



## *Chapter 7*

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# **Children on renal replacement therapy (RRT) for end-stage kidney disease (ESKD) in the UK in 2017**

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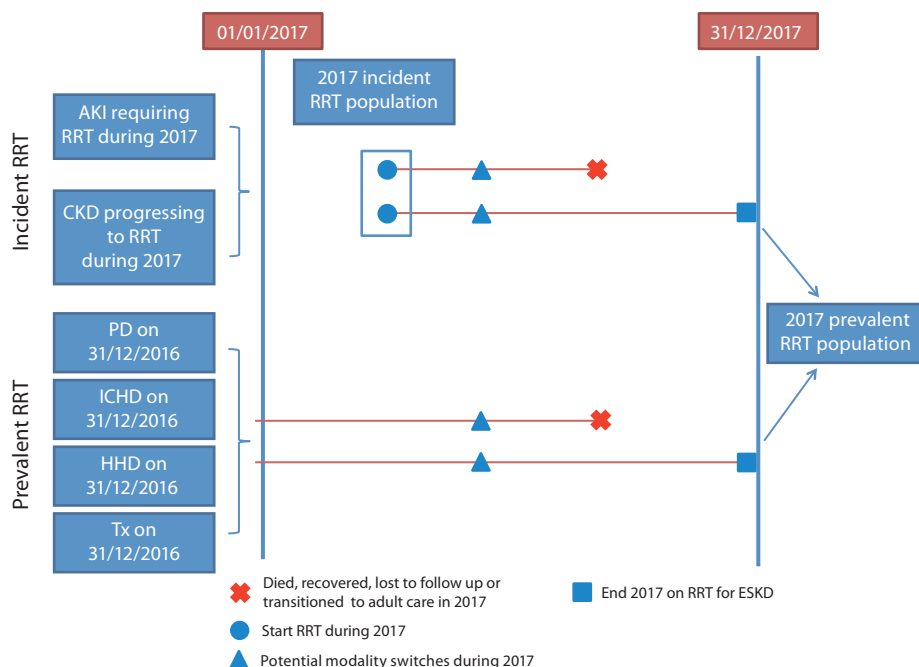
# Introduction

This chapter describes the population of children (aged <18 years) with end-stage kidney disease (ESKD) who were on renal replacement therapy (RRT) in the UK for at least 90 days in 2017 under the care of paediatric renal centres (figure 7.1). This includes patients with a transplant (Tx) and patients on dialysis – in-centre haemodialysis (ICHD), home haemodialysis (HHD) and peritoneal dialysis (PD). Patients coded as acute kidney injury (AKI) or ESKD who died or recovered within the first 90 days of RRT are excluded from the analyses. The populations included in this chapter are:

- **Incident population** – patients who started RRT during 2017 and remained on RRT for at least 90 days
- **Prevalent population** – patients who were on RRT at the end of 2017, aged <18 years and still under the care of a paediatric renal centre
- **Five-year populations** – patients who started RRT and remained on RRT for at least 90 days in the periods 2003–2007, 2008–2012 and 2013–2017.

There are 13 paediatric renal centres in the UK, all of which are equipped to provide both haemodialysis (HD) and PD. Ten of these centres also perform kidney transplantation.

Children aged 16–18 years may be managed in either paediatric or adult services. This is variable across the UK and dependent on local practices, social factors and patient/family wishes. In this chapter, data for patients aged <18 years who were managed within UK paediatric renal centres are described, with a focus on those aged <16 years, because this group represents a complete cohort. Children aged 16–18 years who have only ever received nephrology care from adult centres were not included in the analyses.



**Figure 7.1** Pathways paediatric patients could follow to be included in the UK 2017 incident and/or prevalent RRT populations

Note that patients starting RRT in 2017 are only included in this chapter if they remained on RRT for  $\geq 90$  days  
CKD – chronic kidney disease

This chapter addresses the following key aspects of care of children incident to or on RRT for which there are evidence-based guidelines (table 7.1):

- **Growth** – this includes age and sex adjusted heights and weights
- **Cardiovascular risk factors** – these include age adjusted blood pressure, cholesterol and body mass index (BMI)
- **Complications associated with RRT** – these include anaemia and mineral bone disorders.

Data for height, weight, BMI and blood pressure vary with age, sex and size and are therefore presented as z-scores. Z-scores are a means of expressing the deviation of a given measurement from the age and size specific population mean. This relies on the completeness of height data during the period in question.

# Rationale for analyses

The analyses begin with a description of the 2017 incident and prevalent paediatric RRT populations, including the number on RRT per million age-related population (pmarp). The height and weight of children are measures of healthy growth and may be impacted by kidney disease as well as its treatment.

The published guidelines listed below provide audit measures relevant to the care of paediatric patients on RRT and, where data permit, their attainment by UK renal centres in 2017 is reported in this chapter (table 7.1). For children, reporting estimated glomerular filtration rate (eGFR) is dependent on the completeness of both creatinine and height data. The completeness of both transferrin saturation and percentage hypochromic red cells are too low to be reported as measures of iron stores. Detail about the completeness of data returned to the UK Renal Registry (UKRR) is available on the UKRR website. Audit measures that cannot be reported because the required data items were not collected by the UKRR are omitted – this includes reticulocyte haemoglobin content.

Where revised target ranges are published, the measures in place at the time of patient care are reported. However, where new guidelines remove audit measures, those targets are no longer reported.

**Table 7.1** Audit measures relevant to RRT incidence and prevalence that are reported in this chapter

Audit guideline	Audit criteria	Related analysis/analyses
The Renal Association: Treatment of adults and children with renal failure: standards and audit measures (2002)	Height and weight to be monitored at each clinic visit and plotted on the growth charts of healthy children and adolescents	Figures 7.6–7.13
	Blood pressure during PD or after HD to be maintained at <90th percentile for age, sex and height. Blood pressure in Tx patients to be maintained at <90th percentile for age, sex and height	Tables 7.14, 7.15, figures 7.14, 7.15
	Serum phosphate and calcium should be kept within the normal range. Parathyroid hormone (PTH) levels should be maintained within twice the upper limit of the normal range but, contrary to adult standards, may be kept within the normal range if growth is normal	Table 7.17
	Serum bicarbonate concentrations should be 20–26 mmol/L	Table 7.17
	Typically maintain the aspirational haemoglobin range 100–120 g/L for young people and children aged ≥2 years and 95–115 g/L for children <2 years, reflecting the lower normal range in that age group	Table 7.17
National Heart Lung and Blood Institute and Kidney Disease Improving Global Outcomes (2013)	Screening children at risk of secondary dyslipidaemias including those with CKD	Table 7.15

For definitions and methods relating to this chapter see appendix A. Caterpillar plots exclude centres with <70% data completeness. Suppression of small numbers to minimise risk of patient re-identification limits in-depth analysis of centre level data.

A patient first seen by renal services within 90 days of starting RRT for ESKD is defined as a 'late presentation'. In this report 'late presentation' is used interchangeably with 'late referral'.

## Key findings

- 99 patients aged <16 years started RRT for ESKD in the UK in 2017 compared to 112 patients in 2016
- RRT incidence in patients aged <16 years was 7.9 pmarp
- 966 patients aged <18 years had received RRT for  $\geq 90$  days at UK paediatric renal centres on 31/12/2017, compared to 964 patients in 2016
- RRT prevalence in patients aged <16 years was 64.8 pmarp. 76.3% had a functioning Tx (45.1% living donor and 31.2% deceased donor), 13.1% were receiving HD and 10.6% were receiving PD
- Tubulointerstitial disease accounted for >50% of all primary renal diseases (PRDs) in prevalent paediatric patients, with a high male:female ratio (3.4:1)
- Between 2003 and 2017, a third of patients aged <16 years who were referred early received a pre-emptive Tx
- At the time of transfer to adult services, 84.4% of paediatric patients had a functioning kidney Tx
- The median height z-score for children on dialysis was  $-1.9$  compared with  $-1.1$  for those with a functioning Tx
- The median weight z-score for children on dialysis was  $-1.1$  compared with  $-0.1$  for those with a functioning Tx
- The median systolic blood pressure z-score for children on dialysis was 1.0 compared with 0.4 for those with a functioning Tx
- Of those with complete data, 71.4% of the prevalent paediatric RRT population had 1 or more risk factors for cardiovascular disease; 6.0% had 3 risk factors
- 53.3% and 55.6% of prevalent HD patients achieved systolic blood pressure (SBP) and diastolic blood pressure (DBP) values <90th percentile, respectively
- 60.0% and 66.7% of prevalent PD patients achieved SBP and DBP values <90th percentile, respectively
- 82.9% and 76.5% of prevalent Tx patients achieved SBP and DBP values <90th percentile, respectively.

# Analyses

## Data completeness for prevalent paediatric RRT patients

Data returns of key variables for paediatric Tx and dialysis patients <18 years old at the end of 2017 are shown in tables 7.2 and 7.3, respectively, with further detail available on the UKRR website.

**Table 7.2** Data completeness for paediatric patients (<18 years old) prevalent to Tx on 31/12/2017 by centre

Centre	N with Tx	Data completeness (%)														
		Height at start	Weight at start	BMI	SBP	DBP	Hb	Creat at start	Ferr	ESA	IV iron	Chol	Bicarb	PTH	Ca	Phos
Bham_P	82	95.1	97.6	98.8	98.8	98.8	97.6	97.6	67.1	2.4	1.2	96.3	97.6	24.4	97.6	97.6
Blfst_P	24	79.2	87.5	91.7	91.7	83.3	91.7	91.7	83.3	91.7	91.7	79.2	91.7	83.3	91.7	91.7
Brstl_P	47	93.6	100.0	91.5	97.9	89.4	97.9	100.0	70.2	97.9	95.7	63.8	95.7	74.5	93.6	95.7
Cardf_P	25	96.0	96.0	96.0	100.0	40.0	100.0	96.0	100.0	100.0	0.0	100.0	100.0	96.0	100.0	100.0
Glasg_P	43	93.0	97.7	100.0	100.0	100.0	95.4	97.7	60.5	100.0	100.0	34.9	97.7	95.4	95.4	95.4
L Eve_P	87	70.1	74.7	92.0	93.1	93.1	100.0	75.9	52.9	100.0	100.0	77.0	100.0	100.0	100.0	100.0
L GOSH_P	144	90.3	95.1	97.9	97.9	0.0	99.3	95.1	81.3	97.9	0.7	64.6	99.3	94.4	99.3	99.3
Leeds_P	57	91.2	100.0	96.5	98.3	98.3	100.0	100.0	56.1	100.0	100.0	31.6	100.0	86.0	100.0	100.0
Livpl_P	38	76.3	81.6	97.4	97.4	97.4	100.0	92.1	94.7	97.4	97.4	89.5	100.0	92.1	100.0	100.0
Manch_P	67	95.5	98.5	98.5	100.0	100.0	100.0	98.5	88.1	100.0	100.0	71.6	100.0	100.0	100.0	100.0
Newc_P	28	92.9	92.9	64.3	96.4	0.0	100.0	92.9	85.7	100.0	0.0	67.9	100.0	96.4	100.0	100.0
Nottm_P	73	78.1	94.5	90.4	87.7	84.9	98.6	95.9	93.2	100.0	100.0	90.4	97.3	93.2	95.9	95.9
Soton_P	34	76.5	76.5	97.1	97.1	97.1	100.0	85.3	100.0	100.0	100.0	79.4	100.0	100.0	100.0	100.0
<b>UK</b>	<b>749</b>	<b>86.8</b>	<b>92.3</b>	<b>94.7</b>	<b>96.5</b>	<b>71.0</b>	<b>98.8</b>	<b>93.6</b>	<b>76.8</b>	<b>88.4</b>	<b>62.4</b>	<b>72.1</b>	<b>98.7</b>	<b>85.9</b>	<b>98.3</b>	<b>98.4</b>

Bicarb – bicarbonate; BMI – body mass index; Ca – calcium; Chol – cholesterol; Creat – creatinine; DBP – diastolic blood pressure; ESA – erythropoiesis stimulating agent; Ferr – ferritin; Hb – haemoglobin; IV – intravenous; Phos – phosphate; PTH – parathyroid hormone; SBP – systolic blood pressure

**Table 7.3** Data completeness for paediatric patients (<18 years old) prevalent to dialysis on 31/12/2017 by centre

Centre	N on dialysis	Data completeness (%)														
		Height at start	Weight at start	BMI	SBP	DBP	Hb	Ferr	ESA	IV iron	Chol	Bicarb	PTH	Ca	Phos	
Bham_P	35	85.7	94.3	97.1	100.0	88.6	97.1	94.3	0.0	0.0	94.3	97.1	42.9	97.1	97.1	
Blfst_P	5	100.0	100.0	80.0	80.0	0.0	80.0	80.0	80.0	80.0	60.0	80.0	80.0	80.0	80.0	
Brstl_P	16	50.0	81.3	93.8	100.0	31.3	100.0	87.5	100.0	62.5	68.8	100.0	100.0	100.0	100.0	
Cardf_P	6	100.0	100.0	83.3	83.3	16.7	100.0	100.0	100.0	0.0	66.7	100.0	100.0	100.0	100.0	
Glasg_P	17	94.1	94.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	64.7	100.0	100.0	100.0	100.0	
L Eve_P	24	83.3	83.3	100.0	100.0	75.0	100.0	100.0	100.0	100.0	62.5	100.0	100.0	100.0	100.0	
L GOSH_P	41	70.7	82.9	92.7	100.0	0.0	100.0	90.2	97.6	2.4	63.4	100.0	97.6	100.0	100.0	
Leeds_P	9	88.9	88.9	77.8	88.9	88.9	100.0	100.0	100.0	100.0	88.9	100.0	100.0	100.0	100.0	
Livpl_P	13	92.3	100.0	92.3	84.6	69.2	100.0	100.0	84.6	84.6	69.2	100.0	92.3	100.0	100.0	
Manch_P	23	100.0	100.0	100.0	100.0	30.4	100.0	100.0	100.0	100.0	73.9	100.0	100.0	100.0	100.0	
Newc_P	10	20.0	30.0	70.0	100.0	0.0	90.0	90.0	100.0	0.0	70.0	90.0	90.0	90.0	90.0	
Nottm_P	18	66.7	88.9	88.9	66.7	50.0	100.0	100.0	100.0	100.0	88.9	100.0	100.0	100.0	100.0	
Soton_P	0															
<b>UK</b>	<b>217</b>	<b>78.8</b>	<b>87.6</b>	<b>93.1</b>	<b>94.9</b>	<b>48.4</b>	<b>98.6</b>	<b>95.4</b>	<b>82.0</b>	<b>53.9</b>	<b>73.7</b>	<b>98.6</b>	<b>88.9</b>	<b>98.6</b>	<b>98.6</b>	

Bicarb – bicarbonate; BMI – body mass index; Ca – calcium; Chol – cholesterol; DBP – diastolic blood pressure; ESA – erythropoiesis stimulating agent; Ferr – ferritin; Hb – haemoglobin; IV – intravenous; Phos – phosphate; PTH – parathyroid hormone; SBP – systolic blood pressure



## Changes to the incident paediatric RRT population

The number of incident patients on RRT <16 years old was calculated as an estimated age-related rate per million population (calculated as detailed in appendix A) and grouped by age, sex, five year time period, ethnicity, centre and PRD.

**Table 7.4** Paediatric patients (<16 years old) incident to RRT in 2017 by age and sex

Age group (yrs)	All patients		Male		Female	
	<i>N</i>	pmarp	<i>N</i>	pmarp	<i>N</i>	pmarp
0-<2	18	11.6	12	15.1	6	7.9
2-<4	13	8.2	11	13.5	2	2.6
4-<8	21	6.3	12	7.1	9	5.6
8-<12	19	6.0	10	6.1	9	5.8
12-<16	28	9.7	22	14.9	6	4.3
<b>&lt;16 yrs</b>	<b>99</b>	<b>7.9</b>	<b>67</b>	<b>10.5</b>	<b>32</b>	<b>5.2</b>

pmarp – per million age-related population

**Table 7.5** Paediatric patients (<16 years old) incident to RRT by age and 5 year time period

Age group (yrs)	2003–2007		2008–2012		2013–2017	
	<i>N</i>	pmarp	<i>N</i>	pmarp	<i>N</i>	pmarp
0-<2	85	12.0	98	12.5	111	14.2
2-<4	37	5.5	58	7.5	75	9.1
4-<8	87	6.2	89	6.2	119	7.4
8-<12	112	7.5	125	8.9	133	8.9
12-<16	209	13.4	202	13.4	167	11.8
<b>&lt;16 yrs</b>	<b>530</b>	<b>9.1</b>	<b>572</b>	<b>9.7</b>	<b>605</b>	<b>9.9</b>

pmarp – per million age-related population

**Table 7.6** Paediatric patients (<16 years old) incident to RRT by ethnicity\* and 5 year time period

Ethnicity	2003–2007		2008–2012		2013–2017	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
White	404	76.7	408	72.2	409	68.5
South Asian	83	15.7	97	17.2	105	17.6
Black	20	3.8	23	4.1	32	5.4
Other	20	3.8	37	6.5	51	8.5
<b>&lt;16 yrs</b>	<b>527</b>	<b>100.0</b>	<b>565</b>	<b>100.0</b>	<b>597</b>	<b>100.0</b>

\*3 children in 2003–2007, 7 in 2008–2012 and 8 in 2013–2017 with no ethnicity recorded are excluded from this table

**Table 7.7** Paediatric patients (<16 years old) incident to RRT by centre and 5 year time period

Centre	2003–2007		2008–2012		2013–2017	
	N	%	N	%	N	%
Blfst_P	15	2.8	24	4.2	12	2.0
Bham_P	55	10.4	66	11.5	79	13.1
Brstl_P	38	7.2	29	5.1	36	6.0
Cardf_P	25	4.7	16	2.8	19	3.1
Glasg_P	36	6.8	42	7.3	45	7.4
L Eve_P	45	8.5	64	11.2	68	11.2
L GOSH_P	102	19.2	120	21.0	102	16.9
Leeds_P	55	10.4	45	7.9	49	8.1
Livpl_P	27	5.1	19	3.3	32	5.3
Manch_P	44	8.3	48	8.4	64	10.6
Newc_P	26	4.9	21	3.7	31	5.1
Nottm_P	50	9.4	57	10.0	50	8.3
Soton_P	12	2.3	21	3.7	18	3.0
<b>&lt;16 yrs</b>	<b>530</b>	<b>100.0</b>	<b>572</b>	<b>100.0</b>	<b>605</b>	<b>100.0</b>

PRDs are grouped according to the European Renal Association–European Dialysis and Transplant Association (see appendix A).

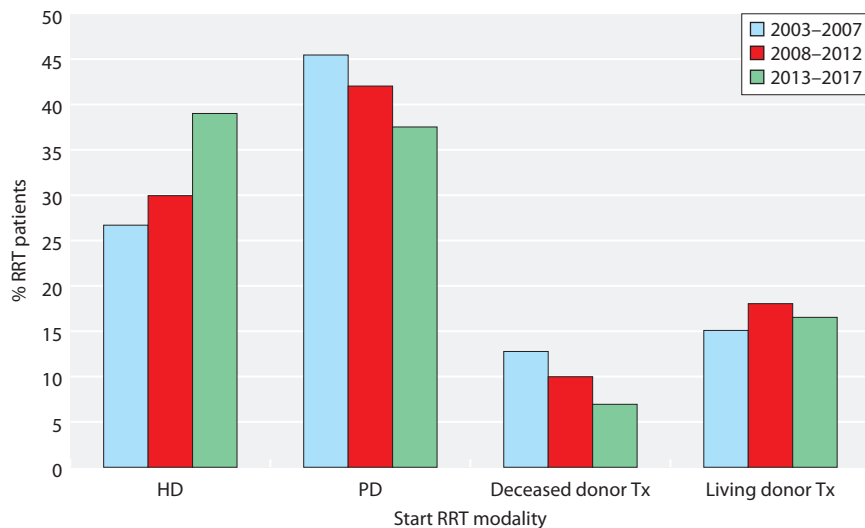
**Table 7.8** Paediatric patients (<16 years old) incident to RRT by primary renal disease (PRD)\* and 5 year time period

PRD	2003–2007		2008–2012		2013–2017	
	N	%	N	%	N	%
Tubulointerstitial disease:	262	50.1	294	51.5	296	49.2
– CAKUT	240	45.9	277	48.5	285	47.3
– Non-CAKUT	22	4.2	17	3.0	11	1.8
Glomerular disease	114	21.8	106	18.6	109	18.1
Familial/hereditary nephropathies	81	15.5	93	16.3	98	16.3
Systemic diseases affecting the kidney	17	3.3	34	6.0	19	3.2
Miscellaneous renal disorders	49	9.4	44	7.7	80	13.3

\*7 children in 2003–2007, 1 in 2008–2012 and 3 in 2013–2017 with no PRD recorded are excluded from this table  
CAKUT – congenital anomalies of the kidneys and urinary tract

## Start modality of incident paediatric RRT patients

Start modality used by patients <16 years old starting RRT between 2003 and 2017 was grouped by five year time period.



**Figure 7.2** Start RRT modality for paediatric patients (<16 years old) incident to RRT by 5 year time period

## Pre-emptive transplantation in incident paediatric RRT patients

The analysis of pre-emptive transplantation excluded patients presenting aged <3 months and patients presenting late (i.e. first seen by a nephrologist within 90 days of RRT start).

**Table 7.9** Pre-emptive transplantation in the incident paediatric RRT population aged 3 months to 16 years by 5 year time period, sex, ethnicity, age at start of RRT and primary renal disease (PRD)

	N on RRT	N (%) with pre-emptive Tx
Total cohort analysed (2003-2017)	1,241	420 (33.8)
<b>Time period</b>		
2003-2007	386	136 (35.2)
2008-2012	404	151 (37.4)
2013-2017	451	133 (29.5)
<b>Sex</b>		
Male	793	290 (36.6)
Female	448	130 (29.0)
<b>Ethnicity</b>		
White	886	335 (37.8)
South Asian	212	49 (23.1)
Black	54	6 (11.1)
Other	74	23 (31.1)
<b>Age at start of RRT (yrs)</b>		
3 mths-<2	137	6 (4.4)
2-<4	148	42 (28.4)
4-<8	236	101 (42.8)
8-<12	284	105 (37.0)
12-<16	436	166 (38.1)
<b>PRD</b>		
Tubulointerstitial disease	679	295 (43.4)
Glomerular disease	233	17 (7.3)
Familial/hereditary nephropathies	190	65 (34.2)
Miscellaneous renal disorders	93	26 (28.0)
Systemic diseases affecting the kidney	38	15 (39.5)

97 patients were excluded because aged <3 months; 369 patients were excluded because late presenters

## Demographics of prevalent paediatric RRT patients

The number of prevalent patients on RRT <16 years old was calculated as an estimated age-related rate per million population (calculated as detailed in appendix A) and grouped by age, sex and ethnicity.

**Table 7.10** Age and sex breakdown of paediatric patients (<16 years old) prevalent to RRT on 31/12/2017

Age group (yrs)	All patients		Male		Female		M:F ratio
	N	pmarp	N	pmarp	N	pmarp	
0-<2	26	16.7	17	21.3	9	11.9	1.8
2-<4	50	31.5	36	44.2	14	18.1	2.4
4-<8	173	52.2	124	73.2	49	30.3	2.4
8-<12	245	77.1	140	86.0	105	67.8	1.3
12-<16	316	109.9	205	139.2	111	79.2	1.8
<b>&lt;16 yrs</b>	<b>810</b>	<b>64.8</b>	<b>522</b>	<b>81.5</b>	<b>288</b>	<b>47.2</b>	<b>1.7</b>

pmarp – per million age related population

**Table 7.11** Age and ethnicity\* breakdown of paediatric patients (<16 years old) prevalent to RRT on 31/12/2017

Age group (yrs)	N			
	White	South Asian	Black	Other
0-<4	52	8	4	9
4-<8	125	26	4	16
8-<12	160	49	13	21
12-<16	218	62	19	17
<b>&lt;16 yrs</b>	<b>555</b>	<b>145</b>	<b>40</b>	<b>63</b>
<b>pmarp &lt;16 yrs</b>	<b>55.0</b>	<b>135.4</b>	<b>73.2</b>	<b>78.9</b>

The 2011 Office for National Statistics census was used to estimate the proportion of White, South Asian, Black and Other ethnicity which was then applied to the population estimate for 2017

\*7 children with no ethnicity recorded are excluded from this table

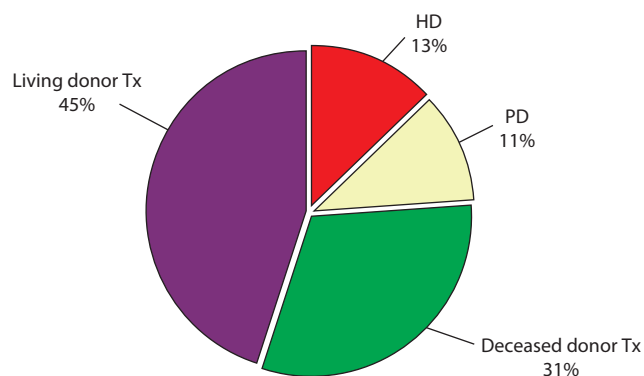
pmarp – per million age related population

## Treatment modality in prevalent paediatric RRT patients

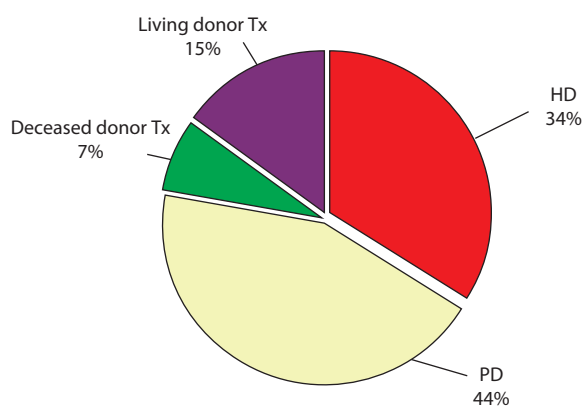
RRT modality for prevalent paediatric RRT patients is shown separately for those aged <18 years and <16 years. Also shown is the modality used at the start of RRT for prevalent RRT patients aged <16 years.

**Table 7.12** RRT modality used by paediatric patients (<18 years old) prevalent to RRT on 31/12/2017 by age group

Age group (yrs)	Total N	HD		PD		Living donor Tx		Deceased donor Tx	
		N	%	N	%	N	%	N	%
0-<2	26	9	34.6	17	65.4	0	0.0	0	0.0
2-<4	50	15	30.0	20	40.0	11	22.0	4	8.0
4-<8	173	26	15.0	20	11.6	83	48.0	44	25.4
8-<12	245	20	8.2	12	4.9	133	54.3	80	32.7
12-<16	316	36	11.4	17	5.4	138	43.7	125	39.6
16-<18	156	14	9.0	11	7.1	62	39.7	69	44.2
<b>&lt;16 yrs</b>	<b>810</b>	<b>106</b>	<b>13.1</b>	<b>86</b>	<b>10.6</b>	<b>365</b>	<b>45.1</b>	<b>253</b>	<b>31.2</b>
<b>&lt;18 yrs</b>	<b>966</b>	<b>120</b>	<b>12.4</b>	<b>97</b>	<b>10.0</b>	<b>427</b>	<b>44.2</b>	<b>322</b>	<b>33.3</b>



**Figure 7.3** RRT modality used by paediatric patients (<16 years old) prevalent to RRT on 31/12/2017



**Figure 7.4** RRT modality used at the start of RRT by paediatric patients (<16 years old) prevalent to RRT on 31/12/2017

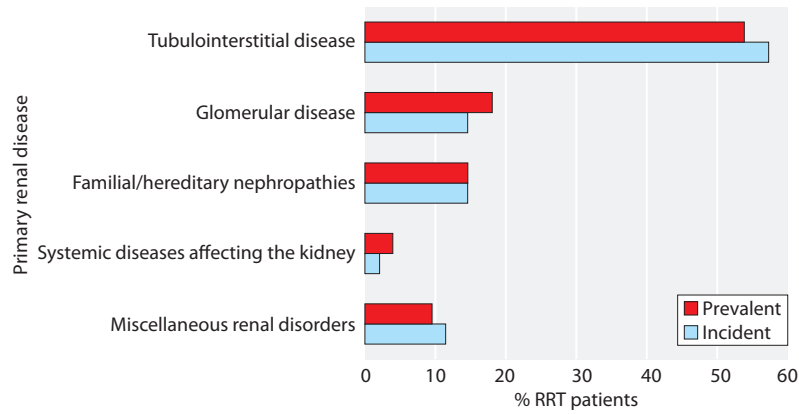
## Causes of ESKD in prevalent paediatric RRT patients

PRDs were grouped into categories as shown in table 7.13, with the mapping of disease codes into groups explained in more detail in appendix A.

**Table 7.13** Primary renal diseases (PRDs) of paediatric patients (<16 years old) prevalent to RRT on 31/12/2017 by sex and ethnicity

PRD	N	%	N male	N female	% non-White patients
Tubulointerstitial disease:	435	53.8	335	100	28.9
- CAKUT	425	52.6	329	96	28.6
- Non-CAKUT	10	1.2	6	4	40.0
Glomerular disease	146	18.1	72	74	32.6
Familial/hereditary nephropathies	118	14.6	52	66	43.1
Systemic diseases affecting the kidney	32	4.0	16	16	18.8
Miscellaneous renal disorders	77	9.5	46	31	26.3
Missing	2	0.2	1	1	0.0
<b>Total</b>	<b>810</b>	<b>100.0</b>	<b>522</b>	<b>288</b>	<b>30.9</b>

CAKUT – congenital anomalies of the kidneys and urinary tract

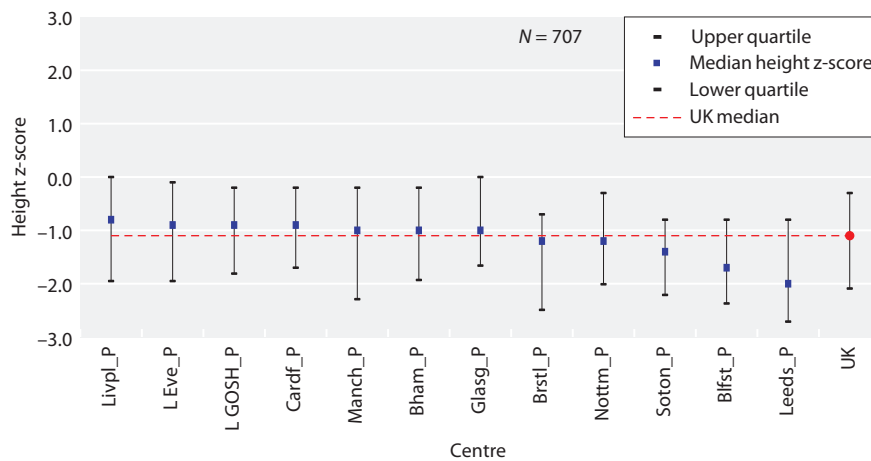


**Figure 7.5** Comparison of primary renal diseases for paediatric patients (<16 years old) incident and prevalent to RRT in 2017 with no missing data

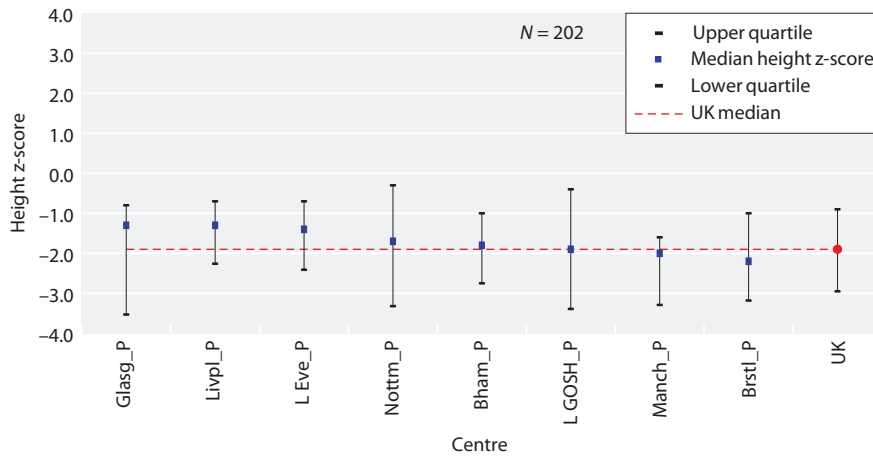
## Growth of prevalent paediatric RRT patients

The height and weight of children receiving RRT were compared to the age and sex matched general childhood population. The UK median score for each measure is represented by a red dotted line.

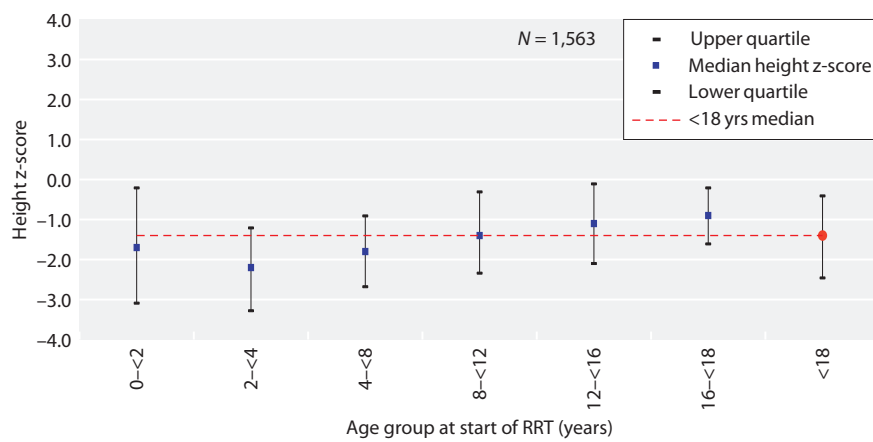
### Height of paediatric RRT patients



**Figure 7.6** Median height z-scores for paediatric patients (<18 years old) prevalent to Tx on 31/12/2017 by centre

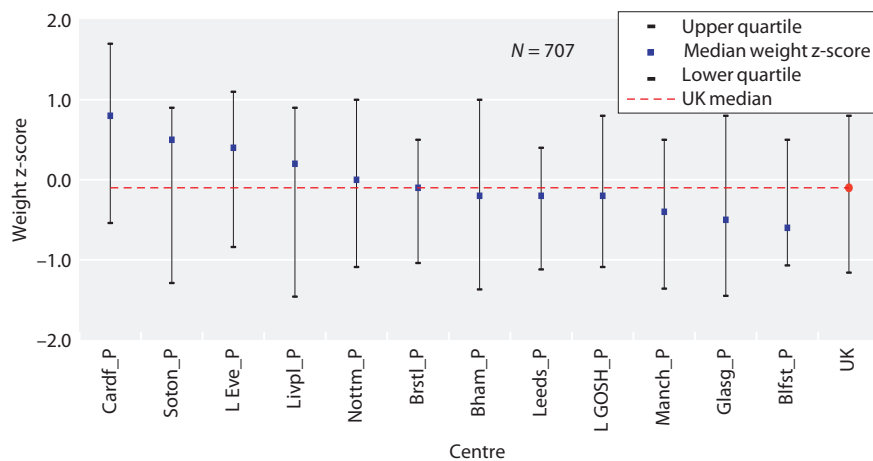


**Figure 7.7** Median height z-scores for paediatric patients (<18 years old) prevalent to dialysis on 31/12/2017 by centre

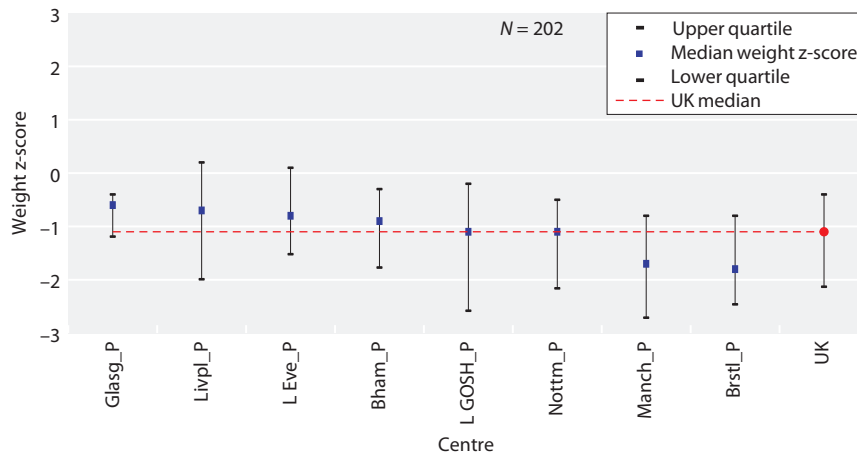


**Figure 7.8** Median height z-scores at start of RRT for incident paediatric RRT patients (<18 years old) between 2003 and 2017 by age group at start of RRT

### Weight of paediatric RRT patients



**Figure 7.9** Median weight z-scores for paediatric patients (<18 years old) prevalent to Tx on 31/12/2017 by centre

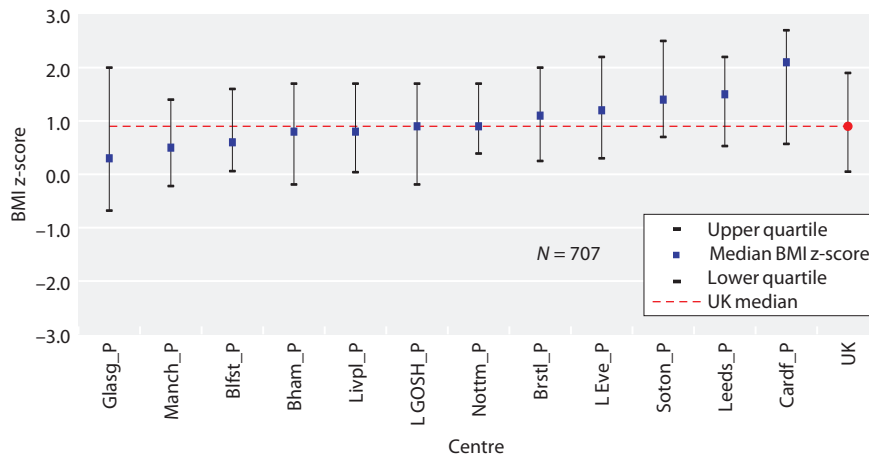


**Figure 7.10** Median weight z-scores for paediatric patients (<18 years old) prevalent to dialysis on 31/12/2017 by centre

## Cardiovascular risk factor evaluation in prevalent paediatric RRT patients

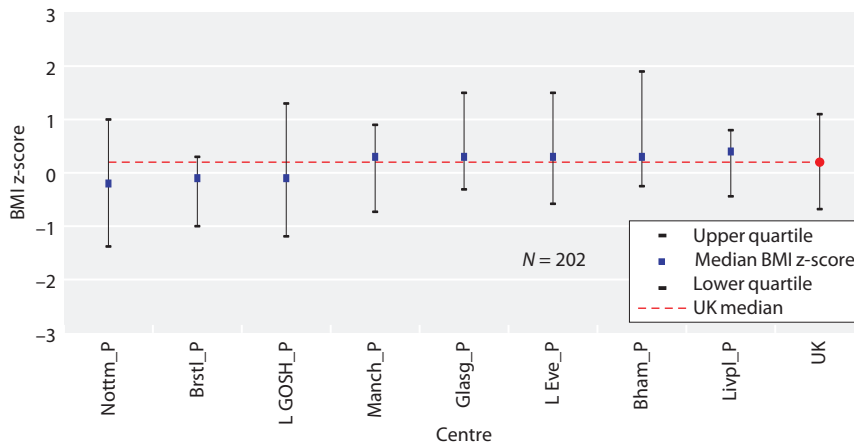
### Obesity in paediatric RRT patients

BMI was calculated using the formula  $BMI = \text{weight (kg)} / \text{height}^2 \text{ (m)}$ . Height and weight were adjusted for age. To account for discrepancies in linear growth secondary to renal disease, BMI was expressed according to height-age, rather than chronological age.

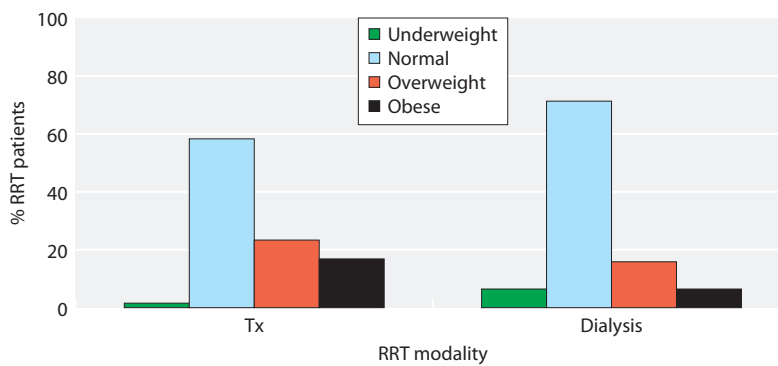


**Figure 7.11** Median body mass index (BMI) z-scores for paediatric patients (<18 years old) prevalent to Tx on 31/12/2017 by centre





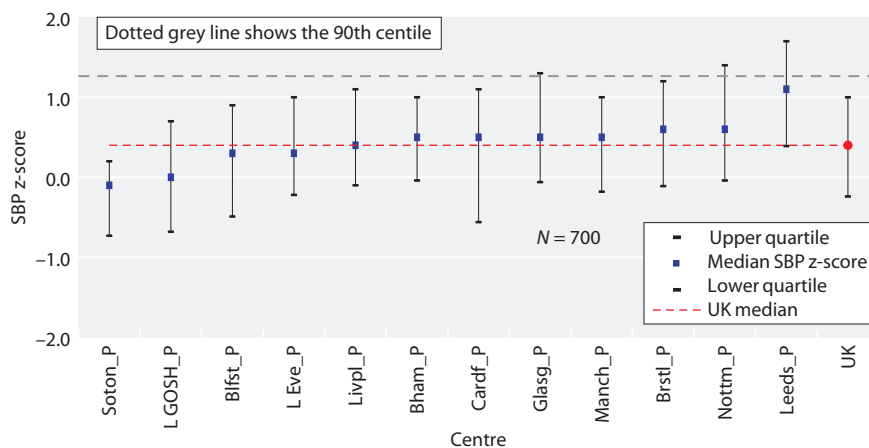
**Figure 7.12** Median body mass index (BMI) z-scores for paediatric patients (<18 years old) prevalent to dialysis on 31/12/2017 by centre



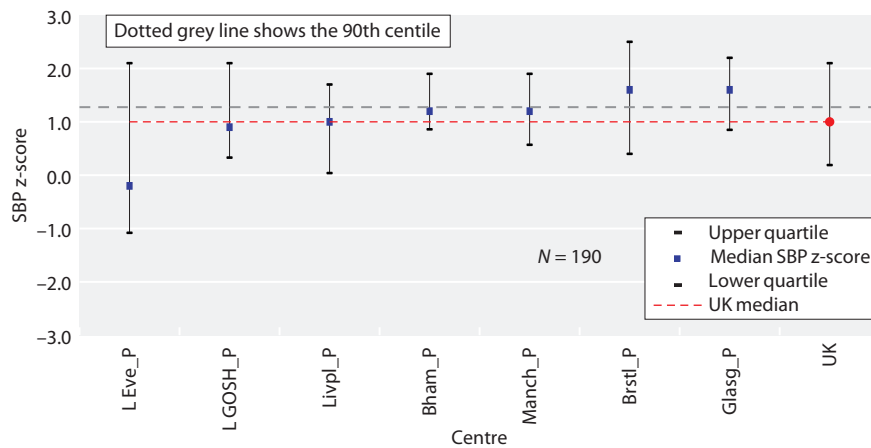
**Figure 7.13** Body mass index categorisation of paediatric patients (<18 years old) prevalent to RRT on 31/12/2017 by RRT modality

### Hypertension in paediatric RRT patients

In paediatric RRT patients, systolic blood pressure should be maintained at <90th percentile for age, sex and height.



**Figure 7.14** Median systolic blood pressure (SBP) z-scores for paediatric patients (<18 years old) prevalent to Tx on 31/12/2017 by centre



**Figure 7.15** Median systolic blood pressure (SBP) z-scores for paediatric patients (<18 years old) prevalent to dialysis on 31/12/2017 by centre

**Table 7.14** Percentage of paediatric patients (<18 years old) prevalent to RRT on 31/12/2017 achieving the standards for blood pressure

	SBP		DBP	
	N	% <90th percentile	N	% <90th percentile
<b>Total</b>	890	77.2	607	74.1
<b>Age group (yrs)</b>				
0-<5	107	57.0	57	57.9
5-<12	350	76.0	232	77.6
12-<16	295	82.7	216	73.2
16-<18	138	84.1	102	77.5
<b>Sex</b>				
Male	578	79.4	407	73.0
Female	312	73.1	200	76.5
<b>Ethnicity</b>				
White	613	78.6	431	77.3
South Asian	157	72.6	109	64.2
Black	43	76.7	24	66.7
Other	69	79.7	41	73.2
<b>Modality</b>				
HD	105	53.3	45	55.6
PD	85	60.0	51	66.7
Tx	700	82.9	511	76.5

DBP – diastolic blood pressure; SBP – systolic blood pressure

### Cardiovascular risk factors in paediatric RRT patients

The analysis of the proportion of prevalent RRT patients with identified cardiovascular risk factors was restricted to the 553 of the 966 patients (57.2%) with data for all three risk factors.

**Table 7.15** Frequency of number of cardiovascular risk factors in paediatric patients (<18 years old) prevalent to RRT on 31/12/2017

N cardiovascular risk factors	Hypertensive	Overweight/obese	Hypercholesterolaemic	N	%	Total %
0	No	No	No	186	28.6	28.6
1	Yes	No	No	77	11.8	37.2
	No	Yes	No	83	12.8	
	No	No	Yes	82	12.6	
2	Yes	Yes	No	58	8.9	28.2
	Yes	No	Yes	61	9.4	
	No	Yes	Yes	64	9.8	
3	Yes	Yes	Yes	39	6.0	6.0
<b>Total N</b>	<b>235</b>	<b>244</b>	<b>246</b>	<b>650</b>		
<b>Total %</b>	<b>36.2</b>	<b>37.5</b>	<b>37.8</b>			<b>100.0</b>

### Biochemistry parameters in prevalent paediatric RRT patients

The median values for eGFR and the proportion with eGFR <30 mL/min/1.73 m<sup>2</sup> for prevalent 2017 paediatric Tx patients are presented.

**Table 7.16** Median estimated glomerular filtration rate (eGFR) and percentage with eGFR <30 mL/min/1.73 m<sup>2</sup> in paediatric patients (<18 years old) prevalent to Tx on 31/12/2017 by centre

Centre	N with Tx	Median eGFR (mL/min/1.73 m <sup>2</sup> )	% eGFR <30 mL/min/1.73 m <sup>2</sup>	% data completeness
Bham_P	82	56	6.3	97.6
Blfst_P	24	75	4.6	91.7
Brstl_P	47	69	7.1	89.4
Cardf_P	25	82	0.0	96.0
Glasg_P	43	74	0.0	95.3
L Eve_P	87	51	8.8	92.0
L GOSH_P	144	57	9.9	97.9
Leeds_P	57	62	7.3	96.5
Livpl_P	38	71	2.7	97.4
Manch_P	67	63	1.5	98.5
Newc_P	28			64.3
Nottm_P	73	58	13.9	89.0
Soton_P	34	64	3.0	97.1
<b>UK</b>	<b>749</b>	<b>60</b>	<b>6.5</b>	<b>94.0</b>

Blank cells – centres with <70% data completeness or <10 patients

**Table 7.17** Attainment of targets for haemoglobin, calcium, phosphate, parathyroid hormone and bicarbonate in paediatric patients (<18 years old) (a) prevalent to dialysis on 31/12/2017 by centre and (b) prevalent to Tx on 31/12/2017 with eGFR <30 mL/min/1.73 m<sup>2</sup> in the UK

Centre	N	% Hb below target	% Hb within target	% Ca below target	% Ca within target	% phos below target	% phos within target	% PTH within target	% bicarb below target	% bicarb within target
<b>DIALYSIS PATIENTS</b>										
Bham_P	35	23.5	52.9	0.0	58.8	2.9	73.5		0.0	85.3
Blfst_P	5									
Brstl_P	16	31.3	62.5	0.0	87.5	0.0	50.0	43.8	12.5	81.3
Cardf_P	6									
Glasg_P	17	35.3	47.1	5.9	88.2	29.4	58.8	41.2	0.0	70.6
L Eve_P	24	54.2	25.0	4.2	91.7	12.5	54.2	20.8	37.5	62.5
L GOSH_P	41	24.4	34.2	17.1	70.7	14.6	41.5	30.0	9.8	78.1
Leeds_P	9									
Livpl_P	13	30.8	53.9	0.0	76.9	38.5	38.5	41.7	0.0	92.3
Manch_P	23	34.8	43.5	13.0	73.9	17.4	39.1	39.1	4.4	73.9
Newc_P	10	44.4	33.3	0.0	66.7	55.6	33.3	77.8	0.0	77.8
Nottm_P	18	27.8	61.1	0.0	83.3	5.6	44.4	44.4	0.0	66.7
Soton_P	0									
<b>UK</b>	<b>217</b>	<b>32.2</b>	<b>43.9</b>	<b>5.6</b>	<b>75.2</b>	<b>15.0</b>	<b>49.1</b>	<b>36.3</b>	<b>8.4</b>	<b>75.2</b>
<b>TX PATIENTS with eGFR &lt;30 mL/min/1.73 m<sup>2</sup></b>										
<b>UK</b>	<b>46</b>	<b>30.4</b>	<b>47.8</b>	<b>2.2</b>	<b>95.7</b>	<b>8.9</b>	<b>77.8</b>	<b>70.6</b>	<b>26.1</b>	<b>73.9</b>

See appendix A for biochemical target ranges

Blank cells – centres with <10 patients or <70% data completeness

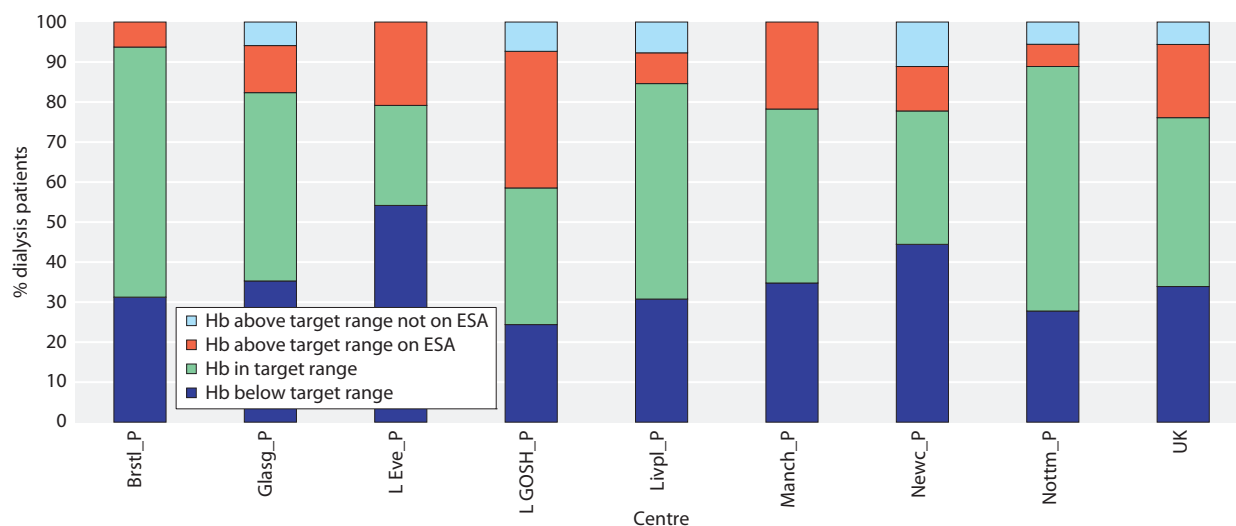
Bicarb – bicarbonate; Ca – calcium; Hb – haemoglobin; Phos – phosphate; PTH – parathyroid hormone

**Table 7.18** Median estimated glomerular filtration rate (eGFR) in paediatric patients (<18 years old) prevalent to Tx on 31/12/2017 by time since transplantation and age group

Time since transplantation	Age group (years)							
	0–<5		5–<12		12–<16		16–<18	
	N	Median eGFR (mL/min/1.73 m <sup>2</sup> )	N	Median eGFR (mL/min/1.73 m <sup>2</sup> )	N	Median eGFR (mL/min/1.73 m <sup>2</sup> )	N	Median eGFR (mL/min/1.73 m <sup>2</sup> )
3 mths	13	98	24	63	20	63	9	48
1 yr	12	84	34	69	26	63	7	53
3 yrs	8	66	99	65	51	59	28	54
5 yrs	0		98	61	60	59	21	54
≥7 yrs	0		46	56	92	57	55	51
<b>Overall median</b>	<b>33</b>	<b>85</b>	<b>301</b>	<b>64</b>	<b>249</b>	<b>58</b>	<b>120</b>	<b>52</b>
<b>IQR</b>		<b>62–105</b>		<b>51–78</b>		<b>46–73</b>		<b>39–66</b>

IQR – interquartile range

The proportion of patients with haemoglobin above target range on ESA is shown by renal centre.



**Figure 7.16** Proportion of paediatric patients (<16 years old) prevalent to dialysis on 31/12/2017 with haemoglobin below, within and above target by centre; for those above target the proportion on erythropoiesis stimulating agent (ESA) therapy is shown

Hb – haemoglobin

## Transfer to adult renal services for prevalent paediatric RRT patients

Ninety-six paediatric patients transitioned to adult renal centres in 2017. The median age of patients at transfer was 17.9 years with an IQR of 17.3–18.1 years. Overall, the demographics of this population reflected those of the prevalent paediatric RRT population, but with a higher proportion having a functioning Tx (84.4% versus 77.5%).

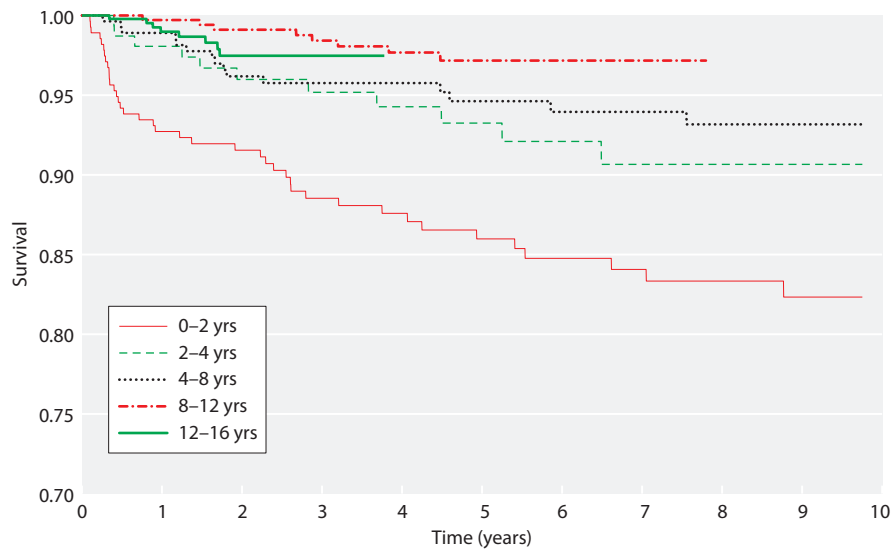
## Survival in paediatric RRT patients

Of patients <16 years of age, 1,575 started RRT between 2003 and 2016 at paediatric renal centres and were included in survival analyses, to allow at least one year follow-up. At the end of the year (31/12/2017) 84 deaths had been reported in children aged <16 years. Patients included in the analysis must have been alive on RRT for 90 days. The median follow-up time (beyond day 90) was 3.4 years (range three days to 14.5 years).

**Table 7.19** Survival of incident paediatric RRT patients (<16 years old) at 1 year intervals of RRT by age at start of RRT

Survival	Age group (yrs)				
	0–<2	2–<4	4–<8	8–<12	12–<16
Survival at 1 year after 90 days	92.7	98.1	98.9	99.7	99.0
95% CI	88.9–95.2	94.1–99.4	96.6–99.6	98–100	97.3–99.6
Survival at 2 years after 90 days	91.5	96.0	96.2	99.1	97.5
95% CI	87.6–94.3	91.3–98.2	93–97.9	97.3–99.7	94.9–98.8
Survival at 3 years after 90 days	88.5	95.2	95.8	98.4	97.5
95% CI	84–91.9	90.1–97.7	92.5–97.6	96.2–99.3	94.9–98.8
Survival at 4 years after 90 days	87.6	94.3	95.8	97.7	
95% CI	82.9–91.1	88.8–97.1	92.5–97.6	95.2–98.9	
Survival at 5 years after 90 days	86.0	93.2	94.6	97.2	
95% CI	80.9–89.8	87.3–96.5	90.8–96.9	94.4–98.6	

CI – confidence interval



**Figure 7.17** Unadjusted Kaplan-Meier survival (from day 90) of incident paediatric RRT patients (<16 years old) between 2003 and 2016 by age group at start of RRT