UK Renal Registry 15th Annual Report: Chapter 9 Centre Variation in Access to Renal Transplantation in the UK (2006–2008)

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Key Words
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

- A patient starting dialysis in a non-transplanting renal centre was less likely to be registered for transplantation (OR (odds ratio) 0.80, 95% CI 0.74–0.87) compared with a patient treated in a transplanting renal centre.
- A patient starting dialysis in a non-transplanting renal centre was less likely to receive a transplant from a donor after cardiac death or a living kidney donor (OR 0.69, 95% CI 0.61–0.77) compared with a patient treated in a transplanting renal centre.
- Once registered for kidney transplantation, patients in both transplanting and non-transplanting renal centres had an equal chance of receiving a transplant from a donor after brainstem death (OR 0.92, 95% CI 0.79 to 1.08).
- After adjustment for case mix, this analysis identified significant centre differences for the probability of being activated on the kidney transplant waiting list ($p < 0.0001$) and the probability of receiving a renal transplant from a donor after brainstem death ($p = 0.015$) or a donor after cardiac death/living kidney donor ($p < 0.0001$).

Introduction

In an era where demand is increasingly outstripping supply, ensuring equity in access and allocation of a scarce resource that is a renal transplant poses many ethical and pragmatic dilemmas. For 'suitable' patients with established renal failure, renal transplantation confers both better quality of life and life expectancy than dialysis [1–3] and is the preferred modality of renal replacement therapy. Defining 'suitable' is a complex concept for which a series of national and international guidelines exist but most such guidelines do not have a robust evidence base for their recommendations. Therefore the fitness for transplantation assessment process ultimately revolves around conducting an individualised assessment of the risks of transplantation as well as the likely benefit. Centre practices and policies play an integral role in influencing this, although other patient specific factors are also known to influence access including age, gender, ethnicity, comorbidity and social deprivation [4–9].

In addition to influencing access to transplantation, centre practices and policies may also influence the likelihood of a patient receiving a living kidney donor or donor after cardiac death particularly during the time period this study covers, when the retrieving centre had the major influence on the distribution of such organs. Once a patient was on the waiting list, the probability of receiving a transplant from a donor after brainstem death however, was predominantly under the influence of the national organ allocation algorithm.

Achieving prompt and timely activation on the waiting list is important not least because increasing length of time on dialysis adversely affects graft and patient survival, but also because the current organ allocation algorithm introduced in April 2006 takes time spent on the waiting list into account when allocating deceased donor kidneys in the UK [10]. Thus, centres that achieve earlier listing for transplantation provide an advantage for their patients compared with centres that take longer.

This analysis aims to evaluate whether equity of access to the renal transplant list exists for patients with end stage renal disease across the UK, whether centres differ in the time taken to activate suitable patients on the waiting list and whether equity exists in the receipt of a renal transplant once the patient is on the transplant list (that is, the conversion efficiency from being on the waiting list to receiving a transplant). Patient specific and independent variables that influenced access to the waiting list or transplantation were analysed.

Methods

Study population

All adult patients starting renal replacement therapy (n = 19,780) between 1st January 2006 and 31st December 2008 in renal centres (n = 72) returning data to the UK Renal Registry (UKRR) were considered for inclusion. For the analysis of the proportion of a centre's patients included on the waiting list, patients aged 65 years or above (n = 9,636), patients with inappropriate activation and early suspension as described below (n = 146) and patients listed for multi-organ transplants other than pancreas (n = 37) were excluded, resulting in a final cohort of 9,961 patients. These patients were followed to 31st December 2010 or until they were put on the waiting list for kidney transplant alone, kidney plus pancreas transplant, or death, whichever was earliest. For the analysis of the proportion transplanted, all patients from the incident cohort who were activated on the waiting list before 31st December 2009 (n = 5,755) were followed until 31st December 2011, to estimate the proportion transplanted with a kidney alone or kidney plus pancreas within two years of inclusion on the waiting list.

Exclusions

Patients listed for multi-organ transplants other than pancreas were excluded as were those who were suspended for more than 30 days within 90 days of first activation. The latter avoided any potential bias from centres that may activate patients on the transplant list and then immediately suspend them before more permanent activation at a later date after more formal medical assessment of the patient's fitness.

Data analysed

Information on start date of renal replacement therapy and relevant patient level data including age (grouped as 18–29, 30–39, 40–49, 50–59, 60–64), gender, ethnicity (white, non-White, missing) and PRD (primary renal diagnosis classified as: patient with diabetes, patient without diabetes, missing) came from the UKRR. The date of activation on the kidney transplant waiting list, date of transplantation, or both came from the UK Transplant Registry held by the Organ Donation and Transplantation Directorate of NHS Blood and Transplant.

Statistical methods

A logistic regression model was developed to identify the influence of patient specific variables including age, gender, ethnicity and primary renal diagnosis, on the probability of access to the transplant list and receipt of a transplant once on the waiting list. After adjusting for patient specific variables, the percentage of patients activated on the transplant list and the percentage of patients on the waiting list who achieved a transplant in each centre were determined. The overall effect of the centre associated with each analysis was assessed by including renal centre as a random effect in the risk-adjusted logistic regression model. The extent of variation between centres was determined by using a log likelihood ratio test that provided the change in the value of -2 LogL on inclusion of the random centre effect. SAS 9.3 was used for analyses; a p value of less than 5% was considered significant.

To analyse access to the transplant list, the proportion of incident patients with end stage renal disease in each centre

who were subsequently activated on the waiting list within two years of starting renal replacement therapy was identified. All patients who achieved live donor transplantation without prior activation on the national transplant waiting list were assumed to have been activated for the purposes of this analysis. Time to activation on the waiting list was defined as the interval between the start of RRT and the date of activation on the waiting list. Patients achieving pre-emptive deceased donor transplantation were considered to have been activated on the same day as starting RRT i.e. a time to activation of 0 days. Patients achieving pre-emptive live donor transplantation without prior activation on the national transplant list were considered to have been 'active' on the list for an arbitrary time of six months. This was to take into account an average of six months required by most centres to complete live donor fitness evaluation and hence the likelihood that the intended recipient was considered fit for transplantation (and by inference suitable to be active on the waiting list) for that duration. This was done to account for different centre practices with regard to listing patients on the deceased donor list prior to receiving a living donor transplant.

The median time to activation was estimated from the Kaplan-Meier plot for patients at each renal centre, with the event as the date of activation and censoring at death or on 31st December 2010, whichever was earlier. Data from patients who did not achieve activation were included in the calculation of median times using this method, thus providing a meaningful estimate of the true time to activation. Including only those patients activated would produce a biased estimate. The overall centre effect associated with time to activation was calculated by including renal centre as a variable in a risk- adjusted Cox regression model.

To analyse the differences between centres in achieving a renal transplant, the percentage of patients activated on the waiting list who received a renal transplant within two years of being activated was estimated (conversion efficiency). The conversion efficiency for receiving a transplant from a donor after brainstem death or a donor after cardiac death/living kidney donor were analysed separately. Receipt of a kidney from a donor after brainstem death was predominantly influenced by national allocation policy, whereas receipt from a donor after cardiac death/live donor kidney was much more dependent on local transplant centre practices. For the cohort under consideration, donor after cardiac death transplantation was predominantly a locally managed service.

Funnel plots are used to present the results for each outcome of interest, providing a visual comparison of each centre's performance compared with its peers. Where relevant, the funnel plots are adjusted for patient specific variables influencing that outcome. The solid black straight line in each funnel plot shows the overall average together with the 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. With 72 centres included, for each outcome of interest, three centres would be predicted to fall between the 95% and 99.8% confidence intervals and no centre should fall outside the 99.8% confidence interval. Centres ($n = 3$) with fewer than 10 patients activated on the waiting list are not included in the funnel plots.

The analysis methodology described above is identical to a previous independent peer reviewed publication [11].

Results

The results of the logistic regression model analysis of patient characteristics influencing access to the waiting list are presented in table 9.1. Ethnicity data were missing for 17.1% of patients and PRD for 5.3% of patients.

Tables 9.2 and 9.3 show the results of the logistic regression analysis of factors influencing the likelihood of receiving a transplant from a donor after brainstem death and the analysis of factors influencing receipt of a transplant from a donor after cardiac death or a

Table 9.1. Patient factors influencing activation on the national kidney transplant waiting list within two years of RRT start

Factor	Category (at baseline)	Patients N (%)	Odds ratio	95% CI	P value
Age	(18–29)	898 (9.0)	1.00	ref	n/a
	30–39	1,442 (14.5)	0.78	0.63–0.96	0.02
	40–49	2,378 (23.9)	0.51	0.42–0.62	<0.0001
	50–59	3,171 (31.8)	0.26	0.21–0.31	<0.0001
	60–64	2,072 (20.8)	0.13	0.11–0.16	<0.0001
Ethnicity	(White)	6,301 (63.3)	1.00	ref	n/a
	Non-White	1,956 (19.6)	0.90	0.80–1.01	0.06
	Missing	1,704 (17.1)	0.54	0.48–0.61	<0.0001
Gender	(Male)	6,057 (60.8)	1.00	ref	n/a
	Female	3,904 (39.2)	0.92	0.84–1.00	0.05
PRD	(Non-diabetic)	7,096 (71.2)	1.00	ref	n/a
	Diabetic	2,335 (23.4)	0.43	0.39–0.48	<0.0001
	Missing	530 (5.3)	0.65	0.54–0.79	<0.0001

ref – reference category, n/a – not applicable

Table 9.2. Patient factors affecting the probability of receiving a transplant from a donor after brainstem death within two years of registration on the national kidney transplant waiting list

Factor	Category (at baseline)	Patients N (%)	Odds ratio	95% CI	P value
Age	(18–29)	731 (12.7)	1.00	ref	n/a
	30–39	1,089 (18.9)	1.20	0.94–1.53	0.14
	40–49	1,603 (27.9)	0.76	0.60–0.96	0.02
	50–59	1,599 (27.8)	0.35	0.27–0.45	<0.0001
	60–64	733 (12.7)	0.17	0.12–0.25	<0.0001
Ethnicity	(White)	3,829 (66.5)	1.00	ref	n/a
	Non-White	1,145 (19.9)	0.50	0.41–0.63	<0.0001
	Missing	781 (13.6)	0.84	0.67–1.06	0.14
Gender	(Male)	3,528 (61.3)	1.00	ref	n/a
	Female	2,227 (38.7)	0.93	0.80–1.09	0.38
PRD	(Non-diabetic)	4,501 (78.2)	1.00	ref	n/a
	Diabetic	971 (16.9)	5.03	4.24–5.96	<0.0001
	Missing	283 (4.9)	1.17	0.81–1.69	0.4

ref – reference category, n/a – not applicable

living kidney donor. Ethnicity data were missing for 13.6% of patients and PRD for 4.9% of patients.

A patient starting dialysis in a non-transplanting renal centre was less likely to be registered for transplantation (OR 0.80, 95% CI 0.74–0.87) or receive a transplant from a donor after cardiac death or a living kidney donor (OR 0.69, 95% CI 0.61–0.77) compared with patients managed in transplanting renal centres. Once registered for kidney transplantation, patients in both transplanting and non-transplanting renal centres had an equal chance of receiving a transplant from a donor after brainstem death (OR 0.92, 95% CI 0.79–1.08).

After adjusting for patient specific variables that were shown to influence outcome (age, ethnicity, gender, PRD), significant centre effects were identified for the probability of being activated on the waiting list (figure 9.1 and table 9.4) (change in $-2\,\mathrm{LogL} = 264.4$, df (degrees of freedom) $= 1$, $p < 0.0001$).

Table 9.3. Patient factors affecting the probability of receiving a transplant from a donor after cardiac death or living kidney donor within two years of registration on the national kidney transplant waiting list

Factor	Category (at baseline)	Patients N (%)	Odds ratio	95% CI	P value
Age	(18–29)	731 (12.7)	1.00	ref	n/a
	30–39	1,089 (18.9)	0.63	0.52–0.77	<0.0001
	40–49	1,603 (27.9)	0.59	0.49–0.71	<0.0001
	50–59	1,599 (27.8)	0.40	0.34–0.49	<0.0001
	60–64	733 (12.7)	0.41	0.33–0.52	<0.0001
Ethnicity	(White)	3,829 (66.5)	1.00	ref	n/a
	Non-White	1,145 (19.9)	0.48	0.41–0.56	<0.0001
	Missing	781 (13.6)	0.63	0.53–0.75	<0.0001
Gender	(Male)	3,528 (61.3)	1.00	ref	n/a
	Female	2,227 (38.7)	0.91	0.81–1.02	0.11
PRD	(Non-diabetic)	4,501 (78.2)	1.00	ref	n/a
	Diabetic	971 (16.9)	0.33	0.28–0.40	<0.0001
	Missing	283 (4.9)	1.09	0.85–1.40	0.5

ref – reference category, n/a – not applicable

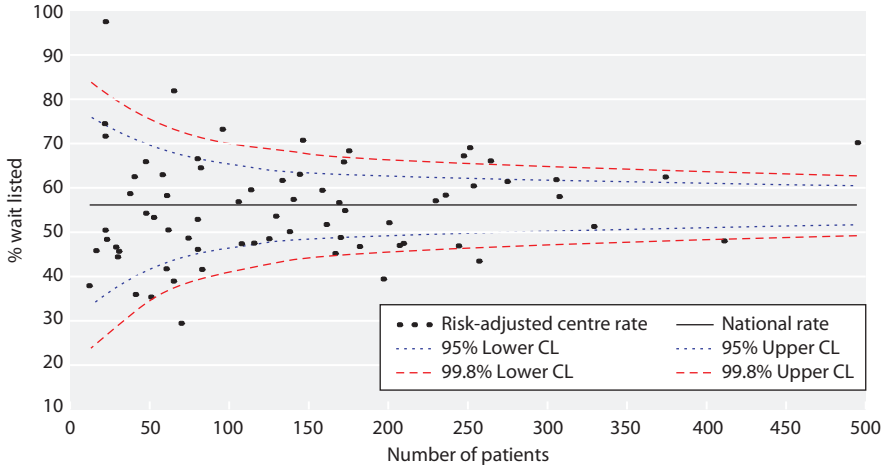

Fig. 9.1. The percentage of patients wait listed for a kidney transplant by renal centre, prior to or within two years of starting dialysis (centres with <10 patients excluded)

Table 9.4. The percentage of patients wait listed for a kidney transplant by renal centre, prior to or within two years of starting dialysis

	RRT	Registrations	% wait listed			RRT	Registrations	% wait listed	
Centre	N	N	Unadjusted	Risk-adjusted	Centre	N	N	Unadjusted	Risk-adjusted
Abrdn	88	51	58.0	71.1	L Barts	411	200	48.7	48.2
Airdrie	80	39	48.8	53.0	L Guys	307	193	62.9	61.8
Antrim	30	12	40.0	44.2	L Kings	208	100	48.1	46.9
B Heart	138	70	50.7	50.2	L Rfree	308	187	60.7	58.2
B QEH	330	176	53.3	51.1	L St.G	106	63	59.4	56.8
Bangor	41	14	34.1	36.1	L West	496	348	70.2	70.3
Basldn	61	26	42.6	41.4	Leeds	237	144	60.8	58.3
Belfast	129	73	56.6	53.7	Leic	375	244	65.1	62.6
Bradfd	115	56	48.7	47.4	Liv Ain	51	16	31.4	34.3
Brightn	144	88	61.1	63.0	Liv RI	201	110	54.7	52.3
Bristol	254	157	61.8	60.6	M RI	169	101	59.8	56.6
Camb	197	84	42.6	39.6	Middlbr	134	86	64.2	62.1
Cardff	276	171	62.0	61.7	Newc	173	98	56.6	55.1
Carlis	40	27	67.5	62.6	Newry	22	11	50.0	50.6
Carsh	258	110	42.6	43.2	Norwch	125	58	46.4	48.5
Chelms	53	26	49.1	53.2	Nottm	183	88	48.1	46.8
Clwyd	23	9	39.1	48.1	Oxford	247	171	69.2	67.3
Colchr	22	12	54.5	71.8	Plymth	95	69	72.6	73.5
Covnt	170	86	50.6	48.6	Ports	252	181	71.8	69.0
D & Gall	22	16	72.7	97.7	Prestn	210	100	47.6	47.5
Derby	113	65	57.5	59.5	Redng	147	108	73.5	70.7
Derry	12	4	33.3	38.0	Salford	230	137	59.6	56.9
Donc	22	16	72.7	74.7	Sheff	245	118	48.2	46.8
Dorset	80	55	68.8	66.5	Shrew	83	36	43.4	41.4
Dudley	70	21	30.0	29.4	Stevng	167	76	45.5	43.9
Dundee	61	29	47.5	58.3	Sthend	58	34	58.6	63.1
Dunfn	48	26	54.2	65.9	Stoke	75	37	49.3	48.6
Edinb	172	95	55.2	65.9	Sund	79	38	48.1	46.0
Exeter	141	77	54.6	57.3	Swanse	161	82	50.9	51.8
Glasgw	265	147	55.5	65.7	Truro	65	46	70.8	81.9
Glouc	82	52	63.4	64.7	Tyrone	29	15	51.7	46.8
Hull	175	99	56.6	68.4	Ulster	16	6	37.5	45.9
Inverns	37	19	51.4	58.8	Wirral	77	32	41.6	39.5
Ipswi	61	33	54.1	50.4	Wolve	108	52	48.1	47.4
Kent	158	99	62.7	59.5	Wrexm	30	16	53.3	45.8
Klmarnk	65	19	29.2	38.9	York	48	28	58.3	54.2

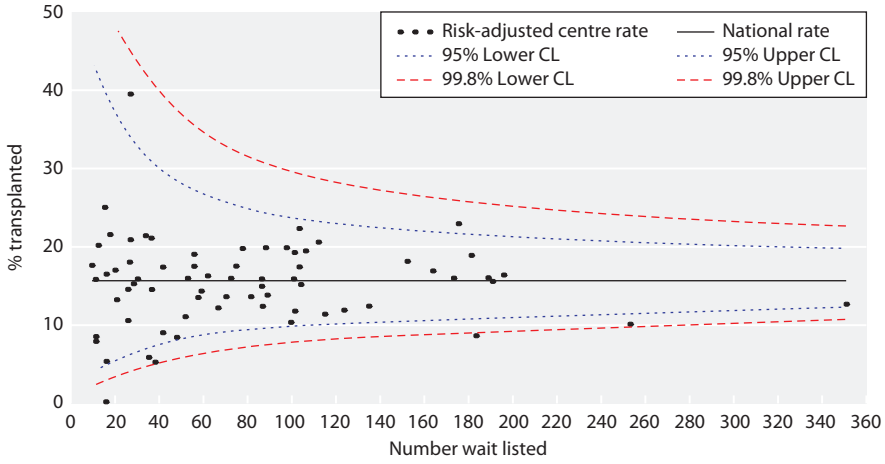

Fig. 9.2. The percentage of patients receiving a transplant from a donor after brainstem death by renal centre, within two years of transplant waiting list registration (centres with <10 patients excluded)

After adjustment for patient variables, significant centre differences were seen in the probability of receiving a renal transplant from a donor after brainstem death (figure 9.2 and table 9.5) (change in $-2\,\text{LogL} = 6.0$, $\text{df} = 1$, $p = 0.015$) or a donor after cardiac death/living kidney donor (figure 9.3 and table 9.5) (change in $-2\,\text{LogL} = 172.9$, $\text{df} = 1$, $p < 0.0001$). As shown, several centres fall outside the 95% and 99.8% confidence intervals.

Figure 9.4 and table 9.6 show the unadjusted median time taken to activate patients on the transplant list for each renal centre.

The funnel plot is based on the assumption of an exponential distribution for time to activation. Although this assumption is broadly consistent with the data, the model based estimate of the national median was greater than that observed. This leads to an unusually large number of centres falling outside the lower 99.8% confidence limit for this national rate and perhaps too few occurring outside the upper limit. However, the plot highlights those centres that have significantly longer time to activation but small numbers of patients on the waiting list. The Cox model giving a risk-adjusted analysis of time to activation identified a significant effect of centre variation (change in $-2\,\text{LogL} = 458.0$, $\text{df} = 71$, $p < 0.0001$). In general, centres with the longest unadjusted waiting times also had the longest risk-adjusted waiting times. The four centres lying outside the upper 99.8% confidence limit all had hazard ratios 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.

Discussion

Patient level factors affecting access

The observation that increasing age was seen to be negatively associated with access to transplantation was not unexpected as the risk-benefit ratio of receiving a renal transplant alters with age. Increased comorbidity burden in older patients may require more intensive time consuming investigations prior to listing and may also deem them unsuitable in some cases. Interestingly, whilst previous reports [12] have cited female gender to be associated with a reduced likelihood to receive a kidney after brainstem death, this was not noted in this study.

Ethnicity has sometimes been cited as being a cause of inequity in accessing transplantation, although it was reassuring to see that in this study it was not seen to impact a patients' probability of being listed (consistent with earlier work undertaken by Udayaraj and colleagues) [13]. It was however seen to be negatively associated with receiving a kidney once listed from a living kidney donor, donor after brainstem death or donor after cardiac death. A likely cause for this may be the widely acknowledged lack of donors from ethnic minorities contributing to the donor pool, as well as the importance given to HLA matching in the national allocation protocol which may have favoured a predominantly white donor pool being matched with white recipients. Although the allocation protocol changed in April 2006 (during the study period) the lack of an observed impact may be due to the fact that all patients in this study irrespective of ethnicity were likely to have been on the waiting list for a similar duration of time,

Table 9.5. The percentage of patients receiving a transplant, by donor type and renal centre, within two years of transplant waiting list registration

		Organ from donor after brainstem death			Organ from living kidney donor/donor after cardiac death		
			Transplant rate (%)			Transplant rate (%)	
Centre	Listed N	Transplanted N	Unadjusted	Risk-adjusted	Transplanted N	Unadjusted	Risk-adjusted
Abrdn	52	5	9.6	10.9	6	11.5	13.6
Airdrie	42	11	26.2	17.3	7	16.7	16.9
Antrim	12	1	8.3	7.9	1	8.3	8.0
B Heart	73	10	13.7	15.7	16	21.9	23.9
B QEH	184	14	7.6	8.5	50	27.2	28.7
Bangor	13	4	30.8	20.0	2	15.4	13.4
Basldn	27	6	22.2	18.0	12	44.4	40.1
Belfast	75	13	17.3	17.4	14	18.7	15.6
Bradfd	56	9	16.1	17.4	15	26.8	26.5
Brightn	89	14	15.7	13.8	35	39.3	37.5
Bristol	164	29	17.7	16.7	59	36.0	34.5
Camb	87	14	16.1	15.6	46	52.9	48.0
Cardff	174	32	18.4	15.8	64	36.8	35.1
Carlis	27	9	33.3	39.4	9	33.3	28.6
Carsh	115	12	10.4	11.2	37	32.2	32.9
Chelms	26	2	7.7	10.4	8	30.8	28.9
Clwyd	10	2	20.0	17.4	3	30.0	27.9
Colchr	12	1	8.3	8.5	6	50.0	54.7
Covnt	87	13	14.9	14.9	40	46.0	42.6
D & Gall	16	2	12.5	16.3	7	43.8	54.2
Derby	67	8	11.9	12.1	6	9.0	8.9
Derry	4	1	25.0	47.3	0	0.0	0.0
Donc	16	1	6.3	5.0	1	6.3	6.0
Dorset	56	12	21.4	18.9	13	23.2	22.5
Dudley	26	4	15.4	14.6	3	11.5	10.5
Dundee	30	4	13.3	15.8	8	26.7	31.6
Dunfn	28	5	17.9	15.3	1	3.6	4.5
Edinb	98	18	18.4	19.7	34	34.7	40.1
Exeter	78	16	20.5	19.6	36	46.2	42.9
Glasgw	153	26	17.0	17.8	41	26.8	30.5
Glouc	53	8	15.1	15.7	11	20.8	19.6
Hull	101	15	14.9	15.7	32	31.7	33.6
Inverns	20	4	20.0	16.9	3	15.0	17.3
Ipswi	34	7	20.6	21.3	15	44.1	38.1
Kent	100	10	10.0	10.2	44	44.0	39.8
Klmarnk	21	3	14.3	13.2	3	14.3	17.6
L Barts	197	27	13.7	16.2	72	36.5	41.4
L Guys	192	33	17.2	15.5	105	54.7	58.5
L Kings	102	10	9.8	11.6	23	22.5	25.5
L Rfree	190	26	13.7	16.0	59	31.1	32.1
L St.G	62	8	12.9	16.2	34	54.8	53.5
L West	351	37	10.5	12.6	156	44.4	54.7
Leeds	153	25	16.3	18.0	64	41.8	39.6
Leic	254	23	9.1	9.9	88	34.6	33.8
Liv Ain	15	3	20.0	24.9	4	26.7	24.5
Liv RI	113	24	21.2	20.4	40	35.4	32.2
M RI	104	25	24.0	22.2	28	26.9	26.1
Middlbr	88	21	23.9	19.8	35	39.8	39.5
Newc	102	21	20.6	19.1	44	43.1	41.2
Newry	12	2	16.7	15.6	0	0.0	0.0
Norwch	59	9	15.3	14.1	21	35.6	34.1

Table 9.5. Continued

		Organ from donor after brainstem death			Organ from living kidney donor/donor after cardiac death		
			Transplant rate (%)			Transplant rate (%)	
Centre	Listed N	Transplanted N	Unadjusted	Risk-adjusted	Transplanted N	Unadjusted	Risk-adjusted
Nottm	104	20	19.2	17.4	29	27.9	26.8
Oxford	176	50	28.4	22.8	52	29.5	30.1
Plymth	71	9	12.7	13.5	41	57.7	53.9
Ports	182	38	20.9	18.8	59	32.4	31.5
Prestn	105	14	13.3	15.1	30	28.6	26.7
Redng	107	21	19.6	19.3	38	35.5	37.2
Salford	135	15	11.1	12.3	38	28.1	26.2
Sheff	124	14	11.3	11.9	43	34.7	30.8
Shrew	38	2	5.3	5.1	11	28.9	25.0
Stevng	87	12	13.8	12.3	32	36.8	36.7
Sthend	36	9	25.0	21.1	6	16.7	18.1
Stoke	36	2	5.6	5.6	13	36.1	31.5
Sund	42	4	9.5	8.8	19	45.2	41.2
Swanse	82	12	14.6	13.4	25	30.5	29.4
Truro	48	4	8.3	8.3	30	62.5	65.2
Tyrone	16	0	0.0	0.0	1	6.3	5.6
Ulster	6	0	0.0	0.0	0	0.0	0.0
Wirral	37	5	13.5	14.3	11	29.7	25.5
Wolve	58	8	13.8	13.3	20	34.5	34.0
Wrexm	18	6	33.3	21.4	6	33.3	29.9
York	27	7	25.9	20.7	5	18.5	16.5

whereas the new allocation policy would primarily have improved access for those listed well before 2006 (not included in this study).

Diabetes was also seen to affect wait listing adversely although this is not surprising as many would be subject to additional diabetic complications and increased cardiovascular risk that would need to be managed. The higher proportion of patients with diabetes receiving a transplant corresponds to an increase in the number of simultaneous kidney-pancreas transplants during the study period, as the allocation algorithm prioritised dual organ recipients.

When interpreting the analyses in this chapter it is important to consider the potential impact of missing data on the results. Missing data occurs as a result of either a renal centre failing to complete relevant fields

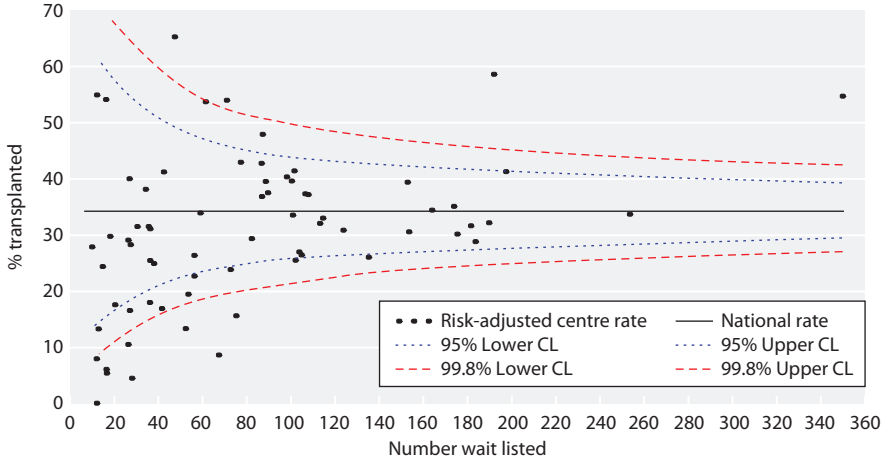

Fig. 9.3. The percentage of patients receiving a transplant from a living kidney donor/donor after cardiac death by renal centre, within two years of transplant waiting list registration (centres with <10 patients excluded)

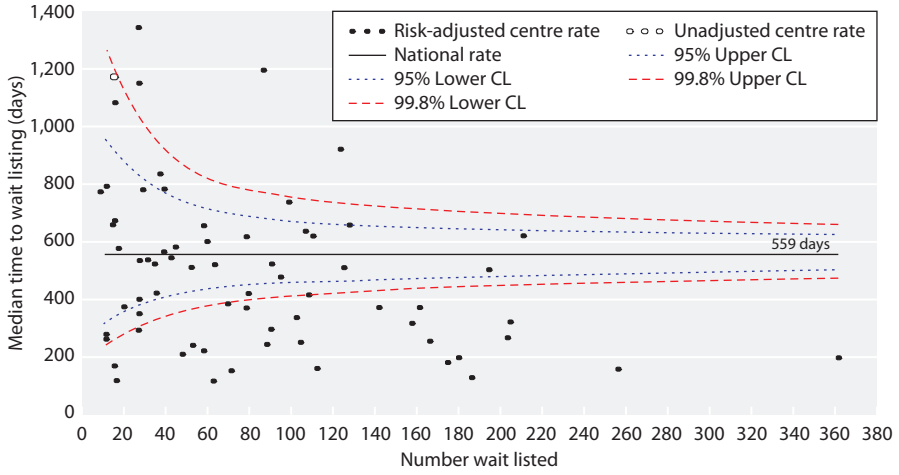

Fig. 9.4. Median time to wait listing for a kidney transplant, by renal centre (centres with <10 patients excluded)
The centre represented by an unfilled symbol has its final event time as the plotting position as the median time could not be estimated

Table 9.6. Median time to wait listing for a kidney transplant, by renal centre (censoring at the earliest of death or 31st December 2010)

Centre	RRT N	Registrations N	Median time to listing (days)	Centre	RRT N	Registrations N	Median time to listing (days)
Abrdn	88	53	511	L Barts	411	212	623
Airdrie	80	45	580	L Guys	307	204	269
Antrim	30	13	794	L Kings	208	108	635
B Heart	138	79	620	L Rfree	308	205	322
B QEH	330	195	501	L St.G	106	64	120
Bangor	41	16	1089	L West	496	362	202
Basldn	61	30	786	Leeds	237	159	320
Belfast	129	79	369	Leic	375	257	153
Bradfd	115	60	603	Liv Ain	51	17	***1181****
Brightn	144	91	296	Liv RI	201	126	512
Bristol	254	167	255	M RI	169	109	418
Camb	197	88	1197	Middlbr	134	89	245
Cardff	276	176	180	Newc	173	103	341
Carlis	40	27	293	Newry	22	12	262
Carsh	258	124	926	Norwch	125	64	526
Chelms	53	28	534	Nottm	183	111	623
Clwyd	23	10	778	Oxford	247	181	197
Colchr	22	12	280	Plymth	95	72	156
Covnt	170	95	482	Ports	252	187	129
D & Gall	22	16	174	Prestn	210	111	622
Derby	113	70	384	Redng	147	113	159
Derry	12	5	881	Salford	230	142	376
Donc	22	17	120	Sheff	245	129	663
Dorset	80	59	223	Shrew	83	40	786
Dudley	70	28	1155	Stevng	167	99	742
Dundee	61	32	540	Sthend	58	36	420
Dunfn	48	28	356	Stoke	75	40	567
Edinb	172	102	338	Sund	79	43	549
Exeter	141	80	419	Swanse	161	91	523
Glasgw	265	162	373	Truro	65	49	213
Glouc	82	54	242	Tyrone	29	16	667
Hull	175	104	333	Ulster	16	7	786
Inverns	37	21	371	Wirral	77	39	838
Ipswi	61	35	519	Wolve	108	59	656
Kent	158	105	252	Wrexm	30	18	579
Klmarnk	65	28	1347	York	48	28	400

* Results in ***bold italics*** are final event times as median times could not be estimated

on their renal IT system or a failure to extract this data. Missing data may not be at random; sicker patients may die more quickly, 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 activated on the national kidney transplant waiting list are more likely to have ethnicity and PRD data reported ($p < 0.0001$) (table 9.1).

Centre variation

The analyses performed within this report highlight significant centre effect in relation to the proportion of patients wait listed with nearly 20% of centres lying outside the lower 95% confidence interval, and three centres outside the lower 99.8% confidence interval, despite adjusting for a range of patient characteristics. Inter-centre differences are also noted in access to transplants from donors after cardiac death/living kidney donors with nine centres lying outside the lower 99.8% confidence interval.

Whilst both these outcomes are subject to individual centre practices and policies (which thus could be deemed a cause of the observed variation), one needs to interpret these results with caution as this study is limited by the lack comprehensive comorbidity data on all patients. Centres with higher prevalence rates of comorbidities would be expected to list proportionally fewer patients to reflect the fact that fewer patients are fit for transplantation. Additionally, it may take longer to activate patients in these centres due to the need for more intensive investigation and medical optimisation prior to transplantation. Indeed lack of comorbidity data limits definitive adjustment for case mix. Other patient level factors which this study too fails to adjust for include social deprivation which has been associated with reduced access to transplantation of a range of organs, as well as the impact of primary renal diagnoses (other than diabetes), health literacy and HLA sensitisation. Also, this study has not analysed the interplay between factors such as social deprivation and ethnicity and whether the observed differences based on ethnicity are likely to persist after adjustment for social deprivation and varying comorbidity burden in different ethnic groups. In essence, the available dataset does not permit definitive adjustment for case mix.

The observation that a patient starting dialysis in a non-transplanting renal centre was less likely to be registered for transplantation or receive a transplant from a donor after cardiac death (or a living kidney donor) compared with patients managed in transplanting renal centres, is interesting as this raises the question of whether patients are being disadvantaged by their address, and if indeed a 'post-code lottery' does exist. Drawing conclusions on this having not fully adjusted for the aforementioned potential confounders is again difficult, although it does add weight to the argument to conduct a more detailed study. Once registered for kidney transplantation, patients in both transplanting and non-transplanting renal centres had an equal chance of receiving a transplant from a donor after brainstem death. This is reassuring as organ allocation is subject to the national allocation algorithm which one would expect to allocate organs equitably.

The UKRR is collaborating with other researchers in the National Institute for Health Research (NIHR) funded Access to Transplant and Transplant Outcome Measures (ATTOM) research project to study access to kidney transplantation in greater detail. ATTOM is a non-interventional, prospective, cohort study that aims to recruit all patients aged 18–75 years starting dialysis, receiving a transplant and a similar number of matched patients active on the transplant waiting list, from all dialysis and transplant centres in the UK over a one year period. It is hoped that this study will provide greater insight into the barriers in access to transplantation, and that accurate comprehensive comorbidity data collected as part of this study will allow for more accurate adjustment for case mix for future analyses, and will hopefully more accurately demonstrate whether true inter-centre variation exists. This study will also allow practices identified in the better performing centres to be disseminated to other centres, thereby facilitating equity of access to transplantation across the UK.

Conclusions

This study highlights the persistence of significant centre variation in access to transplantation with respect to the proportion of patients listed and the time taken to activate suitable patients, even after correction for available relevant patient related variables. Significant differences exist between transplanting and non-transplanting centres, with increasing age and diabetes showing a negative association in terms of accessing the transplant wait list. Ethnicity was not seen to affect access to the wait list though did affect the probability of receiving a transplant once listed.

Conflicts of interest: none

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