Supplementary Material

Table S1. Comorbidity variable definitions

Comorbidity	Definition (presence of any of the following)
Diabetes	• Any cause of diabetes • Type I diabetes – Insulin required from time of diagnosis • Type II diabetes – Treatment with diet-control, oral antidiabetic medication or insulin
Ischaemic heart disease	• Angina – chest pain on exertion, relieved by rest or Glyceryl Trinitrate. As reported by patient or as documented in the case notes, with or without ECG changes, exercise tolerance testing or other imaging • Non-ST segment elevation myocardial infarction (NSTEMI) – troponin rise and non-ST segment elevation ischaemic ECG changes such as ST depression, T-wave inversion or no ECG changes. • ST segment elevation myocardial infarction (STEMI) – troponin rise and ST segment elevation on ECG. • Percutaneous coronary intervention (coronary angioplasty with or without stent insertion) • Coronary artery bypass graft operation
Heart failure	• Congestive cardiac failure • Left ventricular failure • Right ventricular failure • Left or right ventricular dysfunction on cardiac echo • Ejection fraction <30% on cardiac echo
Atrial fibrillation	• Patients in chronic atrial fibrillation at the time of recruitment, previous isolated episodes not included
Cardiac valve replacement	• Any kind of cardiac valve replacement or repair
Pacemaker	• Permanent pacemaker in-situ

Cerebrovascular disease	• Transient ischaemic attack (TIA) – also known as “mini-stroke”. Transient episode of neurologic dysfunction caused by ischaemia without infarction. Symptoms typically lasting less than 24 hours.
	• Cerebrovascular accident (CVA) including:
	  o Ischaemic stroke
	  o Cerebral haemorrhage
	  o Subarachnoid haemorrhage
	  o Subdural haemorrhage
	• Previous carotid intervention including:
	  o Carotid endarterectomy
	  o Carotid angioplasty

Peripheral vascular disease	• Claudication – lower limb pain on walking as reported by the patient, with or without doppler or angiographic evidence.
	• Radiological diagnosis
	• Radiological or surgical intervention including:
	  o Angioplasty
	  o Endarterectomy
	  o Bypass graft
	  o Amputation of any part of limb

Abdominal aortic aneurysm	• Radiological diagnosis under surveillance • Previous endovascular aneurysm repair • Previous open surgical repair
Chronic respiratory disease	• Any kind of chronic respiratory disease including: • Asthma – inflammatory condition of the lungs causing recurrent attacks of breathlessness and wheezing, differs in severity and occurs in all age groups. • Chronic obstructive pulmonary disease (COPD) – chronic and progressive airflow obstruction that is not fully reversible. FEV1/FVC ratio <0.7 and FEV1 < 80% predicted.

	• Bronchiectasis – abnormal and irreversible dilatation of the bronchi due to destruction of elastic and muscular tissue by acute or chronic inflammation and infection. Results in chronic infections and airway obstruction.
Chronic liver disease	• Persistent enzyme evidence of hepatic dysfunction with imaging or biopsy evidence of cirrhotic or noncirrhotic liver disease • Excludes cholecystitis or gallstones
Blood borne viruses	• Hepatitis C • Hepatitis B • HIV
Malignancy	• Diagnosis of any malignancy in the past or in the present. Does not include benign tumours such as breast adenoma, colon polyp, actinic keratosis etc.
Mental illness	• Any diagnosis of mental illness e.g. depression, psychosis, bipolar disorder, substance abuse, deliberate self-harm, schizophrenia

Data for comorbidities were extracted from patient case notes, local electronic patient information systems and/or confirmed with the patients named consultant nephrologist at the time of recruitment to ATTOM.

Table S2. Missing data

Variables	DDKT recipients n=1288	LDKT recipients n=812
Recipient variables		
Recipient age	0	0
Recipient gender	0	0
Recipient ethnicity	4 (0.31%)	0
Primary renal disease	2 (0.16%)	4 (0.49%)
Time on dialysis	0	0
Previous transplant	7 (0.54%)	4 (0.49%)
Sensitisation level	0	0
Smoking status	116 (9.0%)	85 (10.5%)
Donor variables		
Donor age	0	0
Donor gender	0	1 (0.12%)
Donor ethnicity	19 (1.48%)	0
Donor BMI	45 (3.49%)	40 (4.93%)
Transplant variables		
HLA MM level	0	0
CIT (per hour)	17 (1.32%)	66 (8.13%)
Recipient comorbidity variables		
Diabetes	3 (0.23%)	2 (0.25%)
Ischaemic heart disease	3 (0.23%)	2 (0.25%)
Heart failure	2 (0.16%)	2 (0.25%)
Atrial fibrillation	2 (0.16%)	2 (0.25%)
Cardiac valve replacement	3 (0.23%)	4 (0.49%)
Pacemaker	2 (0.16%)	3 (0.37%)
Cerebrovascular disease	2 (0.16%)	3 (0.37%)
Peripheral vascular disease	2 (0.16%)	3 (0.37%)
Abdominal aortic aneurysm	2 (0.16%)	3 (0.37%)
Chronic respiratory disease	2 (0.16%)	2 (0.25%)
Chronic liver disease	2 (0.16%)	2 (0.25%)
Blood borne viruses	3 (0.23%)	2 (0.25%)
Malignancy	2 (0.16%)	2 (0.25%)
Mental illness	2 (0.16%)	2 (0.25%)
BMI	58 (4.50%)	48 (5.91%)
Outcome variables		
Delayed graft function	74 (5.7%)	49 (6.0%)
Graft survival	2 (0.16%)	3 (0.37%)
Patient survival	1 (0.08%)	3 (0.37%)
Cause of graft failure	9 (10.58%)	2 (7.69%)

DDKT; Deceased-donor kidney transplant, LDKT; Living-donor kidney transplant, BMI; body mass index, CIT; cold ischaemia time.

Data are number (%). Diabetes includes any diagnosis of diabetes (both as a primary renal disease and a comorbidity).

Table S3. Demographics of excluded vs recruited kidney transplant recipients

Variable	Excluded (%)	Recruited (%)	p-value
Age group			0.307
18 – 34	15.5	17.2	
35 – 49	29.0	30.1	
50 – 64	38.0	37.9	
65 – 75	17.4	14.9	
Gender			0.332
Male	61.1	63.0	
Female	38.9	37.0	
Ethnicity			0.001
White	76.0	82.4	
Asian	13.5	9.6	
Black	7.4	6.2	
Other	2.3	1.6	
Missing	0.7	0.2	
Type of transplant			0.253
LD	36.3	38.7	
DD	63.7	61.3	

Table S4. Cox regression analysis for impact of comorbidity and delayed graft function on 2-year survival outcomes of deceased donor kidney transplants

	Transplant survival model		Graft survival model		Patient survival model	
Variables	**HR (95% CI)**	**p-value**	**HR (95% CI)**	**p-value**	**HR (95% CI)**	**p-value**
Recipient comorbidity						
Heart failure	2.77 (1.50, 5.12)	0.001	-	-	3.86 (1.82, 8.20)	0.0004
Cerebrovascular disease	2.05 (1.17, 3.59)	0.012	-	-	3.50 (1.73, 7.08)	0.0005
Chronic liver disease	-	-	-	-	4.68 (1.39, 15.79)	0.013
Peripheral vascular disease	-	-	2.58 (1.01, 6.59)	0.047	-	-
BMI, kg/m^2						
Underweight (<18.5)	-	-	1.52 (0.19, 11.67)	0.688	-	-
Normal (18.5 - 24.9)	-	-	1 (reference)		-	-
Overweight (25.0 - 29.9)	-	-	1.96 (1.01, 3.78)	0.046	-	-
Obese (≥30.0)	-	-	2.83 (1.43, 5.62)	0.003	-	-
Other variables						
Delayed graft function	1.75 (1.19, 2.56)	0.004	1.86 (1.12, 3.09)	0.017	1.24 (0.70, 2.20)	0.463
Time on dialysis (years)						
< 3	1 (reference)		1 (reference)		1 (reference)	
≥ 3	2.06 (1.35, 3.13)	0.0008	2.02 (1.15, 3.55)	0.014	2.26 (1.24, 4.15)	0.008
Recipient age (per 10 years)	1.06 (0.88, 1.28)	0.528	0.81 (0.64, 1.03)	0.086	1.56 (1.17, 2.15)	0.0003
Recipient ethnicity						
White	1 (reference)		1 (reference)		-	-
Asian	0.76 (0.39, 1.47)	0.418	0.88 (0.40, 1.96)	0.756	-	-
Black	0.83 (0.41, 1.67)	0.598	1.10 (0.49, 2.46)	0.826	-	-
Other	0.00 (0.00, 0.00)	.	0.00 (0.00, 0.00)	.	-	-
Highly sensitised (cRF≥85%)	1.52 (0.86, 2.67)	0.151	2.35 (1.16, 4.77)	0.018	-	-
Donor age (per 10 years)	1.09 (0.93, 1.27)	0.280	1.14 (0.93, 1.40)	0.208	1.07 (0.86, 1.35)	0.538
HLA MM level						
1	1 (reference)		1 (reference)		1 (reference)	
2	1.25 (0.61, 2.58)	0.544	3.95 (1.14, 13.72)	0.018	0.39 (0.15, 1.04)	0.059
3	1.15 (0.58, 2.27)	0.696	2.94 (0.86, 9.97)	0.084	0.51 (0.23, 1.16)	0.107
4	1.03 (0.38, 2.79)	0.951	2.19 (0.42, 11.42)	0.323	0.74 (0.24, 2.33)	0.608
Cold ischaemia time (per hour)	1.03 (0.99, 1.07)	0.105	1.02 (0.95, 1.06)	0.940	1.05 (0.99, 1.11)	0.102

HR; hazard ratio, CI; confidence interval, BMI; body mass index, cRF; calculated reaction frequency, HLA MM; human leukocyte antigen mismatch.

Table S5. Cox regression analysis for impact of BMI on 2-year graft survival of deceased donor kidney transplants

BMI (kg/m^2)	n	HR (95% CI)	p-value
Underweight (<18.5)	26	0.88 (0.11, 6.49)	0.885
Normal (18.5 - 24.9)	461	1 (reference)	
Overweight (25.0 - 29.9)	462	1.48 (0.84, 2.61)	0.180
Obese class I (30.0 - 34.9)	222	2.29 (1.23, 4.26)	0.009
Obese class II/III (≥35.0)	59	2.19 (0.87, 5.46)	0.094

Model adjusted for peripheral vascular disease, time on dialysis, recipient age, recipient ethnicity, highly sensitised (cRF≥85%), donor age, HLA MM level and cold ischaemia time.

Table S6. Cox regression model for 2-year transplant survival of deceased-donor kidney transplants (including risk score)

Variables	HR (95% CI)	p-value
Heart failure	2.38 (1.30, 4.34)	0.005
Cerebrovascular disease	2.21 (1.34, 3.67)	0.002
Time on dialysis (years)		
< 3	1 (reference)	
≥ 3	2.17 (1.49, 3.16)	<0.0001
Risk score (per unit)	1.11 (1.03, 1.19)	0.005

HR; hazard ratio, CI; confidence interval.
Model is adjusted for a risk score (Box S1) that incorporates relevant confounding variables.

Box S1. Risk score for 2-year transplant survival based on UK transplant registry data for deceased-donor kidney transplants in 2006 - 2011 (n=6469)

Transplant survival risk score = exp [- 0.3687 if recipient age 30-39
- 0.3885 if recipient age 40-49
- 0.2020 if recipient age 50-59
- 0.1863 if recipient age 60-64
+ 0.1589 if recipient age is 65-75
+ 0.1808 if recipient ethnicity Asian
+ 0.2745 if recipient ethnicity Black
- 0.5727 if recipient ethnicity Other
+ 0.2494 if recipient highly sensitised (cRF≥85%)
+ 0.02475 x donor age
- 0.2978 if HLA MM level 1
+ 0.1518 if HLA MM level 3
- 0.07197 if HLA MM level 4
+ 0.00613 x cold ischaemic time in hours]

exp; exponential function, HLA MM; human leukocyte antigen mismatch, cRF; calculated reaction frequency.
HLA MM is classified into 4 levels as defined by the current UK deceased-donor kidney allocation scheme (see Methods section). “Other” is any ethnicity other than White, Asian or Black.

Table S7. Cox regression model for 2-year graft survival of deceased-donor kidney transplants (including risk score)

Variables	HR (95% CI)	p-value
Peripheral vascular disease	2.74 (1.25, 5.99)	0.012
BMI, kg/m^2		
Underweight (<18.5)	0.97 (0.13, 7.23)	0.977
Normal (18.5 - 24.9)	1 (reference)	
Overweight (25.0 - 29.9)	1.33 (0.76, 2.34)	0.319
Obese (≥30.0)	2.14 (1.20, 3.80)	0.010
Time on dialysis (years)		
< 3	1 (reference)	
≥ 3	2.08 (1.29, 3.35)	0.003
Risk score (per unit)	1.21 (1.07, 1.37)	0.003

HR; hazard ratio, CI; confidence interval, BMI; body mass index. Model is adjusted for a risk score (Box S2) that incorporates relevant confounding variables.

Box S2. Risk score for 2-year graft survival based on UK transplant registry data for deceased-donor kidney transplants in 2006 - 2011 (n=5569)

Graft survival risk score = exp [- 0.5205 if recipient age 30-39
- 0.6398 if recipient age 40-49
- 0.5586 if recipient age 50-59
- 0.6910 if recipient age 60-64
- 0.4789 if recipient age is 65-75
+ 0.1503 if recipient ethnicity Asian
+ 0.2982 if recipient ethnicity Black
- 0.6247 if recipient ethnicity Other
+ 0.02813 x donor age
- 0.1626 if HLA MM level 1
+ 0.2599 if HLA MM level 3
- 0.06468 if HLA MM level 4
+ 0.00347 x cold ischaemic time in hours]

exp; exponential function, HLA MM; human leukocyte antigen mismatch. HLA MM is classified into 4 levels as defined by the current UK deceased-donor kidney allocation scheme (see Methods section). “Other” is any ethnicity other than White, Asian or Black.

Table S8. Cox regression model for 2-year patient survival of deceased-donor kidney transplants (including risk score)

Variables	HR (95% CI)	p-value
Comorbidity		
Heart failure	3.72 (1.76, 7.87)	0.0006
Cerebrovascular disease	3.37 (1.69, 6.71)	0.0005
Chronic liver disease	3.94 (1.21, 12.83)	0.023
Time on dialysis (years)		
< 3	1 (reference)	
≥ 3	2.34 (1.30, 4.22)	0.005
Risk score (per unit)	1.02 (1.01, 1.03)	0.0009

HR; hazard ratio, CI; confidence interval.
Model is adjusted for a risk score (Box S3) that incorporates relevant confounding variables.

Box S3. Risk score for 2-year patient survival based on UK transplant registry data for deceased-donor kidney transplants in 2006 - 2011 (n=5569)

Patient survival risk score = exp [- 0.8798 if recipient age 30-39
+ 1.4404 if recipient age 40-49
+ 1.8680 if recipient age 50-59
+ 2.1586 if recipient age 60-64
+ 2.8002 if recipient age is 65-75
+ 0.01730 x donor age
- 0.4345 if HLA MM level 1
- 0.01808 if HLA MM level 3
- 0.1475 if HLA MM level 4
+ 0.01632 x cold ischaemic time in hours]

exp; exponential function, HLA MM; human leukocyte antigen mismatch. HLA MM is classified into 4 levels as defined by the current UK deceased-donor kidney allocation scheme (see Methods section).

Table S9. Cox regression model for 2-year transplant survival of living-donor kidney transplants (including risk score)

Variables	HR (95% CI)	p-value
Comorbidity		
Heart failure	3.63 (1.10, 11.97)	0.035
Diabetes	2.21 (1.05, 4.66)	0.037
Other variables		
Time on dialysis (years)		
< 3	1 (reference)	
≥ 3	2.20 (1.16, 4.16)	0.016
Risk score (per unit)	1.02 (0.46, 2.23)	0.968

HR; hazard ratio, CI; confidence interval.
Diabetes includes any diagnosis of diabetes (both as a primary renal disease and a comorbidity).
Model is adjusted for a risk score (Box S4) that incorporates relevant confounding variables.

Box S4. Risk score for 2-year transplant survival based on UK transplant registry data for living-donor kidney transplants in 2006 - 2011 (n=3837)

Transplant survival risk score = exp [- 0.1519 if recipient age 30-39
- 0.2066 if recipient age 40-49
- 0.4011 if recipient age 50-59
- 0.05848 if recipient age 60-64
+ 0.3659 if recipient age is 65-75
+ 0.00879 x donor age
- 0.07066 if HLA MM level 1
- 0.01556 if HLA MM level 3
- 0.2242 if HLA MM level 4]

exp; exponential function, HLA MM; human leukocyte antigen mismatch. HLA MM is classified into 4 levels as defined by the current UK deceased-donor kidney allocation scheme (see Methods section).