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UK Renal Registry 19th Annual Report: Chapter 11 Centre Variation in Access to Kidney Transplantation (2010–2015)

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Keywords

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

Summary

- Patients of non-White ethnicity had, for the first time, an equal chance of being listed to receive a kidney transplant within two years of starting renal replacement therapy (OR 1.03, 95% CI 0.93–1.15). This overall improvement in equity of access to transplantation belies a persisting reduced odds of receiving a transplant once on the waiting list.
- Patients treated at non-transplanting renal centres were less likely to be wait listed for transplantation compared to patients treated at transplanting renal centres (OR 0.78, 95% CI 0.72–0.85).
- Patients treated at non-transplanting renal centres were less likely to receive a transplant from a donor after cardiac death or living kidney donor compared to patients treated at a transplanting renal centre (OR 0.79, 95% CI 0.71–0.89).
- Once wait listed for transplantation, patients from both transplanting and non-transplanting renal centres had an equal chance of receiving a transplant from a donor after brainstem death (OR 1.03, 95% CI 0.88–1.20).
- After adjustment for case mix, there were significant differences between renal centres in the rate of transplant wait listing ($p < 0.0001$), time from start of renal replacement therapy to wait listing ($p < 0.0001$), rate of transplantation from a donor after brainstem death ($p = 0.0046$) and rate of transplantation from a donor after cardiac death or living donor ($p < 0.0001$).

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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. Further, 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 (i.e. conversion efficiency from wait listing to transplantation) were analysed according to patient characteristics. Time taken to wait listing was also analysed. Differences between renal centres and between transplanting versus non-transplanting renal centres were analysed, with adjustment for case mix.

Methods

Study population

To identify factors which influence the likelihood of wait listing for transplantation, an incident RRT cohort was analysed. All adult patients starting RRT between 1st January 2010 and 31st December 2012 at renal centres returning data to the UK Renal Registry ($N = 71$ centres) were considered for inclusion ($N = 20{,}268$ patients). Patients aged 65 years and over (10,026), patients listed for multi-organ transplants other than kidney and pancreas ($N = 41$) and patients who were suspended for more than 30 days within 90 days of wait listing ($N = 464$) were excluded. The latter exclusion avoided any potential bias from centres that may activate patients on the transplant list and then immediately suspend them before reactivation after medical assessment of a patient's fitness for transplantation. The remaining 9,737 patients were followed until two years from RRT start (latest 31st December 2014), 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, patients from the above cohort who were wait listed before 31st December 2013 were identified. These 5,555 patients were followed until two years after wait listing (latest 31st December 2015), until they received a kidney transplant alone or kidney and pancreas transplant, or until death, whichever was earliest.

For patients transplanted after starting dialysis, renal centre is recorded by the UKRR as the centre providing dialysis. For patients transplanted pre-emptively, there may be instances where the renal centre recorded is the transplanting centre, even when work-up has taken place in a non-transplanting centre.

Data analysed

Baseline data

UK Renal Registry (UKRR) data included start date of RRT and patient characteristics including age group (18–29, 30–39, 40–49, 50–59, or 60–64 years), gender, 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.

Outcome variables

Proportion of incident dialysis patients wait listed within two years of RRT start. In addition to patients wait listed during the study period, any patient who received a living donor transplant within two years of RRT start was also included, even if they were not on the national transplant waiting list before transplantation.

Days from RRT start to transplant wait listing. For all patients formally wait listed after starting dialysis, time from dialysis start to wait listing was used. Patients receiving a pre-emptive transplant (living or deceased-donor) were recorded as wait listed on the day of starting RRT (i.e. time 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 on the day of transplantation.

Conversion efficiency: the proportion of wait listed patients receiving a transplant within two years of listing. Transplants from donors after brainstem death were considered separately from transplants from donors after cardiac 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 cardiac 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).

Statistical methods

Logistic regression models were fitted to examine the relationship between patient characteristics (age group, ethnicity, gender and PRD) and transplant wait listing within two years of RRT start, 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 RRT start 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. The overall effect of renal centre on each outcome variable was measured by including renal centre as a random effect in a risk-adjusted logistic regression model. The significance of any variation between centres was determined using a log likelihood

ratio test that provided the change in the value of −2 Log L on inclusion of the random centre effect.

Median time from RRT start to wait listing at each renal centre was estimated by Kaplan-Meier analysis, censored at death or on 31st December 2014, whichever was earlier. This methodology takes into account all patients at risk of wait listing during the study period, not only those who were wait listed. 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 amongst patients from all centres. Median times to wait listing by centre (and their confidence intervals) were derived by simulations based on the actual data.

Funnel plots are used to present the results for each outcome variable, providing a visual comparison of the relative performance of renal centres. Where appropriate, funnel plots are adjusted for patient characteristics known to influence each outcome, based on the results of the logistic regression models described above. The solid black line in each funnel plot indicates the national average. Dashed lines indicate 95% and 99.8% confidence intervals, which correspond to two and three standard deviations from the mean. Each point on the plot represents one renal centre. For each outcome measure, if no significant between-centre variation is 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 those centres ($N = 2$) with fewer than 10 patients wait listed at the start of the study period.

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

Table 11.1 shows results from logistic regression analysis of the relationship between patient characteristics and the odds of transplant wait listing at two years from RRT start. There were missing ethnicity data for 7.8% of patients and missing PRD data for 3.7%.

Tables 11.2 and 11.3 show results from logistic regression analyses of the relationship between patient characteristics and the likelihood of receiving a transplant from a donor after brainstem death or from a donor after cardiac death/living kidney donor within two years of wait listing, respectively. Ethnicity data were missing for 7.1% of patients and PRD for 3.3%.

A patient starting dialysis in a non-transplanting renal centre was less likely to be wait listed for transplantation (OR 0.78, 95% CI 0.72–0.85) or receive a transplant from a donor after cardiac death or living donor (OR 0.79, 95% CI 0.71–0.89) compared with patients managed in transplanting renal centres. Once active on the transplant waiting list, patients in both transplanting and non-transplanting renal centres had an equal chance of receiving a transplant from a donor after brainstem death (OR 1.03, 95% CI 0.88–1.20).

After adjusting for patient characteristics, there were significant differences between renal centres in the proportion of patients wait listed for transplantation at two years from RRT start (change in $-2 \log L = 164.6$,

Table 11.1. Logistic regression model showing the relationship between patient characteristics and odds of transplant wait listing within two years of RRT start

Factor	Category (at baseline)	Patients *N* (%)	Odds ratio	95% CI	*P* value
Age	18–29	851 (8.7)	1	ref	n/a
	30–39	1,288 (13.2)	0.75	0.60–0.93	0.0076
	40–49	2,337 (24.0)	0.50	0.41–0.60	<0.0001
	50–59	3,198 (32.8)	0.27	0.22–0.32	<0.0001
	60–64	2,063 (21.2)	0.14	0.11–0.17	<0.0001
Ethnicity	White	6,629 (68.1)	1	ref	n/a
	Non-White	2,348 (24.1)	1.03	0.93–1.15	0.54
	Missing	760 (7.8)	0.85	0.73–1.01	0.057
Gender	Male	5,914 (60.7)	1	ref	n/a
	Female	3,823 (39.3)	0.85	0.78–0.93	0.0002
PRD	Not diabetic	6,826 (70.1)	1	ref	n/a
	Diabetic	2,546 (26.2)	0.45	0.41–0.50	<0.0001
	Missing	365 (3.7)	0.64	0.51–0.79	<0.0001

ref – reference category; n/a – not applicable

Table 11.2. 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 (at baseline)	Patients *N* (%)	Odds ratio	95% CI	*P* value
Age	18–29	702 (12.6)	1	ref	n/a
	30–39	971 (17.5)	1.18	0.91–1.53	0.20
	40–49	1,535 (27.6)	0.89	0.70–1.14	0.36
	50–59	1,626 (29.3)	0.47	0.36–0.61	<0.0001
	60–64	721 (13.0)	0.35	0.24–0.49	<0.0001
Ethnicity	White	3,770 (67.9)	1	ref	n/a
	Non-White	1,387 (25.0)	0.79	0.65–0.95	0.0012
	Missing	398 (7.1)	1.29	0.97–1.70	0.078
Gender	Male	3,430 (61.8)	1	ref	n/a
	Female	2,125 (38.2)	1.12	0.96–1.31	0.17
PRD	Not diabetic	4,341 (78.1)	1	ref	n/a
	Diabetic	1,031 (18.6)	2.72	2.28–3.24	<0.0001
	Missing	183 (3.3)	1.18	0.76–1.83	0.46

ref – reference category; n/a – not applicable

Table 11.3. Logistic regression model showing the relationship between patient characteristics and the odds of receiving a transplant from a donor after cardiac 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	702 (12.6)	1	ref	n/a
	30–39	971 (17.5)	0.64	0.52–0.78	<0.0001
	40–49	1,535 (27.6)	0.47	0.39–0.56	<0.0001
	50–59	1,626 (29.3)	0.46	0.38–0.55	<0.0001
	60–64	721 (13.0)	0.44	0.36–0.55	<0.0001
Ethnicity	White	3,770 (67.9)	1	ref	n/a
	Non-White	1,387 (25.0)	0.45	0.39–0.51	<0.0001
	Missing	398 (7.1)	0.62	0.50–0.77	<0.0001
Gender	Male	3,430 (61.8)	1	ref	n/a
	Female	2,125 (38.2)	0.87	0.78–0.98	0.018
PRD	Not diabetic	4,341 (78.1)	1	ref	n/a
	Diabetic	1,031 (18.6)	0.54	0.46–0.63	<0.0001
	Missing	183 (3.3)	0.90	0.66–1.22	0.50

ref – reference category; n/a – not applicable

df (degrees of freedom) = 1, $p < 0.0001$, see figure 11.1 and table 11.4).

After adjusting for patient characteristics, there were significant differences between renal centres in the proportion of patients receiving a renal transplant within two years of wait listing. This was true for transplants from donors after brainstem death (change in $-2 \log L = 8.1$, df = 1, $p = 0.0046$, see figure 11.2 and table 11.5) and transplants from donors after cardiac death or living donors (change in $-2 \log L = 162.6$, df = 1, $p < 0.0001$, see figure 11.3, table 11.5). Several centres fell outside the 95% and 99.8% confidence intervals.

Table 11.6 shows unadjusted median days from RRT start to transplant wait listing for each renal centre.

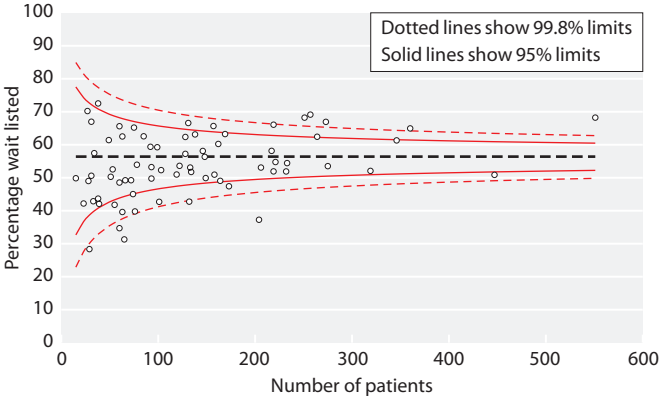

Fig. 11.1. Proportion of patients wait listed within 2 years of RRT start

Table 11.4. Proportion of patients in each renal centre wait listed for a kidney transplant prior to or within two years of RRT start

Centre	RRT *N*	Wait listed at 2 years *N*	% wait listed	
			Unadjusted	Risk-adjusted
England				
B Heart	148	83	56.1	56.3
B QEH	319	170	53.3	52.1
Basldn	63	23	36.5	39.6
Bradfd	103	55	53.4	52.3
Brightn	149	73	49.0	49.9
Bristol	217	135	62.2	58.1
Camb	138	92	66.7	63.1
Carlis	38	27	71.1	72.5
Carsh	275	148	53.8	53.5
Chelms	63	38	60.3	62.5
Colchr	39	16	41.0	42.1
Covnt	164	85	51.8	49.1
Derby	101	41	40.6	42.7
Donc	60	38	63.3	65.6
Dorset	85	51	60.0	62.6
Dudley	60	20	33.3	34.7
Exeter	128	76	59.4	62.4
Glouc	72	35	48.6	49.2
Hull	122	64	52.5	53.6
Ipswi	60	30	50.0	48.5
Kent	162	100	61.7	60.2
L Barts	447	239	53.5	50.9
L Guys	232	123	53.0	51.9
L Kings	204	76	37.3	37.3
L Rfree	346	220	63.6	61.3
L St.G	128	75	58.6	57.2
L West	551	376	68.2	68.2
Leeds	219	119	54.3	51.9
Leic	360	232	64.4	65.0
Liv Ain	76	30	39.5	39.8
Liv Roy	173	86	49.7	47.4
M RI	264	173	65.5	62.4
Middlbr	157	104	66.2	65.7
Newc	158	82	51.9	50.9
Norwch	93	48	51.6	49.7
Nottm	146	85	58.2	58.1
Oxford	273	183	67.0	66.9
Plymth	75	47	62.7	65.2
Ports	251	168	66.9	68.2
Prestn	206	108	52.4	53.1
Redng	131	87	66.4	66.6
Salford	219	135	61.6	66.1
Sheff	221	120	54.3	54.8
Shrew	65	18	27.7	31.3
Stevng	169	110	65.1	63.2
Sthend	31	21	67.7	67.0
Stoke	99	58	58.6	59.2
Sund	93	49	52.7	53.2
Truro	49	29	59.2	61.4
Wirral	74	31	41.9	45.0
Wolve	132	57	43.2	42.8
York	66	34	51.5	49.2
N Ireland				
Antrim	34	18	52.9	57.5
Belfast	119	63	52.9	51.0
Newry	28	12	42.9	49.0
Ulster	31	14	45.2	50.6
West NI	33	15	45.5	42.9
Scotland				
Airdrie	92	52	56.5	59.4
Abrdn	78	40	51.3	53.9
D & Gall	15	7	46.7	49.8
Dundee	55	21	38.2	41.8
Edinb	133	66	49.6	53.1
Glasgw	257	167	65.0	69.1
Inverns	27	19	70.4	70.2
Klmarnk	51	23	45.1	50.3
Krkcldy	53	25	47.2	52.5
Wales				
Bangor	29	7	24.1	28.4
Cardff	233	126	54.1	54.4
Clwyd	23	10	43.5	42.2
Swanse	134	68	50.7	51.7
Wrexm	38	16	42.1	43.7

Figure 11.4 shows a funnel plot of adjusted median days from RRT start to transplant wait listing, with confidence intervals. These values were derived from simulations based on the actual data and for four centres (those with fewer events and/or longer waiting times), median values could not be estimated, so final event times are shown. The Cox model giving a risk-adjusted analysis of time to wait listing identified significant variation between renal centres (change in $-2 \log L = 313.2$, $df = 70$, $p < 0.0001$). In general, renal centres with the longest unadjusted waiting times also had the longest risk-adjusted waiting times. The centre lying outside the upper 99.8% confidence limit had a hazard ratio that indicated a significant delay in the chance of wait listing compared with a baseline centre that had a median time comparable to the national median.

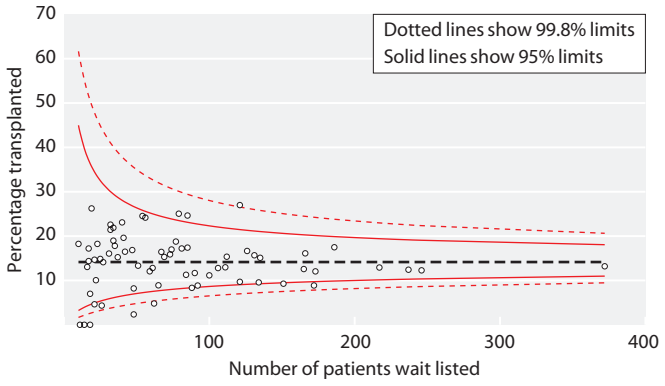

Fig. 11.2. Proportion of patients receiving a donor after brainstem death transplant within 2 yrs of wait listing (excluding centres with <10 patients wait listed)

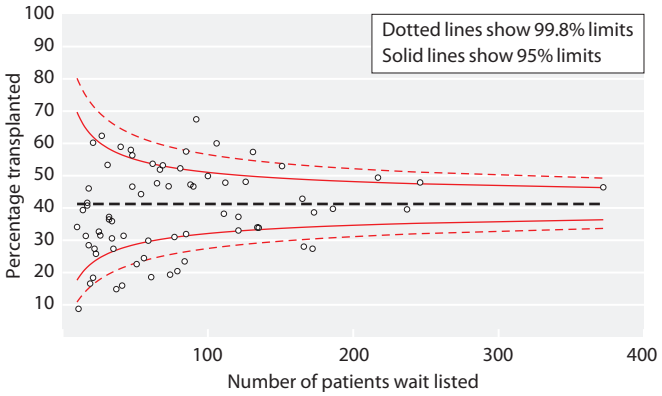

Fig. 11.3. Proportion of patients receiving a transplant from a donor after cardiac death or living donor within 2 yrs of wait listing (excluding centres with <10 patients wait listed)

Table 11.5. Proportion of patients receiving a transplant within two years of wait listing, by donor type and renal centre

		Organ from donor after brainstem death			Organ from donor after cardiac death/living kidney donor		
			Proportion transplanted within 2 years of wait listing (%)			Proportion transplanted within 2 years of wait listing (%)	
Centre	Wait listed *N*	Transplanted *N*	Unadjusted	Risk-adjusted	Transplanted *N*	Unadjusted	Risk-adjusted
Transplanting centre median (IQR)			–	13.2 (11.7–16.8)	–	–	46.7 (37.3–52.3)
Non-transplanting centre median (IQR)			–	14.8 (9.7–18.5)	–	–	34 (25.2–47.5)
England							
B Heart	84	10	11.9	11.3	18	21.4	23.5
B QEH	**172**	**13**	**7.6**	**8.9**	**47**	**27.3**	**27.4**
Basldn	26	1	3.8	4.3	8	30.8	31.5
Bradfd	54	13	24.1	24.5	21	38.9	44.3
Brightn	74	11	14.9	17.0	16	21.6	19.3
Bristol	**134**	**12**	**9.0**	**9.6**	**51**	**38.1**	**34.0**
Camb	**92**	**8**	**8.7**	**8.8**	**69**	**75.0**	**67.5**
Carlis	27	4	14.8	14.1	19	70.4	62.4
Carsh	151	13	8.6	9.3	78	51.7	53.0
Chelms	40	9	22.5	23.1	24	60.0	58.9
Colchr	17	3	17.6	14.4	8	47.1	41.6
Covnt	**90**	**10**	**11.1**	**11.7**	**47**	**52.2**	**46.7**
Derby	41	7	17.1	19.6	7	17.1	16.0
Donc	37	6	16.2	15.2	6	16.2	14.9
Dorset	51	7	13.7	13.3	13	25.5	22.6
Dudley	21	1	4.8	4.6	4	19.0	18.4
Exeter	77	14	18.2	18.8	26	33.8	31.0
Glouc	34	7	20.6	21.9	11	32.4	30.6
Hull	65	6	9.2	8.9	35	53.8	47.7
Ipswi	31	5	16.1	16.1	19	61.3	53.3
Kent	100	13	13.0	11.1	52	52.0	49.9
L Barts	**246**	**28**	**11.4**	**12.3**	**101**	**41.1**	**47.9**
L Guys	**131**	**20**	**15.3**	**15.7**	**68**	**51.9**	**57.4**
L Kings	79	17	21.5	25.0	14	17.7	20.4
L Rfree	**217**	**26**	**12.0**	**12.9**	**95**	**43.8**	**49.4**
L St.G	**73**	**11**	**15.1**	**15.9**	**31**	**42.5**	**46.7**

Table 11.5. Continued

Centre	Wait listed *N*	Organ from donor after brainstem death			Organ from donor after cardiac death/living kidney donor		
		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
L West	**372**	**46**	**12.4**	**13.2**	**143**	**38.4**	**46.4**
Leeds	**121**	**32**	**26.4**	**27.0**	**48**	**39.7**	**37.3**
Leic	**237**	**27**	**11.4**	**12.4**	**93**	**39.2**	**39.6**
Liv Ain	32	7	21.9	22.6	13	40.6	36.5
Liv Roy	**81**	**13**	**16.0**	**17.2**	**46**	**56.8**	**52.3**
M RI	**173**	**22**	**12.7**	**12.0**	**68**	**39.3**	**38.6**
Middlbr	106	14	13.2	12.8	70	66.0	60.0
Newc	**85**	**14**	**16.5**	**17.4**	**54**	**63.5**	**57.5**
Norwch	48	4	8.3	8.2	26	54.2	46.6
Nottm	**85**	**20**	**23.5**	**24.6**	**29**	**34.1**	**31.9**
Oxford	**186**	**36**	**19.4**	**17.5**	**71**	**38.2**	**39.7**
Plymth	**47**	**7**	**14.9**	**16.8**	**31**	**66.0**	**58.0**
Ports	**166**	**28**	**16.9**	**16.1**	**48**	**28.9**	**28.0**
Prestn	111	14	12.6	13.0	45	40.5	38.2
Redng	88	8	9.1	8.3	37	42.0	47.2
Salford	135	20	14.8	15.1	47	34.8	33.9
Sheff	**121**	**12**	**9.9**	**9.7**	**42**	**34.7**	**33.0**
Shrew	18	1	5.6	7.0	9	50.0	46.1
Stevng	112	17	15.2	15.3	52	46.4	47.8
Sthend	21	3	14.3	14.7	14	66.7	60.2
Stoke	59	7	11.9	12.1	20	33.9	29.9
Sund	48	1	2.1	2.3	30	62.5	56.3
Truro	32	8	25.0	21.4	13	40.6	37.2
Wirral	35	7	20.0	17.8	10	28.6	27.4
Wolve	61	7	11.5	12.8	11	18.0	18.6
York	34	7	20.6	19.0	15	44.1	35.9
N Ireland							
Antrim	18	0	0.0	0.0	6	33.3	28.5
Belfast	**62**	**3**	**4.8**	**4.8**	**38**	**61.3**	**53.7**
Newry	11	0	0.0	0.0	1	9.1	8.8
Ulster	14	0	0.0	0.0	6	42.9	39.3
West NI	16	2	12.5	13.0	6	37.5	31.3
Scotland							
Abrdn	42	9	21.4	16.5	12	28.6	31.4
Airdrie	56	15	26.8	24.2	14	25.0	24.5
D & Gall	7	0	0.0	0.0	4	57.1	66.8
Dundee	22	3	13.6	10.1	5	22.7	27.4
Edinb	**67**	**14**	**20.9**	**16.4**	**30**	**44.8**	**51.9**
Glasgw	**165**	**25**	**15.2**	**12.6**	**60**	**36.4**	**42.9**
Inverns	19	5	26.3	26.2	3	15.8	16.6
Klmarnk	23	5	21.7	18.2	5	21.7	25.8
Krkcldy	25	5	20.0	14.9	7	28.0	32.7
Wales							
Bangor	8	3	37.5	44.8	2	25.0	21.7
Cardff	**126**	**23**	**18.3**	**16.6**	**66**	**52.4**	**48.1**
Clwyd	10	2	20.0	18.2	4	40.0	34.1
Swanse	69	12	17.4	15.3	41	59.4	53.2
Wrexm	17	3	17.6	17.2	8	47.1	40.8

Transplanting renal centres are shown in bold

Table 11.6. Median time to transplant wait listing by renal centre

Centre	RRT *N*	Wait listed at 2 years *N*	Median time to listing (days)
England			
B Heart	148	91	453
B QEH	319	183	431
Basldn	63	28	1011
Bradfd	103	58	458
Brightn	149	79	671
Bristol	217	141	204
Camb	138	97	23
Carlis	38	27	159
Carsh	275	161	435
Chelms	63	42	320
Colchr	39	18	748
Covnt	164	93	531
Derby	101	43	***1,230****
Donc	60	41	200
Dorset	85	54	320
Dudley	60	23	***1,011****
Exeter	128	79	375
Glouc	72	37	684
Hull	122	69	414
Ipswi	60	32	423
Kent	162	106	292
L Barts	447	269	531
L Guys	232	142	468
L Kings	204	91	1,305
L Rfree	346	233	225
L St.G	128	82	371
L West	551	397	256
Leeds	219	126	340
Leic	360	242	108
Liv Ain	76	35	837
Liv Roy	173	89	613
M RI	264	185	225
Middlbr	157	111	159
Newc	158	92	350
Norwch	93	50	324
Nottm	146	85	152
Oxford	273	192	95
Plymth	75	48	290
Ports	251	176	133
Prestn	206	118	568
Redng	131	91	173
Salford	219	141	181
Sheff	221	128	396
Shrew	65	19	***1,037****
Stevng	169	115	270
Sthend	31	21	181
Stoke	99	61	308
Sund	93	53	487
Truro	49	33	153
Wirral	74	35	835
Wolve	132	64	957
York	66	35	474
N Ireland			
Antrim	34	19	442
Belfast	119	67	514
Newry	28	15	1,000
Ulster	31	15	689
West NI	33	17	1,133
Scotland			
Abrdn	78	43	543
Airdrie	92	58	435
D & Gall	15	7	***231****
Dundee	55	26	1,099
Edinb	133	71	613
Glasgw	257	171	203
Inverns	27	19	131
Klmarnk	51	25	702
Krkcldy	53	26	604
Wales			
Bangor	29	9	***1,283****
Cardff	233	127	307
Clwyd	23	10	***553****
Swanse	134	70	477
Wrexm	38	17	776

*A result in ***bold italics*** is a final event time as median time could not be estimated

Discussion

Patient characteristics and access to transplantation

Increasing patient age was associated with reduced 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 RRT start. 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].

Patients with a PRD of diabetes were less likely to be wait listed or to receive a transplant from a donor after cardiac death/living donor. The expected increased comorbidity among patients with diabetes may preclude

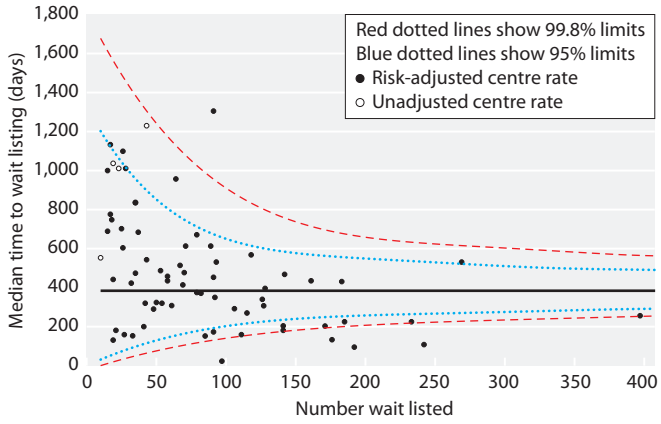

Fig. 11.4. Median time from RRT start to wait listing.
Centres represented by an unfilled circle have the final event time as the plotting position as the median time could not be estimated

transplantation or lengthen the medical evaluation process, explaining this finding. Patients with a PRD of diabetes 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.

Unlike previous reports, non-White ethnicity did not significantly influence the likelihood of wait listing (OR: 1.03; 95% CI: 0.93–1.15, compared with 0.80, 0.72–0.89 in the 2014 Seventeenth Annual Report) [5]. Further, the effect of non-White ethnicity in reducing the chance of transplantation from a donor after brainstem death within two years of listing has diminished compared to data from previous years (OR 0.79; 95% CI: 0.65–0.95 compared to 0.65; 95% CI: 0.52–0.81 in analyses from 2008–2010) [5]. The overall effect of these changes is that patients with non-White ethnicity no longer have reduced access to transplantation from donors after brainstem death. This may reflect changes in the practice of transplant wait listing, 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 HLA matching. The latter change means that recipients with non-White ethnicity are less likely to be disadvantaged by the relative lack of organs from non-White donors. It should be noted that differences in socioeconomic status between ethnic groups have been found previously to explain differences in access to transplantation by ethnicity [7, 8]. 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 are missing either because a renal centre fails 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 are 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 from any donor type, after adjustment for patient demographics and PRD. However, such results should be interpreted with caution. Adjustment for comorbidity included only diabetes as 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. Also, in the analysis of time to transplant wait listing, patients receiving a live donor transplant after starting dialysis but without prior wait listing were recorded as wait listed on the day of transplantation. In reality, such patients are likely to have been adequately prepared for listing before this time.

Whilst the processes of wait listing or transplantation from a donor after cardiac 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 cardiac 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. Of course, this analysis is also subject to concerns about lack of conclusive adjustment for case mix. It also allocates many pre-emptive transplants to transplanting centres, even if the work-up has been initiated in a timely fashion by the non-transplanting centre. Lastly, there is competition between the two outcome variables (transplant from a donor after brainstem death versus transplant from a donor after cardiac death/living donor). As such, patients from centres with a higher rate of transplantation from a donor after cardiac 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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