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UK Renal Registry 20th Annual Report: Chapter 9 Centre Variation in Access to Kidney Transplantation (2011–2013 incident cohort)

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Keywords

Centre variation · Comorbidity · Donor after brainstem death · Donor after circulatory death · Equity of access · Living kidney donor · Outcomes · Patient factors · Quality improvement · Renal transplantation · Transplant waiting list

Summary

For the 2011–2013 incident cohort:

- Patients of non-White ethnicity had an equal chance of transplant wait-listing within two years of starting renal replacement therapy (OR 1.03, 95% CI 0.93–1.14). This represents an improvement in equity of access to the kidney transplant waiting list compared to findings from 2008–2010. Once on the transplant waiting list, non-White patients had a 60% lower chance of receiving a kidney transplant of any type within two years (OR 0.40, 95% CI 0.35–0.45).

- Compared to men, women had a 17% lower chance of being activated on the kidney transplant waiting list within two years of starting renal replacement therapy (OR 0.83, 95% CI 0.76–0.90). Once on the transplant waiting list, women had a 15% lower chance of receiving a kidney transplant of any type within two years (OR 0.85, 95% CI 0.76–0.96).
- Compared to patients treated at transplanting centres, patients treated at non-transplanting centres were less likely to be wait-listed for transplantation within two years of starting dialysis (OR 0.70, 95% CI 0.65–0.77), had an equal chance of receiving a transplant from a donor after brainstem death within two years of wait-listing (OR 1.06, 95% CI 0.91–1.23), but were less likely to receive a transplant from a donor after circulatory death or living kidney donor within two years of wait-listing (OR 0.85, 95% CI 0.76–0.95). Overall, this equated to a reduced chance of receiving a transplant from any donor type for patients treated at non-transplanting renal centres (OR 0.88, 95% CI 0.78–0.98).

Introduction

Kidney transplantation is associated with improved clinical outcomes and quality of life compared to dialysis [1–3], so is the preferred method of renal replacement therapy (RRT) for clinically suitable patients. Early transplantation minimises time on dialysis, a factor associated with reduced graft and patient survival.

Early transplant wait-listing increases the probability of transplantation from a deceased donor because the current national kidney allocation scheme [4] prioritises potential transplant recipients who have accrued more time on the waiting list. Therefore, renal centres achieving earlier transplant wait-listing provide their patients with a clinical advantage.

This analysis aims to evaluate whether access to transplant wait-listing and access to transplantation is equitable in the UK. Rates of wait-listing and rates of transplantation after wait-listing were analysed according to patient characteristics. Time from starting RRT to wait-listing was also analysed. Differences between renal centres and between transplanting versus non-transplanting renal centres were analysed, with adjustment for patient characteristics.

Methods

Study population

To identify factors which influence the likelihood of wait-listing for transplantation, an incident RRT cohort was analysed. All adult patients ($N = 20,675$) starting RRT between 1 January 2011 and 31 December 2013 at renal centres ($N = 71$) returning data to the UK Renal Registry (UKRR) were considered for inclusion. Patients aged 65 years and over ($N = 10,151$), patients listed for multi-organ transplants other than kidney and pancreas ($N = 33$) and patients who were suspended for more than 30 days within 90 days of wait-listing ($N = 593$) were excluded. The latter exclusion avoided any potential bias from centres that may activate patients on the transplant waiting list and then immediately suspend them before reactivation after medical assessment of a patient's fitness for transplantation. The remaining 9,898 patients were followed until two years after starting RRT (latest 31 December 2015), until they were registered on the waiting list for a kidney transplant alone or kidney and pancreas transplant, or until death, whichever was earliest.

To identify factors which influence the likelihood of transplantation after wait-listing, patients from the above cohort who were wait-listed before 31 December 2014 were identified. These 5,691 patients were followed until two years after wait-listing (latest 31 December 2016), until they received a kidney transplant alone or kidney and pancreas transplant, or until death, whichever was earliest.

Patients transplanted after starting dialysis were assigned to the renal centre recorded by the UKRR as having provided the dialysis. For patients transplanted pre-emptively, there may be instances where the renal centre recorded was the transplanting centre, even when work-up took place in a non-transplanting centre.

Data analysed

UKRR data included start date of RRT and patient characteristics including age group (18–29, 30–39, 40–49, 50–59, 60–64 years), sex (male, female), ethnicity (White, non-White, missing), and primary renal diagnosis (PRD, classified as: diabetes, other, missing). Date of wait-listing and date of transplantation were provided by the UK Transplant Registry, held by the Organ Donation and Transplantation Directorate of NHS Blood and Transplant.

Outcomes

Proportion of incident dialysis patients wait-listed within two years of starting RRT. In addition to patients wait-listed during the study period, patients who received a living donor transplant within two years of starting RRT were also considered to have been wait-listed.

Days from starting RRT to transplant wait-listing. For patients wait-listed after starting dialysis, time from starting dialysis to wait-listing was recorded. Patients receiving a pre-emptive transplant (living or deceased donor) were recorded as wait-listed on the day of transplantation (i.e. time from starting RRT to wait-listing: zero days). Patients who received a living donor transplant after starting dialysis who had *not* been formally wait-listed prior to transplantation were recorded as wait-listed six months before the date of their transplant (with a minimum time to wait-listing of zero days). This aimed to account for the time needed to prepare patients for a living donor transplant, assuming suitability for wait-listing six months before living donor transplantation.

Proportion of wait-listed patients receiving a transplant within two years of wait-listing. Transplants from donors after brainstem death were considered separately from transplants from donors after circulatory death or living donors, because of differences in the process of allocation. Kidneys from donors after brainstem death are allocated according to national allocation policy, while kidneys from donors after circulatory death are allocated regionally according to the 2006 donor after brainstem death kidney allocation scheme, and one kidney from each donor is offered to the local transplant centre [4]. The process of living donor transplantation is managed by the transplanting centre (and referring non-transplanting centre). The overall proportion transplanted from any donor type was also calculated.

Statistical methods

Logistic regression models were fitted to examine the relationship between patient characteristics (age group, ethnicity, sex, PRD) and transplant wait-listing within two years of starting RRT, or receipt of a transplant within two years of wait-listing. The proportion of all incident RRT patients listed for transplantation within two years of starting RRT and the proportion of wait-listed patients who were transplanted within two years were calculated for each renal centre, with adjustment for the above patient characteristics. Differences in outcome measures between transplanting and non-transplanting renal centres were assessed.

Median time from starting RRT to wait-listing at each renal centre was estimated by Kaplan-Meier (KM) analysis, censored at death or on 31 December 2015, whichever was earlier. Confidence intervals of median time to wait-listing by centre were derived using bootstrapping. In centres where the KM curve did not reach 50% (and therefore median time could not be calculated), the final event time point was used instead. The effect of renal centre on time to wait-listing was calculated by including renal centre as a covariate in a Cox regression model for time to wait-listing including patients from all centres.

Funnel plots were used to present results for each outcome variable, providing a visual comparison of the relative performance of renal centres. Where appropriate, funnel plots were adjusted for patient characteristics known to influence each outcome, based on the results of the logistic regression models described above. In each funnel plot, the solid thick line indicates the national mean. Dashed lines indicate 95% and 99.8% confidence intervals, corresponding to two and three standard deviations from the mean respectively. Each point on the plot represents one renal centre. For each outcome measure, if no significant inter-centre variation was present, three of 71 renal centres would be expected to fall between the 95% and 99.8% confidence intervals and no centre should fall outside the 99.8% confidence interval. Funnel plots showing the proportion of patients transplanted at two years after wait-listing excluded centres with fewer than ten patients wait-listed at the start of the study period ($N = 3$).

SAS 9.3 was used for all analyses. A p value below 5% was considered statistically significant. The analysis described is based on the methodology described in chapter 11 of the UKRR 17th Annual Report [5] and a previous independently peer-reviewed publication [6].

Results

Access to transplantation by patient characteristics

Table 9.1 shows results of logistic regression analysis for the relationship between patient characteristics and the odds of transplant wait-listing within two years of starting RRT. There were missing ethnicity data for 7.9% of patients and missing PRD data for 4.5%.

The results of logistic regression analyses for the relationship between patient characteristics and the likelihood of receiving a kidney transplant within two years of wait-listing are shown in table 9.2 (donor after brain-stem death), table 9.3 (donor after circulatory death or living kidney donor) and table 9.4 (any donor type). Ethnicity data were missing for 7.6% of patients and PRD data for 3.6%.

Access to transplantation by individual renal centre

After adjusting for patient characteristics (age, ethnicity, sex, PRD), there were significant differences between renal centres in the proportion of patients wait-listed within two years of starting RRT (figure 9.1, table 9.5).

After adjusting for patient characteristics (age, ethnicity, sex, PRD), there were also significant differences between renal centres in the proportion of patients receiving a kidney transplant within two years of wait-listing. This was true for transplants from donors after

Table 9.1. Multivariable logistic regression model showing the relationship between patient characteristics and odds of transplant wait-listing within two years of starting RRT

Factor	Category	Patients N (%)	Odds ratio	95% CI	P value
Age	18–29	818 (8.3)	1	ref	n/a
	30–39	1,256 (12.7)	0.73	0.59–0.91	0.0046
	40–49	2,392 (24.2)	0.48	0.40–0.59	<0.0001
	50–59	3,349 (33.8)	0.28	0.23–0.34	<0.0001
	60–64	2,083 (21.0)	0.14	0.11–0.17	<0.0001
Ethnicity	White	6,613 (66.8)	1	ref	n/a
	Non-White	2,505 (25.3)	1.03	0.93–1.14	0.54
	Missing	780 (7.9)	0.97	0.83–1.14	0.70
Sex	Male	6,047 (61.1)	1	ref	n/a
	Female	3,851 (38.9)	0.83	0.76–0.90	<0.0001
PRD	Not diabetic	6,857 (69.3)	1	ref	n/a
	Diabetic	2,597 (26.2)	0.47	0.43–0.52	<0.0001
	Missing	444 (4.5)	0.57	0.47–0.70	<0.0001

ref – reference category; n/a – not applicable

Table 9.2. Multivariable logistic regression model showing the relationship between patient characteristics and odds of receiving a transplant from a donor after brainstem death within two years of wait-listing

Factor	Category	Patients N (%)	Odds ratio	95% CI	P value
Age	18–29	680 (12.0)	1	ref	n/a
	30–39	954 (16.8)	1.02	0.80–1.30	0.87
	40–49	1,578 (27.7)	0.62	0.49–0.78	<0.0001
	50–59	1,745 (30.7)	0.39	0.31–0.50	<0.0001
	60–64	734 (12.9)	0.31	0.23–0.43	<0.0001
Ethnicity	White	3,780 (66.4)	1	ref	n/a
	Non-White	1,480 (26.0)	0.72	0.60–0.85	0.0002
	Missing	431 (7.6)	1.27	0.98–1.65	0.068
Sex	Male	3,554 (62.5)	1	ref	n/a
	Female	2,137 (37.5)	0.95	0.82–1.10	0.50
PRD	Not diabetic	4,391 (77.2)	1	ref	n/a
	Diabetic	1,093 (19.2)	2.55	2.15–3.01	<0.0001
	Missing	207 (3.6)	1.32	0.90–1.95	0.16

ref – reference category; n/a – not applicable

Table 9.3. Multivariable logistic regression model showing the relationship between patient characteristics and the odds of receiving a transplant from a donor after circulatory death or living kidney donor within two years of wait-listing

Factor	Category (at baseline)	Patients N (%)	Odds ratio	95% CI	P value
Age	18–29	680 (12.0)	1	ref	n/a
	30–39	954 (16.8)	0.66	0.54–0.81	<0.0001
	40–49	1,578 (27.7)	0.51	0.42–0.61	<0.0001
	50–59	1,745 (30.7)	0.50	0.42–0.60	<0.0001
	60–64	734 (12.9)	0.43	0.34–0.53	<0.0001
Ethnicity	White	3,780 (66.4)	1	ref	n/a
	Non-White	1,480 (26.0)	0.47	0.41–0.54	<0.0001
	Missing	431 (7.6)	0.71	0.58–0.87	0.0012
Sex	Male	3,554 (62.5)	1	ref	n/a
	Female	2,137 (37.5)	0.88	0.79–0.98	0.023
PRD	Not diabetic	4,391 (77.2)	1	ref	n/a
	Diabetic	1,093 (19.2)	0.55	0.48–0.64	<0.0001
	Missing	207 (3.6)	0.66	0.49–0.89	0.0058

ref – reference category; n/a – not applicable

brainstem death (figure 9.2, table 9.6) and transplants from donors after circulatory death or living donors (figure 9.3, table 9.6). The number of centres falling on or outside the 99.8% confidence intervals was more marked in the analysis of transplants from donors after circulatory death or living kidney donors, with five falling above and ten centres below. Overall, this equated to a significant inter-centre difference in the proportion of patients receiving a transplant from any donor type within two years of wait-listing (figure 9.4, table 9.6).

Access to transplantation by transplanting vs non-transplanting renal centre

Compared to patients treated at transplanting renal centres, those treated at non-transplanting renal centres:

- Were less likely to be wait-listed within two years of starting dialysis (OR 0.70, 95% CI 0.65–0.77)
- Had an equal chance of receiving a transplant from a donor after brainstem death within two years of wait-listing (OR 1.06, 95% CI 0.91–1.23)

Table 9.4. Multivariable logistic regression model showing the relationship between patient characteristics and the odds of receiving a transplant from any donor type (DBD, DCD or living donor) within two years of wait-listing

Factor	Category (at baseline)	Patients N (%)	Odds ratio	95% CI	P value
Age	18–29	680 (12.0)	1	ref	n/a
	30–39	954 (16.8)	0.61	0.49–0.77	<0.0001
	40–49	1,578 (27.7)	0.33	0.27–0.41	<0.0001
	50–59	1,745 (30.7)	0.26	0.21–0.32	<0.0001
	60–64	734 (12.9)	0.21	0.16–0.26	<0.0001
Ethnicity	White	3,780 (66.4)	1	ref	n/a
	Non-White	1,480 (26.0)	0.40	0.35–0.45	<0.0001
	Missing	431 (7.6)	0.81	0.66–1.00	0.048
Sex	Male	3,554 (62.5)	1	ref	n/a
	Female	2,137 (37.5)	0.85	0.76–0.96	0.0063
PRD	Not diabetic	4,391 (77.2)	1	ref	n/a
	Diabetic	1,093 (19.2)	1.03	0.90–1.19	0.67
	Missing	207 (3.6)	0.77	0.57–1.03	0.079

DBD – donor after brainstem death; DCD – donor after circulatory death; ref – reference category; n/a – not applicable

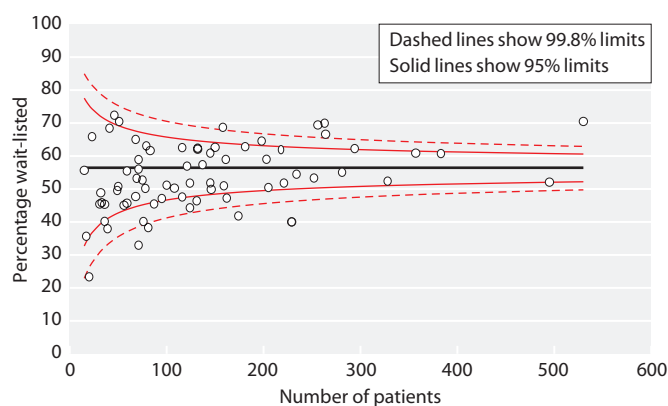


Fig. 9.1. Proportion of incident 2011–2013 RRT patients wait-listed prior to, or within two years of starting RRT, by renal centre



Fig. 9.3. Proportion of incident 2011–2013 RRT patients, listed by 31 December 2014, who received a transplant from a donor after circulatory death or living donor within two years of wait-listing, by renal centre

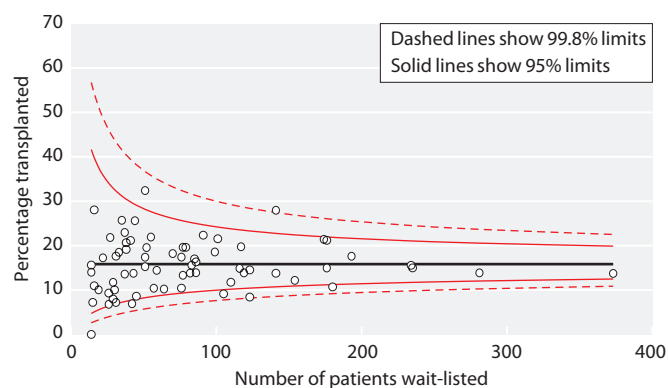


Fig. 9.2. Proportion of incident 2011–2013 RRT patients, listed by 31 December 2014, who received a transplant from a donor after brainstem death within two years of wait-listing, by renal centre

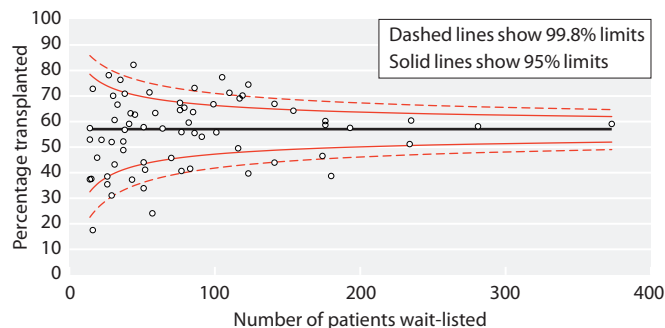


Fig. 9.4. Proportion of incident 2011–2013 RRT patients, listed by 31 December 2014, who received a transplant from any donor type (donor after brainstem death, donor after circulatory death or living donor) within two years of wait-listing, by renal centre

Table 9.5. Proportion of incident patients in each renal centre wait-listed for a kidney transplant prior to or within two years of starting RRT

Centre	RRT N	Wait-listed at 2 years N	% wait-listed		Centre	RRT N	Wait-listed at 2 years N	% wait-listed	
			Unadjusted	Risk-adjusted				Unadjusted	Risk-adjusted
England					Plymth	68	43	63.2	65.0
B Heart	137	78	56.9	57.4	Ports	264	173	65.5	66.6
B QEH	328	175	53.4	52.4	Prestn	205	103	50.2	50.5
Basldn	68	30	44.1	47.7	Redng	132	78	59.1	62.1
Bradfd	108	57	52.8	50.3	Salford	198	117	59.1	64.6
Brightn	162	77	47.5	47.2	Sheff	203	119	58.6	59.0
Bristol	218	140	64.2	61.9	Shrew	76	28	36.8	40.1
Camb	150	101	67.3	62.6	Stevng	181	118	65.2	62.8
Carlis	46	34	73.9	72.4	Sthend	41	30	73.2	68.4
Carsh	281	150	53.4	55.1	Stoke	100	49	49.0	51.2
Chelms	59	33	55.9	55.5	Sund	87	39	44.8	45.5
Colchr	36	14	38.9	40.2	Truro	51	36	70.6	70.5
Covnt	146	77	52.7	49.9	Wirral	69	35	50.7	53.2
Derby	116	54	46.6	47.6	Wolve	124	56	45.2	44.3
Donc	71	41	57.7	58.9	York	71	41	57.7	56.0
Dorset	83	51	61.4	61.7	N Ireland				
Dudley	71	23	32.4	33.0	Antrim	32	15	46.9	48.9
Exeter	116	71	61.2	62.6	Belfast	121	74	61.2	56.9
Glouc	75	39	52.0	52.7	Newry	31	13	41.9	45.5
Hull	124	62	50.0	51.8	Ulster	33	14	42.4	45.8
Ipswi	56	26	46.4	45.1	West NI	36	18	50.0	45.4
Kent	161	94	58.4	59.0	Scotland				
L Barts	495	269	54.3	52.1	Abrdn	78	37	47.4	50.2
L Guys	221	114	51.6	51.8	Airdrie	79	49	62.0	63.1
L Kings	229	90	39.3	40.0	D & Gall	15	9	60.0	55.7
L Rfree	357	229	64.1	60.9	Dundee	59	26	44.1	45.7
L St.G	132	81	61.4	62.4	Edinb	145	74	51.0	51.8
L West	530	369	69.6	70.5	Glasgw	256	175	68.4	69.4
Leeds	252	139	55.2	53.3	Inverns	23	15	65.2	65.9
Leic	383	230	60.1	60.8	Klmarnk	50	24	48.0	50.8
Liv Ain	81	30	37.0	38.3	Krkldy	49	22	44.9	49.6
Liv Roy	174	77	44.3	41.8	Wales				
M RI	294	187	63.6	62.3	Bangor	20	4	20.0	23.4
Middlbr	158	108	68.4	68.7	Cardff	234	125	53.4	54.5
Newc	159	83	52.2	51.0	Clwyd	17	6	35.3	35.7
Norwch	95	46	48.4	47.1	Swanse	131	59	45.0	46.4
Nottm	145	89	61.4	60.9	Wrexm	39	14	35.9	38.0
Oxford	263	181	68.8	70.0					

- Were less likely to receive a transplant from a donor after circulatory death or living donor within two years of wait-listing (OR 0.85, 95% CI 0.76–0.95).

Overall, this equated to a reduced chance of receiving a transplant from any donor type for patients treated at non-transplanting renal centres (OR 0.88, 95% CI 0.78–0.98).

Time to transplant wait-listing by renal centre

Table 9.7 shows the median time (days), or the final event time, from starting RRT to wait-listing for each renal centre. Figure 9.5 shows a funnel plot of time from starting RRT to wait-listing by renal centre. These values were derived from simulations based on the actual data and for six centres (those with fewer events and/or longer waiting times) median values could not be estimated, so final event times are shown.

Table 9.6. Proportion of patients receiving a transplant within two years of wait-listing, by donor type and renal centre

Centre	Donor after brainstem death				Donor after circulatory death/ living kidney donor				Any donor type				
	Wait-listed N	Transplanted N	Proportion transplanted within 2 years of wait-listing (%)		Transplanted N	Proportion transplanted within 2 years of wait-listing (%)		Transplanted N	Proportion transplanted within 2 years of wait-listing (%)				
			Unadjusted	Risk- adjusted		Unadjusted	Risk- adjusted		Unadjusted	Risk- adjusted			
Transplanting centre median (IQR)													60.2 (55.5–67.4)
Non-transplanting centre median (IQR)													55.0 (41.3–63.4)
England													
B Heart	83	14	16.9	15.6	19	22.9	25.5	33	39.8	41.5			
B QEH	180	17	9.4	10.7	50	27.8	28.0	67	37.2	38.7			
Basldn	31	2	6.5	7.2	11	35.5	35.7	13	41.9	43.2			
Bradfd	55	11	20.0	21.9	27	49.1	50.8	38	69.1	71.4			
Brightn	77	14	18.2	19.6	19	24.7	22.4	33	42.9	40.7			
Bristol	141	19	13.5	13.8	47	33.3	30.4	66	46.8	43.9			
Camb	105	9	8.6	9.1	77	73.3	66.6	86	81.9	77.3			
Carlis	33	6	18.2	18.5	18	54.5	47.4	24	72.7	66.6			
Carsh	154	18	11.7	12.2	77	50.0	51.7	95	61.7	64.2			
Chelms	35	9	25.7	25.7	19	54.3	51.8	28	80.0	76.3			
Colchr	16	5	31.3	28.0	8	50.0	44.2	13	81.3	72.8			
Covnt	82	11	13.4	13.8	42	51.2	45.3	53	64.6	59.6			
Derby	52	10	19.2	19.6	12	23.1	22.2	22	42.3	41.2			
Donc	43	6	14.0	13.8	11	25.6	23.8	17	39.5	37.3			
Dorset	51	10	19.6	17.4	9	17.6	16.2	19	37.3	33.9			
Dudley	26	2	7.7	6.8	8	30.8	28.8	10	38.5	35.4			
Exeter	70	13	18.6	18.2	22	31.4	28.2	35	50.0	45.8			
Glouc	38	7	18.4	19.1	15	39.5	37.9	22	57.9	56.8			
Hull	64	7	10.9	10.2	33	51.6	46.8	40	62.5	57.3			
Ipswi	27	6	22.2	21.8	17	63.0	56.0	23	85.2	78.2			
Kent	99	21	21.2	18.6	50	50.5	48.1	71	71.7	66.8			
L Barts	281	36	12.8	13.9	107	38.1	44.6	143	50.9	58.1			
L Guys	119	16	13.4	13.9	60	50.4	56.6	76	63.9	70.2			
L Kings	91	18	19.8	22.4	26	28.6	31.7	44	48.4	54.1			
L Rfree	235	33	14.0	15.0	93	39.6	45.6	126	53.6	60.4			
L St.G	85	12	14.1	17.0	34	40.0	46.3	46	54.1	63.7			
L West	373	47	12.6	13.7	142	38.1	45.6	189	50.7	59.1			
Leeds	141	36	25.5	28.0	61	43.3	40.3	97	68.8	66.9			
Leic	234	35	15.0	15.6	82	35.0	35.7	117	50.0	51.2			
Liv Ain	31	5	16.1	17.6	14	45.2	42.8	19	61.3	60.6			
Liv Roy	79	15	19.0	19.6	41	51.9	45.8	56	70.9	65.4			
M RI	193	33	17.1	17.6	77	39.9	39.7	110	57.0	57.5			
Middlbr	110	14	12.7	11.8	70	63.6	59.4	84	76.4	71.3			
Newc	86	12	14.0	13.9	55	64.0	58.5	67	77.9	73.2			
Norwch	45	4	8.9	8.6	28	62.2	52.9	32	71.1	62.7			
Nottm	86	13	15.1	16.3	37	43.0	39.2	50	58.1	55.5			

Table 9.6. Continued

Centre	Donor after brainstem death				Donor after circulatory death/ living kidney donor				Any donor type			
	Transplanted		Proportion transplanted within 2 years of wait-listing (%)		Transplanted		Proportion transplanted within 2 years of wait-listing (%)		Transplanted		Proportion transplanted within 2 years of wait-listing (%)	
	Wait-listed N	N	Unadjusted	Risk- adjusted	N	N	Unadjusted	Risk- adjusted	N	N	Unadjusted	Risk- adjusted
Oxford	176	39	22.2	21.2	63	63	35.8	37.2	102	102	58.0	58.7
Plymouth	44	10	22.7	25.6	28	28	63.6	57.1	38	38	86.4	82.2
Ports	174	39	22.4	21.4	46	46	26.4	25.4	85	85	48.9	46.5
Prestn	101	21	20.8	21.5	37	37	36.6	34.9	58	58	57.4	55.8
Redng	77	11	14.3	13.3	30	30	39.0	43.4	41	41	53.2	55.9
Salford	116	18	15.5	14.9	37	37	31.9	34.5	55	55	47.4	49.5
Sheff	123	11	8.9	8.4	41	41	33.3	31.3	52	52	42.3	39.7
Shrew	29	2	6.9	8.0	13	13	44.8	42.9	15	15	51.7	52.0
Stevng	117	22	18.8	19.7	57	57	48.7	49.3	79	79	67.5	69.1
Sthend	30	3	10.0	10.0	20	20	66.7	59.0	23	23	76.7	70.1
Stoke	51	8	15.7	15.3	16	16	31.4	28.6	24	24	47.1	44.0
Sund	42	3	7.1	6.9	26	26	61.9	55.6	29	29	69.0	63.2
Truro	38	9	23.7	20.7	21	21	55.3	49.7	30	30	78.9	70.9
Wirral	37	6	16.2	13.6	15	15	40.5	38.9	21	21	56.8	52.2
Wolve	57	5	8.8	10.4	8	8	14.0	14.1	13	13	22.8	24.1
York	41	9	22.0	21.2	19	19	46.3	38.5	28	28	68.3	59.1
N Ireland												
Antrim	15	1	6.7	7.2	5	5	33.3	29.8	6	6	40.0	37.6
Belfast	76	8	10.5	10.4	47	47	61.8	53.2	55	55	72.4	64.5
Newry	16	2	12.5	11.0	1	1	6.3	6.1	3	3	18.8	17.5
Ulster	14	0	0.0	0.0	7	7	50.0	46.0	8	8	57.1	53.0
West NI	19	2	10.5	10.0	8	8	42.1	35.7	10	10	52.6	45.9
Scotland												
Abrdn	37	12	32.4	23.0	7	7	18.9	20.4	19	19	51.4	48.8
Airdrie	51	18	35.3	32.4	13	13	25.5	24.7	31	31	60.8	57.8
D&Gall	9	1	11.1	8.2	5	5	55.6	56.8	6	6	66.7	61.5
Dundee	29	4	13.8	11.7	5	5	17.2	18.6	9	9	31.0	31.1
Edinb	76	17	22.4	17.4	36	36	47.4	50.2	53	53	69.7	67.4
Glasgw	176	31	17.6	15.0	74	74	42.0	45.9	105	105	59.7	60.2
Inverns	14	2	14.3	14.0	3	3	21.4	23.1	5	5	35.7	37.4
Kilmarnk	26	3	11.5	9.3	7	7	26.9	29.6	10	10	38.5	38.5
Krklcly	22	5	22.7	17.2	7	7	31.8	34.2	12	12	54.5	52.8
Wales												
Bangor	5	1	20.0	22.7	1	1	20.0	16.1	2	2	40.0	35.5
Cardff	123	19	15.4	14.5	80	80	65.0	59.9	99	99	80.5	74.5
Clwyd	6	1	16.7	16.5	3	3	50.0	42.7	4	4	66.7	59.0
Swanse	59	10	16.9	14.4	33	33	55.9	48.8	43	43	72.9	63.4
Wrexm	14	2	14.3	15.6	7	7	50.0	42.1	9	9	64.3	57.4

Transplanting renal centres are shown in bold

Table 9.7. Median time (days), or final event time*, from starting RRT to transplant wait-listing by renal centre

Centre	RRT N	Wait-listed at 2 years N	Median time to listing (days)	Final event time (days*)	Centre	RRT N	Wait-listed at 2 years N	Median time to listing (days)	Final event time (days*)
England					Plymth	68	46	213	
B Heart	137	84	385		Ports	264	181	147	
B QEH	328	187	466		Prestn	205	110	589	
Basldn	68	32	854		Redng	132	81	372	
Bradfd	108	61	489		Salford	198	122	256	
Brightn	162	82	750		Sheff	203	127	300	
Bristol	218	143	176		Shrew	76	30	n/a	1,252
Camb	150	107	2		Stevng	181	124	198	
Carlis	46	34	93		Sthend	41	30	107	
Carsh	281	170	480		Stoke	100	53	387	
Chelms	59	36	402		Sund	87	44	796	
Colchr	36	16	787		Truro	51	39	105	
Covnt	146	86	511		Wirral	69	38	483	
Derby	116	59	748		Wolve	124	61	965	
Donc	71	45	250		York	71	41	179	
Dorset	83	52	266		N Ireland				
Dudley	71	27	n/a	1,095	Antrim	32	16	482	
Exeter	116	72	337		Belfast	121	78	232	
Glouc	75	42	538		Newry	31	18	911	
Hull	124	66	623		Ulster	33	15	1,100	
Ipswi	56	28	865		West NI	36	19	436	
Kent	161	102	349		Scotland				
L Barts	495	299	509		Abrdn	78	40	615	
L Guys	221	122	512		Airdrie	79	51	351	
L Kings	229	98	n/a	1,064	D & Gall	15	9	214	
L Rfree	357	251	188		Dundee	59	32	855	
L St.G	132	91	260		Edinb	145	79	507	
L West	530	391	223		Glasgw	256	179	162	
Leeds	252	149	308		Inverns	23	16	231	
Leic	383	240	147		Klmarnk	50	26	441	
Liv Ain	81	35	869		Krkcldy	49	23	633	
Liv Roy	174	84	914		Wales				
M RI	294	196	244		Bangor	20	5	n/a	1,283
Middlbr	158	116	148		Cardff	234	132	330	
Newc	159	95	535		Clwyd	17	6	n/a	512
Norwch	95	48	622		Swanse	131	60	719	
Nottm	145	93	126		Wrexm	39	15	n/a	958
Oxford	263	191	125						

n/a – not applicable

*Final event time given for centres where median time could not be estimated

Discussion

Patient characteristics and access to transplantation

Increasing patient age was associated with reducing odds of wait-listing and of transplantation from any donor type. This is an expected finding because of the effect of age on the risks and benefits of transplantation: older age is associated with increasing comorbidity and therefore increased clinical risk of transplantation, while

the potential benefit of transplantation in extending life reduces with increasing age. Older patients who are suitable for transplantation would be expected to have increased comorbidity and therefore require more screening investigations before being wait-listed, reducing the chance of wait-listing within two years of starting RRT. Reduced odds of receiving a transplant from a donor after brainstem death in older patients reflects the role of age in the national kidney allocation scheme [4].

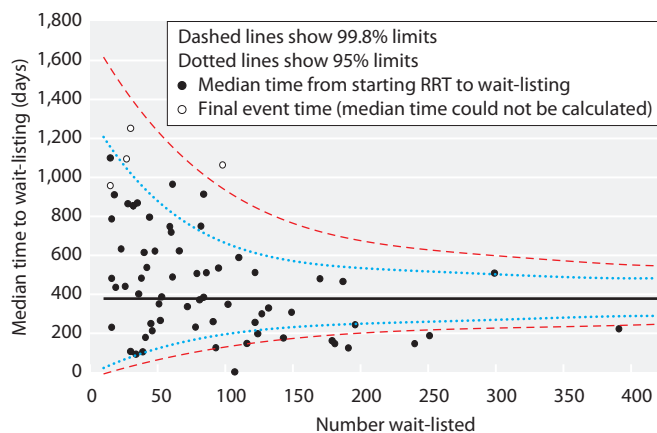


Fig. 9.5. Median time (or final event time) from starting RRT to wait-listing, by renal centre in the 2011–2013 incident cohort

In analyses adjusted for age, ethnicity and PRD, female sex was associated with a reduced chance of transplant wait-listing within two years of starting RRT (OR 0.83; 95%CI: 0.76–0.90), reduced chance of DCD/living donor transplant within two years of wait-listing (OR 0.88; 95% CI: 0.79–0.98), and reduced chance of any transplant within two years of wait-listing (OR 0.85; 95% CI: 0.76–0.96). As would be expected, there was no significant difference by sex in the odds of transplantation from a donor after brainstem death within two years of wait-listing (OR 0.95; 95% CI: 0.82–1.10). While previous reports have not always shown significant differences in wait-listing or transplantation by sex, when there have been differences, women have been shown to be at a relative disadvantage. This finding needs validating in an extended, multi-year UK cohort with data on comorbidity, but if confirmed clearly needs work to explore possible explanations.

Patients with diabetes as their PRD were less likely to be wait-listed within two years of starting RRT, and less likely to receive a transplant from a donor after circulatory death/living donor within two years of wait-listing. Higher prevalence of comorbidity amongst patients with diabetes may preclude transplantation or lengthen the medical evaluation process, explaining this finding. Patients with diabetes as their PRD were found to be more likely to receive a transplant from a donor after brainstem death once on the waiting list. This is likely to reflect the prioritisation of dual organ transplantation in organ allocation policy, in addition to the increase in the number of simultaneous kidney pancreas transplants during the study period. There was no overall difference by diabetic status in the likelihood of transplantation at

two years after wait-listing when all donor types were considered.

As in the 19th Annual Report [7], non-White ethnicity did not significantly influence the likelihood of wait-listing (OR 1.03; 95% CI: 0.93–1.15). There was a persisting effect of non-White ethnicity in reducing the chance of transplantation from a donor after brainstem death within two years of wait-listing, with a similar magnitude to analysis from 2013–2015 (OR 0.72; 95% CI: 0.60–0.85 compared to OR 0.79; 95% CI: 0.65–0.95) [7]. This effect remained smaller than the one observed on the incident 2008–2010 cohort (OR 0.65; 95% CI: 0.52–0.81) [5]. This may reflect changes in the efficiency of preparation for transplant wait-listing (for instance, earlier completion of pre-transplant investigations for patients with diabetes, who were more likely to have non-White ethnicity), changes in the demographics of potential transplant recipients with non-White ethnicity, and alterations in the national kidney allocation scheme, which now has less strict criteria in relation to human leucocyte antigen (HLA) matching [4]. The latter change means that recipients with non-White ethnicity were less likely to be disadvantaged by the relative lack of organs from non-White donors. There were persisting differences by ethnicity in rates of transplantation from a donor after circulatory death/living donor. It should be noted that differences in socioeconomic status between ethnic groups have previously been found to account for some of the difference in access to transplantation by ethnicity [8, 9]. Lack of adjustment for socioeconomic status therefore limits the reliability of these results. The UKRR is collaborating with the Access to Transplant and Transplant Outcome Measures (ATTOM) study, whose forthcoming results include analyses with detailed adjustment for comorbidity and individual level socioeconomic status.

When interpreting the analyses in this chapter it is also important to consider the potential impact of missing data on the results. Data were missing either because a renal centre failed to complete relevant fields on their renal IT system or from a failure to extract this data. Missing data may not be at random: patients with increased comorbidity are likely to die sooner, allowing inadequate time for their physician to enter relevant comorbidity data. The very process of working up and listing a patient makes it less likely that data will be missing. It is therefore perhaps not surprising that patients on the national kidney transplant waiting list were more likely to have ethnicity and PRD data reported ($p < 0.0001$)

Centre variation in access to transplantation

The analyses presented here suggest significant inter-centre variation in access to the transplant waiting list and access to transplantation, after adjustment for patient demographics and PRD. However, such results should be interpreted with caution. Adjustment for comorbidity included only diabetes as a PRD. Other comorbidities, unaccounted for in these analyses, may also preclude or delay wait-listing and transplantation. Adjustment for several other factors known to influence access to transplantation, including socioeconomic status, PRD other than diabetes, comorbidity, and HLA sensitisation was not performed. Whilst the processes of wait-listing or transplantation from a donor after circulatory death/living donor are directly influenced by individual centre practice, the allocation of transplants from donors after brainstem death is controlled by the national kidney allocation scheme. Therefore, rates of transplantation from donors after brainstem death should be relatively independent of centre practice differences (except for variation in the acceptance criteria of individual clinicians). As such, the persistence of significant inter-centre variation in rates of transplantation from donors after brainstem death is consistent with under-adjustment for patient factors.

After adjustment for patient characteristics, patients treated at transplanting renal centres had increased access to transplant wait-listing and to transplantation from a

donor after circulatory death or living donor. There was no difference in access to transplants from donors after brainstem death once patients were wait-listed. These have been consistent findings in UKRR analyses since 2010, suggesting that reduced contact with clinicians directly involved in transplantation and increased geographical distance to transplanting centres reduces access to transplantation. This analysis may be subject to bias by lack of conclusive adjustment for patient characteristics as well as the allocation of patients receiving a pre-emptive transplant to their transplanting centre, even if the work-up had been initiated in a timely fashion by the non-transplanting centre. Lastly, there was competition between the two outcome variables (transplant from a donor after brainstem death versus transplant from a donor after circulatory death/living donor). As such, patients from centres with a higher rate of transplantation from a donor after circulatory death/living donor may have reduced odds of transplantation from a donor after brainstem death (and vice versa).

These issues will be addressed in future analyses, allocating patients according to their location of residence (rather than their treatment centre), and using methodology which accounts for competing risk. In addition, the results of analyses from the ATTOM study with more detailed adjustment for case mix are forthcoming.

Conflicts of interest: the authors declare no conflicts of interest

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