**-138-340**

* Includes pre-emptive LD transplants
** Patients receiving LD pre-emptive transplants excluded
*** Truncated to -182 days

199 patients received a pre-emptive transplant in 2012-2016, 117 from a live donor (LD), 82 from a deceased donor (DD).

A further 79 patients received a LD transplant within one year of starting RRT.

Renal Association guidelines suggest that patients with progressive deterioration in renal function who are suitable for transplantation should be placed on the national transplant list within six months (-182 days) of their anticipated dialysis start date. Patients listed from transplantation for longer than six months prior to starting RRT have their duration of listing truncated to six months for the analysis.

F5.3 Time from start of RRT to activation on transplant waiting list patients starting RRT 2011-2015, by NHS Board area of residence at start of RRT

	Number starting RRT 2011-2015	Patients active on Tx waiting list by 31 Dec 2016*		Days from start of RRT to listing**	
		n	%	Median	IQR
A&A	212	67	31.6	37	-111-375
BORD	45	20	44.4	-13	-144-135
D&G	78	31	39.7	32	-182-75
FIFE	218	41	18.8	167	-96-377
FV	157	58	36.9	26	-182-236
GRAM	278	78	28.1	57	-98-413
GG&C	646	241	37.3	-11	-182-205
HIGH	137	53	38.7	-35	-159-245
LAN	350	136	38.9	119	-134 -334
LOTH	325	95	29.2	91	-118-340
ORKN	13	4	30.8	-	-
SHET	10	1	10.0	-	-
TAY	231	60	26.0	26	-182-257
WI	16	3	18.8	-	-
Scotland	**2716**	**888**	**32.7**	**30**	**-154 - 293**

Note: 3 patients lived outwith Scotland when they started RRT
* Patients active on transplant waiting list at any time up until 31 December 2016.
**Truncated to -182 days

Renal Association guidelines suggest that patients with progressive deterioration in renal function who are suitable for transplantation should be placed on the national transplant list within six months (-182 days) of their anticipated dialysis start date. Patients listed from transplantation for longer than six months prior to starting RRT have their duration of listing truncated to six months for the analysis.

SECTION G PERITONEAL DIALYSIS

Prospective audit of the incidence of peritoneal dialysis (PD) associated peritonitis, adequacy of dialysis and causes of technique failure have been reported the Scottish Renal Registry (SRR) by all adult renal units in Scotland since 1999.

In this report, details of the type of peritonitis (first episode, repeat, relapse, recurrent) and outcome of peritonitis are also presented for 2016.

The number of prevalent adult patients treated with PD was 230 at the end of December 2016 with 75% of adult PD patients using automated PD (APD).

G1 Reasons for starting and stopping PD in adult renal units 2012-2016

Renal unit	New	From HD	Transfer in	From Tx	Total in	Death	To Tx	To HD	Transfer out	Re-covered	Total out
ARI	41	24	4	8	**77**	7	24	47	0	1	**79**
XH	49	16	2	1	**68**	34	19	27	0	0	**80**
DGRI	30	3	3	4	**40**	8	7	26	2	0	**43**
GLAS	111	46	3	17	**177**	39	49	86	4	2	**180**
MONK	47	11	2	4	**64**	8	12	31	1	1	**53**
NINE	37	18	0	2	**57**	9	11	36	1	1	**58**
RAIG	31	23	2	3	**59**	4	15	44	2	0	**65**
RIE	61	24	8	5	**98**	21	22	44	1	4	**92**
VHK	37	12	0	1	**50**	13	12	38	0	0	**63**
Total	**444**	**177**	**24**	**45**	**690**	**143**	**171**	**379**	**11**	**9**	**713**

G2 PD associated peritonitis rates in adult renal units 2000-2016

	2000-2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Months between episodes	19.9	18.5	18.7	18.8	23.4	27	22.1	24.2	20.6	15.8

2016 saw high rates of peritonitis in most units, reflected in the highest overall rate for many years of 1 episode every 15.8 months in Scotland.

The definition of PD associated peritonitis used by the SRR can be found on the SRR website:

http://www.srr.scot.nhs.uk/Projects/Projects3.html#periton

G3 PD associated peritonitis rates in adult renal units 2012-2016				
Unit	**No. of peritonitis episodes**	**Total patient months on PD**	**Peritonitis rate (months between episodes)**	**Peritonitis rate (episodes per PD treatment year)**
ARI	66	1514	22.9	0.5
XH	88	2346	26.7	0.5
DGRI	41	823	20.1	0.6
GLAS	117	2838	24.3	0.5
MONK	42	698	16.6	0.7
NINE	36	1163	32.3	0.4
RAIG	60	855	14.2	0.8
RIE	110	1800	16.4	0.7
VHK	63	1214	19.3	0.6
SCOTLAND	**623**	**13251**	**21.3**	**0.6**

MONK, RAIG and RIE have peritonitis rates across the five years worse than the minimum standard specified by the Renal Association 2010 guideline (<1 episode per 18 months).

The Renal Association updated guideline (published June 2017) recommends that peritonitis rates should be less than 0.5 episodes per patient year. All units except XH have peritonitis rates ≥ 0.5 episodes per patient year and so fail to meet this revised standard.

The proportion of patients treated with PD in 2016 who developed peritonitis varied between units from 4.3% to 50%.

Peritonitis may occur as a single episode, or may be followed by further episodes which are described as relapse, recurrent or repeat according to the definition agree by the International Society for Peritoneal dialysis (ISPD) and available on the SRR website:

http://www.srr.scot.nhs.uk/Projects/Projects3.html#periton

The SRR has previously reported peritonitis rate using all episodes of peritonitis (which will result in a higher overall rate). The ISPD recommend omitting recurrent, relapsed and repeat episodes from rate calculations; using these criteria the rate by unit for the 2 audit periods in 2016 are shown in table G4. The outcome of peritonitis by unit is also shown.

G4 PD associated peritonitis in adult renal units 2016 by audit period and episode type with outcomes

Unit		Proportion of patients experiencing peritonitis per unit			Type of peritonitis episode					Outcome of Peritonitis		
		Patients treated with PD	Patients with peritonitis		Single episode	Re-current	Re-lapse	Repeat	Rate**	% Cure	% Catheter Removed	% Death
		n	n	%								
ARI	a*	31	8	25.8	8	0	0	1	17.0	70	30	0
	b	27	3	11.1	3	1	0	0	41.8	75	25	0
XH	a	46	13	28.3	14	1	0	1	9.5	100	0	0
	b	44	8	18.2	12	0	1	3	15.3	88	6	6
DGRI	a	15	5	33.3	6	1	1	0	13.0	100	0	0
	b	15	2	13.3	1	0	1	0	68.0	100	0	0
GLAS	a	74	5	6.8	10	0	0	0	30.4	70	30	0
	b	69	6	8.7	4	0	0	1	73.3	100	0	0
MONK	a	26	5	19.2	2	0	2	3	46.4	43	43	14
	b	25	7	28.0	8	0	2	1	14.5	90	10	0
NINE	a	23	1	4.3	1	0	0	0	98.0	0	100	0
	b	28	8	28.6	8	0	0	1	11.9	60	40	0
RAIG	a	17	3	17.6	3	0	0	0	23.7	33	67	0
	b	14	7	50.0	7	0	0	0	8.0	71	29	0
RIE	a	41	5	12.2	5	0	0	1	38.1	80	20	0
	b	44	14	31.8	16	2	4	1	12.1	73	27	0
VHK	a	25	6	24.0	6	0	0	0	20.7	80	20	0
	b	29	8	27.6	9	0	2	1	12.4	75	17	8
Scotland	**a**	**298**	**51**	**17.1**	**55**	**2**	**3**	**6**	**22.3**	**77.0**	**21.0**	**2.0**
	b	**295**	**63**	**21.4**	**68**	**3**	**10**	**8**	**18.3**	**79.0**	**19.0**	**2.0**

* a refers to first 6 months and b refers to second 6 months of each year.
** Peritonitis rate (number of months between episodes) excluding repeat, recurrent and relapsed episodes.

In 2016, 78% of peritonitis episodes were cured, 20% resulted in PD catheter removal, and 2% resulted in patient death. The UK Renal Association guideline targets an 80% primary cure rate.

G5 Rate (PD treatment months between episodes) of causative organisms of PD peritonitis in adult renal units 2012-2016

Renal unit	Staph aureus	Coagulase negative staph	Gram negative bacilli	Fungi	Other	Culture negative	Total Rate
ARI	757.0	94.6	116.5	1514.0	84.1	94.6	22.9
XH	195.5	335.1	195.5	-	195.5	53.3	26.7
DGRI	274.3	63.3	102.9	-	68.6	137.2	20.1
GLAS	218.3	105.1	129.0	567.6	113.5	113.5	24.3
MONK	63.6	-	174.8	233.0	116.5	38.8	16.6
NINE	193.9	145.4	145.4	-	96.9	581.6	32.3
RAIG	213.9	65.8	71.3	-	40.7	85.6	14.2
RIE	105.9	81.8	138.4	1799.5	40.9	138.4	16.4
VHK	303.6	46.7	71.4	-	151.8	202.4	19.3
Scotland	**184.1**	**100.4**	**121.6**	**1019.4**	**83.9**	**94.7**	**21.3**

The organisms cultured vary between units. The culture negative rate 2012-2016 was 22%, above the UK Renal Association target of less than 20%. The culture negative rate varies from 5.6-50% between units.

G6 Number of patients with total (peritoneal and renal) creatinine clearances (litres/week/1.73m2) in each 6 months audit period 2012-2016 and percentage of patients with inadequate (<50) and borderline (50-60) creatinine clearances

Year	Adequacy						% < 50	% 50-60
	< 50	50-60	61-70	>70	Unassessed	Total		
2012a*	24	37	26	94	54	235	**10.2**	**15.7**
2012b	25	24	34	103	45	231	**10.8**	**10.4**
2013a	16	30	33	92	112	283	**5.7**	**10.6**
2013b	23	31	34	84	52	224	**10.3**	**13.8**
2014a	25	29	27	79	44	204	**12.3**	**14.2**
2014b	25	29	30	88	34	206	**12.1**	**14.1**
2015a	28	28	19	73	59	207	**13.5**	**13.5**
2015b	25	27	26	74	61	213	**11.7**	**12.7**
2016a	23	28	21	76	49	197	**11.7**	**14.2**
2016b	24	25	18	74	70	211	**11.4**	**11.8**
TOTAL	**238**	**288**	**268**	**837**	**580**	**1803**	**13.2**	**16.0**

* a refers to first 6 months and b refers to second 6 months of each year

The adequacy results are for patients still on PD at the end of each audit period as opposed to all adequacy tests performed. Most units wait at least 2 months after starting PD before performing an initial adequacy test.

The proportion of patients with inadequate dialysis (ie below 50 litres/week/1.73m2) has remained stable for the last 5 years.

G7 Causes of PD technique failure in each adult renal unit 2012-2016

Unit	Peritonitis		Access		Under-dialysis		Poor UF*		High IP**		Wish HD		Stop Dialysis		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
ARI	16	38	2	5	15	38	0	0	3	7	5	12	1	2	42
XH	32	37	3	3	21	22	5	6	11	13	14	16	1	1	87
DGRI	16	41	4	10	9	29	1	3	2	5	5	13	2	5	39
GLAS	23	42	9	16	6	16	2	4	0	0	12	22	3	5	55
MONK	14	37	5	13	9	29	3	8	3	8	3	8	1	3	38
NINE	20	65	4	13	3	6	1	3	0	0	3	10	0	0	31
RAIG	16	41	4	10	8	21	0	0	4	10	7	18	0	0	39
RIE	5	18	3	11	8	23	2	7	3	11	7	25	0	0	28
VHK	5	21	1	4	12	45	1	4	2	8	3	13	0	0	24
Scotland	**147**	**38**	**35**	**9**	**91**	**24**	**15**	**4**	**28**	**7**	**59**	**15**	**8**	**2**	**383**

* Poor ultrafiltration
** High intraperitoneal pressure

The causes of technique failure have remained consistent overall in Scotland, with 38% caused by peritonitis, but there is variation between units.

SECTION H VASCULAR ACCESS FOR HAEMODIALYSIS

Details of vascular access used for haemodialysis for all hospital and home haemodialysis patients were collected during the SRR census week in May 2017. The SRR has collected data about the access used for first haemodialysis for incident patients since the start of 2012.

The Renal Association guideline (2015) suggests that 60% of all incident patients with established end stage kidney disease commencing planned haemodialysis should receive dialysis via a functioning arteriovenous fistula (AVF) or arteriovenous graft (AVG), and that 80% of all prevalent long term dialysis patients should receive dialysis treatment via definitive access: AVF or AVG.

Between 01 January 2016 and 31 December 2016 there were 436 incident adult haemodialysis patients in Scotland. 206 (47.2%) of these commenced dialysis with AV access and 230 (52.8%) with a central venous catheter (CVC). Between the 01 January 2017 and 30 June 2017 there were 231 incident adult haemodialysis patients. 102 (44.2%) patients commenced with AV access and 129 (55.8%) with a CVC. During the same 6-month period, 2 paediatric patients started HD in total at RHSC both commenced HD with a CVC.

There are no missing data.

H1 Types of vascular access used for first haemodialysis 2012 to June 2017

Year	No. starting HD	No. with data	Arteriovenous				Central Venous Catheter			
					Total				Total	
			Fistula	Graft	n	%	Tunnelled	Non-tunnelled	n	%
2012	418	418	173	2	**175**	**41.9**	164	79	**243**	**58.1**
2013	397	397	168	7	**175**	**44.1**	146	76	**222**	**55.9**
2014	433	433	183	9	**192**	**44.3**	155	86	**241**	**55.7**
2015	473	473	187	14	**201**	**42.5**	165	107	**272**	**57.5**
2016	436	436	185	21	**206**	**47.2**	139	91	**230**	**52.8**
2017*	231	231	95	7	**102**	**44.2**	80	49	**129**	**55.8**

* 01 January - 30 June 2017.

In the four years 2012-2015 a total of 978 patients started RRT via a central venous catheter. 60.4% were male, the distribution of primary renal diagnoses also reflected the incident RRT population as a whole, 27% had a primary renal diagnosis of diabetic nephropathy.

25 (2.6%) of the individuals starting RRT via a CVC had a live donor transplant within the first year of starting RRT.

30 (3.1%) of the individuals startIng RRT via a CVC died within the first year of starting RRT and had malignancy recorded as primary cause of death.

It is not possible from Registry data to tell if a planned live donated kidney transplant, or knowledge of a life limiting malignancy influenced the decision not to form AV access for haemodialysis for these individuals.

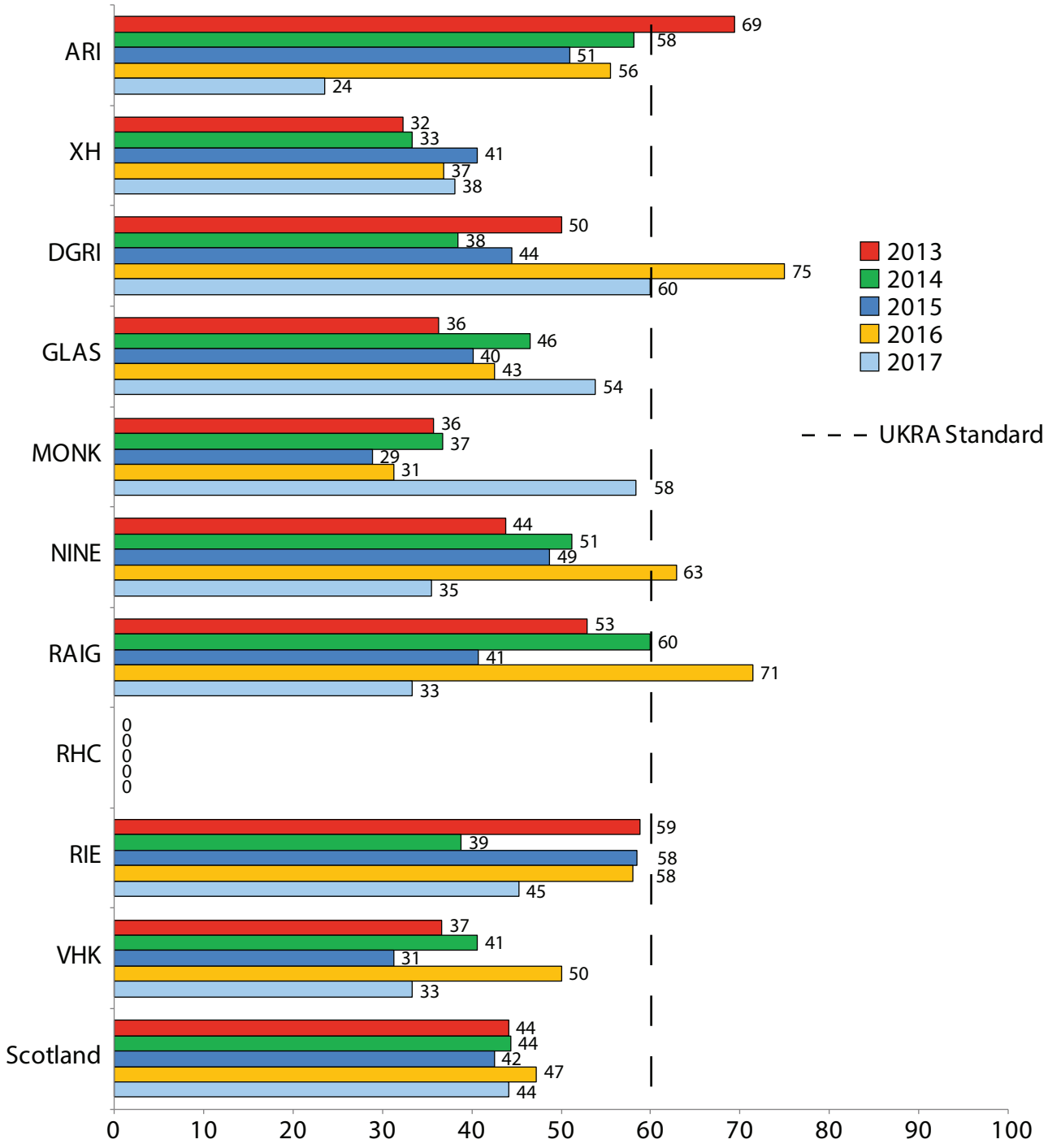
H2 Relationship between time of first referral to nephrology and access used for first HD 01 January 2012 - 30 June 2017

Type of Access	Total on HD	No. with data	Early referral		Late referral		Median time between referral and RRT	
			n	%	n	%	Months	IQR
AV	1051	1017	993	51.3	20	5.3	60.5	31 - 113
Line	1337	1309	944	48.7	354	94.7	22.7	2.1 - 70.1
Total	**2388**	**2326**	**1937**	**-**	**374**	**-**	**40.9**	**9.8 - 92.4**

Date of referral to renal services was available for 2326 (97.4%) of the incident haemodilaysis patients. Late referral was defined as less then 3 months between referral and first haemodialysis session.

Of patients referred within six months of starting haemodialysis 42 (9%) started haemodialysis using AV access and 97 (15%) of those referred within 12 months.

H3 Percentage of patients with AV access for first haemodialysis by renal unit 01 January 2013 - 30 June 2017

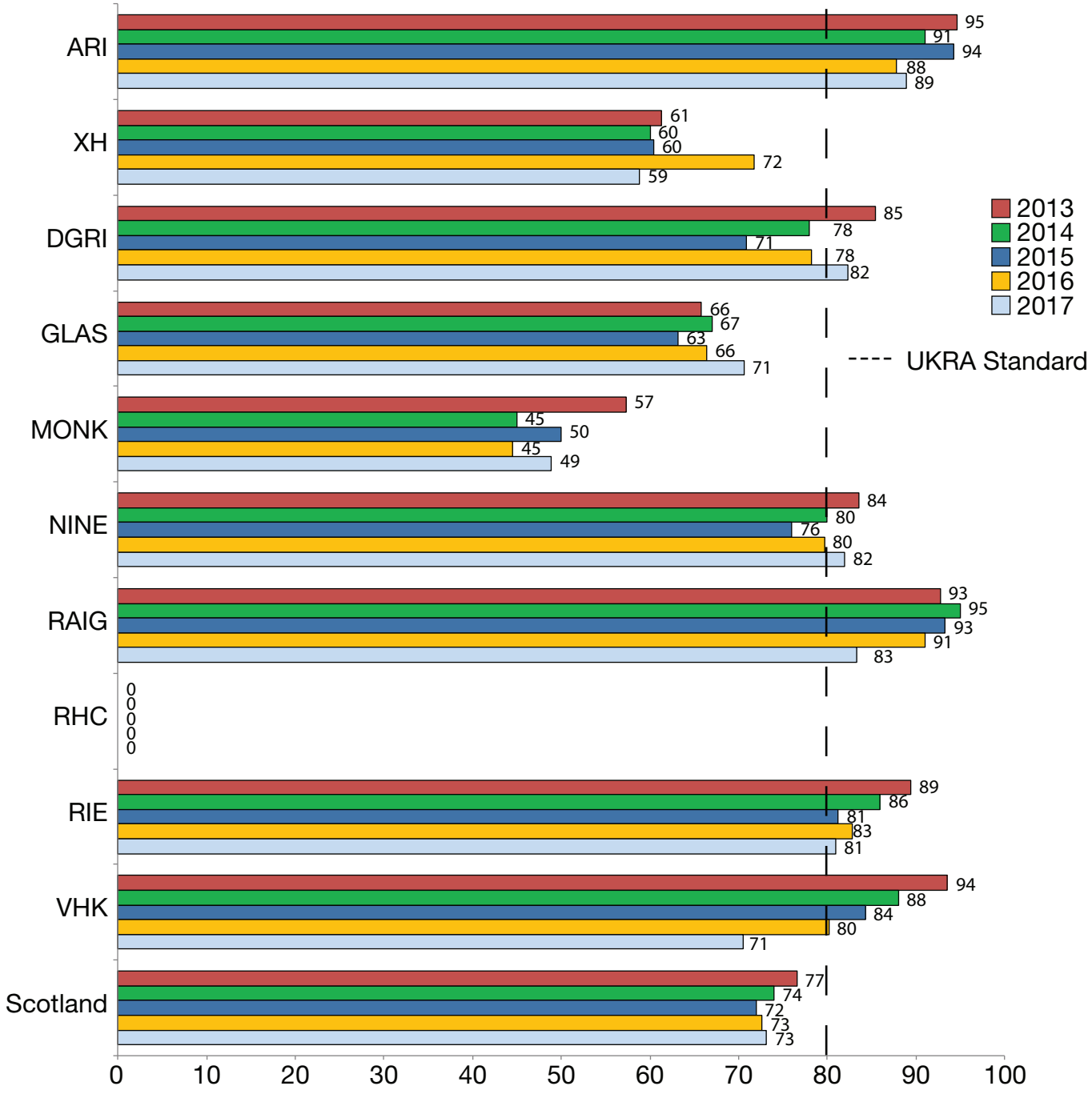


H4	Types of vascular access for haemodialysis patients each May 2009-2017											
Year	No. on HD	No. with data		Arteriovenous					Central Venous Catheter			
							Total				Total	
		n	%	Fistula	Graft	Un-known	n	%	Tun-nelled	Non-tun-nelled	n	%
2009	1848	1699	91.9	1206	58	16	**1280**	**75.3**	385	34	**419**	**24.7**
2010	1868	1748	93.6	1262	51	2	**1315**	**75.2**	400	33	**433**	**24.8**
2011	1877	1810	96.4	1275	54	40	**1369**	**75.6**	405	36	**441**	**24.4**
2012	1873	1769	94.4	1284	72	10	**1366**	**77.2**	379	24	**403**	**22.8**
2013	1885	1680	89.1	1217	69	0	**1286**	**76.5**	343	51	**394**	**23.5**
2014	1853	1803	97.3	1256	76	4	**1336**	**74.1**	437	30	**467**	**25.9**
2015	1906	1831	96.1	1236	79	0	**1315**	**71.8**	482	34	**516**	**28.2**
2016	1878	1817	96.8	1207	114	1	**1322**	**72.8**	470	25	**495**	**27.2**
2017	1954	1874	95.9	1221	145	0	**1366**	**72.9**	491	17	**508**	**27.1**

1954 patients with established renal failure were being treated by haemodialysis in May 2017, details of vascular access were available for 1874 (95.9%).

There were large, significant differences between renal units. Figure H5 shows the percentage of AV access in each unit for 2013-2017.

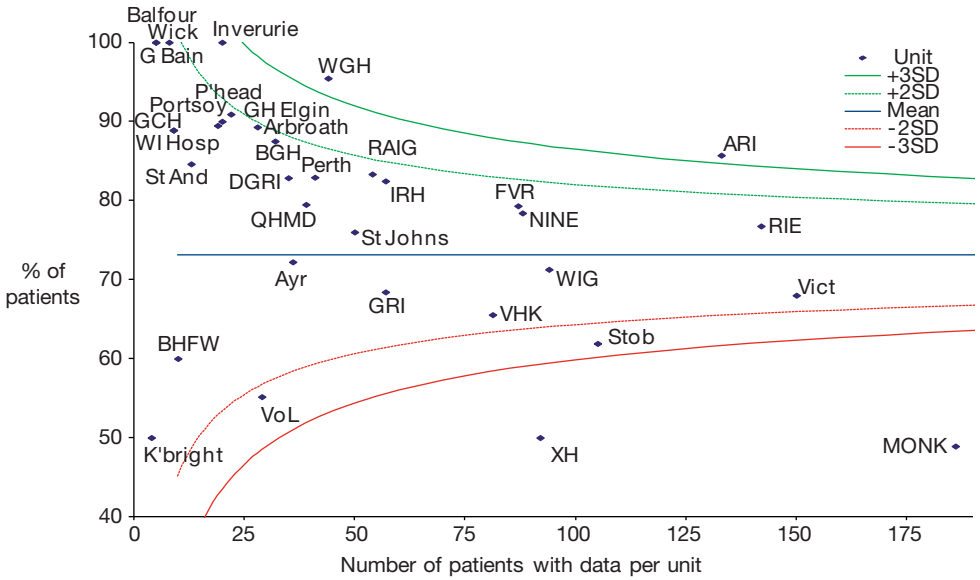
H5 Percentage of haemodialysis patients with AV access by renal unit: Census results 2013 - 2017



Rates of AV access (for patients with data submitted) in the adult units in May 2017 ranged from 49% to 89%.

The Renal Association guideline (2015) suggests that 80% of all prevalent adult patients on haemodialysis should receive dialysis via a functioning arteriovenous access.

H6 Percentage of patients on hospital haemodialysis with AV access by satellite unit May 2017



RHC had no patients with AV access and is not shown on the funnel plot.

Of the 56 patients receiving home haemodialysis during the census, information on vascular access was available for 51 (91.1%).

Of those with data, 47 patients were receiving dialysis via AV fistula or graft (92.2%) and 4 via a central venous catheter (7.8%).

H7 Number of patients confirmed as using buttonhole cannulation technique by renal unit May 2017

	ARI	XH	DGRI	GLAS	MONK	NINE	RAIG	RHC	RIE	VHK	Scotland
Total on HD	240	144	54	609	187	181	89	10	299	141	1954
Total with AV access	208	80	42	423	91	132	70	0	226	94	1366
Sufficient data	192	80	41	388	86	129	65	0	222	88	1291
Buttonhole yes	144	63	2	11	65	88	45	0	107	5	530
Buttonhole no	48	17	39	377	21	41	20	0	115	83	761

1291 (94.5%) of the 1366 prevalent haemodialysis patients with AV access had their AV access cannulation technique recorded in the May 2017 census.

SECTION I BACTERAEMIA IN RRT RECIPIENTS: A JOINT REPORT WITH HEALTH PROTECTION SCOTLAND

Patients treated by renal replacement therapy (RRT) for established renal failure are at high risk of infection with associated increased morbidity and mortality. Infection was the second most frequent cause of death of RRT recipients in 2016.

All bacteraemia in Scotland, that is bacteria being detected within a patient's blood stream by means of a positive blood culture, are reported directly from microbiology laboratories to Health Protection Scotland (HPS) using the Electronic Communication of Surveillance in Scotland (ECOSS) system. Methicillin resistant *Staphylococcus aureus* (MRSA) bacteraemia incidence surveillance has been mandatory in Scotland since 2001 and surveillance was extended in 2006 to include methicillin sensitive *S. aureus* (MSSA). In addition, mandatory *Escherichia coli* bacteraemia surveillance was introduced in Scotland in April 2016. Whilst surveillance of bacteraemia with other organisms is not mandatory, all positive blood cultures are reported to ECOSS enabling these data to be used robustly in epidemiological analyses.

Database linkage was performed between the Scottish Renal Registry including all patients who have received RRT in Scotland and ECOSS bacteraemia data namely *S. aureus*, *Staphylococcus epidermidis*, *Streptococcus* sp., *E. coli*, *Klebsiella* sp. and *Pseudomonas* sp.. These organisms were chosen due to their clinical significance in RRT patients. For the purpose of the analyses, *E. coli*, *Klebsiella* sp. and *Pseudomonas* sp. were grouped as Gram negative organisms. Linkage was performed for the period 01 January 2012 to 31 December 2016. An episode of bacteraemia was defined as a bacteraemia in a patient without a previous episode of bacteraemia with the same organism in the preceding two weeks.

I1 Bacteraemia reported in patients treated by RRT 2012-2016

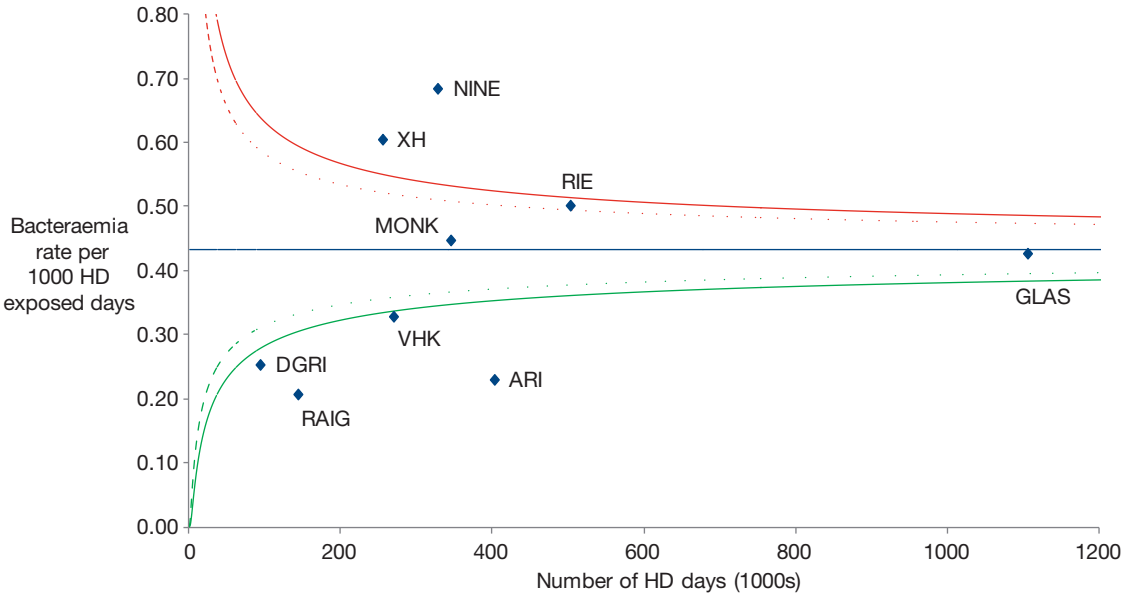
I1.1 Incidence of Bacteraemia in RRT population 2012-2016 by modality of RRT

Organism	HD		PD		Tx		All
	n	%	n	%	n	%	n
Gram negative*	353	**50**	18	**3**	329	**47**	700
Staphylococcus aureus	493	**91**	12	**2**	37	**7**	542
Staphylococcus epidermidis	478	**84**	17	**3**	75	**13**	570
Streptococcus sp.	187	**80**	8	**3**	38	**16**	233
Total	1511	**74**	55	**3**	479	**23**	2045

* Gram negative organism group comprises *Escherichia coli*, *Klebsiella* sp. and *Pseudomonas* sp.

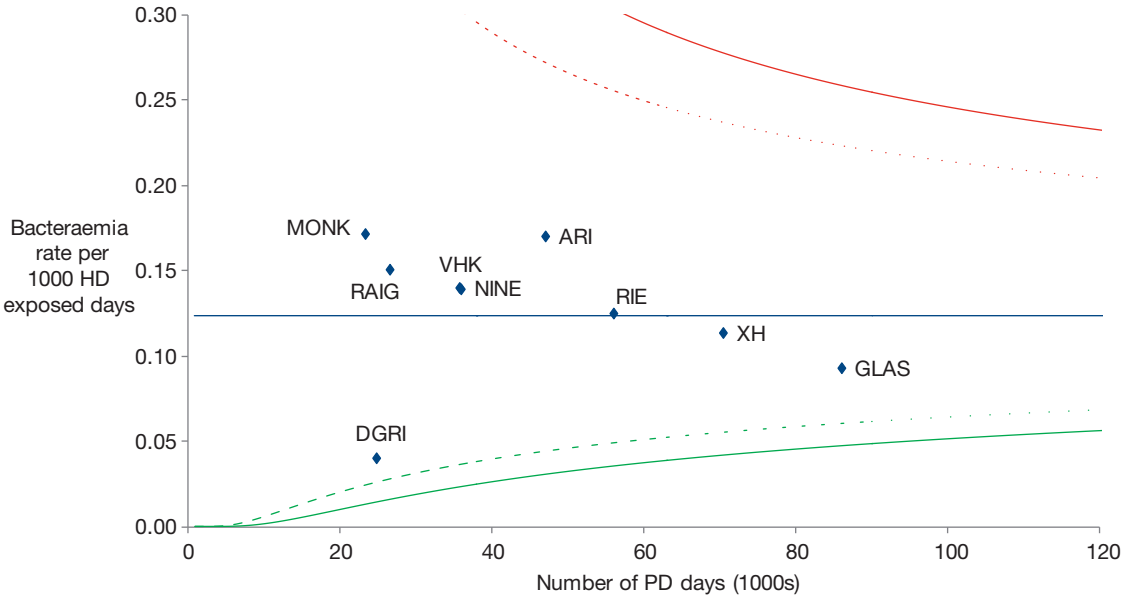
S. epidermidis, a member of the coagulase negative *Staphylococcus* group, are commonly found on the skin and may be identified in blood cultures incidentally due to a breakdown in technique during collection of blood cultures. *S. epidermidis* bacteraemia rates should be interpreted with some caution as clinical investigation, not undertaken whilst using a data linkage approach to measurement of bacteraemia outcome, is required to assess whether the bacteraemia are significant or due to contaminated blood cultures.

I1.2 Haemodialysis patient bacteraemia* rate per 1000 HD treatment days by adult renal unit 2012-2016



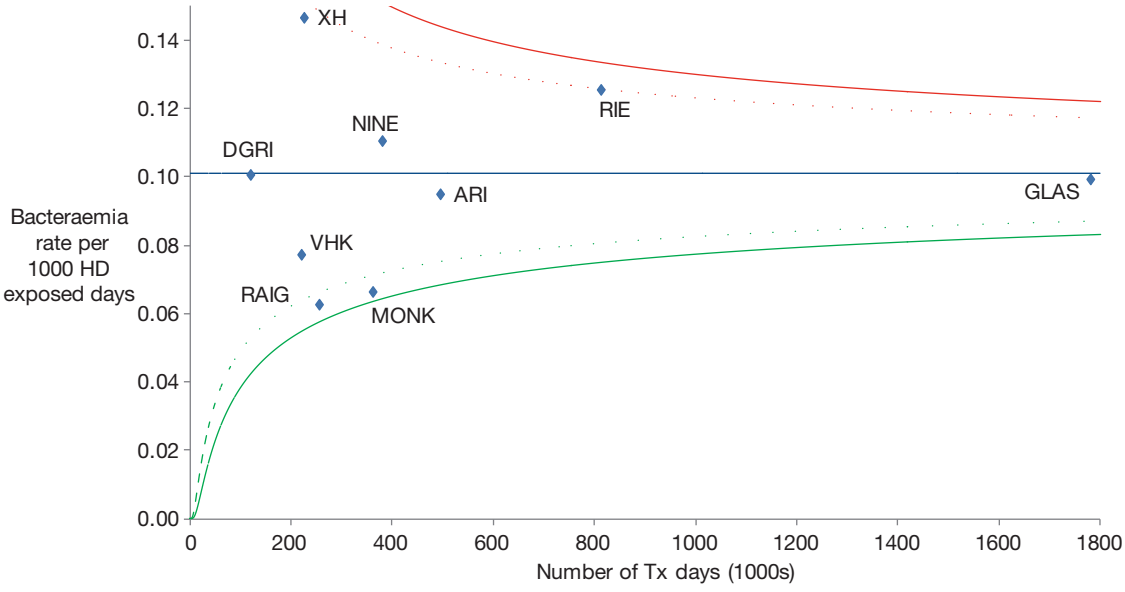
* Includes *S. aureus*, *S. epidermidis*, *Streptococcus* sp. and Gram negative group as previously defined.

I1.3 Peritoneal dialysis patient bacteraemia* rate per 1000 PD treatment days by adult renal unit 2012-2016



*Includes *S. aureus*, *S. epidermidis*, *Streptococcus* sp. and Gram negative group as previously defined.

I1.4 Transplanted patient bacteraemia* rate per 1000 Tx treatment days by adult renal unit 2012-2016



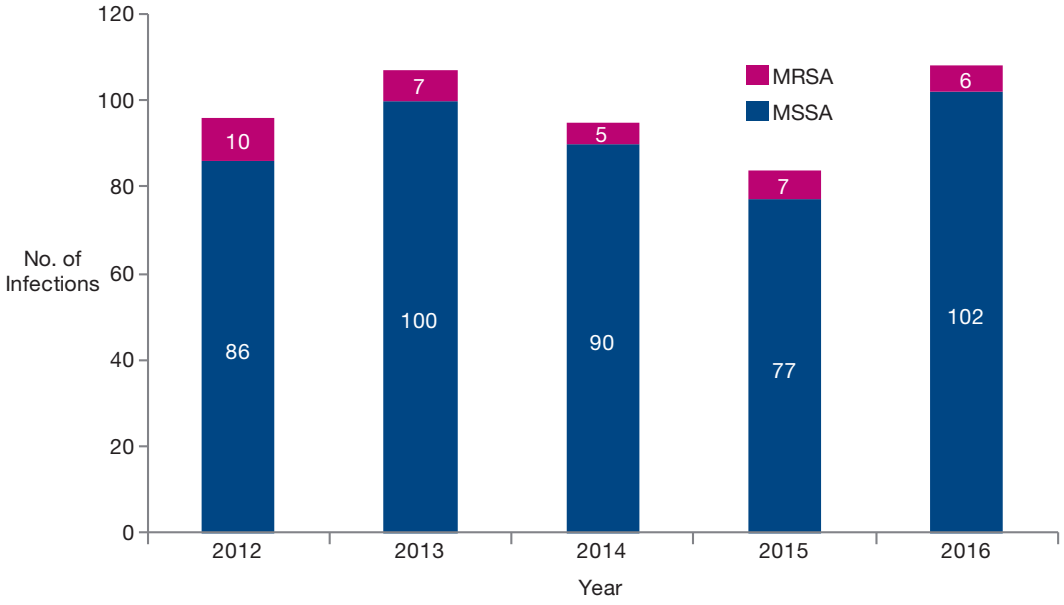
*Includes *S. aureus*, *S. epidermidis*, *Streptococcus* sp. and Gram negative group as previously defined.

Graphs I1.2, I1.3 and I1.4 show the bacteraemia rate occurring in patients treated by each mode of RRT. The number of treatment days for each modality is the total number of days provided at each adult unit for all patients in the time period 2012-2016.

Across Scotland as a whole during 2012-2016 one bacteraemia epsiode occured in every 2307 days of delivered haemodialysis; every 8110 days of delivered peritoneal dialysis and 9880 days in patients with a kidney transplant.

I2 Staphylococcus aureus bacteraemia reported in patients treated by RRT 2012-2016

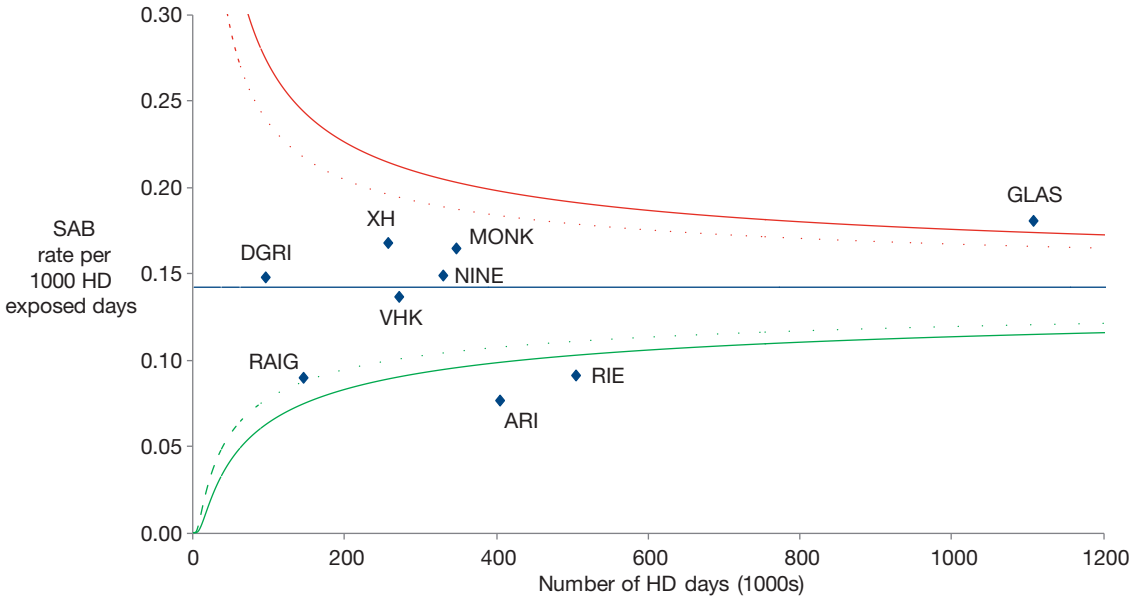
I2.1 Incidence of MRSA and MSSA bacteraemia reported in RRT patients in Scotland 2012-2016



I2.2 *Staphylococcus aureus* bacteraemia rate for haemodialysis patients by adult renal unit 2012-2016

Unit	Rate per 1000 HD Days 2012-2016	95% CI
ARI	0.08	(0.05, 0.11)
XH	0.17	(0.12, 0.23)
DGRI	0.15	(0.08, 0.25)
GLAS	0.18	(0.16, 0.21)
MONK	0.16	(0.12, 0.21)
NINE	0.15	(0.11, 0.2)
RAIG	0.09	(0.05, 0.15)
RIE	0.09	(0.07, 0.12)
VHK	0.14	(0.1, 0.19)
SCOTLAND	0.14	(0.13, 0.16)

I2.3 *Staphylococcus aureus* bacteraemia (SAB) rate for haemodialysis patients by adult renal unit 2012-2016



SECTION J ADEQUACY OF HAEMODIALYSIS

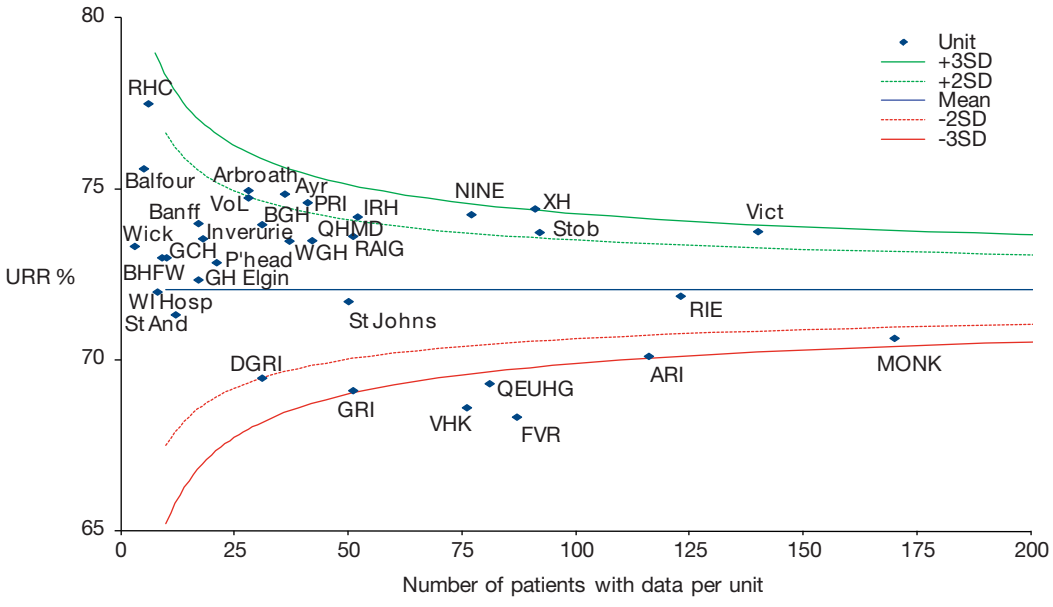
The quality of haemodialysis treatment for ERF can be assessed by measuring the urea reduction ratio (URR). The UKRA guideline for adult patients on three times per week HD is to achieve a URR consistently >65%.

The URR audit was performed in May 2017; all patients in Scotland receiving hospital or home haemodialysis on 01 May 2017 were included in the audit. There were 1821 results from 1954 patients (93.2%).

Although most patients continue to receive haemodialysis three times per week, it is clear that a large proportion of home and a small proportion of hospital haemodialysis patients are receiving more frequent sessions.

Of the 1834 patients with information on dialysis frequency, 1758 continue to have three times per week and 55 patients received a greater frequency (35 hospital HD (1.8% of total on hospital HD) and 20 home HD (35.7% of total on home HD)). 20 patients were receiving twice weekly dialysis and 1 patient was recorded as receiving once per week dialysis. For those patients not dialysing three times per week, URR may not reflect adequately the quality of dialysis and for these patients standardised Kt/V is preferable. We therefore have limited URR comparison to those receiving three times weekly HD in Figures J1 and J2 and used data from the census to calculate standardised Kt/V for all those with sufficient data.

J1 Mean achieved URR in Hospital HD patients on thrice weekly treatment in May 2017 by dialysis unit



All units lie within 3 standard deviations of the population mean (72.6%) with the exception of XH which achieved higher than 3SD above the mean and VHK, QEUHG and FVR which fall more than 3SD below the mean.

1738 patients (88.9%) had adequate data to calculate standardised Kt/V (URR, dialysis frequency, dialysis treatment time and access used). More information about this method of calculating Kt/V is available on the SRR website.

1423 patients had sufficient data on dialysis modality from the May census to quantify use of haemodiafiltration (HDF) versus standard haemodialysis (HD). Across Scotland 789 (55.4%) were confirmed as receiving HDF whereas 634 (44.6%) were confirmed as receiving HD.

Since 2007 the median URR achieved during each annual census by all units in Scotland has been very steady fluctuating between 73% and 74%.

http://www.srr.scot.nhs.uk/Projects/Projects1.html#adequ

J2 Number of haemodialysis patients, median URR, median stdKt/V and achievement of audit standard by parent renal unit May 2017

	ARI	XH	DGRI	GLAS	MONK	NINE	RAIG	RHC*	RIE	VHK	Scotland
Number of patients on HD	240	144	54	609	187	181	89	10	299	141	**1954**
Number of patients with missing data	10	12	7	25	4	24	3	2	39	7	**133**
% patients with URR >65%**	**82**	**88**	**76**	**81**	**82**	**92**	**88**	**100**	**90**	**75**	**84**
Upper quartile**	76	80	77	77	75	80	76	82	76	75	**77**
Median URR**	72	75	71	73	71	76	75	79	73	72	**73**
Lower quartile**	68	69	66	68	67	71	71	74	69	66	**68**
% patients with data for stdKt/V***	**94**	**88**	**85**	**90**	**94**	**83**	**91**	**80**	**83**	**90**	**89**
Median stdKt/V***	2.14	2.22	2.12	2.12	2.07	2.22	2.18	2.21	2.12	2.08	**2.14**
Number of patients with sufficient HDF data	**39**	**120**	**44**	**574**	**186**	**158**	**68**	**8**	**109**	**117**	**1423**
HDF - YES	37	120	42	54	86	158	68	3	107	114	**789**
HDF - NO	2	0	2	520	100	0	0	5	1	3	**634**

* Data for RHC. The standards set for adult patients are not applicable to children; data are given for reference purposes only.
** Analysis limited to those with sufficient data and confirmed as receiving thrice-weekly haemodialysis (n = 1689).
*** Standardised Kt/V calculation only possible for patients with URR, dialysis frequency, dialysis treatment time and access used (n = 1738).

SECTION K ANAEMIA

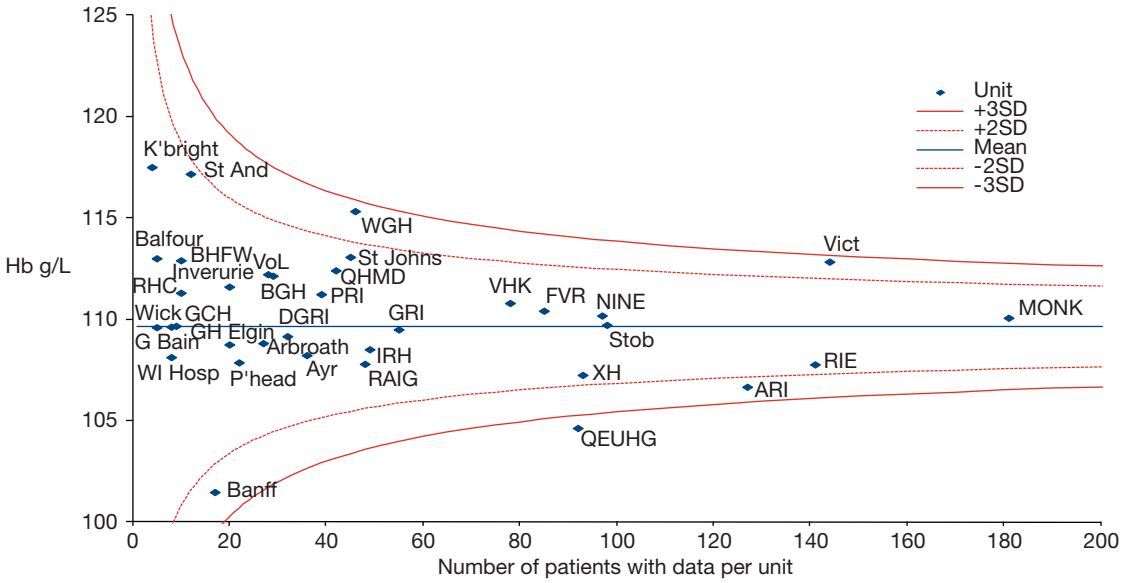
The anaemia audit was performed in May 2017; all patients in Scotland receiving hospital or home haemodialysis on 01 May 2017 were included in the audit. Results were excluded for patients who had received a recent blood transfusion. There were 1904 results from 1954 patients (97.4%).

Haemoglobin concentration (Hb) was measured in a pre-dialysis blood sample after the first short interdialytic gap of the audit week, or as soon as possible thereafter. Auditing after the short (2 day) gap is done in order to minimise the potential effect of dilution due to fluid overload.

The UK Renal Association (UKRA) guideline from November 2010 and updated in 2017 recommends a target Hb of 100 120g/L for patients with chronic kidney disease, but only for those patients receiving Erythropoiesis Stimulating Agents (ESA) therapy.

We have reported the mean achieved Hb value by satellite dialysis unit where data are available and also the percentage of patients, by parent unit, achieving the UKRA standard.

K1 Mean Hb of Hospital HD patients in each dialysis unit May 2017



Patients with Hb >120g/L and confirmed as not receiving ESA therapy (97 patients) are excluded from the funnel plot. All units lie within 3 standard deviations of the population mean (109.6g/L) with the exception of QEUHG which falls more than 3SD below the mean.

K2 Number of HD patients, median Hb and achievement of audit standards by renal unit May 2017											
	ARI	XH	DGRI	GLAS	MONK	NINE	RAIG	RHC*	RIE	VHK	Scot-land
Number of patients	240	144	54	609	187	181	89	10	299	141	1954
Missing data or transfused	7	2	2	12	2	6	3	0	9	7	50
% patients with Hb data	97	99	96	98	99	97	97	100	97	95	97
Median Hb all patients**	108	110	113	111	112	113	111	110	114	113	111
% patients with Hb 100-120 g/L***	59.2	51.2	71.4	48.8	61.9	69.8	75.8	50.0	50.5	59.3	56.1
% patients with Hb >120 g/L***	16.4	20.2	14.3	26.8	21.6	17.1	10.6	30.0	28.0	25.4	22.7
Upper quartile***	116	119	118	121	118	119	116	121	121	121	120
Median Hb g/L***	107	110	110	110	111	112	109	110	113	113	111
Lower quartile***	100	98	105	100	102	105	103	103	102	105	101
Range g/L***	65 - 141	74 - 136	78 - 138	64 - 158	66 - 147	72 - 142	82 - 137	65 - 156	46 - 151	83 – 140	46 - 158

* The standards set for adults are not applicable to children.
** All patients with results except those with recent blood transfusion (n=1904)
*** UKRA standard. Hb 100-120 g/L on ESA therapy. Patients were excluded if there were no data, they had recently received a blood transfusion or were not receiving ESA therapy on the census date (n=1619).

Of the 1904 patients with Hb values, 1511 (79.4%) had Hb ≥100g/L.

230 patients were confirmed as not receiving ESA therapy and had not recently received a blood transfusion. Of the 222 with data, 24 (10.8%) had Hb <100g/L, 101 (45.5%) had Hb 100 - 120g/L and 97 (43.7%) had Hb >120g/L.

Data on ESA treatment (including patients confirmed as not receiving ESA) were available for 1882 (96.3%) patients. Using this information we were able to calculate the proportion of patients achieving the UKRA standard (Hb 100-120g/L) receiving ESA therapy on the census date. Of the 1619 patients confirmed as receiving ESA treatment and who had data and had not recently been transfused, 909 (56.1%) achieved the UKRA standard. Hb was <100g/L in 343 (21.2%) of patients, Hb was >120g/L in 367 (22.7%) and 190 (11.7%) had Hb >125g/L.

There is variation in practice across Scotland for ESA prescription when patients are diagnosed with malignancy; some units stop therapy whereas other take a more individualised approach. We have not taken this into account in our analyses.

SECTION L BONE MINERAL METABOLISM

The laboratory data relating to bone mineral metabolism were audited in May 2017 for all prevalent patients receiving hospital or home haemodialysis. Pre-dialysis blood samples were collected after a short interdialytic gap. Any samples marked 'post-haemodialysis' were excluded.

As recommended by the Working Group of Senior Scottish Clinical Biochemists on bone biochemistry targets in the management of renal failure, the PTH data in this report are presented according to the recommended assay specific targets appropriate to each renal unit.

The working group's recommendations which have been adopted across Scotland are available on the SRR website:

http://www.srr.scot.nhs.uk/Projects/Projects1.html#calc

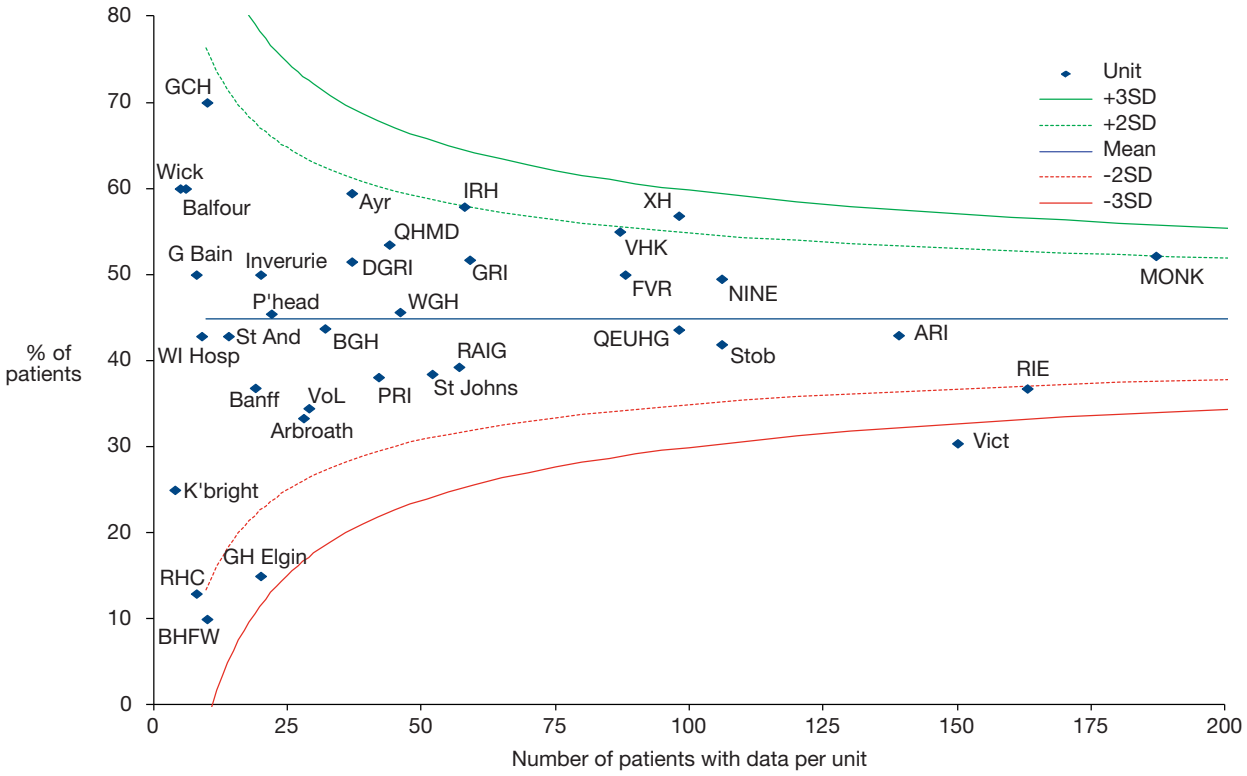
L1 Achievement of guideline targets for phosphate (PO4), corrected calcium (cCa) and PTH in haemodialysis patients by renal unit May 2017

Renal Unit	Number of patients	% with PO4 result	Mean PO4 mmol/L	% with result 1.1-1.7 mmol/L	% with cCa result	% with cCa in normal range	% with PTH result	% PTH result 2-9x UL* normal
ARI	240	98.3	1.68	42.4	98.3	80.1	82.5	48.0
XH	144	97.9	1.38	55.3	98.6	83.1	97.9	51.8
DGRI	54	92.6	1.62	54.0	98.1	86.8	94.4	62.7
GLAS	609	97.4	1.77	42.3	97.7	89.6	92.3	50.7
MONK	187	98.4	1.38	52.2	99.5	76.9	97.9	55.7
NINE	181	96.7	1.72	44.0	97.8	81.9	80.7	51.4
RAIG	89	95.5	1.82	37.6	95.5	83.5	91.0	45.7
RHC	10	100.0	1.26	30.0	100.0	90.0	100.0	20.0
RIE	299	96.7	1.78	39.4	96.7	85.5	93.3	55.9
VHK	141	97.1	1.65	54.5	95.7	91.1	90.8	65.0
Scotland	**1954**	**97.1**	**1.68**	**44.9**	**97.6**	**85.1**	**90.8**	**52.8**

* UL - upper limit of normal

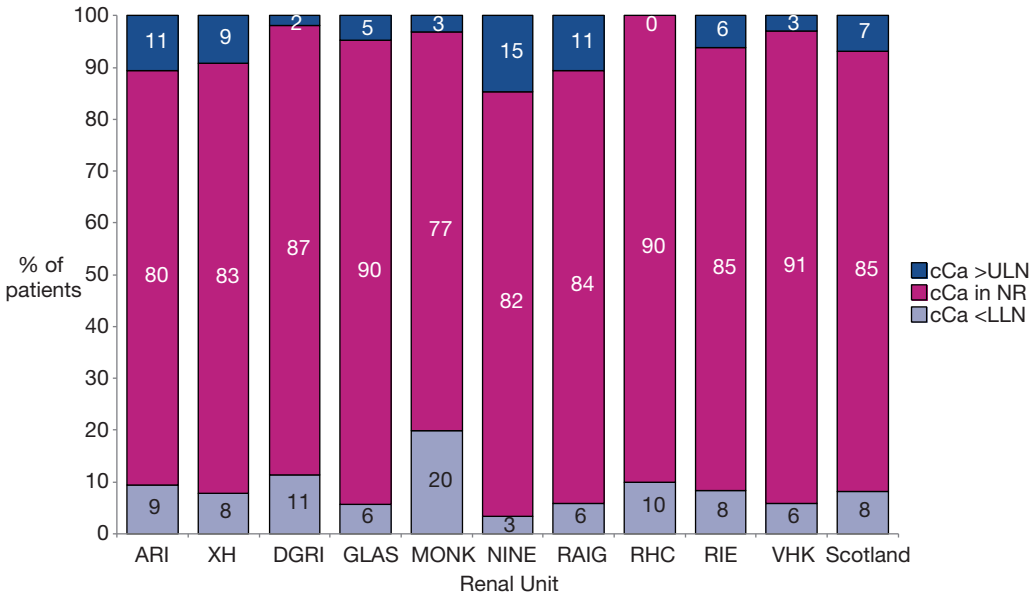
Analytical methods for phosphate are standard across Scotland and results are comparable both between units, and against the UKRA recommended guideline (Pre-dialysis PO4 between 1.1 and 1.7 mmol/L).

L2 Percentage of hospital HD patients achieving pre-dialysis PO4 target of 1.1-1.7 mmol/L by dialysis unit May 2017



1897 (97.1%) patients had phosphate results. 223 (11.8%) had a phosphate <1.1 mmol/L, 851 (44.9%) achieved the UKRA standard and 823 (43.4%) had phosphate >1.7 mmol/L.

L3 Distribution of pre-dialysis corrected serum calcium in haemodialysis patients by renal unit May 2017



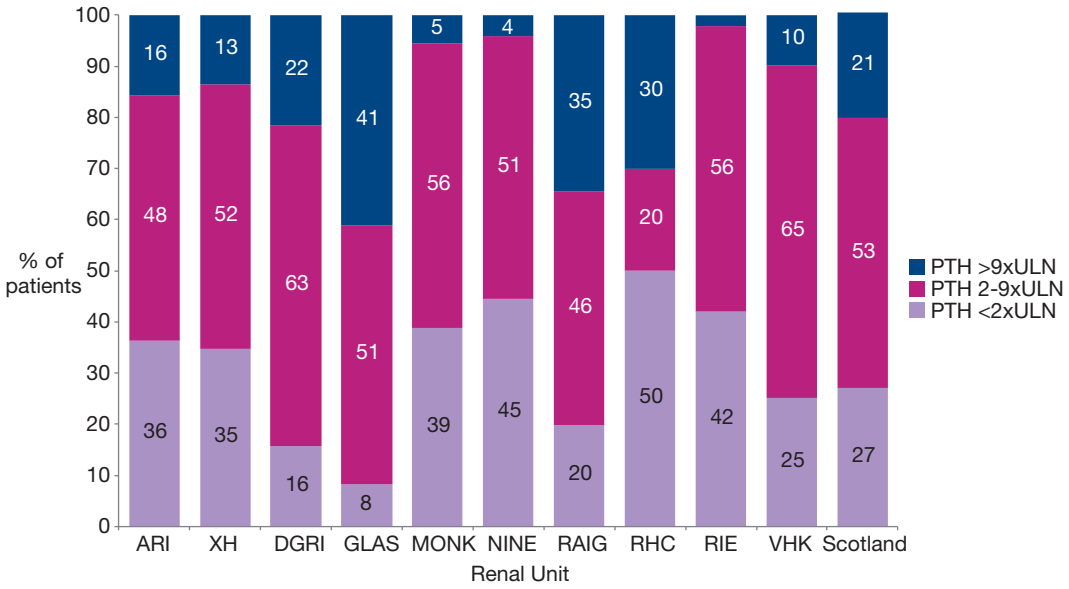
The graph shows the percentage of patients within each unit, who were hypocalcaemic (cCa< lower limit of normal range (LLN)), normocalcaemic (cCa in normal range (NR)) and hypercalcaemic (cCa>upper limit of normal range (ULN)) according to the local assay ranges for the biochemistry laboratory serving each dialysis unit.

The UKRA guideline suggests that corrected calcium should be maintained within the local normal range, the normal range differs between renal units, therefore actual calcium values are not shown.

The local ranges for corrected calcium for the biochemistry laboratories that serve each dialysis unit are available on the SRR website:

http://www.srr.scot.nhs.uk/Projects/Projects1.html#calc

L4 Distribution of pre-dialysis serum PTH in haemodialysis patients by renal unit May 2017



The UKRA guideline suggests that PTH levels should be maintained between 2 and 9 times the upper limit of normal (ULN) for the assay used.

Assay specific PTH ranges are available on the SRR website:

http://www.srr.scot.nhs.uk/Projects/Projects1.html#calc

SECTION M SCOTTISH RENAL BIOPSY REGISTRY: SURVEY OF TRANSPLANT KIDNEY BIOPSY IN SCOTLAND 2016

All renal units in Scotland were able to provide date of procedure, date of birth, sex, and main diagnosis for all transplant renal biopsies performed in the calendar year 2016. Biopsy diagnosis was selected from a bespoke codeset agreed by the SRR Biopsy Steering Group (see M3 below). Renal units also provided indication for biopsy, selected from pre-defined terms. Biopsies at the time of transplant ('implantation biopsies', 'time zero biopsies') were not included.

The total number of reported transplant biopsies was 319 in 229 patients giving an incidence of 59.0 transplant biopsies per million population (pmp) per year, down from 70.6 pmp in 2015.

This amounts to 0.12 biopsies per prevalent transplant recipient using the Scottish Renal Registry reported prevalent transplant patient data from 31 December 2015.

Total number of biopsies and total number of patients having transplant renal biopsy in each centre were expressed pmp and per prevalent transplant patient and for each centre based on the populations shown in M1.

M1 Number of transplant biopsies in each renal unit 2016								
Renal unit	NHS Board	Population 2016	Prevalent transplant patients 31/12/2015	Total transplant biopsies 2016	Total number patients having biopsy	Transplant biopsies pmp/year	Patients having transplant biopsies pmp/year	Transplant biopsies per prevalent transplant patient/yr
ARI	GRAM + SHET + ORKN	633150	299	38	27	60.0	42.6	0.13
XH	A&A	370560	195	4	4	10.8	10.8	0.02
DGRI	D&G	149520	71	0	0	0.0	0.0	0.00
GLAS	GG&C + FV	1465850	842	134	108	91.4	73.7	0.16
MONK	LAN	654490	370	0	0	0.0	0.0	0.00
NINE	TAY	415470	198	11	9	26.5	21.7	0.06
RAIG	HIGH + WI	348800	194	15	13	43.0	37.3	0.08
RIE	LOTH + BORD	994530	432	102	66	102.6	66.4	0.24
VHK	FIFE	370330	170	15	12	40.5	32.4	0.09
East		2762280	1293	181	117[a]	65.5	42.4	0.14
West		2640420	1478	138	112[a]	52.3	42.4	0.09
Scotland		**5402700**	**2771**	**319**	**229[a]**	**59.0**	**42.4**	**0.12**

a. 10 patients had a transplant biopsy in 2 different centres during 2016.

Some centres perform no transplant biopsies or only a proportion of the transplant biopsies for patients from their NHS Board area with the others being performed at the relevant transplant centre. For this reason, all analyses include a comparison of the NHS Board areas served by the Glasgow (West) transplant unit (A&A, D&G, GG&C, FV, LAN) and Edinburgh (East) transplant unit (GRAM, SHET, ORKN, TAY, HIGH, WI, LOTH, BORD, FIFE).

M2 Indication for transplant biopsy 2016

	ARI	XH	DGRI	GLAS	MONK	NINE	RAIG	RIE	VHK	East	West	Scotland
Surveillance during delayed graft function	1	0	0	14	0	0	0	23	0	24	14	38
Achieved transplant function lower than expected	8	0	0	10	0	4	1	0	1	14	10	24
AKI	8	0	0	43	0	2	4	53	5	72	43	115
Assessment of response to treatment of rejection	7	0	0	0	0	0	2	6	0	15	0	15
Assessment of response to BK virus treatment	0	0	0	0	0	0	0	0	1	1	0	1
Protocol (surveillance) biopsy	2	0	0	0	0	0	0	7	0	9	0	9
Chronically deteriorating transplant function and proteinuria	2	2	0	15	0	0	4	1	3	10	17	27
Chronically deteriorating transplant function only	9	2	0	45	0	1	4	7	5	26	47	73
Preserved transplant function and proteinuria	0	0	0	0	0	0	0	0	0	0	0	0
Nephrotic Syndrome	1	0	0	3	0	4	0	0	0	5	3	8
Other	0	0	0	4	0	0	0	5	0	5	4	9

There were no biopsies without a recorded indication.

M3 Histopathological diagnosis made from transplant biopsy 2016

	ARI	XH	DGRI	GLAS	MONK	NINE	RAIG	RIE	VHK	East	West	Scotland
Acute tubulodegenerative change (ATN)	1	0	0	20	0	0	0	32	0	33	20	53
Rejection: ACR (1A)	3	0	0	13	0	0	0	0	2	5	13	18
Rejection: ACR (1B)	1	0	0	4	0	0	0	1	0	2	4	6
Rejection: ACR (2A, 2B, 3)	1	0	0	17	0	1	0	3	0	5	17	22
Rejection: ACR (NOS)	0	0	0	0	0	0	0	10	0	10	0	10
Rejection: acute / active ABMR	0	0	0	0	0	0	0	1	0	1	0	1
Rejection: borderline	1	1	0	7	0	0	0	4	2	7	8	15
Rejection: chronic ABMR	0	1	0	4	0	0	2	2	1	5	5	10
Rejection: chronic allograft arteriopathy	0	0	0	0	0	0	0	0	1	1	0	1
Rejection: chronic, active ABMR	0	1	0	7	0	0	0	2	0	2	8	10
Rejection: mixed ABMR & ACR	0	0	0	0	0	0	0	1	0	1	0	1
Rejection - other	0	0	0	0	0	0	0	0	0	0	0	0
BKVAN	3	0	0	9	0	0	0	3	2	8	9	17
Recurrent disease	2	0	0	7	0	4	0	1	0	7	7	14
CNI toxicity	6	1	0	2	0	0	3	3	0	12	3	15
IFTA	7	0	0	4	0	2	1	13	1	24	4	28
iIFTA	0	0	0	4	0	0	0	0	0	0	4	4
Donor disease	1	0	0	0	0	3	1	6	0	11	0	11
Infection (other than BKVAN)	0	0	0	0	0	0	0	3	0	3	0	3
No significant histopathological abnormality	8	0	0	6	0	0	1	14	6	29	6	35
Insufficient Tissue for Diagnosis	0	0	0	6	0	1	0	1	0	2	6	8
Other	4	0	0	24	0	0	7	1	0	12	24	36
Not stated	0	0	0	0	0	0	0	1	0	1	0	1

ACR = acute cellular rejection, 1A, 1B, 2A, 2B, 3 refer to Banff classification
ABMR = antibody mediated rejection
BKVAN = BK virus associated nephropathy
CNI = calcineurin inhibitor
IFTA = interstitial fibrosis and tubular atrophy
iIFTA = inflammatory interstitial fibrosis and tubular atrophy

Nephrologists were asked to select the diagnosis that was the main explanation for the clinico-pathological features.

M4 Clinician who performed the transplant biopsies in each renal unit 2016					
Renal unit	**Radiologist**	**Consultant nephrologist**	**Nephrology trainee**	**Transplant surgeon**	**Not stated**
ARI	0	21	17	0	0
XH	3	1	0	0	0
DGRI	0	0	0	0	0
GLAS	0	8	121	2	3
MONK	0	0	0	0	0
NINE	0	9	2	0	0
RAIG	12	3	0	0	0
RIE	99	0	0	0	3
VHK	0	15	0	0	0
Total	**114**	**57**	**140**	**2**	**6**

M5 Major complications	
Complication	**n**
Arteriography and embolisation	0
Arteriography no embolisation	0
Blood transfusion only	1
Clot obstruction managed conservatively	0
Clot obstruction requiring intervention	0
Death	0
Nephrectomy	0
Other please specify	0
Surgery no nephrectomy	1
Total	**2**

There were 2 major complications (0.6%) with no loss of transplant kidney or death.

This is the second consecutive analysis of all transplant kidney biopsies in Scotland in a calendar year.

Analysing the data by region (East v West) demonstrates a higher incidence of transplant biopsies in the East region (65.5 v 52.3 pmp) despite a higher incidence of kidney transplantation in the West region. The difference is not as great as in 2015 (92.1 v 45.5 pmp). Interestingly the difference is accounted for by repeat biopsies in the same patients since the incidence of patients having at least one transplant biopsy in the two regions is exactly the same (42.4 pmp).

SECTION N SCOTTISH RENAL BIOPSY REGISTRY: SURVEY OF NATIVE RENAL BIOPSY IN SCOTLAND 2016

All centres in Scotland were able to provide date of birth, sex, indication for biopsy, major complications and main diagnosis for all native renal biopsies performed in the calendar year 2016.

Diagnosis was selected from the 2012 ERA/EDTA primary renal diagnosis codes (http://www.era-edta-reg.org/prd.jsp) with the addition of 'Complement 3 glomerulopathy', 'Kidney biopsy result normal' and 'Insufficient histological evidence from kidney biopsy for diagnosis'. Indication for biopsy, operator and major complications were selected from pre-defined codesets.

The total number of reported biopsies was 752 in 728 patients giving an incidence of 139.2 native kidney biopsies per million population (pmp) per year which is higher than the incidence of 130.1 pmp in 2015 and 127.1 pmp in 2014. This was the first year that centres were asked to indicate if this was the first biopsy ever with this diagnosis to take account of patients having repeat biopsies to monitor disease.

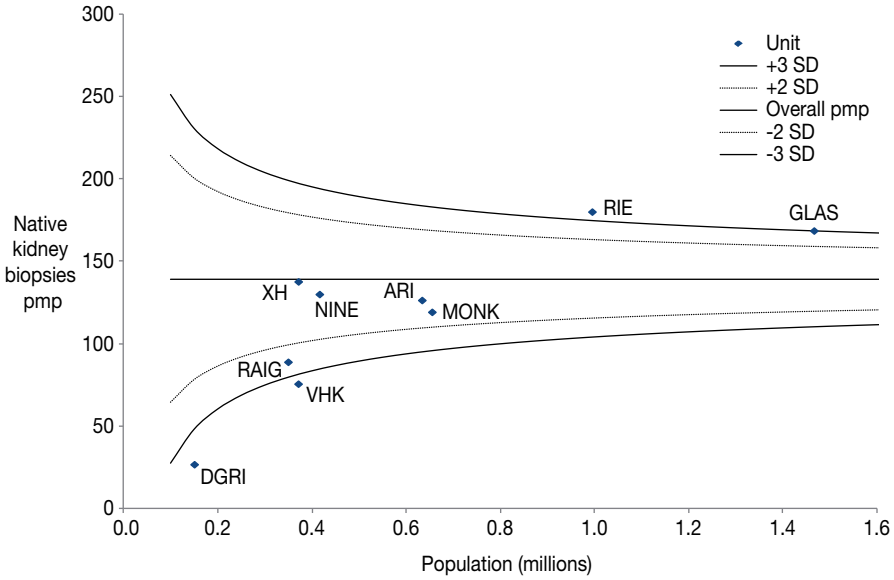
Total number of biopsies and total number of patients having native renal biopsy were expressed pmp for each centre based on the populations shown in N1.

N1 Number of native kidney biopsies 2016 by renal unit and NHS Board

Renal Unit	NHS board	Population 2016	Total native biopsies	Second or subsequent biopsies	Number patients having biopsy	No. of pts having 1st renal biopsy	Native biopsies pmp/yr	Patients having first renal biopsy pmp/yr	Mean age at biopsy (yrs)	% Male
ARI	GRAM + SHET + ORKN	633150	80	5	75	69	126.4	109.0	59.1	57.5
XH	A&A	370560	51	0	51	51	137.6	137.6	59.0	43.1
DGRI	D&G	149520	4	0	4	3	26.8	20.1	60.4	100.0
GLAS	GG&C + FV	1465850	247	5	242	230	168.5	156.9	58.2	52.2
MONK	LAN	654490	78	1	77	72	119.2	110.0	55.1	55.1
NINE	TAY	415470	54	3	51	50	130.0	120.3	61.9	74.1
RAIG	HIGH + WI	348800	31	0	31	31	88.9	88.9	59.4	71.0
RIE	LOTH + BORD	994530	179	9	170	153	180.0	153.8	55.6	52.2
VHK	FIFE	370330	28	1	27	27	75.6	72.9	66.8	53.6
Scotland		**5402700**	**752**	**24**	**728**	**686**	**139.2**	**127.0**	**58.2**	**55.2**

The number of patients experiencing a renal biopsy in 2016 pmp for each centre was compared in a funnel plot (N2).

N2 Incidence per million population of native kidney biopsies in 2016 by renal unit

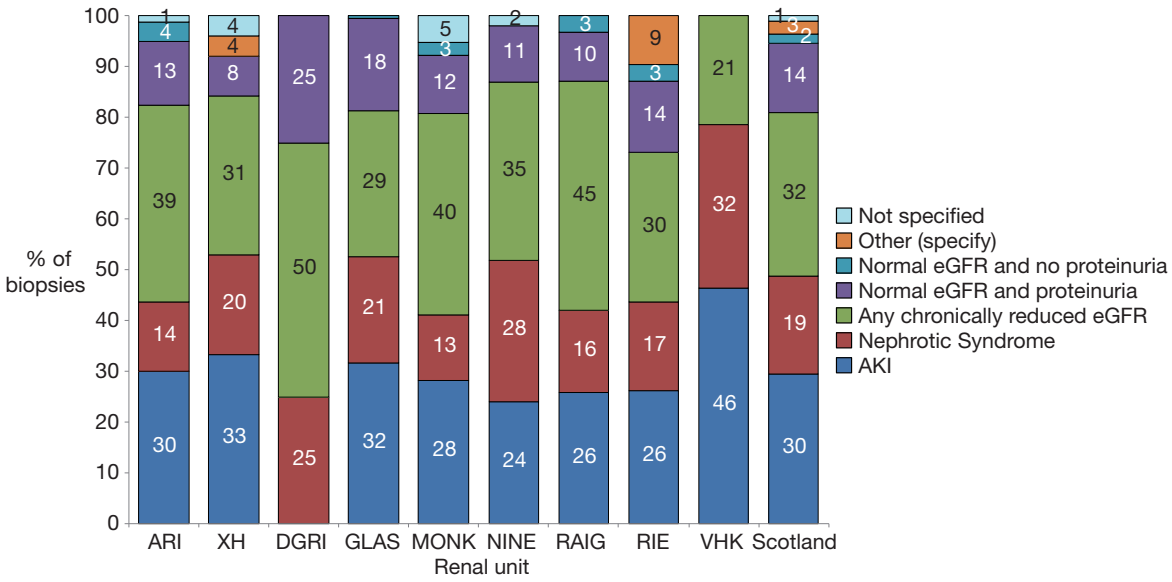


The incidence of native kidney biopsies per million population in 2016 was higher in units serving larger populations.

Indication for biopsy

Indication for native renal biopsy using pre-defined indication terms was expressed per million population and shown in N3.

N3 Indication for native kidney biopsy in 2016 by renal unit



Diagnosis

Nephrologists were asked to select the diagnosis that was the main explanation for the clinico-pathological features. A diagnosis was recorded in all cases.

In 8 cases the diagnosis was recorded as insufficient tissue for diagnosis (most of which had a further biopsy procedure).

For 12 biopsies the diagnosis was recorded as 'Chronic kidney disease (CKD) / chronic renal failure (CRF) - aetiology uncertain / unknown - histologically proven'.

9 biopsies were reported as 'Kidney biopsy result normal'.

Of the remainder a total of 53 different ERA/EDTA Primary Renal Diagnosis terms were recorded as the primary explanation for the clinical indication for native renal biopsy. In a further 6 cases the nephrologists felt that none of the ERA/EDTA terms were sufficient (recorded as 'other'). The diagnoses for all biopsies including patients having a second or subsequent biopsy are presented. The top 20 reported diagnoses are shown in table 2 in order of frequency along with the frequency in 2014 and 2015 the SRR annual reports for those years.

All recorded diagnoses and frequencies in renal unit can be viewed on the Scottish Renal Registry website:

http://www.srr.scot.nhs.uk/Biopsy-Registry/Main.html

N4 Most frequently recorded native kidney biopsy diagnoses recorded in 2016 by renal unit and compared with incidence 2014 and 2015

Centre	ARI	XH	DGRI	Glas	Monk	Nine	Raig	RIE	VHK	Scotland 2016	Scotland 2014	Scotland 2015
IgA nephropathy - histologically proven	5	5	2	39	13	10	6	23	1	104	101	101
Tubulointerstitial nephritis - histologically proven[a]	8	1	0	21	9	8	2	12	4	65	62	61
Microscopic polyangiitis - histologically proven	5	6	0	19	2	2	2	16	3	55	42	34
Membranous nephropathy - idiopathic	6	4	0	15	2	4	1	8	2	42	42	73
Primary focal segmental glomerulosclerosis (FSGS)	3	6	0	13	5	6	0	5	3	41	44	31
Minimal change nephropathy - histologically proven	1	4	0	14	2	1	1	6	2	31	35	28
Acute kidney injury	1	0	0	11	2	1	0	9	2	26	18	14
Granulomatosis with polyangiitis - histologically proven	2	3	0	13	0	4	0	1	0	23	34	33
Diabetic nephropathy in type II diabetes - histologically proven	4	1	0	9	4	0	1	4	0	23	30[b]	42[b]
Systemic lupus erythematosus / nephritis - histologically proven	0	0	0	13	1	1	3	4	0	22	28	39
Ischaemic nephropathy / microvascular disease - histologically proven	1	4	0	7	2	0	2	1	1	18	13	10
AL amyloid secondary to plasma cell dyscrasia	3	1	1	4	1	4	2	0	1	17	7	12
Henoch-Schönlein purpura / nephritis - histologically proven	3	0	0	5	3	0	1	3	0	15	0	10
Mesangial proliferative glomerulonephritis	0	1	0	5	1	0	0	8	0	15	9	6

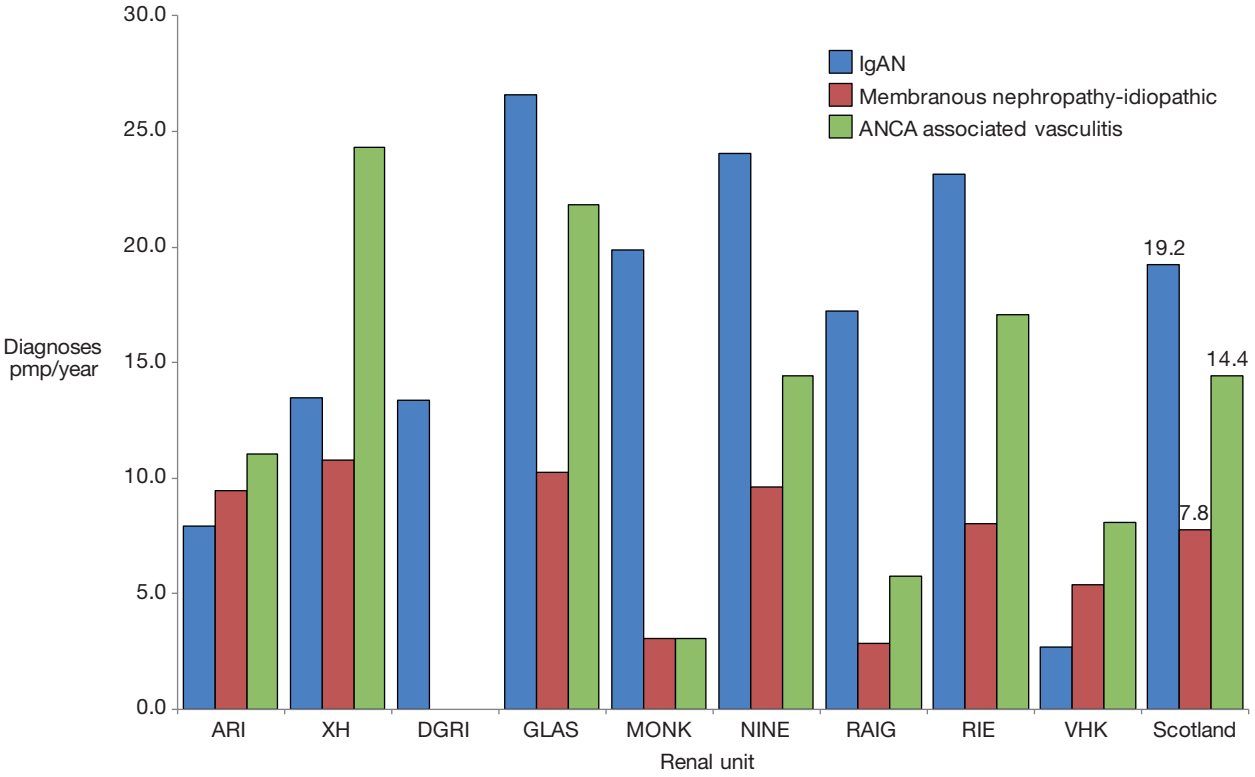
N4 Most frequently recorded native kidney biopsy diagnoses recorded in 2016 by renal unit and compared with incidence 2014 and 2015

Centre	ARI	XH	DGRI	Glas	Monk	Nine	Raig	RIE	VHK	Scotland 2016	Scotland 2014	Scotland 2015
Chronic hypertensive nephropathy - histologically proven	3	2	0	5	1	0	1	2	0	14	8	11
Chronic kidney disease (CKD) / chronic renal failure (CRF) - aetiology uncertain / unknown - histologically proven	1	0	0	4	0	0	2	5	0	12	16	12
Glomerulonephritis - histologically indeterminate	1	0	0	4	4	0	0	2	0	11	16	7
Diabetic nephropathy in type I diabetes - histologically proven	3	2	0	0	3	0	0	0	1	9	[b]	[b]
Kidney biopsy result normal	0	0	0	1	1	2	0	5	0	9		8
Thin basement membrane disease	1	0	0	3	2	0	0	2	0	8		5

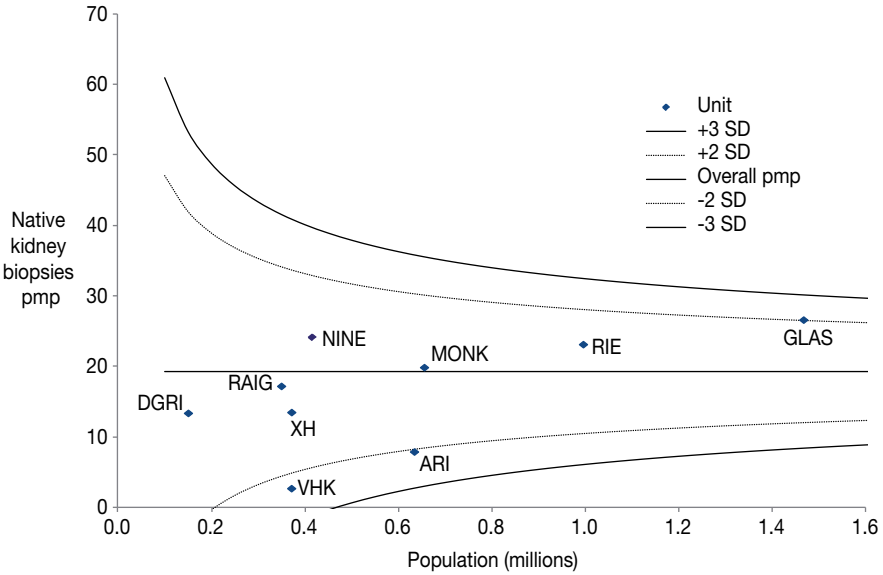
a. Not including tubulo-interstitial nephritis where a specific cause stated.
b. In previous years cases of type 1 and type 2 diabetic nephropathy were included together.

The incidences of IgA nephropathy, idiopathic membranous nephropathy and ANCA associated vasculitis (a combination of granulomatosis with polyangiitis, microscopic polyangiitis and Churg Strauss syndrome) were expressed pmp and compared between centres in N5. Funnel plots of the incidence of IgAN and ANCA associated vasculitis are shown in N6 and N7 respectively.

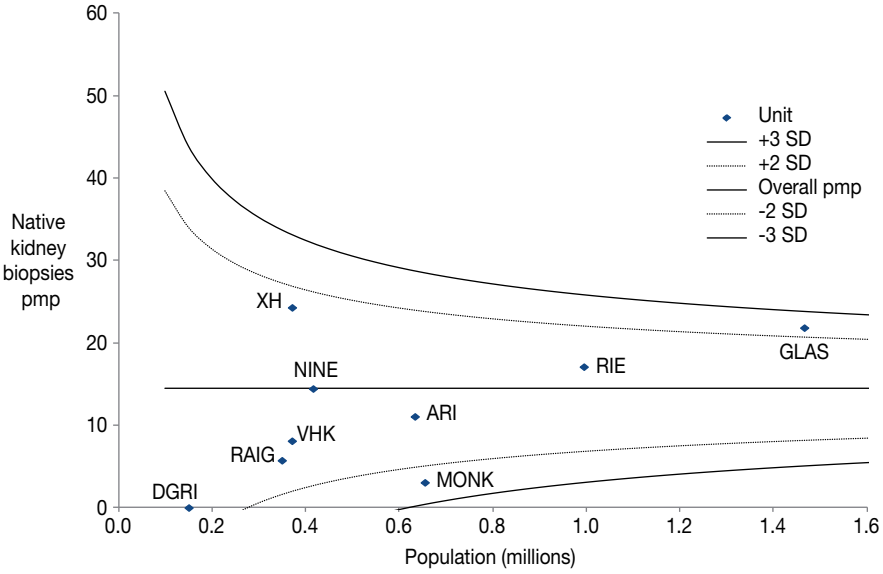
N5 Incidences per million population of selected biopsy diagnoses 2016



N6 Incidence per million population of biopsy diagnosis of IgA nephropathy by renal unit 2016



N7 Incidence per million population of biopsy diagnosis of ANCA associated vascilitides (AAV) by renal unit 2016



N8 Major complications of native kidney biopsies in 2016

Complication	n
Arteriography and embolisation	8
Arteriography no embolisation	0
Blood transfusion only	2
Clot obstruction managed conservatively	0
Clot obstruction requiring intervention	3
Death	0
Nephrectomy	0
Other please specify	1[a]
Surgery no nephrectomy	0
Total	**14**

a. Self-limiting post-procedure ileus.

Major complications were defined as shown in N8. There were 14 major complications (1.9%).

APPENDIX 1 ABBREVIATIONS USED IN THE TEXT

Some definitions and further details of parent and satellite renal units are given in the SRR website at: http://www.srr.scot.nhs.uk/Renal_Units/Main.html

Abbreviation	Expanded text
AAPD	Assisted Automated Peritoneal Dialysis
AAV	ANCA Associated Vasculitis
ABMR	Anti-body Mediated Rejection
ACR	Acute Cellular Rejection
AKI	Acute Kidney Injury
ANCA	Anti-Neutrophil Cytoplasmic Antibody
APD	Automated Peritoneal Dialysis
AV	Arteriovenous
AVF	Arteriovenous Fistula
AVG	Arteriovenous Graft
BKVAN	BK Virus Associated Nephropathy
BP	Blood Pressure
CAPD	Continuous Ambulatory Peritoneal Dialysis
Cat	Category
cCa	Corrected calcium
CI	Confidence Interval
CKD	Chronic Kidney Disease
CNI	Calcineurin inhibitor
CVC	Central Venous Cannula
DBD	Donor after Brain-stem Death
DCD	Donor after Circulatory Death
DD	Deceased Donor
DM	Diabetes Mellitus
DN	Diabetic Nephropathy
ECOSS	Electronic Communication of Surveillance in Scotland
eKt/V	equilibrated Kt/V
EPR	Electronic Patient Record
ERA-EDTA	European Renal Association-European Dialysis and Transplant Association
ERF	Established (chronic) Renal Failure
ESA	Erythropoiesis Stimulating Agent
ESRD	End Stage Renal Disease
g/L	Grams per Litre
GN	Glomerulonephritis
Hb	Haemoglobin concentration
HD	Haemodialysis
HDF	Haemodiafiltration
HHD	Home Haemodialysis
HR	Hazard Ratio
IFTA	Interstitial Fibrosis and Tubular Atrophy
iIFTA	inflammatory Interstitial Fibrosis and Tubular Atrophy

IP	Intraperitoneal Pressure
IQR	Interquartile Range
ISD	Information Services Division NHS Scotland
IU/L	International Unit per Litre
IV	Intravenous
KDOQI	Kidney Disease Outcomes Quality Initiative
Kg	Kilogram
LD	Living Donor
LLN	Lower Limit of Normal range
m2	Metre squared
Max	Maximum
MDRD	Modification of Diet in Renal Disease
Min	Minimum
mmol/L	Millimole per Litre
MRSA	Meticillin Resistant Staphylococcus Aureus
MSSA	Meticillin Sensitive Staphylococcus Aureus
n	Number
NHS	National Health Service
NHSBT	NHS Blood and Transplant
NHS QIS	NHS Quality Improvement Scotland
NHSScotland	National Health Service in Scotland
NK	Not Known
NR	Normal Range
NTCVC	Non Tunnelled Central Venous Cannula
OR	Odds Ratio
PD	Peritoneal Dialysis
PHI	Public Health and Intelligence
pmol/L	picomoles per Litre
PMP	Patients per million population
PO4	Phosphate
PRD	Primary Renal Diagnosis
PTH	Parathyroid Hormone
RA	Renal Association
RCP	Royal College of Physicians
RRT	Renal Replacement Therapy
SAB	Staphylococcus aureus Bacteraemia
SD	Standard Deviation
SIMD	Scottish Index of Multiple Deprivation
SMARRT	Scottish Mortality Audit of Renal Replacement Therapy
SMR	Standardised Mortality Ratio
sp.	Species
SRA	Scottish Renal Association
SRR	Scottish Renal Registry
StdKt/V	Standardised Kt/V
TCVC	Tunnelled Central Venous Cannula
Tx	Transplant
UF	Ultrafiltration
UK	United Kingdom

UKRA	United Kingdom Renal Association
UKRR	UK Renal Registry
UL	Upper Limit
ULN	Upper Limit of Normal range
URR	Urea Reduction Ratio

Renal and Satellite units

Abbreviation	**Expanded text**
Arbroath	Arbroath Infirmary dialysis unit
ARI	Aberdeen Royal Infirmary
Ayr	Ayr Hospital
Balfour	Balfour Hospital
Banff	Chalmers Hospital, Banff
BGH	Borders General Hospital
BHFW	Belford Hospital, Fort William
DGRI	Dumfries and Galloway Royal Infirmary
FVR	Forth Valley Royal Hospital
G Bain	Gilbert Bain Hospital
GCH Stran	Galloway Community Hospital, Stranraer
GH Elgin	Dr Gray's Hospital, Elgin
GLAS	Glasgow Renal and Transplant Unit
GRI	Glasgow Royal Infirmary
Inverurie	Inverurie Dialysis unit
IRH	Inverclyde Royal Hospital
K'bright	Kirkcudbright Hospital
MONK	Monklands Hospital
NINE	Ninewells Hospital
P'head	Peterhead Community Hospital
PRI	Perth Royal Infirmary
QEUHG	Queen Elizabeth University Hospital Glasgow
QMHD	Queen Margaret's Hospital, Dunfermline
RAIG	Raigmore Hospital
RHC	Royal Hospital for Children Glasgow
RIE	Royal Infirmary of Edinburgh
St And	St Andrews Community Hospital
St John's	St John's Hospital
Stob	Stobhill Hospital
VHK	Victoria Hospital, Kirkcaldy
Vict	Victoria Hospital
VoL	Vale of Leven Hospital
XH	Crosshouse Hospital
WGH	Western General Hospital
Wick	Caithness General Hospital
WIG	Western Infirmary Glasgow
WI Hosp	Western Isles Hospital

NHS Boards

Abbreviation	Expanded text
A&A	Ayrshire& Arran
BORD	Borders
D&G	Dumfries & Galloway
FIFE	Fife
FV	Forth Valley
GRAM	Grampian
GG&C	Greater Glasgow and Clyde
HIGH	Highland
LAN	Lanarkshire
LOTH	Lothian
ORKN	Orkney
SHET	Shetland
TAY	Tayside
WI	Western Isles

APPENDIX 2 RENAL UNITS, SATELLITE DIALYSIS UNITS AND HEALTH BOARD AREA OF UNITS' LOCATION

Parent Renal Unit	Satellites	Health Board	Full name
ARI		GRAM	Aberdeen Royal Infirmary
	Balfour	ORKN	Balfour Hospital, Orkney
	Banff	GRAM	Chalmers Hospital, Banff
	G Bain	SHET	Gilbert Bain Hospital, Lerwick
	GH Elgin	GRAM	Dr Gray's Hospital, Elgin
	Inverurie	GRAM	Inverurie Dialysis Unit
	P'head	GRAM	Peterhead Community Hospital
XH		A&A	University Hospital Crosshouse, Kilmarnock
	Ayr	A&A	University Hospital Ayr
DGRI		D&G	Dumfries and Galloway Royal Infirmary
	GCH Stran	D&G	Galloway Community Hospital, Stranraer
	K'bright	D&G	Kirkcudbright Hospital
GLAS		GG&C	Glasgow Renal and Transplant Unit, Queen Elizabeth University Hospital, Glasgow
	FVR	FV	Forth Valley Royal Hospital
	GRI	GG&C	Glasgow Royal Infirmary
	IRH	GG&C	Inverclyde Royal Hospital, Greenock
	Stob	GG&C	Stobhill Hospital, Glasgow
	Vict	GG&C	Victoria Hospital, Glasgow
	VoL	GG&C	Vale of Leven Hospital, Alexandria
MONK		LAN	Monklands Hospital, Airdrie
NINE		TAY	Ninewells Hospital, Dundee
	Arbroath	TAY	Arbroath Infirmary Dialysis unit
	PRI	TAY	Perth Royal Infirmary
VHK		FIFE	Victoria Hospital, Kirkcaldy
	St And	FIFE	St Andrews Community Hospital
	QMHD	FIFE	Queen Margaret Hospital, Dunfermline

Parent Renal Unit	Satellites	Health Board	Full name
RAIG		HIGH	Raigmore Hospital, Inverness
	BHFW	HIGH	Belford Hospital, Fort William
	Wick	HIGH	Caithness General Hospital
	WI Hosp	WI	Western Isles Hospital, Stornoway
RHC		GG&C	Royal Hospital for Children, Glasgow
RIE		LOTH	Royal Infirmary of Edinburgh
	BGH	BORD	Borders General Hospital, Melrose
	St John's	LOTH	St John's Hospital, Livingston
	WGH	LOTH	Western General Hospital, Edinburgh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