

# **ANNUAL REPORT ON CARDIOTHORACIC TRANSPLANTATION**

**REPORT FOR 2013/2014  
(1 APRIL 2004 – 31 MARCH 2014)**

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**PRODUCED IN COLLABORATION WITH NHS ENGLAND**



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# **EXECUTIVE SUMMARY**



## EXECUTIVE SUMMARY

This report presents key figures about cardiothoracic transplantation in the UK. The period reported covers 10 years of transplant data, from 1 April 2004. The report presents information on the number of transplants and survival analysis after first heart and/or lung transplantation, both on a national and centre-specific basis.

### Key findings

- On 31 March 2014, there were 246 patients on the UK [active heart transplant list](#) which represents a 23% increase in the number of patients a year earlier. The equivalent number of patients on the active lung transplant list was 287, representing a 19% increase from the previous year.
- There were 3021 cardiothoracic **transplants** performed in the UK in the ten year period. Of these, 1408 were first heart-only transplants and 1555 were first lung or heart/lung transplants.
- Centre-specific [risk-adjusted survival rates](#) at 30 days, 1 year, 3 years and 5 years post **heart** transplant are all within the 99.8% [confidence limits](#) of the national average survival rate, for **adult** recipients at all transplant centres.
- Centre-specific risk-adjusted survival rates at 30 days and 1 year post **lung** transplant are within the 99.8% confidence limits of the national average survival rate, for **adult** recipients at all transplant centres. Risk-adjusted survival rates at 3 years and 5 years post lung transplant for one centre are however below the 99.8% lower confidence limit of the national average survival rate.
- The national rate of survival 30 days after first **heart transplantation of adults** is 87.3%. These rates vary between centres, ranging from 75.6% to 94.1% ([risk-adjusted](#)).
- The national rate of survival 30 days after first **heart transplantation of paediatrics** is 96.3%. These rates vary between centres, ranging from 95.4% to 97.4% ([unadjusted](#)). Centre-specific estimates of these rates must be interpreted with caution due to the small number of transplants upon which they are based.
- The national rate of survival 90 days after first **lung transplantation of adults** from deceased donors is 90.5%. These rates vary between centres, ranging from 78.9% to 92.2% (risk-adjusted).
- The national rate of survival 90 days after first **lung transplantation of paediatrics** from deceased donors is 93.3%.

# INTRODUCTION



## INTRODUCTION

This report presents information on transplant activity and patient mortality after first heart and/or lung transplantation between 01 April 2004 and 31 March 2014, for all centres performing heart and/or lung transplantation in the UK. Data were obtained from the UK Transplant Registry at NHS Blood & Transplant which holds information relating to donors, recipients and outcomes for all cardiothoracic transplants performed in the UK.

There are two paediatric transplant centres; Great Ormond Street and Newcastle (also an adult transplant centre). Results are described separately for hearts and lungs and also for adult (aged  $\geq 16$  years) and paediatric patients (aged  $< 16$  years). However, both adult and paediatric transplants carried out at Great Ormond Street are included in the paediatric report, and paediatric transplants carried out at non-paediatric centres are included in the adult report. Heart lung blocks are included in the lung analysis.

The centre specific results for adult first transplants are adjusted for differences in risk factors between the centres. The risk models used are described in the Appendix.

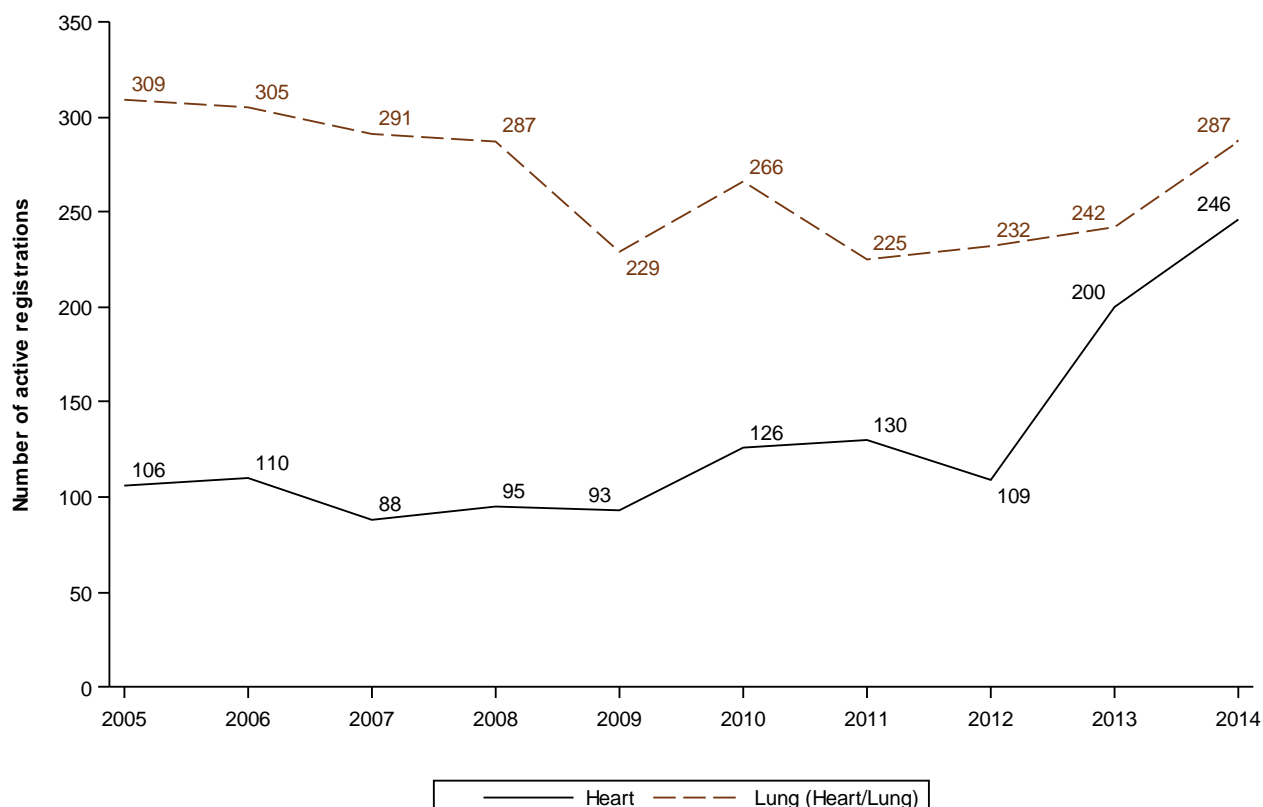
Continuous monitoring charts (cumulative observed minus expected mortality and tabular CUSUM) for 30-day heart transplant mortality and 90-day lung transplant mortality are presented for data accrued since January 2011. Outcomes are [unadjusted](#) for risk.

Methods used are described in the Appendix.

Patients requiring multi-organ transplants (other than heart/lung transplants) are excluded from all analyses other than those presented in this Introduction section. In addition, partial lung transplants and patients receiving their second (or more) graft are excluded from the survival analysis calculations.

**Figure 1.1** shows the number of patients on the [active transplant list](#) at 31 March each year between 2005 and 2014. The number of patients waiting for a lung transplant fell each year from 309 in 2005 to 229 in 2009 and has increased since to 287 in 2014. The number of patients waiting for a heart transplant has increased substantially from 93 in 2009 to 246 in 2014.

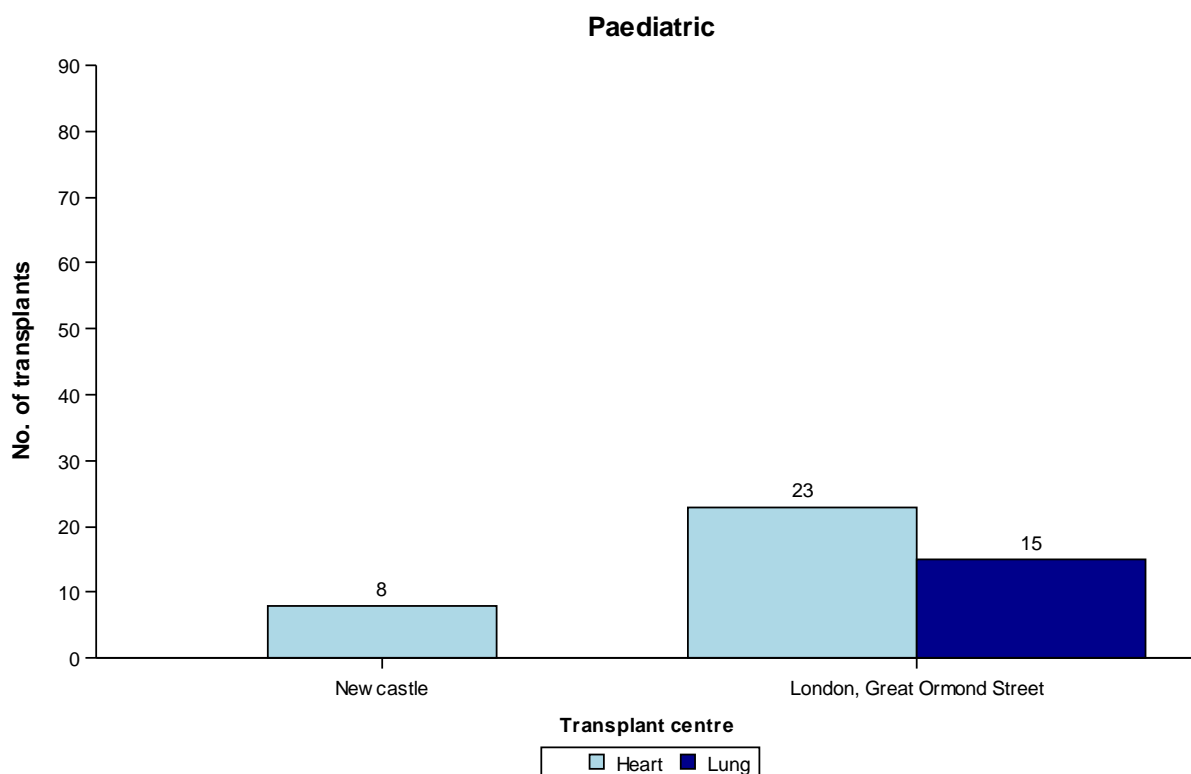
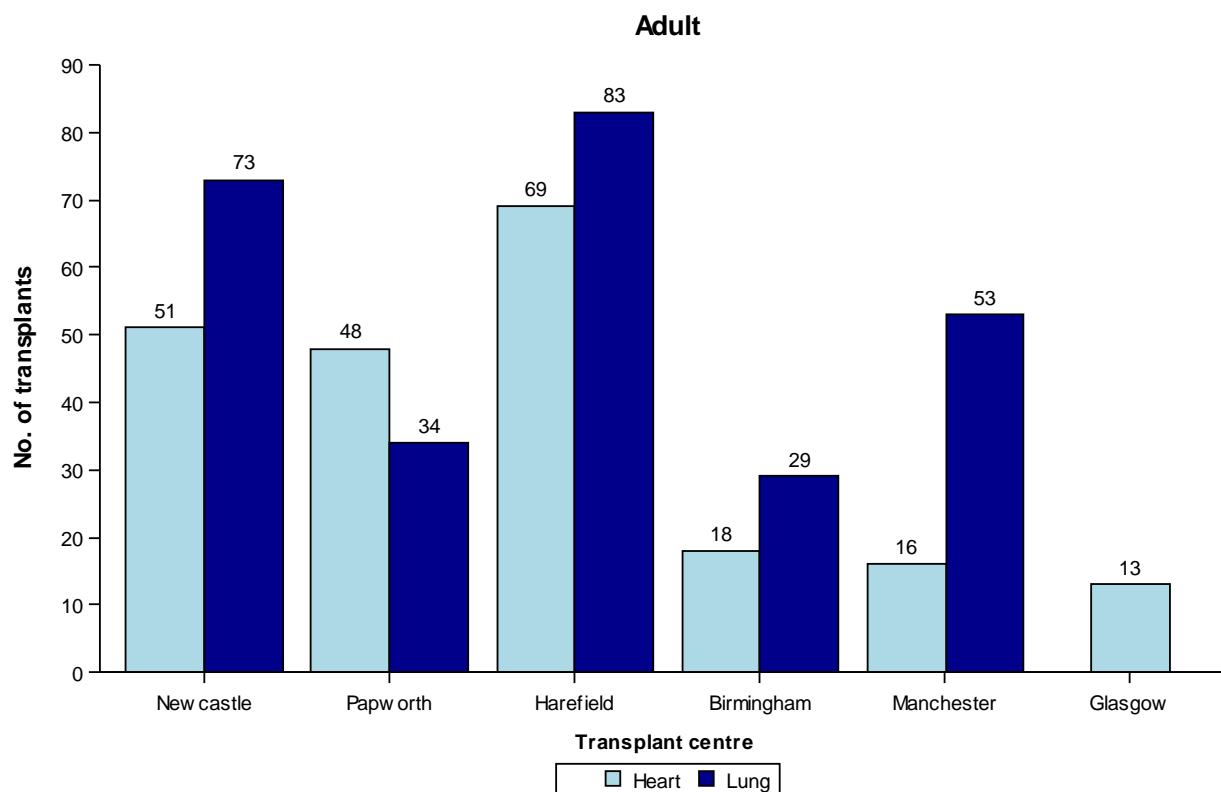
**Figure 1.1 Number of patients on the active transplant list at 31 March each year from 2005 to 2014**





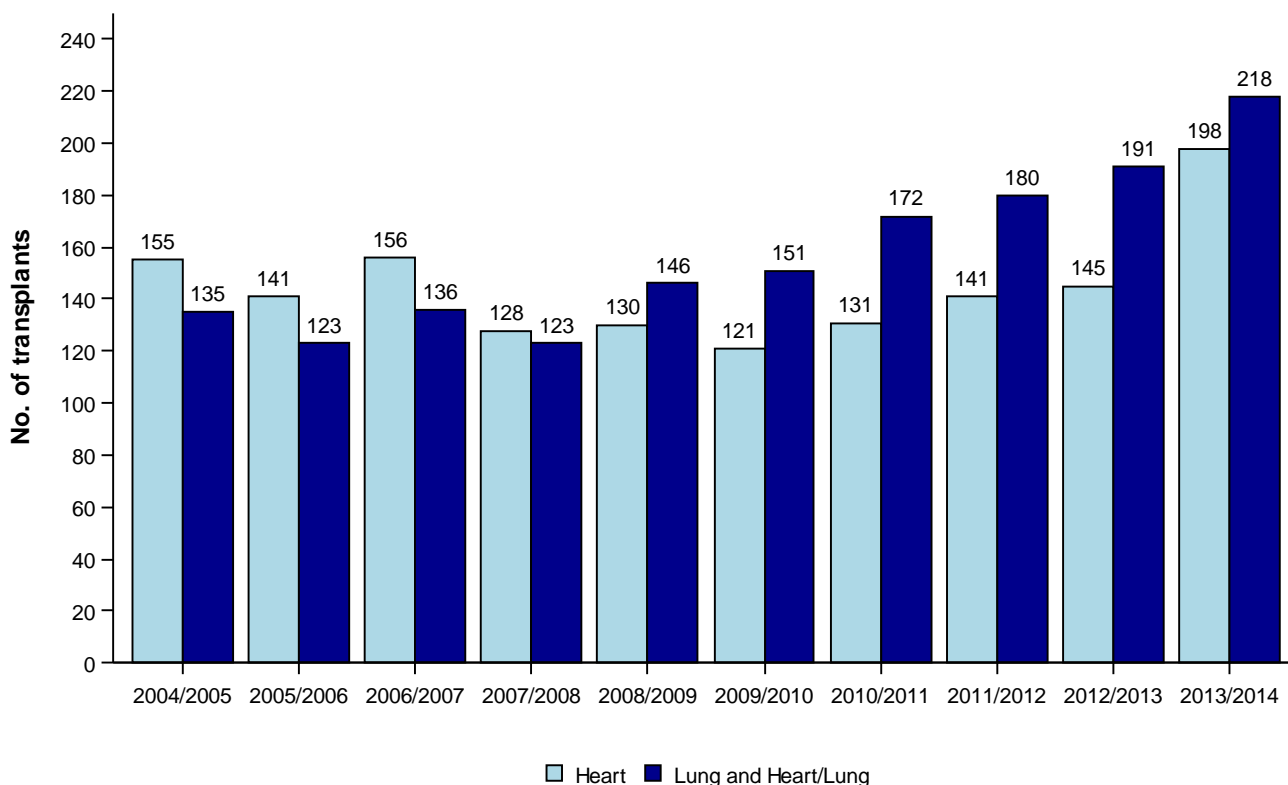
**Figure 1.2** shows the number of adult and paediatric patients on the [active transplant list](#) at 31 March 2014 by centre. In total, there were 487 adults and 46 paediatric patients. Harefield had the largest proportion of the adult transplant list.

**Figure 1.2 Patients on the Heart and lung transplant lists at 31 March 2014, by centre**



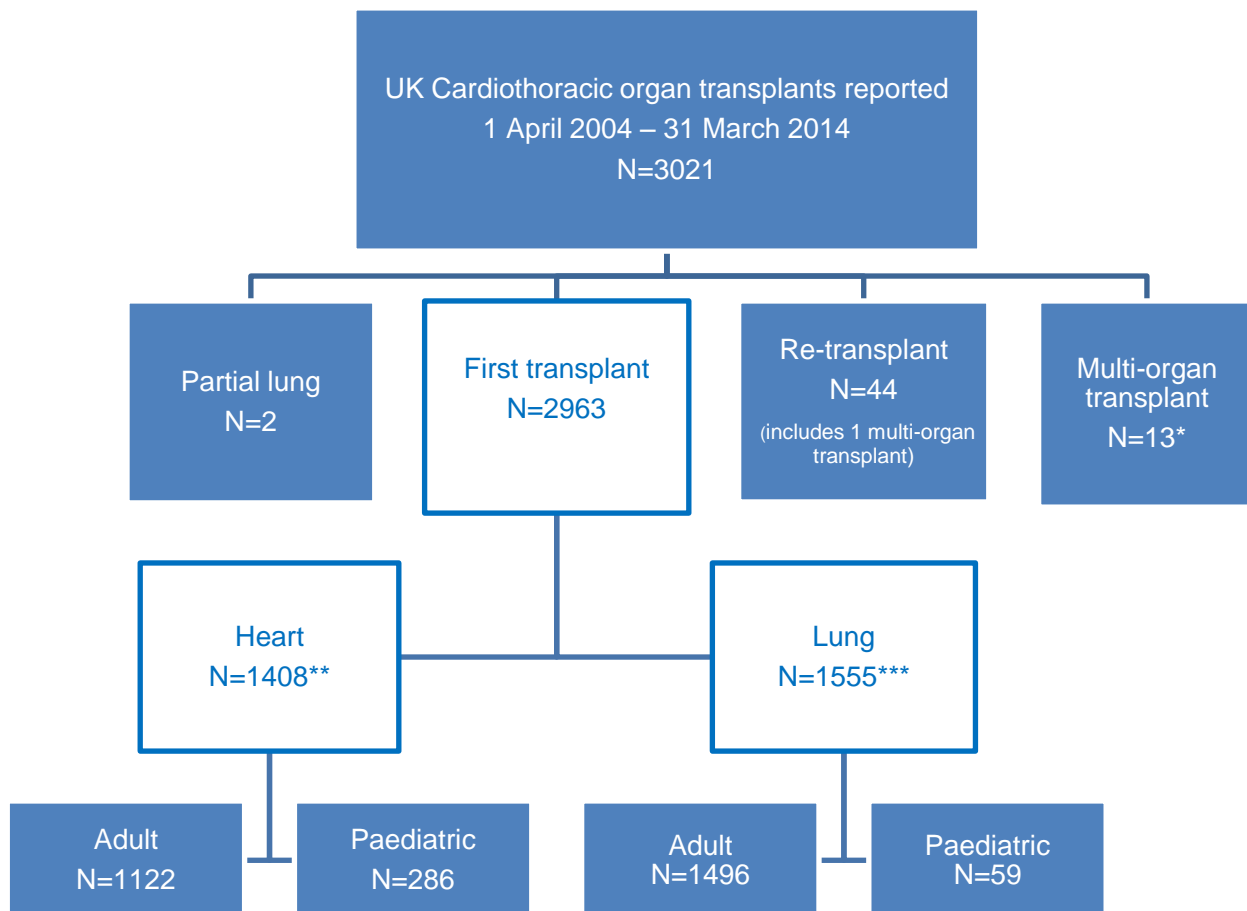
**Figure 1.3** shows the total number of transplants performed in the last ten years. The number of heart transplants per year dropped to 128 in 2007/08 but began increasing slightly in 2010/11. There was a substantial increase between 2012/13 and 2013/14 from 145 to 198. The number of lung transplants per year has been steadily increasing since 2007/08 to 218 in 2013/14.

**Figure 1.3 Number of cardiothoracic transplants in the UK, 01 April 2004 – 31 March 2014 by financial year**



**Figure 1.4** details the 3021 cardiothoracic transplants performed in the UK in the ten year period. Of these, 3008 transplants are analysed in the following sections (multi-organ transplants are not included). The exception to this however is that survival analyses are based on 1408 (47%) heart transplants and 1555 lung transplants (51%) as partial lung transplants and re-transplants are excluded.

**Figure 1.4 UK Cardiothoracic organ transplants reported from 01 April 2004 to 31 March 2014**



\* includes 10 heart /kidney and 3 lung/liver transplants

\*\* includes 5 domino donor transplants

\*\*\* includes 62 heart lung block transplants

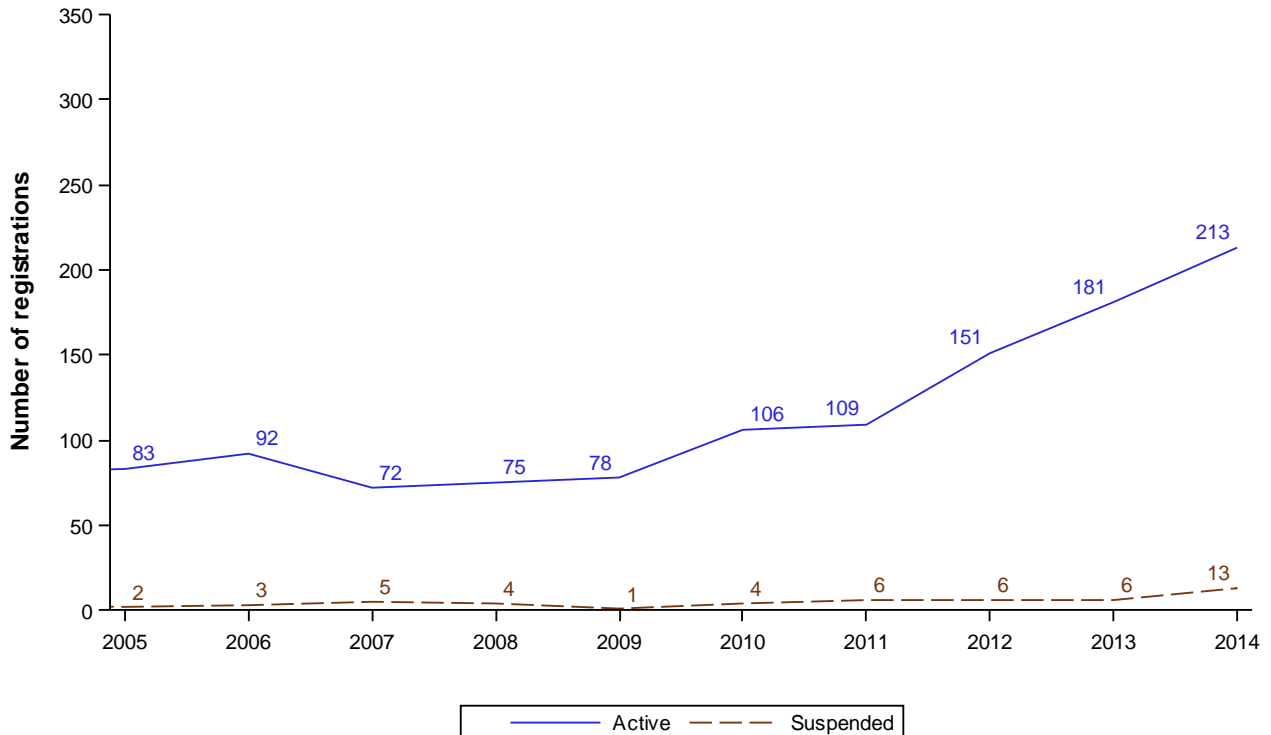
# **ADULT HEART TRANSPLANTATION**

## **Transplant List**



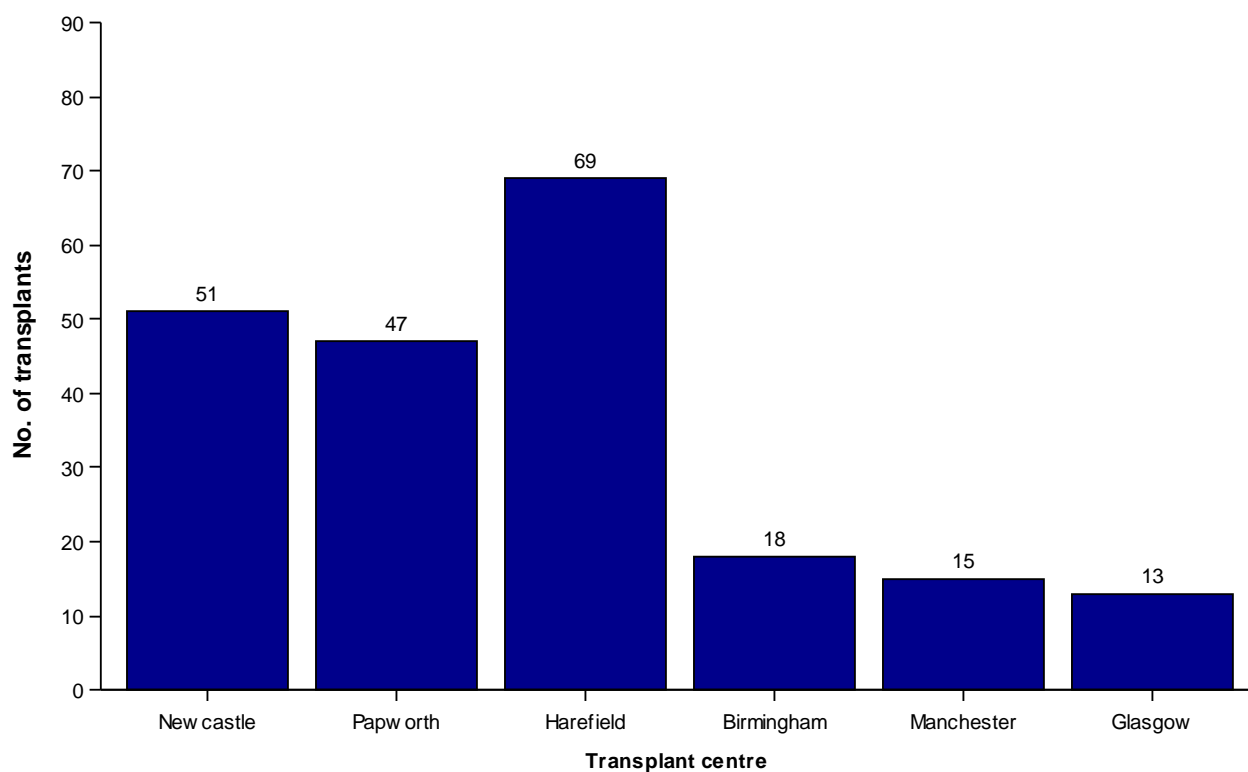
**Figure 2.1** shows the number of adult patients on the heart only transplant list at 31 March each year between 2005 and 2014. The number of patients actively waiting for a heart transplant increased each year from 83 in 2005 to 213 in 2014.

**Figure 2.1 Adult heart patients on the cardiothoracic transplant lists at 31 March for the last 10 years, by year**



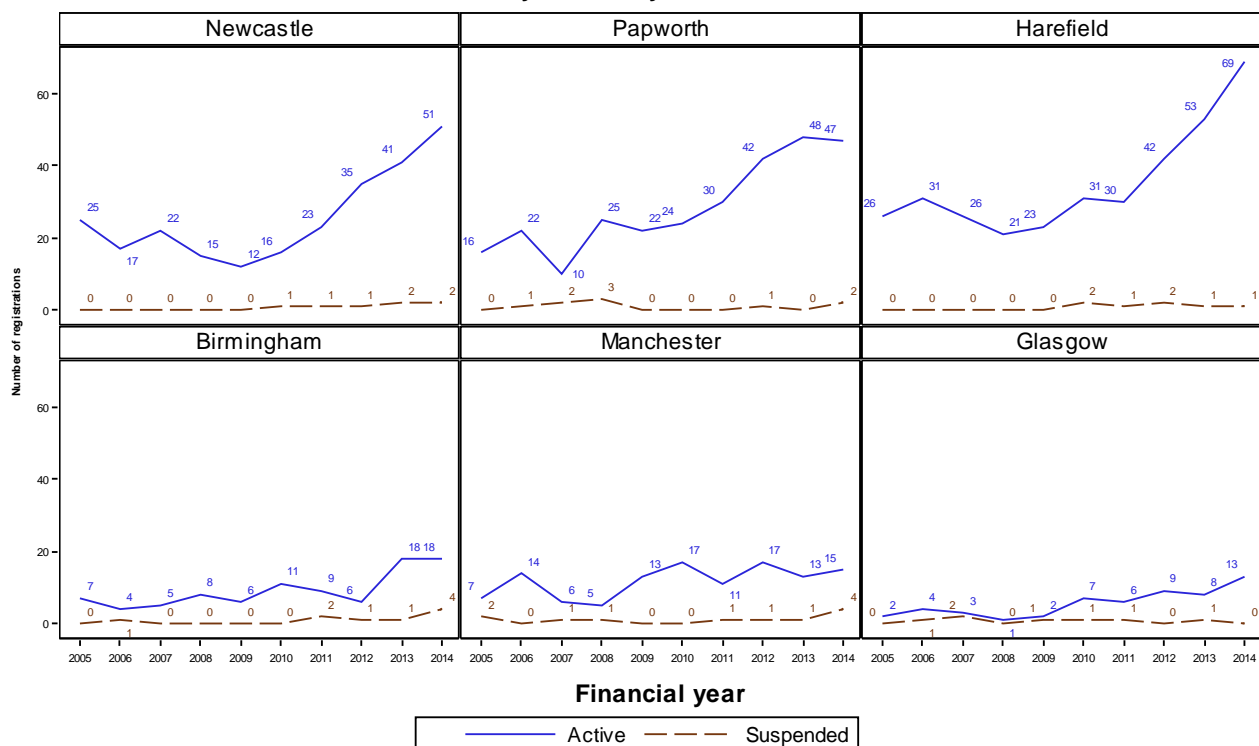
**Figure 2.2** shows the number of adult patients on the [active heart only transplant list](#) at 31 March 2014 by centre. In total, there were 213 adults patients. Harefield had the largest proportion (32%) of the transplant list while Glasgow had the smallest (6%).

**Figure 2.2 Adult patients on the heart active transplant list at 31 March 2014, by centre**



**Figure 2.3** shows the number of adult patients on the transplant list at 31 March each year between 2005 and 2014 for each transplant centre.

**Figure 2.3 Adult heart patients on the cardiothoracic transplant list at 31 March for the last 10 years, by year and by centre**



The demographic characteristics of the 213 adult patients on the [active heart transplant list](#) in the latest year are shown by centre and overall in **Table 2.1**. 85% of these recipients were male and the [median](#) age was 51 years. For some characteristics, due to rounding, percentages may not add up to 100.

<b>Table 2.1 Demographic characteristics of adult heart active transplant list patients at 31 March 2014, by centre</b>								
		Newcastle N (%)	Papworth N (%)	Harefield N (%)	Birmingham N (%)	Manchester N (%)	Glasgow N (%)	TOTAL N (%)
Number		51	47	69	18	15	13	<b>213 (100)</b>
Recipient sex	Male	46 (90)	38 (81)	59 (86)	16 (89)	12 (80)	11 (85)	<b>182 (85)</b>
	Female	5 (10)	9 (19)	10 (14)	2 (11)	3 (20)	2 (15)	<b>31 (15)</b>
Recipient ethnicity	White	48 (94)	39 (83)	59 (86)	14 (78)	13 (87)	12 (92)	<b>185 (87)</b>
	Non-white	2 (4)	8 (17)	9 (13)	4 (22)	2 (13)	1 (8)	<b>26 (12)</b>
	Missing	1 (2)	0	1 (1)	0	0	0	<b>2 (1)</b>
Recipient age	Median ( <a href="#">IQR</a> )	47 (37,57)	53 (43,60)	51 (42,61)	56.5 (47,60)	51 (42,56)	54 (49,56)	<b>51.00 (42.00,59.00)</b>
	Missing	0	0	0	0	0	0	<b>0</b>
Primary Disease	Coronary heart disease	14 (27)	6 (13)	10 (14)	4 (22)	2 (13)	9 (69)	<b>45 (21)</b>
	Cardiomyopathy	17 (33)	21 (45)	43 (62)	3 (17)	7 (47)	1 (8)	<b>92 (43)</b>
	Congenital heart disease	13 (25)	2 (4)	2 (3)	1 (6)	0	0	<b>18 (9)</b>
	Other heart disease	2 (4)	9 (19)	5 (7)	6 (33)	4 (27)	0	<b>26 (12)</b>
	Graft failure/Rejection	1 (2)	0	0	0	0	0	<b>1 (1)</b>
	Others	4 (8)	9 (19)	7 (10)	4 (22)	2 (13)	3 (23)	<b>29 (14)</b>
	Missing	0	0	2 (3)	0	0	0	<b>2 (1)</b>

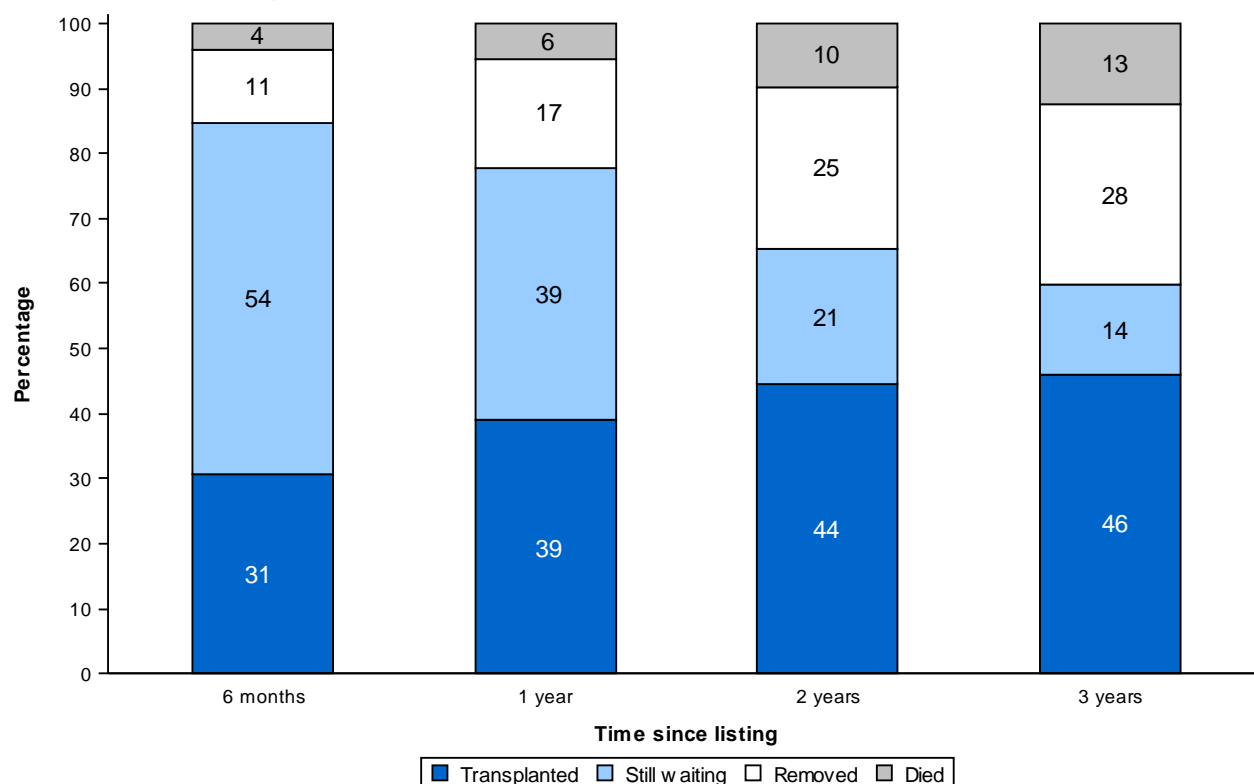


**Table 2.1 Demographic characteristics of adult heart active transplant list patients at 31 March 2014, by centre**

		Newcastle N (%)	Papworth N (%)	Harefield N (%)	Birmingham N (%)	Manchester N (%)	Glasgow N (%)	<b>TOTAL N (%)</b>
Previous open heart surgery	None	35 (69)	27 (57)	36 (52)	12 (67)	10 (67)	8 (62)	<b>128 (60)</b>
	One	9 (18)	15 (32)	22 (32)	3 (17)	5 (33)	4 (31)	<b>58 (27)</b>
	More than one	7 (14)	4 (9)	10 (14)	2 (11)	0	1 (8)	<b>24 (11)</b>
	Missing	0	1 (2)	1 (1)	1 (6)	0	0	<b>3 (1)</b>
Previous thoracotomy	No	47 (92)	47 (100)	61 (88)	14 (78)	13 (87)	9 (69)	<b>191 (90)</b>
	Yes	3 (6)	0	7 (10)	3 (17)	2 (13)	4 (31)	<b>19 (9)</b>
	Missing	1 (2)	0	1 (1)	1 (6)	0	0	<b>3 (1)</b>
Serum Bilirubin umol/l	Median ( <a href="#">IQR</a> )	15 (9,25)	14 (9,21)	14 (12,22)	13 (12,22)	23 (16,42)	7 (5,14)	<b>14 (11,23)</b>
	Missing	1	2	1	1	0	0	<b>5</b>
Serum Creatinine umol/l	Median ( <a href="#">IQR</a> )	108 (89,144)	104 (96,131)	90 (73,111)	107 (87,126)	84 (73,105)	106 (96,117)	<b>100 (83,119)</b>
	Missing	0	1	1	1	0	0	<b>3</b>

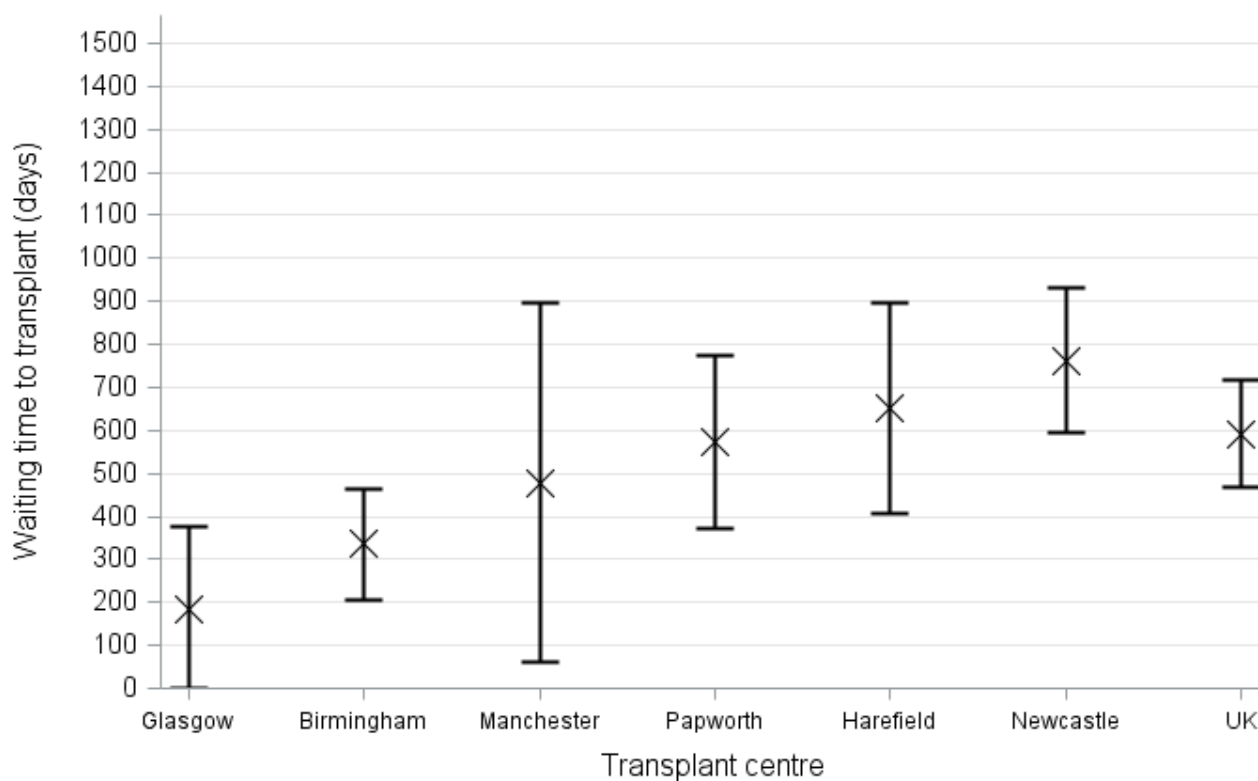
An indication of outcomes for adult patients listed for a non-urgent heart transplant is summarised in **Figure 2.4**. This shows the proportion of patients transplanted or still waiting six months, one, two and three years after joining the list. It also shows the proportion removed from the transplant list (typically because they become too unwell for transplant) and those dying while on the transplant list. Within six months of listings, 31% of non-urgent heart patients were transplanted while 4% have died waiting. Three years after listing 46% have received a transplant.

**Figure 2.4 Post-registration outcome for 72 new non-urgent heart only registrations made in the UK, 1 April 2010 to 31 March 2011**



The [median](#) waiting time to transplant for adult patients on the non-urgent heart transplant list is shown in **Figure 2.5** and **Table 2.2**. The median waiting time is the lowest for Glasgow at 183 days and highest for Newcastle at 763 days.

**Figure 2.5 Median waiting time to transplant for adult patients registered on the non-urgent transplant list, from 1 April 2008 to 31 March 2011**



**Table 2.2** [Median](#) waiting time to non-urgent heart only transplant in the UK, for adult patients registered 1 April 2008 - 31 March 2011

Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% <a href="#">Confidence interval</a>
Newcastle	74	763	596 - 930
Papworth	87	574	374 - 774
Harefield	64	651	406 - 896
Birmingham	60	336	208 - 464
Manchester	44	478	60 - 896
Glasgow	25	183	-
<b>UK</b>	<b>354</b>	<b>592</b>	<b>468 - 716</b>

- Not estimated due to small numbers of patients

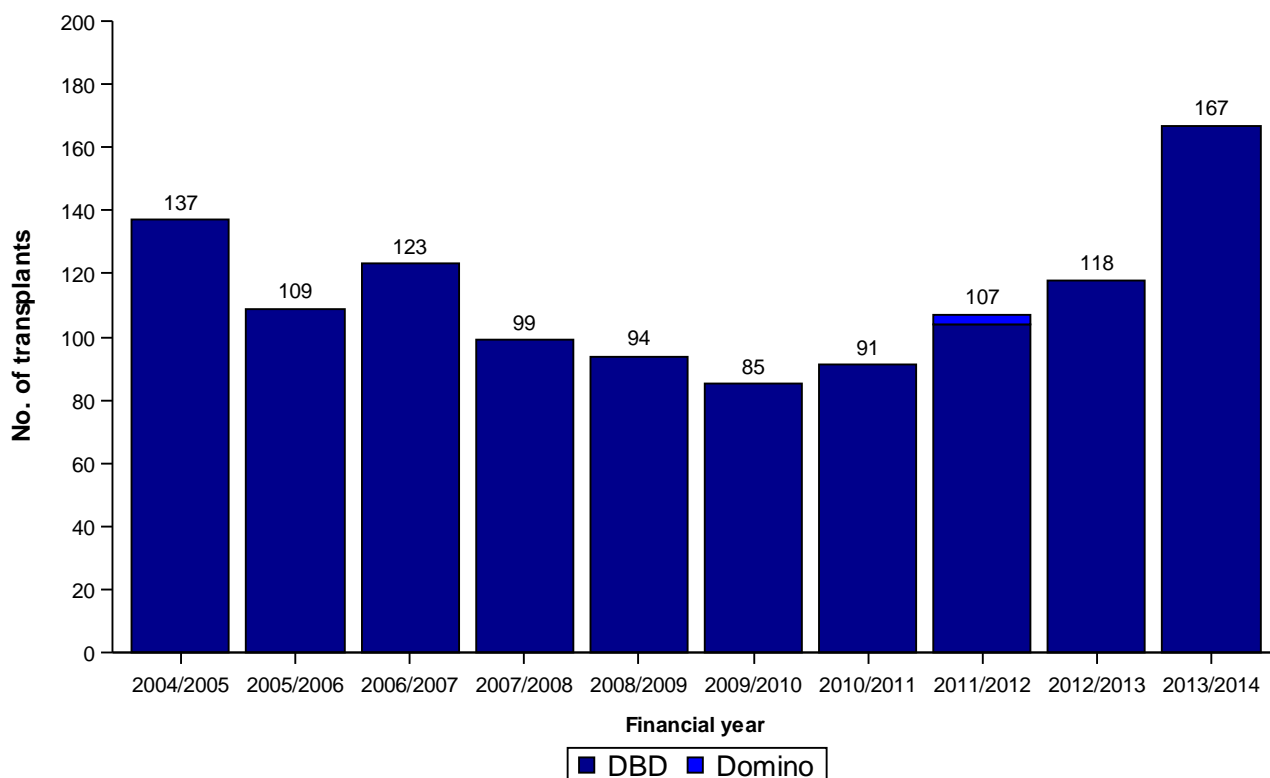
# **ADULT HEART TRANSPLANTATION**

## **Transplants**

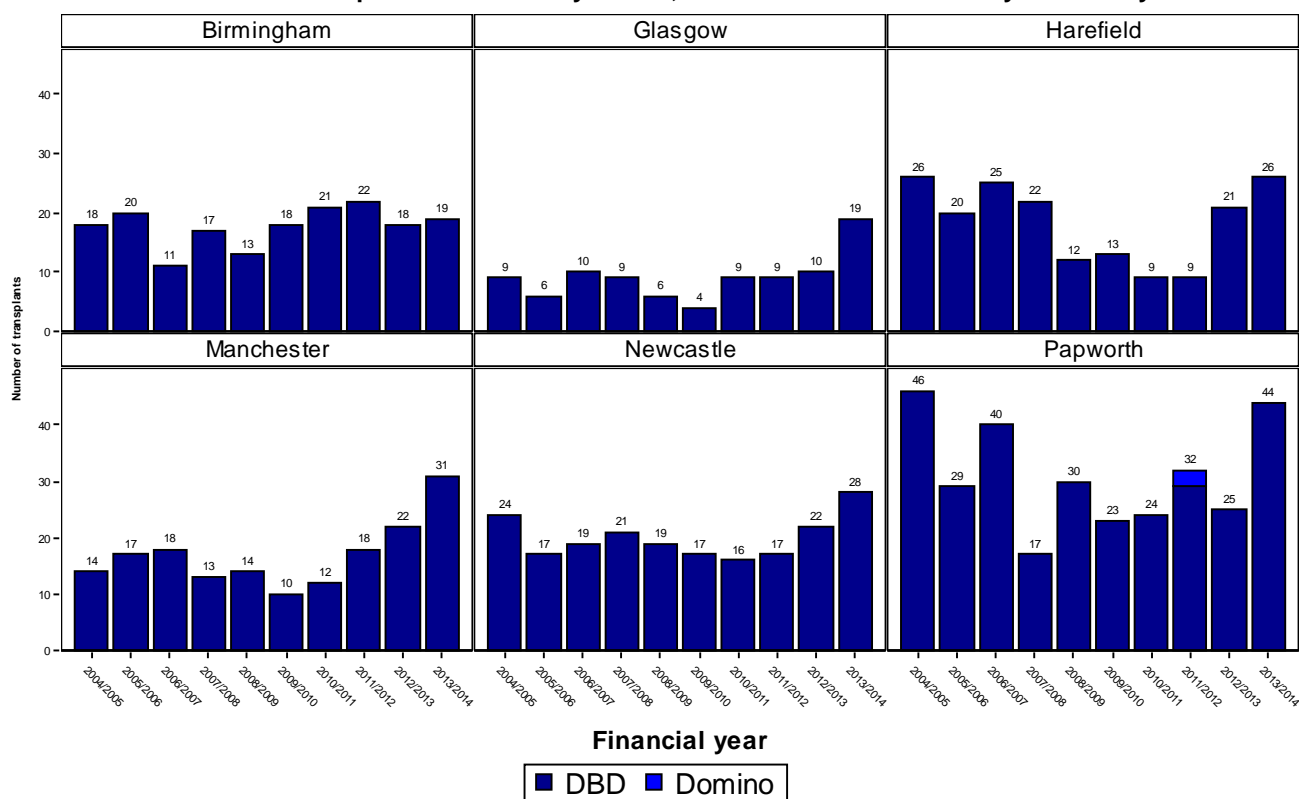


**Figures 3.1 and 3.2** show the total number of heart only transplants performed in the last ten years overall and by centre, respectively. The number of transplants increased steadily between 2009 and 2013, after which a substantial increase occurred; the number of transplants increased by 42% over the last financial year. The number of transplants in the latest financial year (2013-2014) is shown by centre in **Figure 3.3**.

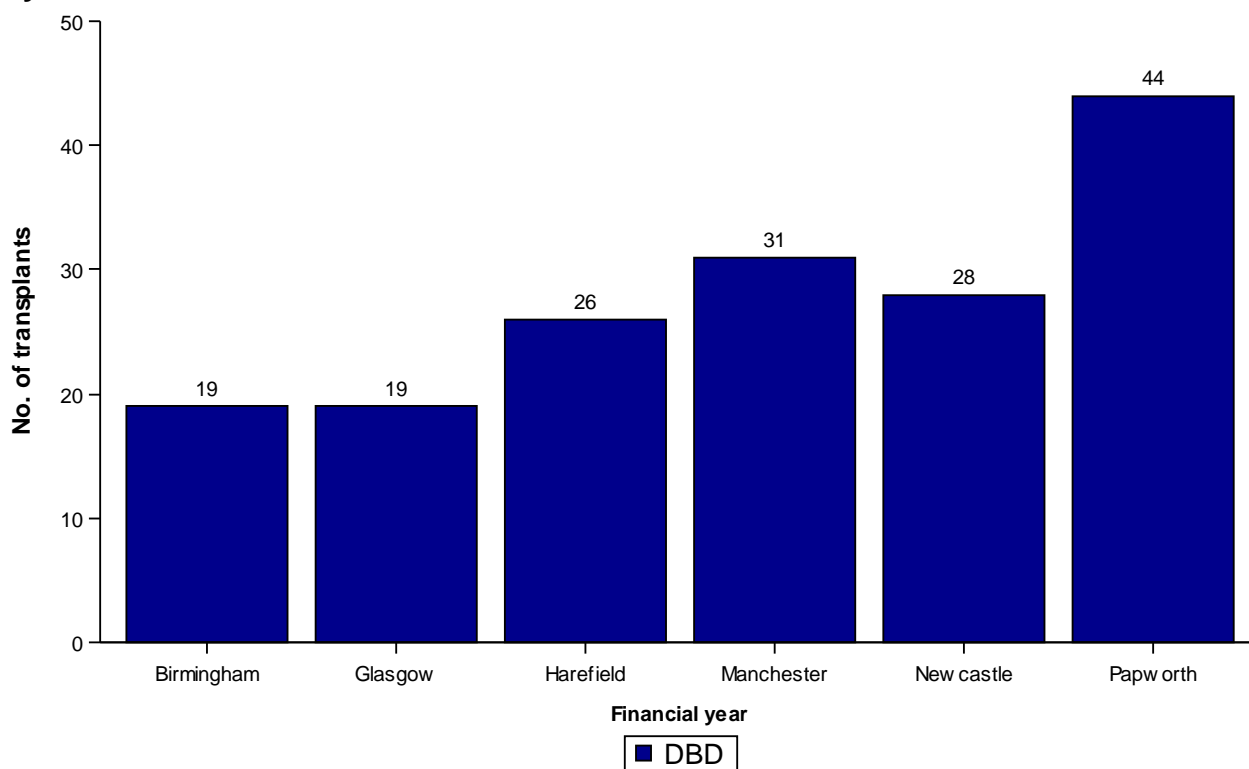
**Figure 3.1 Number of adult heart transplants in the UK, 1 April 2004 to 31 March 2014, by financial year**



**Figure 3.2 Number of adult heart transplants in the UK, 1 April 2004 to 31 March 2014, by centre and financial year**



**Figure 3.3 Number of adult heart transplants in the UK, 1 April 2013 to 31 March 2014, by centre**



The demographic characteristics of 167 adult heart transplant recipients in the latest year are shown by centre and overall in **Table 3.1**. 74% of these recipients were male and the [median](#) age was 48 years. For some characteristics, due to rounding, percentages may not add up to 100.

<b>Table 3.1 Demographic of first Adult Heart transplant recipients by centre, from 1 April 2013 to 31 March 2014</b>								
		Newcastle N (%)	Papworth N (%)	Harefield N (%)	Birmingham N (%)	Manchester N (%)	Glasgow N (%)	<b>TOTAL N (%)</b>
Recipient sex	Male	17 (61)	30 (68)	21 (81)	16 (84)	25 (81)	15 (79)	<b>124 (74)</b>
	Female	11 (39)	14 (32)	5 (19)	3 (16)	6 (19)	4 (21)	<b>43 (26)</b>
Recipient ethnicity	White	23 (82)	37 (84)	23 (88)	18 (95)	28 (90)	18 (95)	<b>147 (88)</b>
	Non-white	2 (7)	7 (16)	3 (12)	1 (5)	3 (10)	1 (5)	<b>17 (10)</b>
	Missing	3 (11)	0	0	0	0	0	<b>3 (2)</b>
Recipient age	Median ( <a href="#">IQR</a> )	46 (33,56)	48 (33,57)	46 (30,56)	48 (44,53)	56 (45,61)	48 (37,55)	<b>48 (37,57)</b>
	Missing	0	0	0	0	0	0	
Recipient weight	Median ( <a href="#">IQR</a> )	70 (54,78)	75 (63,85)	73 (62,85)	79 (72,85)	81 (69,93)	84 (70,86)	<b>76 (64,86)</b>
	Missing	0	0	0	0	0	0	
NYHA class	II	0	3 (7)	0	0	0	1 (5)	<b>4 (2)</b>
	III	11 (39)	19 (43)	7 (27)	2 (11)	10 (32)	10 (53)	<b>59 (35)</b>
	IV	17 (61)	22 (50)	18 (69)	15 (79)	21 (68)	8 (42)	<b>101 (61)</b>
	Missing	0	0	1 (4)	2 (11)	0	0	<b>3 (2)</b>
Recipient on ventilator	No	18 (64)	28 (64)	22 (85)	15 (79)	26 (84)	13 (68)	<b>122 (73)</b>
	Yes	0	1 (2)	0	2 (11)	0	0	<b>3 (2)</b>
	Missing	10 (36)	15 (34)	4 (15)	2 (11)	5 (16)	6 (32)	<b>42 (25)</b>
Recipient on inotropes	No	3 (11)	14 (32)	7 (27)	3 (16)	7 (23)	11 (58)	<b>45 (27)</b>
	Yes	15 (54)	15 (34)	16 (62)	14 (74)	19 (61)	4 (21)	<b>83 (50)</b>
	Missing	10 (36)	15 (34)	3 (12)	2 (11)	5 (16)	4 (21)	<b>39 (23)</b>
Recipient IABP	No	18 (64)	27 (61)	20 (77)	17 (89)	23 (74)	11 (58)	<b>116 (70)</b>
	Yes	0	3 (7)	3 (12)	0	3 (10)	4 (21)	<b>13 (8)</b>
	Missing	10 (36)	14 (32)	3 (12)	2 (11)	5 (16)	4 (21)	<b>38 (23)</b>

**Table 3.1 Demographic of first Adult Heart transplant recipients by centre, from 1 April 2013 to 31 March 2014**

		Newcastle	Papworth	Harefield	Birmingham	Manchester	Glasgow	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Recipient VAD	None	17 (61)	19 (43)	14 (54)	12 (63)	21 (68)	11 (58)	<b>94 (56)</b>
	Left	3 (11)	1 (2)	9 (35)	2 (11)	4 (13)	3 (16)	<b>22 (13)</b>
	Right	0	3 (7)	0	3 (16)	0	0	<b>6 (4)</b>
	Both	0	7 (16)	1 (4)	0	1 (3)	1 (5)	<b>10 (6)</b>
	Missing	8 (29)	14 (32)	2 (8)	2 (11)	5 (16)	4 (21)	<b>35 (21)</b>
Recipient TAH	No	18 (64)	29 (66)	23 (88)	17 (89)	26 (84)	15 (79)	<b>128 (77)</b>
	Yes	0	1 (2)	0	0	0	0	<b>1 (1)</b>
	Missing	10 (36)	14 (32)	3 (12)	2 (11)	5 (16)	4 (21)	<b>38 (23)</b>
Recipient ECMO	No	18 (64)	29 (66)	23 (88)	16 (84)	26 (84)	14 (74)	<b>126 (75)</b>
	Yes	0	1 (2)	0	1 (5)	0	1 (5)	<b>3 (2)</b>
	Missing	10 (36)	14 (32)	3 (12)	2 (11)	5 (16)	4 (21)	<b>38 (23)</b>
Recipient CMV status	No	18 (64)	20 (45)	16 (62)	9 (47)	19 (61)	12 (63)	<b>94 (56)</b>
	Yes	10 (36)	24 (55)	9 (35)	10 (53)	12 (39)	7 (37)	<b>72 (43)</b>
	Missing	0	0	1 (4)	0	0	0	<b>1 (1)</b>
Recipient HCV status	No	28 (100)	43 (98)	25 (96)	19 (100)	31 (100)	19 (100)	<b>165 (99)</b>
	Missing	0	1 (2)	1 (4)	0	0	0	<b>2 (1)</b>
Recipient HBV status	No	28 (100)	43 (98)	25 (96)	16 (84)	31 (100)	16 (84)	<b>159 (95)</b>
	Yes	0	0	0	1 (5)	0	3 (16)	<b>4 (2)</b>
	Missing	0	1 (2)	1 (4)	2 (11)	0	0	<b>4 (2)</b>
Recipient HIV status	No	28 (100)	44 (100)	25 (96)	19 (100)	31 (100)	19 (100)	<b>166 (99)</b>
	Missing	0	0	1 (4)	0	0	0	<b>1 (1)</b>
Recipient Serum Creatinine umol/l	Median ( <a href="#">IQR</a> )	99 (86,148)	102 (68,127)	91 (83,105)	104 (82,137)	87 (73,117)	86 (76,102)	<b>98 (81,119)</b>
	Missing	0	3	3	2	0	2	<b>21</b>
Donor sex	Male	17 (61)	29 (66)	20 (77)	15 (79)	25 (81)	9 (47)	<b>115 (69)</b>
	Female	11 (39)	15 (34)	6 (23)	4 (21)	6 (19)	10 (53)	<b>52 (31)</b>



**Table 3.1 Demographic of first Adult Heart transplant recipients by centre, from 1 April 2013 to 31 March 2014**

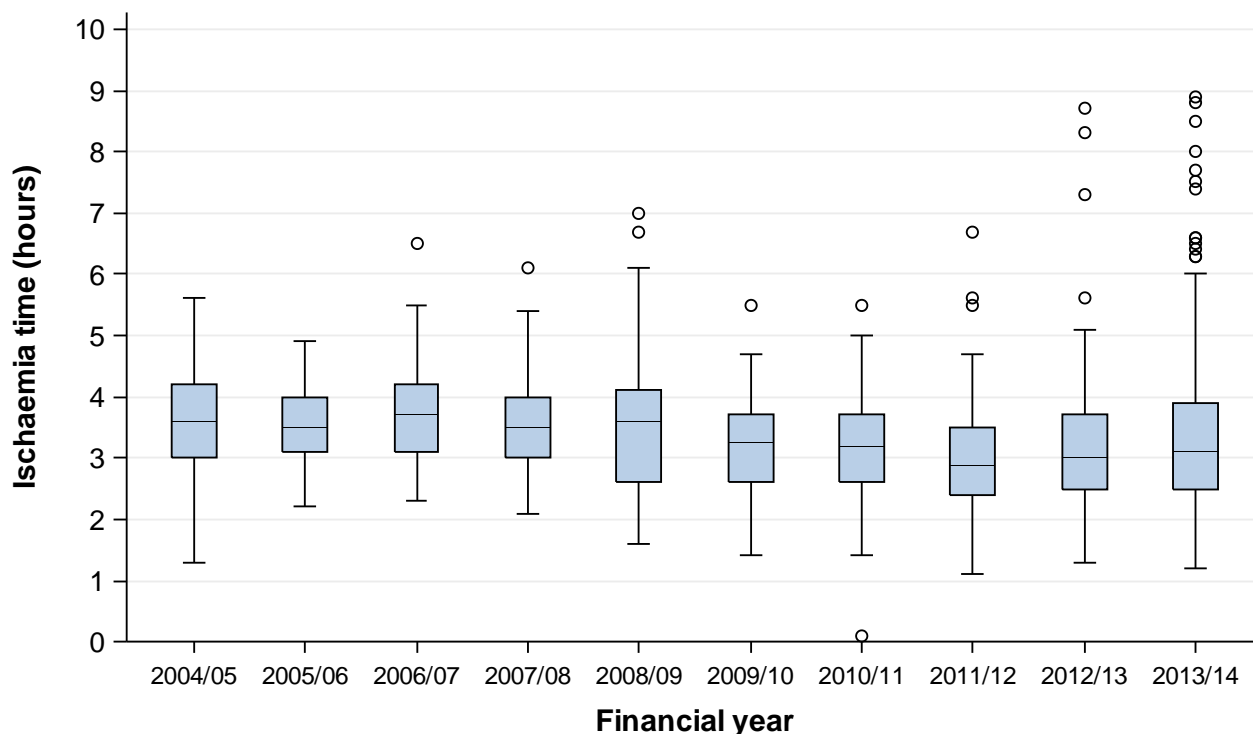
		Newcastle N (%)	Papworth N (%)	Harefield N (%)	Birmingham N (%)	Manchester N (%)	Glasgow N (%)	<b>TOTAL N (%)</b>
Donor ethnicity	White	27 (96)	35 (80)	22 (85)	17 (89)	27 (87)	19 (100)	<b>147 (88)</b>
	Non-white	0	9 (20)	2 (8)	1 (5)	2 (6)	0	<b>14 (8)</b>
	Missing	1 (4)	0	2 (8)	1 (5)	2 (6)	0	<b>6 (4)</b>
Donor age	Median ( <a href="#">IQR</a> )	39 (29,48)	41 (29,53)	39 (26,49)	43 (33,54)	40 (23,46)	43 (25,50)	<b>41 (28,50)</b>
	Missing	0	0	0	0	0	0	
Donor BMI	Median ( <a href="#">IQR</a> )	25 (23,29)	26 (23,29)	25 (23,27)	25 (23,28)	23 (21,27)	26 (24,28)	<b>25 (23,28)</b>
	Missing	0	0	0	0	0	0	
Donor Cause of Death	CVA	20 (71)	35 (80)	19 (73)	15 (79)	25 (81)	13 (68)	<b>127 (76)</b>
	Trauma	7 (25)	7 (16)	6 (23)	2 (11)	3 (10)	5 (26)	<b>30 (18)</b>
	Others	1 (4)	2 (5)	1 (4)	2 (11)	3 (10)	1 (5)	<b>10 (6)</b>
Donor hypotension (less than 70mmHg systolic)	No	8 (29)	33 (75)	15 (58)	13 (68)	26 (84)	17 (89)	<b>112 (67)</b>
	Yes	13 (46)	10 (23)	9 (35)	1 (5)	5 (16)	2 (11)	<b>40 (24)</b>
	Missing	7 (25)	1 (2)	2 (8)	5 (26)	0	0	<b>15 (9)</b>
Donor past diabetes	No	27 (96)	43 (98)	23 (88)	18 (95)	30 (97)	18 (95)	<b>159 (95)</b>
	Yes	1 (4)	1 (2)	0	0	0	1 (5)	<b>3 (2)</b>
	Missing	0	0	3 (12)	1 (5)	1 (3)	0	<b>5 (3)</b>
Donor cardiac arrest	No	16 (57)	34 (77)	17 (65)	14 (74)	24 (77)	15 (79)	<b>120 (72)</b>
	Yes	9 (32)	10 (23)	6 (23)	3 (16)	7 (23)	4 (21)	<b>39 (23)</b>
	Missing	3 (11)	0	3 (12)	2 (11)	0	0	<b>8 (5)</b>
Donor past hypertension	No	25 (89)	37 (84)	23 (88)	9 (47)	28 (90)	16 (84)	<b>138 (83)</b>
	Yes	3 (11)	6 (14)	0	9 (47)	2 (6)	3 (16)	<b>23 (14)</b>
	Missing	0	1 (2)	3 (12)	1 (5)	1 (3)	0	<b>6 (4)</b>
Donor past tumour	No	27 (96)	36 (82)	22 (85)	17 (89)	30 (97)	17 (89)	<b>149 (89)</b>
	Yes	1 (4)	7 (16)	1 (4)	1 (5)	1 (3)	2 (11)	<b>13 (8)</b>
	Missing	0	1 (2)	3 (12)	1 (5)	0	0	<b>5 (3)</b>

**Table 3.1 Demographic of first Adult Heart transplant recipients by centre, from 1 April 2013 to 31 March 2014**

		Newcastle	Papworth	Harefield	Birmingham	Manchester	Glasgow	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Donor past smoker	No	17 (61)	22 (50)	9 (35)	2 (11)	13 (42)	6 (32)	69 (41)
	Yes	11 (39)	21 (48)	14 (54)	16 (84)	18 (58)	12 (63)	92 (55)
	Missing	0	1 (2)	3 (12)	1 (5)	0	1 (5)	6 (4)

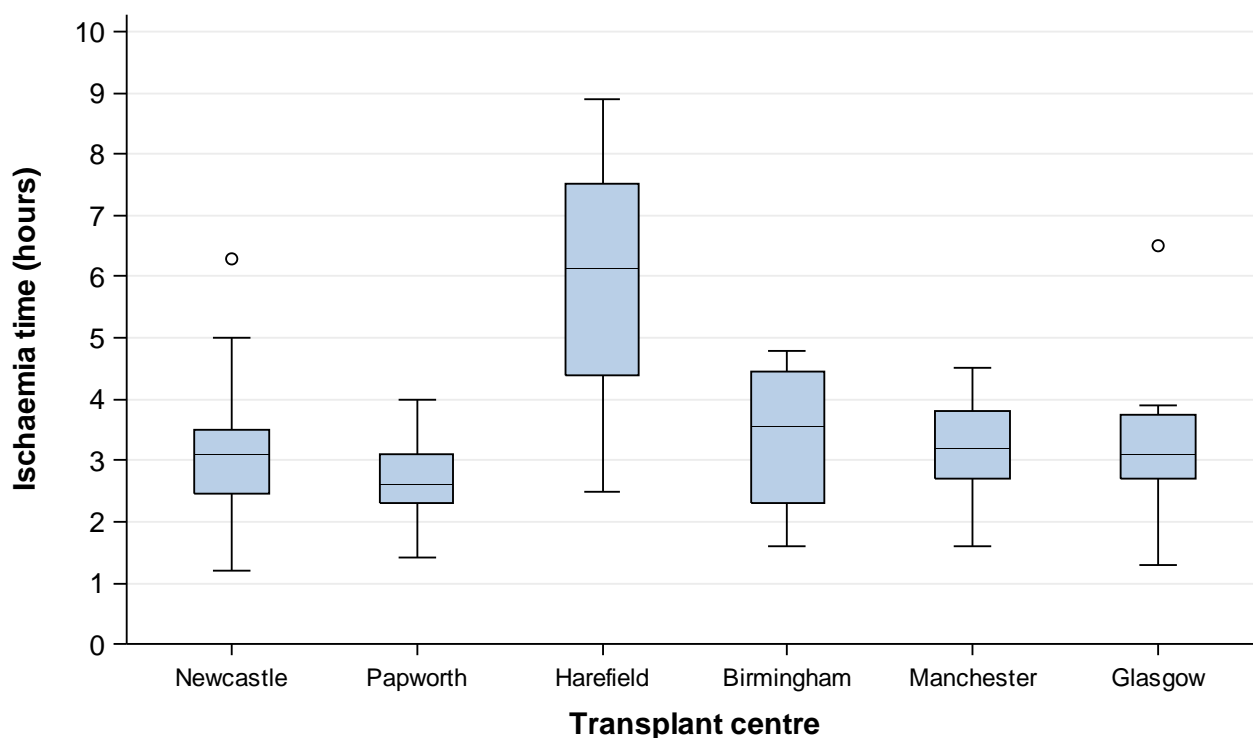
**Figure 3.4** shows the [median](#) total ischaemia time in adult [DBD](#) donor heart transplants over the last 10 years. The median total ischaemia time has remained fairly stable over the last 10 years.

**Figure 3.4 Median total ischaemia time in adult DBD donor heart transplants, 1 April 2004 to 31 March 2014**

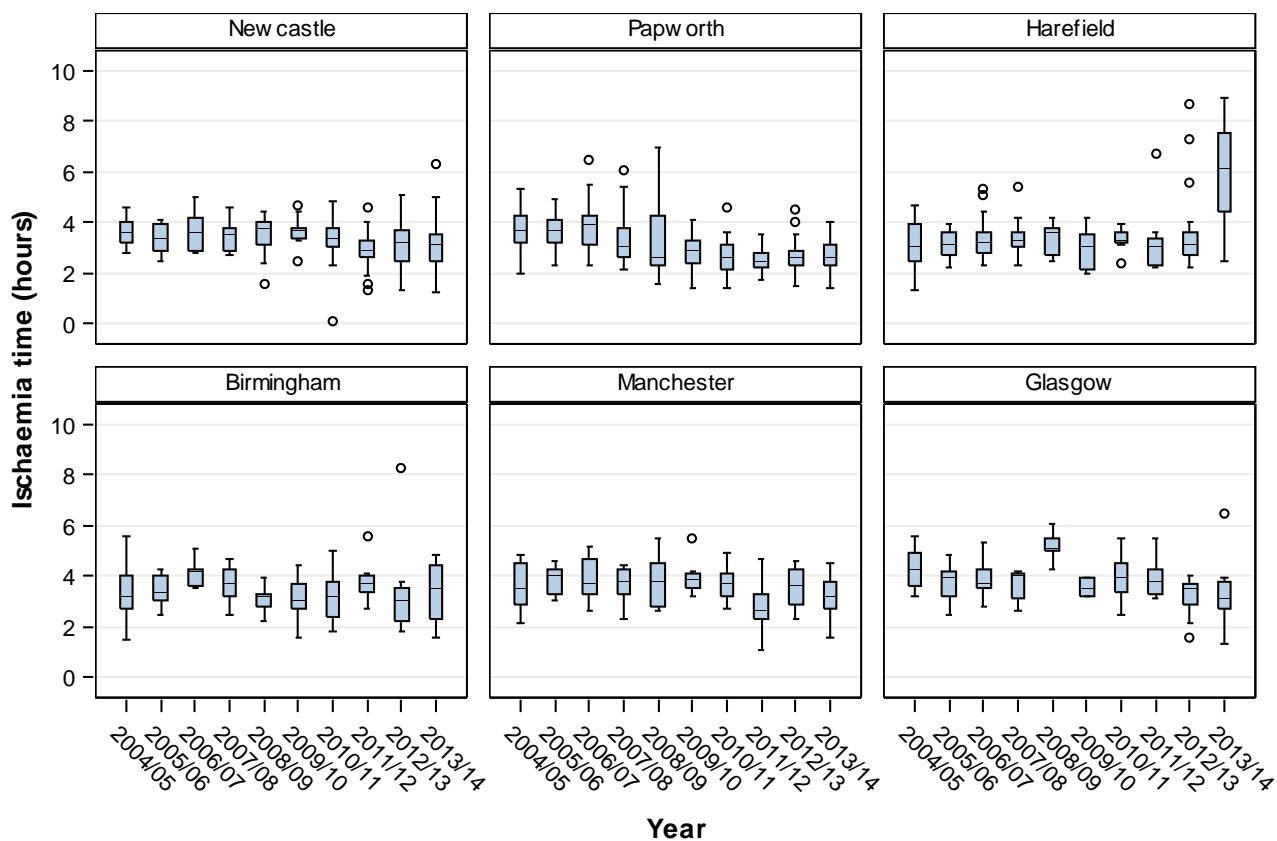


**Figures 3.5 and 3.6** show the [median](#) total ischaemia time in adult [DBD](#) donor heart transplants by centre, over the last 10 years and in the latest financial year (2013-2014) respectively. Papworth has seen an overall decrease in median total ischaemia time. Harefield experienced a substantial increase in median total ischaemia time during 2013/14 which has led to this centre having a much higher median time than all other centres. However, this analysis does not take into account the use of donor organ maintenance systems for some transplants. These enable warm blood perfusion to continue ex-vivo during transportation. For such transplants, the definition of total ischemia time used here (cross-clamp to reperfusion) over-estimates the true ischaemia time because the heart is not subject to ischaemia during transportation.

**Figure 3.5 Median total ischaemia time in adult DBD donor heart transplants, 1 April 2013 to 31 March 2014**



**Figure 3.6 Median total ischaemia time in adult DBD donor heart transplants, 1 April 2004 to 31 March 2014**



# **ADULT HEART TRANSPLANTATION**

## **Post-Transplant Survival**



The survival analysis results presented in this section exclude;

- [Multi organ transplants](#)
- Second (or greater) graft transplants

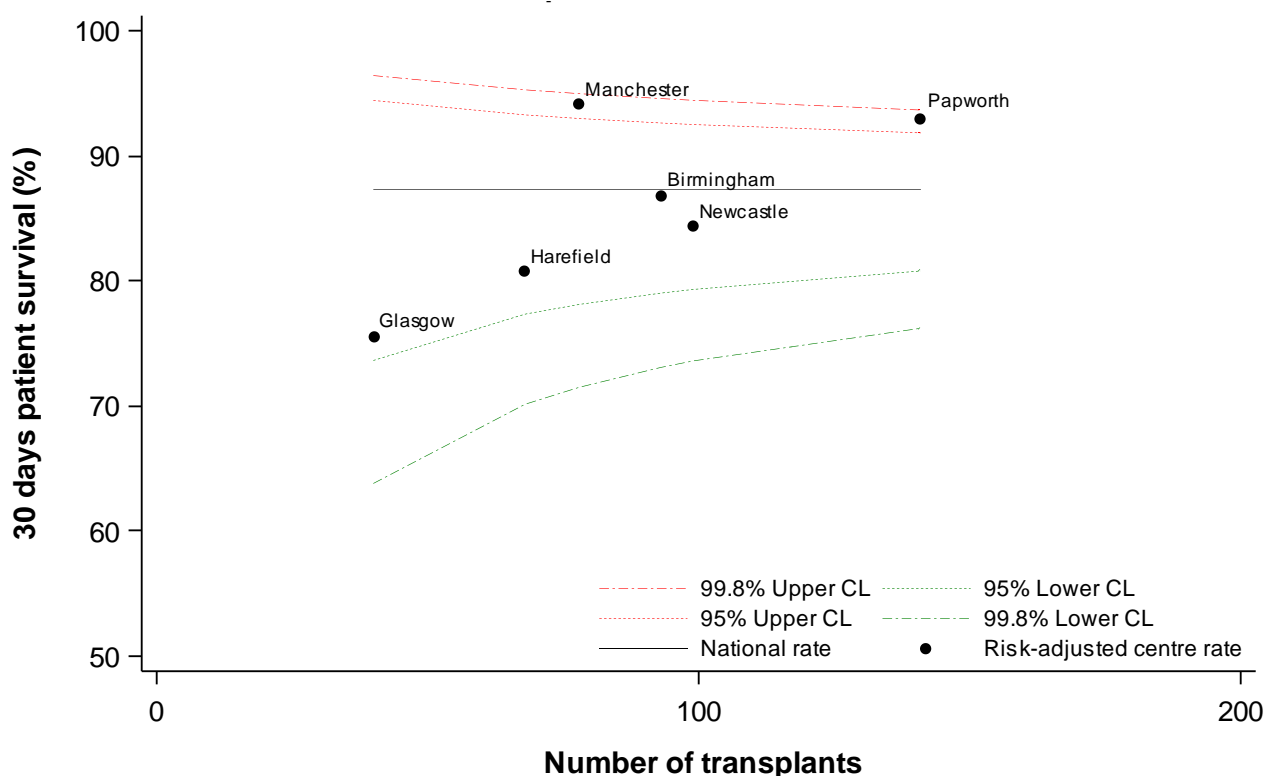
30-day and 1-year [survival rates](#) are based on transplants performed in the period 1 April 2008 to 31 March 2013 while 3-year and 5-year survival rates are based on transplants performed in the period 1 April 2003 to 31 March 2013.

For the 488 heart transplants that were performed in the period 1 April 2008 and 31 March 2013, 30-day outcome information was known for all patients. Thirty day [unadjusted](#) and [risk-adjusted](#) patient survival for these heart transplants is shown in **Table 4.1** and **Figure 4.1**. None of the centres were statistically significantly different to the national rate, as shown in the funnel plot in **Figure 4.1**. Papworth and Manchester had higher survival rates than the national average; these rates were outside of the 95% [confidence limits](#) but within the 99.8% confidence limits.

**Table 4.1 30 day patient survival for adult heart first transplants, between 1 April 2008 and 31 March 2013**

Centre	Number of transplants	30 day survival % (95% CI)			
		Unadjusted		Risk adjusted	
Birmingham	91	87.9	(79.2 - 93.1)	86.7	(77.1 - 92.3)
Glasgow	38	76.3	(59.4 - 86.9)	75.6	(55.9 - 86.5)
Harefield	63	77.8	(65.4 - 86.2)	80.7	(68.5 - 88.2)
Manchester	74	91.9	(82.8 - 96.3)	94.1	(86.8 - 97.3)
Newcastle	91	84.6	(75.4 - 90.6)	84.3	(74.0 - 90.6)
Papworth	131	93.9	(88.2 - 96.9)	93	(86.5 - 96.4)
<b>UK</b>	<b>488</b>	<b>87.3</b>	<b>(84.0 - 90.0)</b>		

**Figure 4.1 Risk-adjusted 30 day patient survival for adult heart transplants between 1 April 2008 and 31 March 2013**

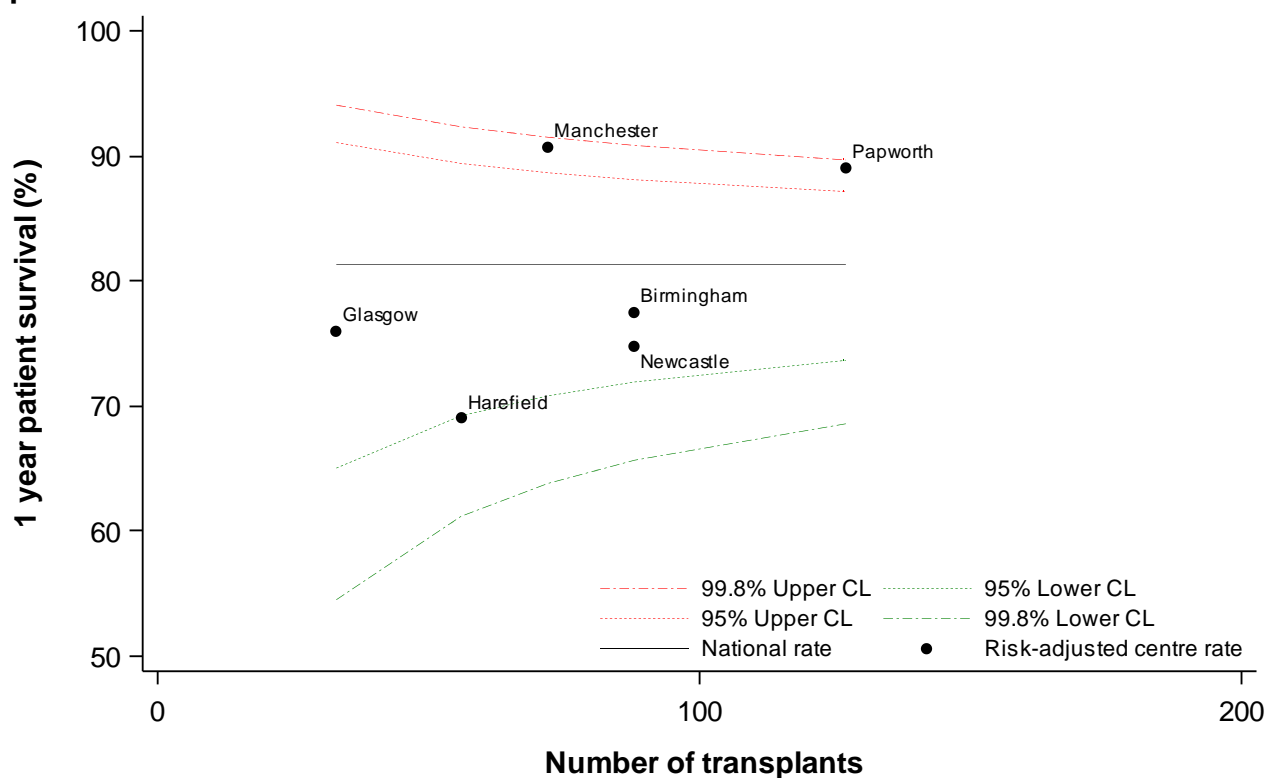


For the 488 heart transplants that were performed in the period 1 April 2008 and 31 March 2013, one-year outcome information was known for 434 patients. One year [unadjusted](#) and [risk-adjusted](#) patient survival for these heart transplants is shown in **Table 4.2** and **Figure 4.2**. The one year [survival rates](#) for Manchester and Papworth exceeded the 95% upper [confidence limit](#) but both were within the 99.8% confidence limit.

**Table 4.2 One year patient survival for adult heart first transplants, between 1 April 2008 and 31 March 2013**

Centre	Number of transplants	1 year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Birmingham	91	77.9	(67.8 - 85.1)	77.4	(65.3 - 85.3)
Glasgow	38	76.3	(59.4 - 86.9)	76	(52.0 - 88.0)
Harefield	63	69.8	(56.9 - 79.6)	69.1	(49.6 - 81.1)
Manchester	74	89.2	(79.5 - 94.4)	90.7	(81.5 - 95.4)
Newcastle	91	78	(68.0 - 85.2)	74.8	(61.4 - 83.6)
Papworth	131	88.5	(81.7 - 92.9)	89	(81.0 - 93.6)
<b>UK</b>	<b>488</b>	<b>81.3</b>	<b>(77.6 - 84.5)</b>		

**Figure 4.2 Risk-adjusted 1 year patient survival for adult heart transplants between 1 April 2008 and 31 March 2013**



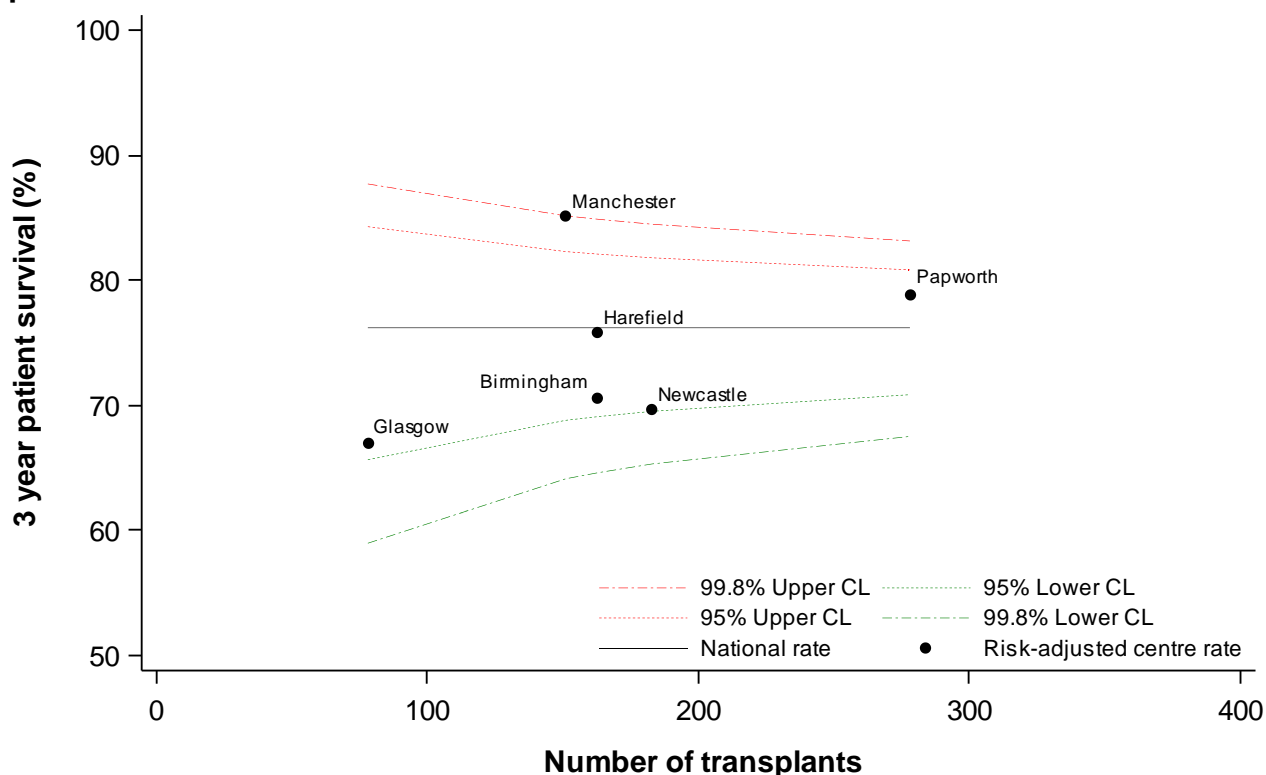


For the 1075 heart transplants that were performed in the period between 1 April 2003 and 31 March 2013, three-year outcome information was known for 847 patients. Three year [unadjusted](#) and [risk-adjusted](#) patient survival for these heart transplants is shown in **Table 4.3**. None of the centres were statistically significantly different to the national rate, as shown in the funnel plot in **Figure 4.3**. Three year survival at Manchester exceeded the 95% [confidence limit](#) but was just within the 99.8% confidence limit.

**Table 4.3 Three year patient survival for adult heart first transplants, between 1 April 2003 and 31 March 2013**

Centre	Number of transplants	3 year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Birmingham	173	72.7	(65.1 - 78.9)	70.5	(60.5 - 78.0)
Glasgow	83	67.7	(56.2 - 76.8)	67	(51.6 - 77.6)
Harefield	176	75.2	(68.1 - 81.0)	75.9	(66.7 - 82.5)
Manchester	152	83.5	(76.1 - 88.8)	85.1	(77.9 - 89.9)
Newcastle	190	72.7	(65.5 - 78.6)	69.6	(59.9 - 77.0)
Papworth	301	79.7	(74.6 - 83.9)	78.9	(72.6 - 83.7)
<b>UK</b>	<b>1075</b>	<b>76.2</b>	<b>(73.5 - 78.7)</b>		

**Figure 4.3 Risk-adjusted 3 year patient survival for adult heart transplants between 1 April 2003 and 31 March 2013**

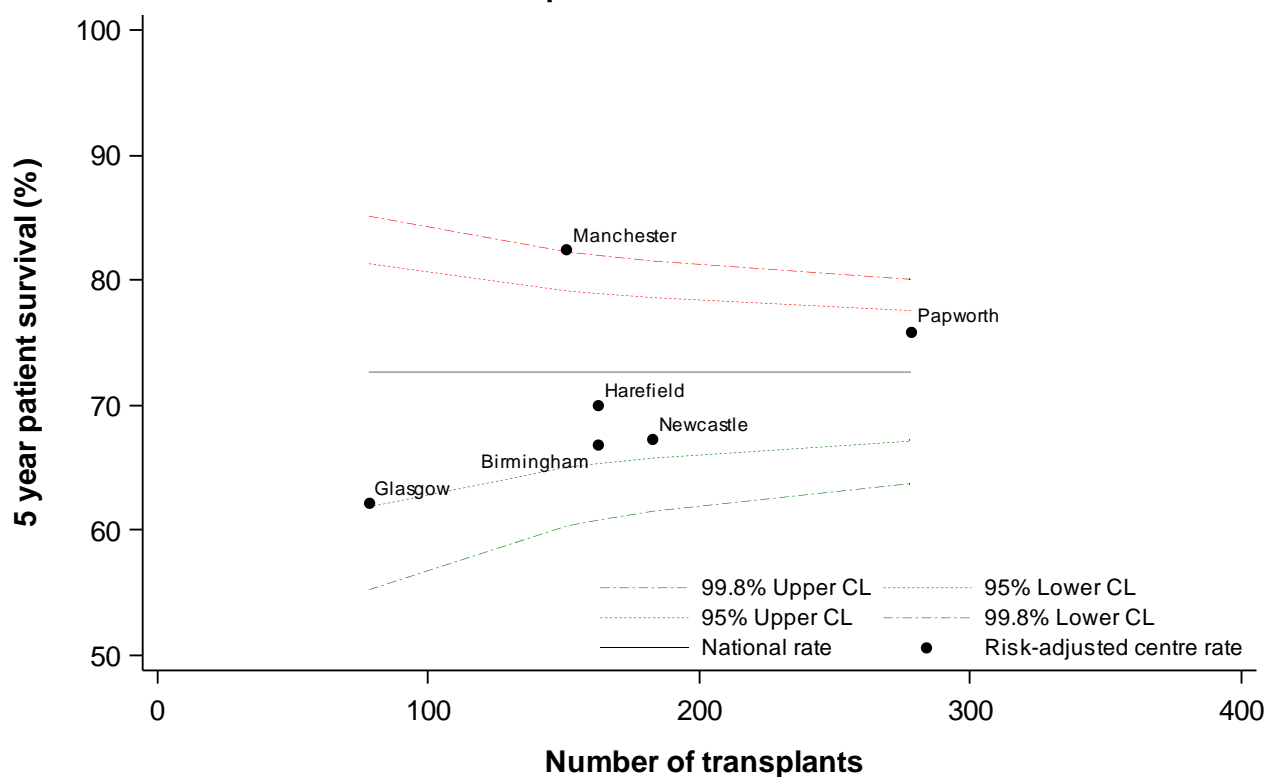


For the 1075 heart transplants that were performed in the period between 1 April 2003 and 31 March 2013, five-year outcome information was known for 714 patients. Five year [unadjusted](#) and [risk-adjusted](#) patient survival for these heart transplants is shown in **Table 4.4**. None of the centres were statistically significantly different to the national rate, as shown in the funnel plot in **Figure 4.4**. Five year survival at Manchester exceeded the 95% [confidence limit](#) but fell on the 99.8% confidence limit.

**Table 4.4 Five year patient survival for adult heart first transplants, between 1 April 2003 and 31 March 2013**

Centre	Number of transplants	5 year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Birmingham	173	68.8	(60.5 - 75.6)	66.9	(56.1 - 75.0)
Glasgow	83	63.8	(51.6 - 73.7)	62.1	(45.1 - 73.8)
Harefield	176	69.2	(61.4 - 75.8)	70	(59.9 - 77.5)
Manchester	152	80.4	(72.4 - 86.3)	82.5	(74.6 - 87.9)
Newcastle	190	71.8	(64.5 - 77.9)	67.3	(57.0 - 75.2)
Papworth	301	76.1	(70.5 - 80.8)	75.8	(69.0 - 81.1)
<b>UK</b>	<b>1075</b>	<b>72.7</b>	<b>(69.7 - 75.4)</b>		

**Figure 4.4 Risk-adjusted 5 year patient survival for adult heart transplants between 1 April 2003 and 31 March 2013s**



# **ADULT HEART TRANSPLANTATION**

## **Survival from Listing**

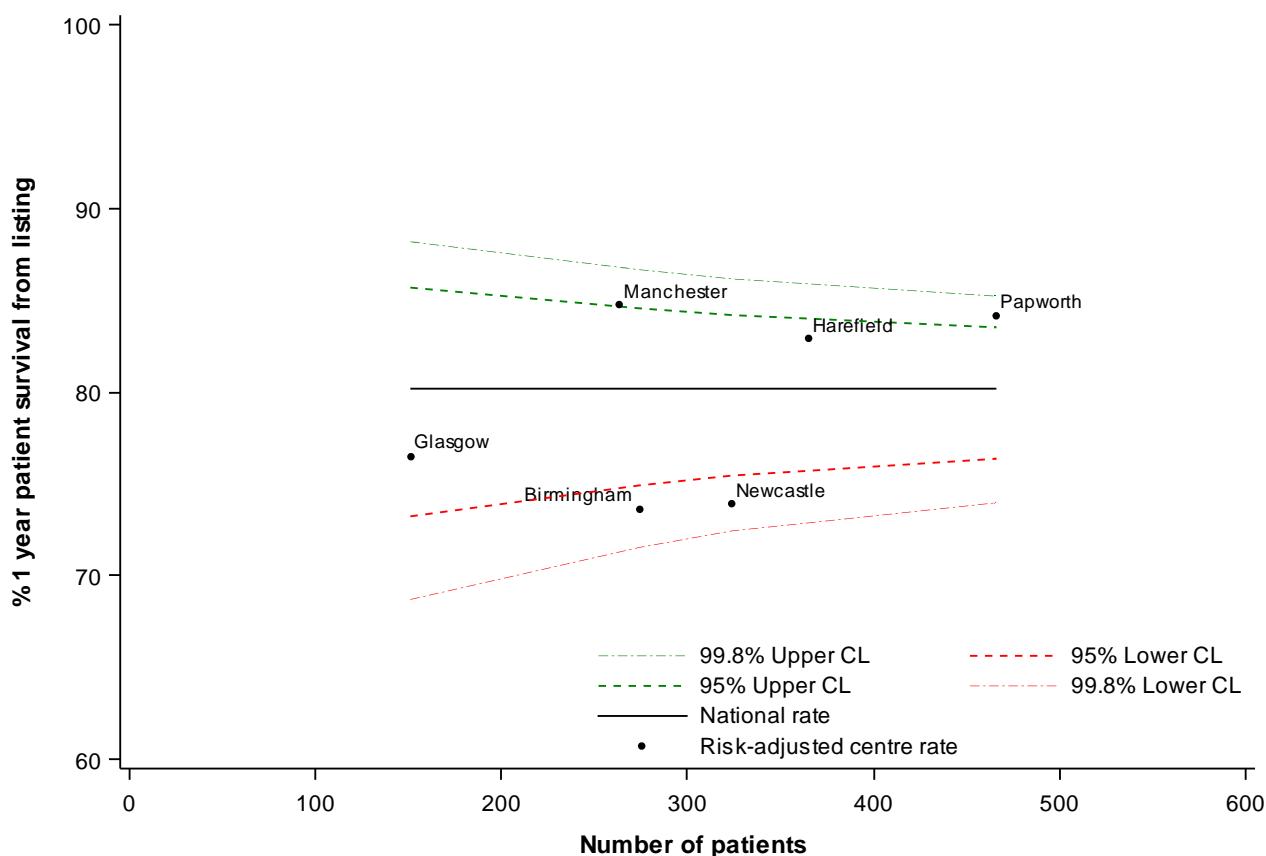


Survival from listing was analysed for patients  $\geq 18$  years registered for the first time for a heart transplant between 1 January 2002 and 31 December 2013. One, five and ten year [risk-adjusted survival rates](#) from the point of heart transplant listing are shown by centre in **Figures 5.1, 5.2 and 5.3** respectively.

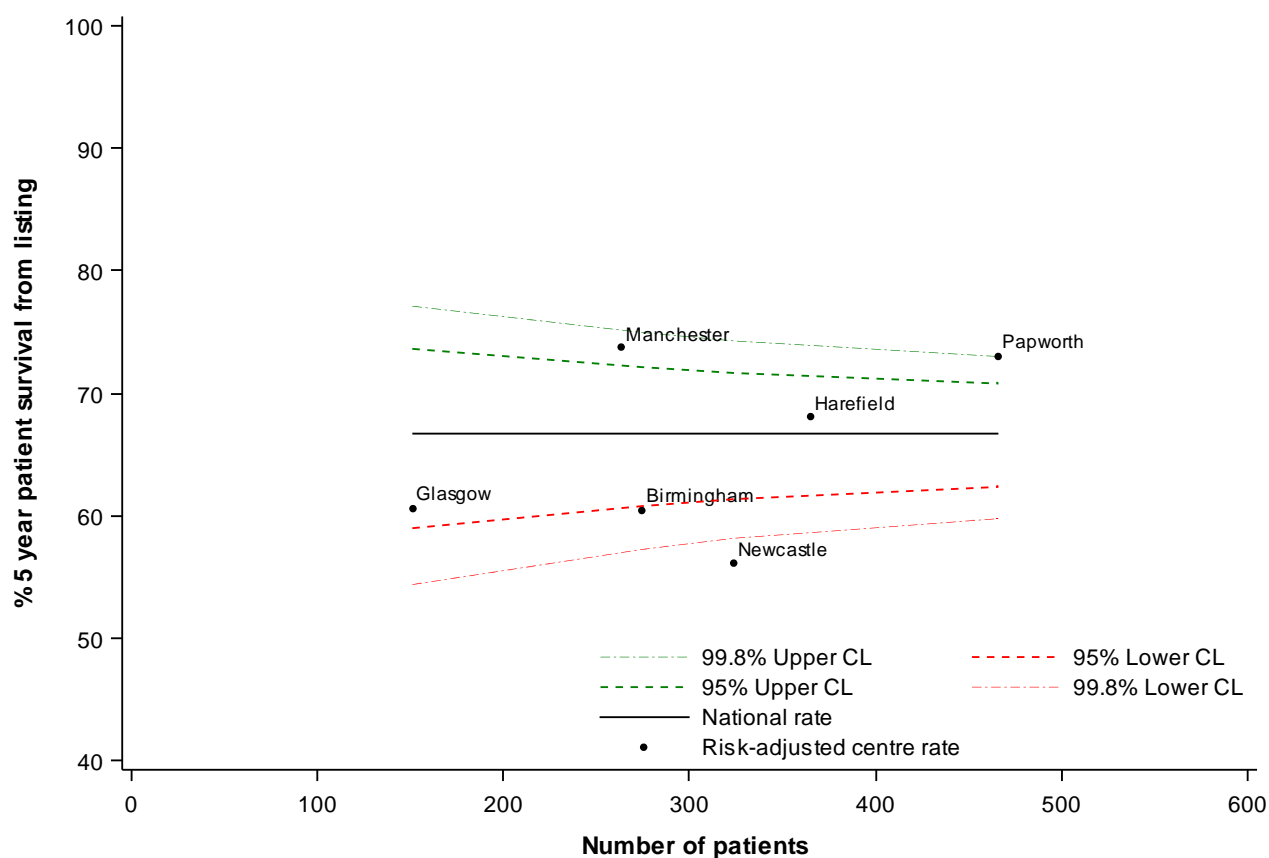
In terms of one year survival rate, three centres fell below and three fell above the national average, however all survival rates were within the 99.8% [confidence limits](#). Five and ten year survival from listing rates at Newcastle, however, fell below the 99.8% confidence limit suggesting that these rates may be significantly lower than the national average.

At one year, centre-specific risk adjusted heart survival rates range between 74% (95% CI 66-79%) and 85% (95% CI 80-87%). At five years, centre-specific risk adjusted heart survival rates range between 56% (95% CI 47-64%) and 74% (95% CI 66-79%). At ten years, centre-specific risk adjusted heart survival rates range between 45% (95% CI 35-54%) and 63% (95% CI 56-69%).

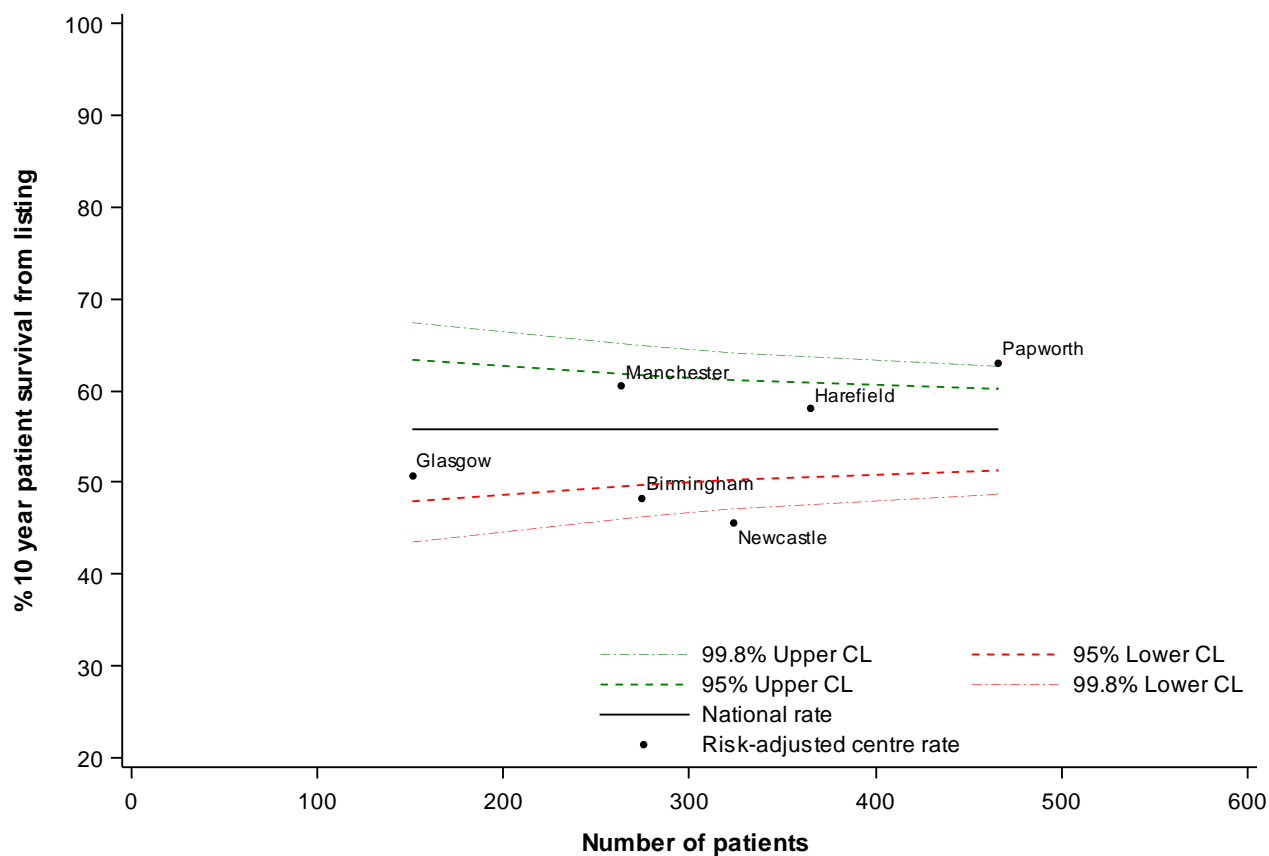
**Figure 5.1 One year patient survival from listing**



**Figure 5.2 Five year patient survival from listing**



**Figure 5.3 Ten year patient survival from listing**



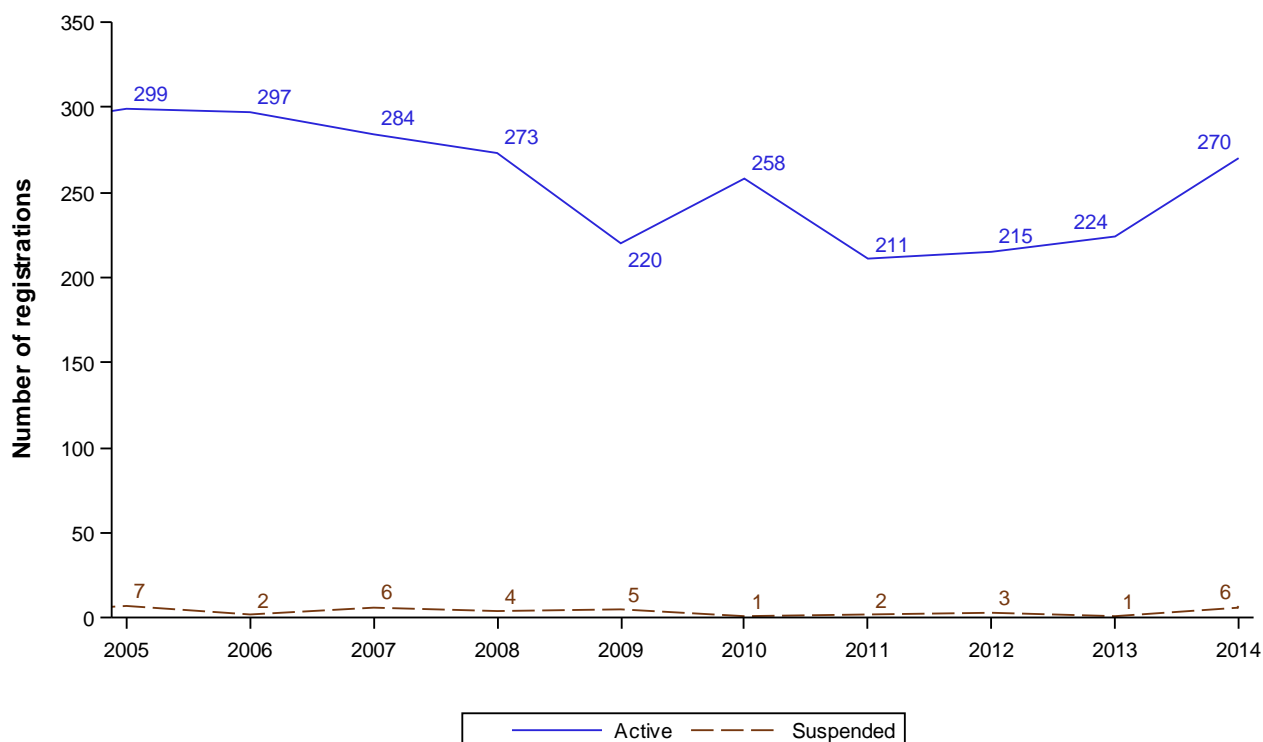
# **ADULT LUNG TRANSPLANTATION**

## **Transplant List**



**Figure 6.1** shows the number of adult patients on the lung transplant list at 31 March each year between 2005 and 2014. The number of patients actively waiting for a lung transplant generally decrease each year from 299 in 2005 to 220 in 2009 and has since been on the increase, reaching 270 in 2014.

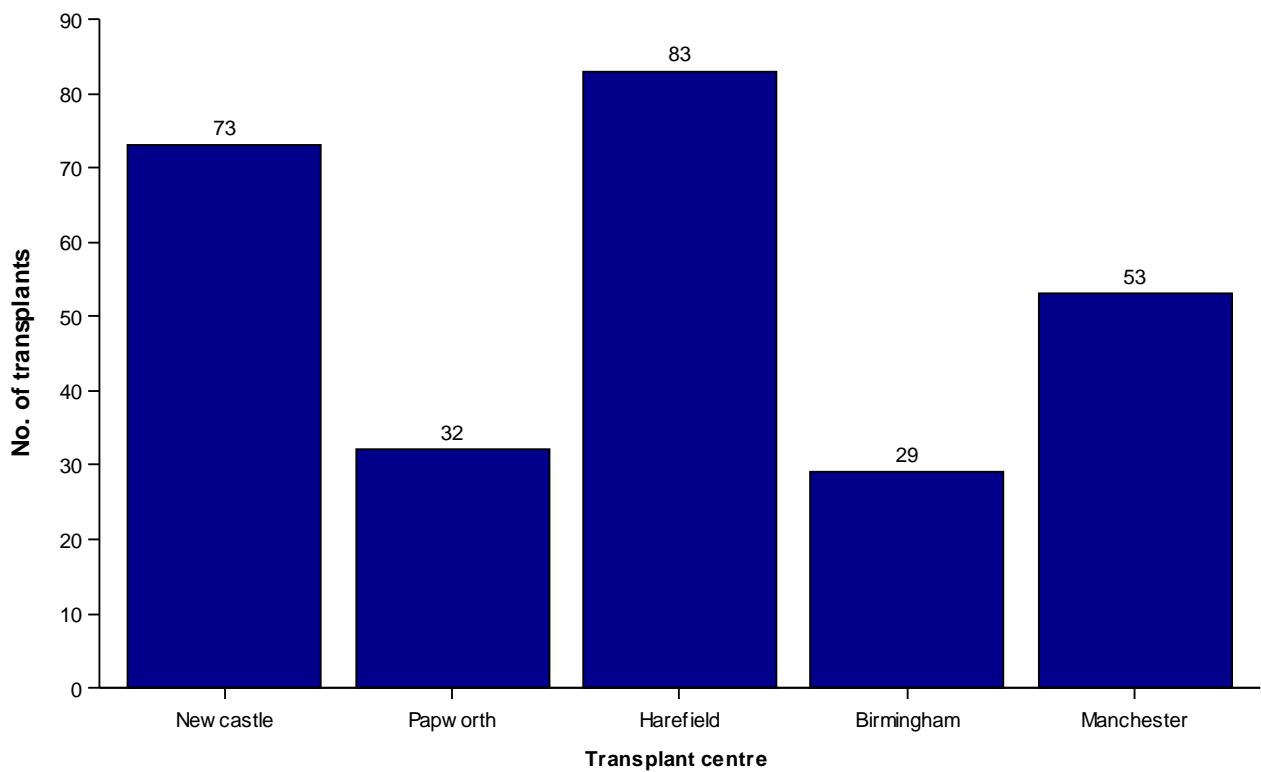
**Figure 6.1 Adult patients on the lung transplant lists at 31 March for the last 10 years, by financial year**





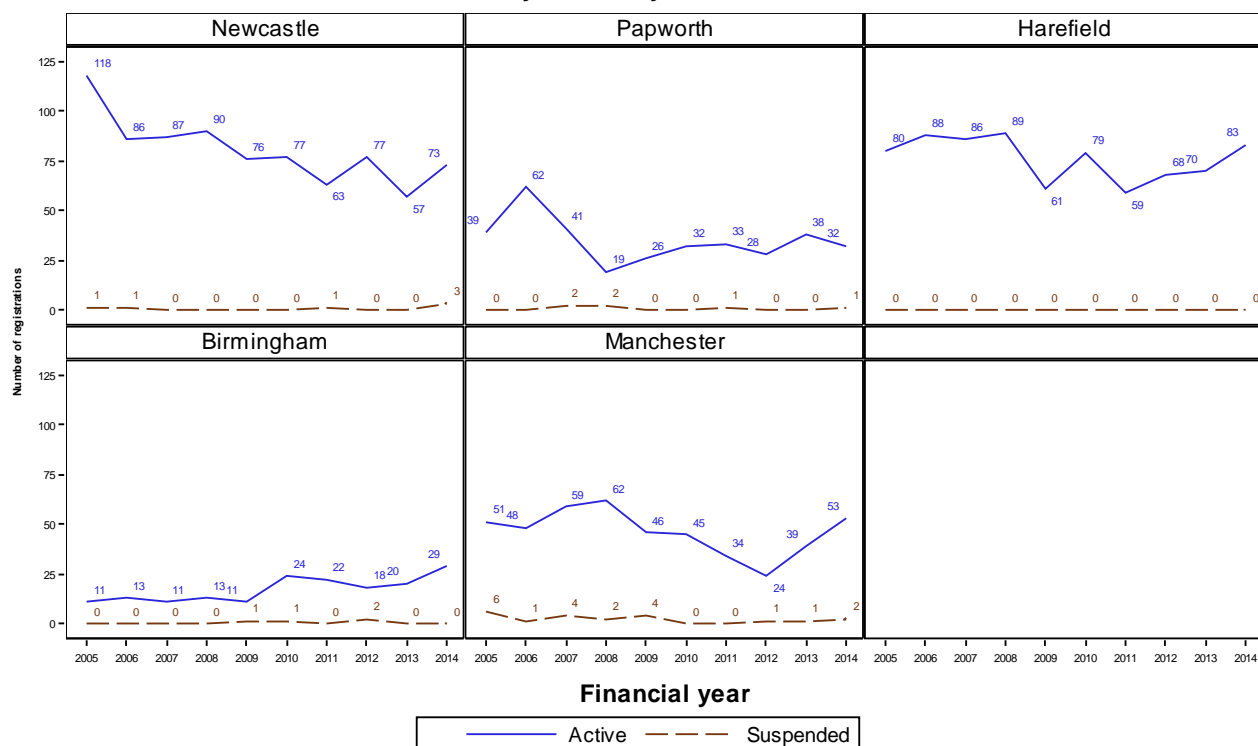
**Figure 6.2** shows the number of adult patients on the [active lung transplant list](#) at 31 March 2014 by centre. In total, there were 270 adults patients. Harefield had the largest proportion (31%) of the transplant list and Birmingham had the smallest (11%).

**Figure 6.2 Adult patients on the active lung transplant list a 31 March 2014, by centre**



**Figure 6.3** shows the number of adult patients on the lung transplant list at 31 March each year between 2005 and 2014 for each transplant centre.

**Figure 6.3 Adult patients on the lung transplant lists at 31 March for the last 10 years, by financial year and by centre**



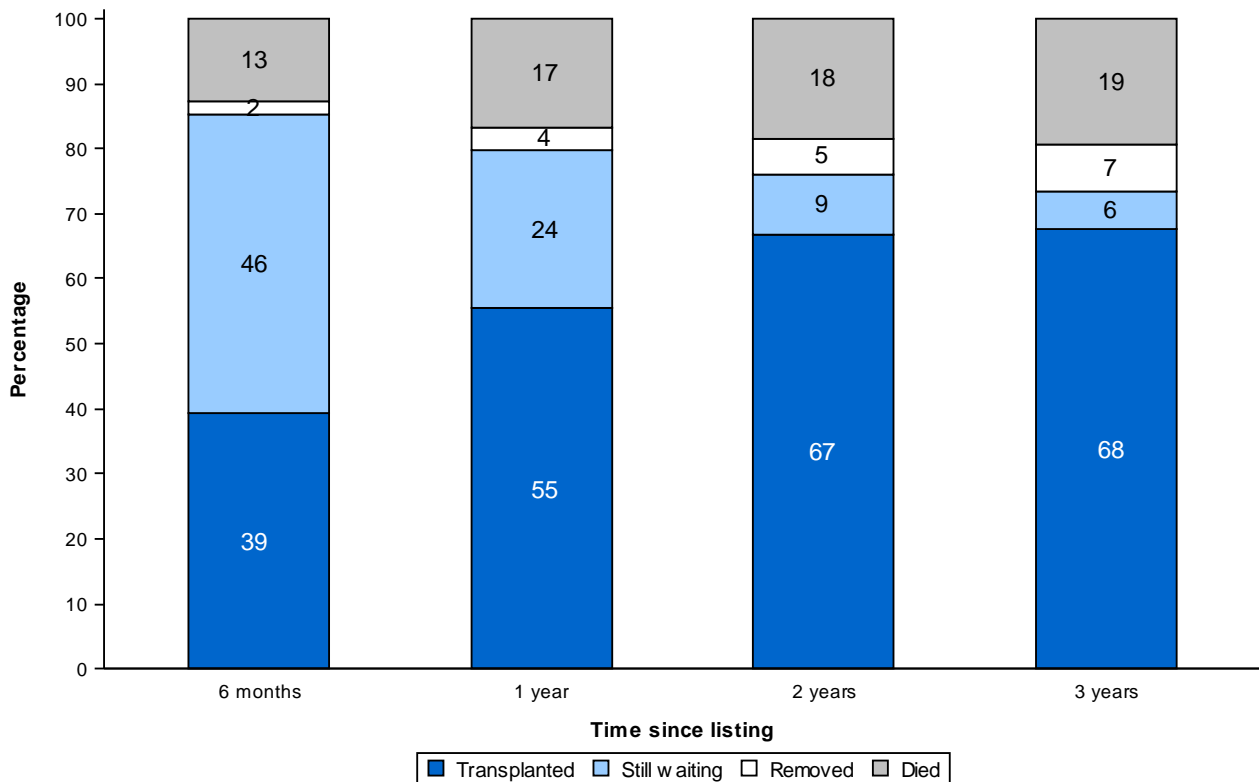
The demographic characteristics of the 270 adult patients on the [active lung transplant list](#) in the latest year are shown by centre and overall in **Table 6.1**. 36% of these recipients were male and the [median](#) age was 50 years. For some characteristics, due to rounding, percentages may not add up to 100.

<b>Table 6.1 Demographic characteristics of Adult Lung active transplant list patients at 31 March 2014, by centre</b>							
		Newcastle N (%)	Papworth N (%)	Harefield N (%)	Birmingham N (%)	Manchester N (%)	<b>TOTAL N (%)</b>
Number		73	32	83	29	53	<b>270 (100)</b>
Recipient sex	Male	26 (36)	10 (31)	28 (34)	10 (34)	22 (42)	<b>96 (36)</b>
	Female	46 (63)	22 (69)	54 (65)	19 (66)	31 (58)	<b>172 (64)</b>
	Missing	1 (1)	0	1 (1)	0	0	<b>2 (1)</b>
Recipient ethnicity	White	72 (99)	29 (91)	74 (89)	26 (90)	49 (92)	<b>250 (93)</b>
	Non-white	1 (1)	3 (9)	9 (11)	3 (10)	0	<b>16 (6)</b>
	Missing	0	0	0	0	4 (8)	<b>4 (2)</b>
Recipient age	Median ( <a href="#">IQR</a> )	48 (33,57)	56 (31,60)	47 (32,56)	51 (38,59)	53 (45,59)	<b>50 (35,58)</b>
	Missing	0	0	0	0	0	<b>0</b>
Primary Disease	Congenital heart disease	2 (3)	1 (3)	0	0	0	<b>3 (1)</b>
	Cystic fibrosis	20 (27)	7 (22)	26 (31)	7 (24)	6 (11)	<b>66 (24)</b>
	Eisenmenger's syndrome	0	0	0	0	1 (2)	<b>1 (0)</b>
	Other heart/lung disease	11 (15)	9 (28)	12 (14)	9 (31)	5 (9)	<b>46 (17)</b>
	Others	40 (55)	15 (47)	45 (54)	13 (45)	39 (74)	<b>152 (56)</b>
	Missing	0	0	0	0	2 (4)	<b>2 (1)</b>
Smoker	No	73 (100)	31 (97)	83 (100)	28 (97)	53 (100)	<b>268 (99)</b>
	Yes	0	1 (3)	0	1 (3)	0	<b>2 (1)</b>

Table 6.1 Demographic characteristics of Adult Lung active transplant list patients at 31 March 2014, by centre							
		Newcastle N (%)	Papworth N (%)	Harefield N (%)	Birmingham N (%)	Manchester N (%)	TOTAL N (%)
Lung function - FEV	Median ( <a href="#">IQR</a> )	0.90 (0.62,1.27)	1.00 (0.75,1.83)	0.85 (0.60,1.24)	0.98 (0.67,1.45)	1.16 (0.70,1.93)	<b>0.93 (0.65,1.41)</b>
	Missing	0	0	0	0	0	<b>0</b>
Lung function - FVC	Median ( <a href="#">IQR</a> )	1.80 (1.40,2.28)	1.88 (1.31,2.48)	1.58 (1.31,2.17)	2.27 (1.68,2.82)	2.07 (1.60,2.78)	<b>1.81 (1.39,2.48)</b>
	Missing	0	0	0	0	0	<b>0</b>
Lung function - VO2(max)	Median ( <a href="#">IQR</a> )	-	-	9	-	-	<b>9</b>
	Missing	73	32	82	29	53	<b>269</b>

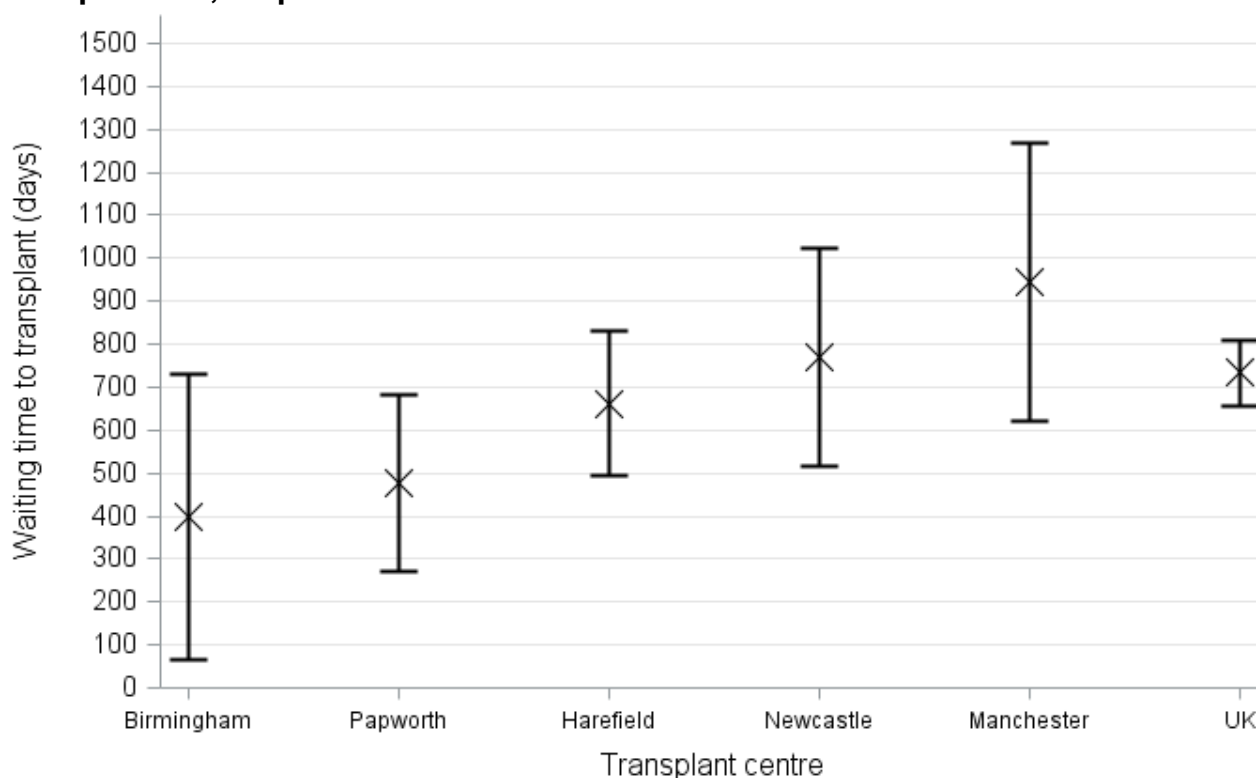
An indication of outcomes for adult patients listed for a lung transplant is summarised in **Figure 6.4** This shows the proportion of patients transplanted or still waiting six months, one, two and three years after joining the list. It also shows the proportion removed from the transplant list (typically because they become too unwell for transplant) and those dying while on the transplant list. Within six months of listing, 39% are transplanted, while 13% have died waiting. Within 3 years however, 68% have been transplanted

**Figure 6.4 Post registration outcome for 210 new adult lung only registrations made in the UK, 1 April 2010 to 31 March 2011**



The [median](#) waiting time to transplant for adult patients on the lung transplant list is shown in **Figure 6.5** and **Table 6.2**. The median waiting time is the lowest for Birmingham at 397 days and highest for Manchester at 946 days although [confidence intervals](#) are wider for both these centres.

**Figure 6.5 median waiting time to transplant for adult patients registered on the lung transplant list, 1 April 2008 to 31 March 2011**



**Table 6.2** [Median](#) waiting time to lung only transplant in the UK, for adult patients registered 1 April 2008 - 31 March 2011

Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% <a href="#">Confidence interval</a>
Newcastle	189	770	515 - 1025
Papworth	144	477	273 - 681
Harefield	176	662	495 - 829
Birmingham	57	397	65 - 729
Manchester	96	946	623 - 1269
<b>UK</b>	<b>662</b>	<b>734</b>	<b>657 - 811</b>

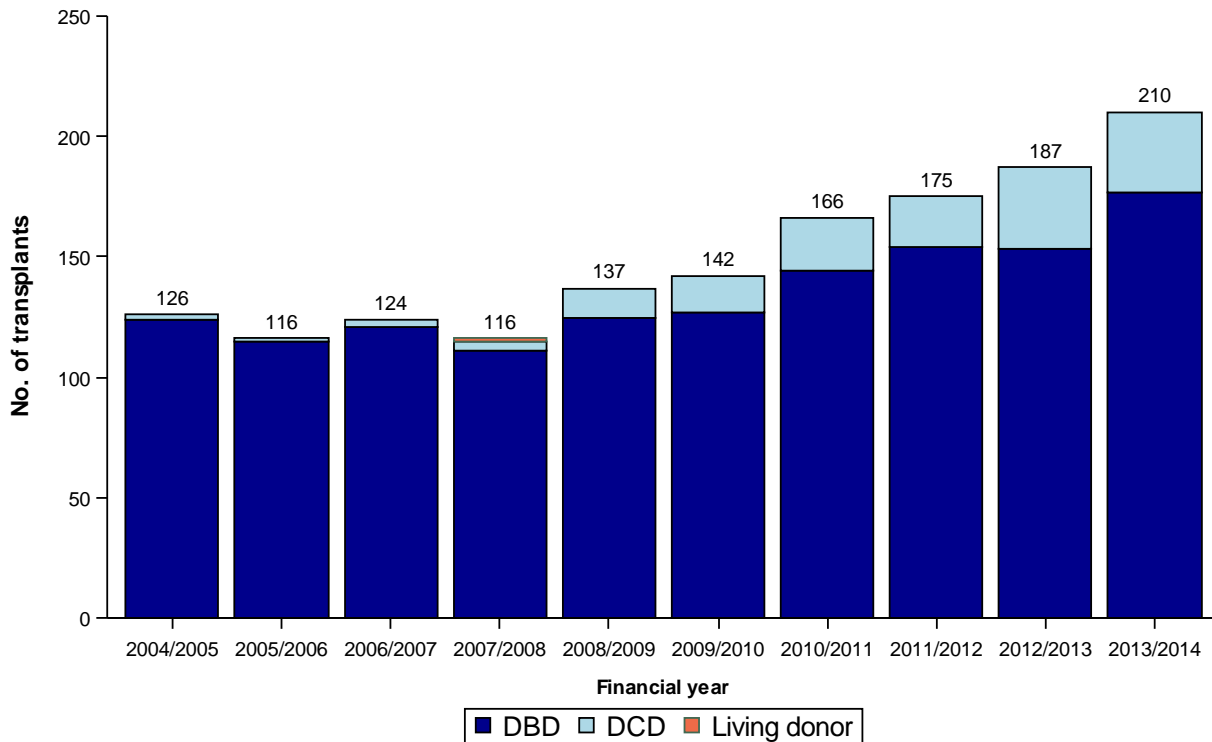
# **ADULT LUNG TRANSPLANTATION**

## **Transplants**



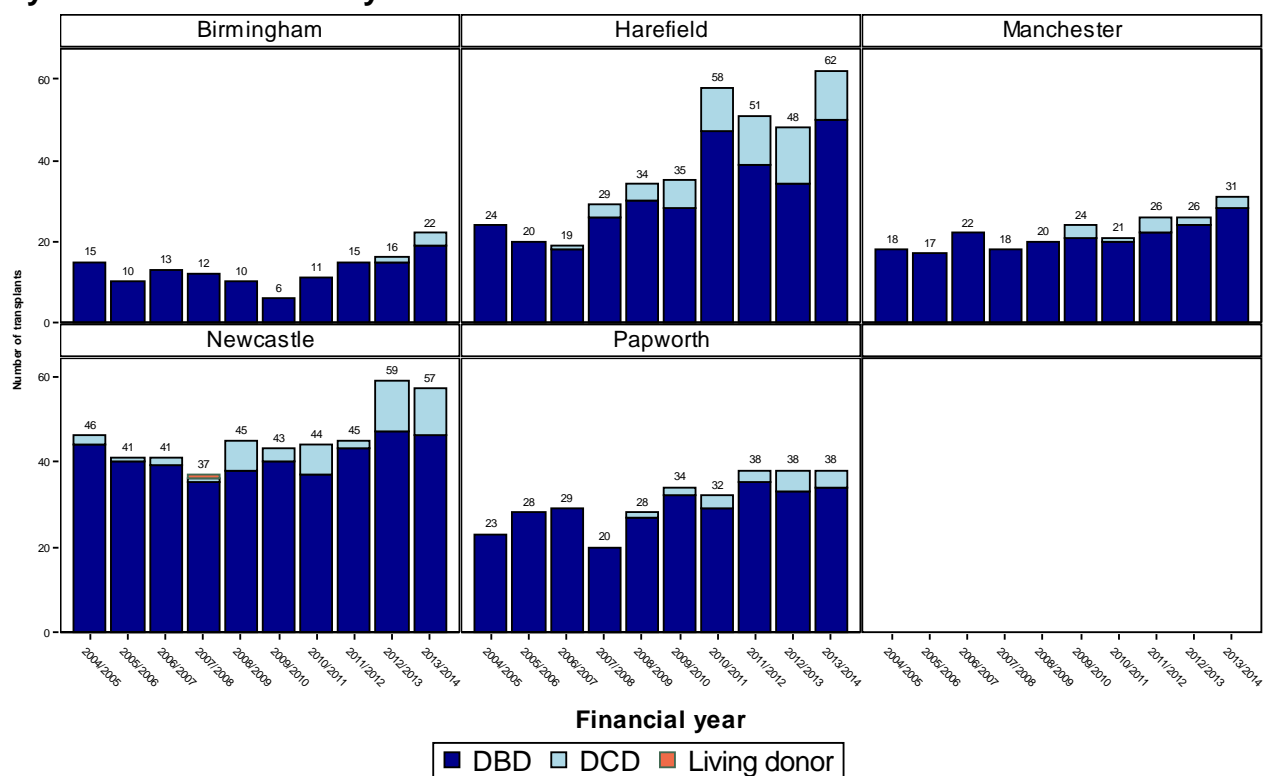
**Figure 7.1** and **7.2** show the total number of lung transplants performed in the last ten years overall and by centre, respectively. The number of transplants from donors after brain death ([DBD](#)) has generally increased since 2007 from 116 to 210 in 2013/2014. The number of transplants in the latest financial year (2013-2014) is shown by centre in **Figure 7.3**.

**Figure 7.1 Number of adult lung transplants in the UK, 1 April 2004 to 31 March 2014, by financial year**

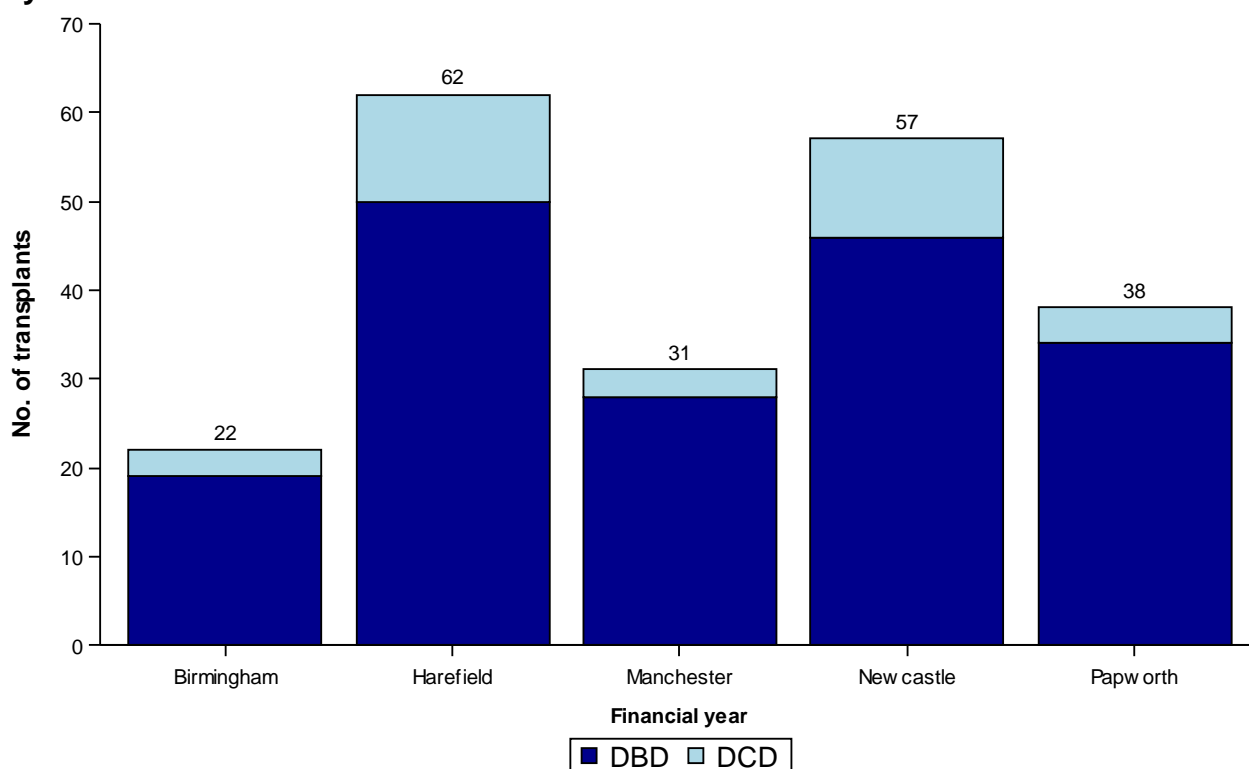




**Figure 7.2 Number of adult lung transplants in the UK, 1 April 2004 to 31 March 2014, by centre and financial year**



**Figure 7.3 Number of adult lung transplants in the UK, 1 April 2013 to 31 March 2014, by centre**



The demographic characteristics of 210 adult lung transplant recipients in the latest year are shown by centre and overall in **Table 7.1**. 58% of these recipients were male and the [median](#) age was 52 years. For some characteristics, due to rounding, percentages may not add up to 100.

Table 7.1 Demographic of first Adult Lung transplant recipients by centre, from 1 April 2013 to 31 March 2014							
		Newcastle N (%)	Papworth N (%)	Harefield N (%)	Birmingham N (%)	Manchester N (%)	TOTAL N (%)
Recipient sex	Male	40 (70)	19 (50)	34 (55)	11 (50)	18 (58)	122 (58)
	Female	17 (30)	19 (50)	28 (45)	11 (50)	13 (42)	88 (42)
Recipient ethnicity	White	54 (95)	36 (95)	59 (95)	20 (91)	31 (100)	200 (95)
	Non-white	2 (4)	2 (5)	2 (3)	2 (9)	0	8 (4)
	Missing	1 (2)	0	1 (2)	0	0	2 (1)
Recipient age	Median ( <a href="#">IQR</a> )	51 (40,59)	52 (35,60)	43 (28,58)	56 (41,61)	58 (46,62)	52 (36,60)
	Missing	0	0	0	0	0	0
Recipient weight	Median ( <a href="#">IQR</a> )	69 (56,79)	66 (52,87)	66 (55,77)	66 (56,74)	68 (59,79)	68 (56,79)
	Missing	0	0	0	0	0	0
NYHA class	I	0	0	1 (2)	4 (18)	0	5 (2)
	II	0	10 (26)	8 (13)	2 (9)	2 (6)	22 (11)
	III	57 (100)	14 (37)	44 (71)	15 (68)	28 (90)	158 (75)
	IV	0	14 (37)	8 (13)	1 (5)	1 (3)	24 (11)
	Missing	0	0	1 (2)	0	0	1 (1)
Recipient on ventilator	No	5 (9)	9 (24)	40 (65)	21 (95)	2 (6)	77 (37)
	Yes	0	0	4 (6)	1 (5)	0	5 (2)
	Missing	52 (91)	29 (76)	18 (29)	0	29 (94)	128 (61)
Recipient on inotropes	No	4 (7)	10 (26)	42 (68)	22 (100)	2 (6)	80 (38)
	Yes	0	0	2 (3)	0	0	2 (1)
	Missing	53 (93)	28 (74)	18 (29)	0	29 (94)	128 (61)
Recipient CMV status	No	33 (58)	21 (55)	36 (58)	10 (45)	15 (48)	115 (55)
	Yes	24 (42)	16 (42)	26 (42)	12 (55)	16 (52)	94 (45)

**Table 7.1 Demographic of first Adult Lung transplant recipients by centre, from 1 April 2013 to 31 March 2014**

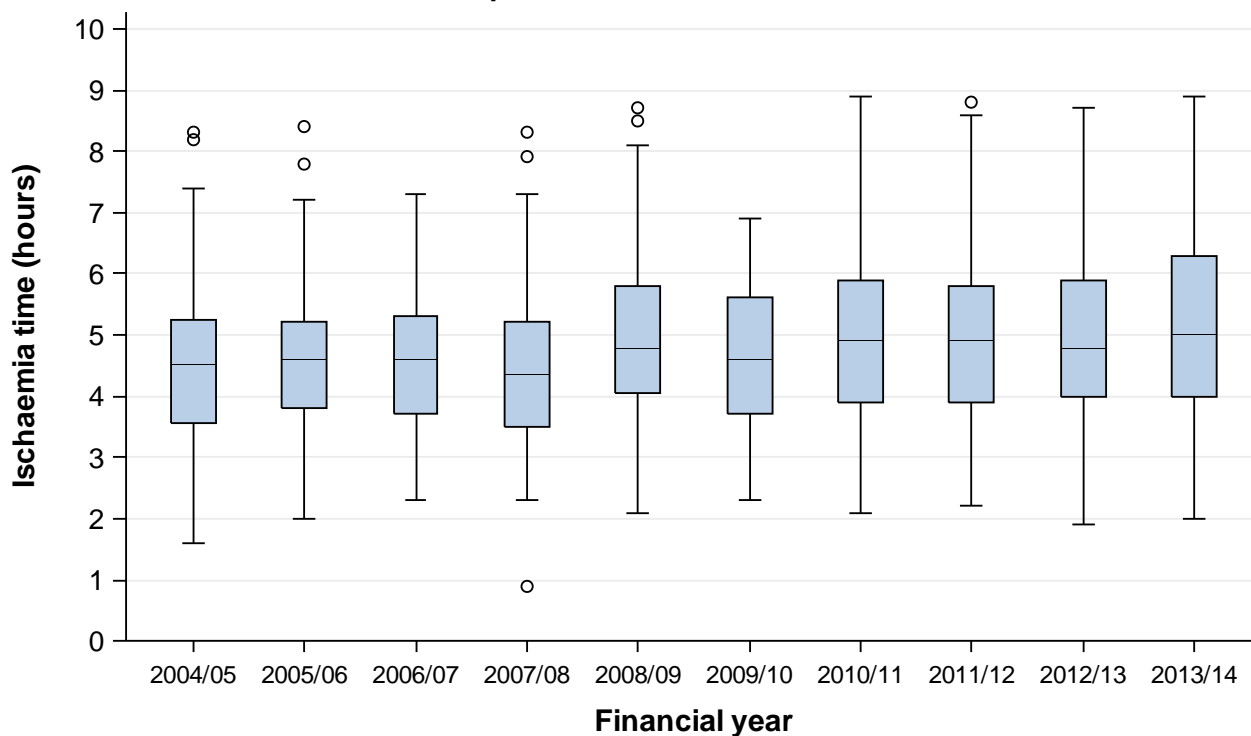
		Newcastle N (%)	Papworth N (%)	Harefield N (%)	Birmingham N (%)	Manchester N (%)	TOTAL N (%)
Recipient HCV status	No	57 (100)	38 (100)	62 (100)	22 (100)	31 (100)	<b>210 (100)</b>
Recipient HBV status	No	57 (100)	38 (100)	61 (98)	22 (100)	31 (100)	<b>209 (100)</b>
	Missing	0	0	1 (2)	0	0	<b>1 (1)</b>
Recipient HIV status	No	57 (100)	38 (100)	62 (100)	22 (100)	31 (100)	<b>210 (100)</b>
Recipient Serum Creatinine umol/l	Median ( <a href="#">IQR</a> )	68 (53,83)	78 (57,96)	63 (43,76)	70 (65,83)	75 (62,90)	<b>69 (55,86)</b>
	Missing	0	1	1	0	0	<b>21</b>
Donor sex	Male	32 (56)	16 (42)	30 (48)	10 (45)	11 (35)	<b>99 (47)</b>
	Female	25 (44)	22 (58)	32 (52)	12 (55)	20 (65)	<b>111 (53)</b>
Donor ethnicity	White	57 (100)	32 (84)	55 (89)	19 (86)	28 (90)	<b>191 (91)</b>
	Non-white	0	4 (11)	5 (8)	2 (9)	2 (6)	<b>13 (6)</b>
	Missing	0	2 (5)	2 (3)	1 (5)	1 (3)	<b>6 (3)</b>
Donor age	Median ( <a href="#">IQR</a> )	40 (30,53)	47 (39,53)	45 (32,53)	44 (34,59)	47 (31,54)	<b>45 (32,53)</b>
	Missing	0	0	0	0	0	
Donor BMI	Median ( <a href="#">IQR</a> )	25 (24,28)	27 (24,29)	26 (23,28)	26 (22,28)	25 (22,28)	<b>26 (23,28)</b>
	Missing	0	0	0	0	0	
Donor Cause of Death	CVA	47 (82)	34 (89)	55 (89)	19 (86)	28 (90)	<b>183 (87)</b>
	Trauma	7 (12)	3 (8)	4 (6)	1 (5)	1 (3)	<b>16 (8)</b>
	Others	3 (5)	1 (3)	3 (5)	2 (9)	2 (6)	<b>11 (5)</b>
Donor hypotension (less than 70mmHg systolic)	No	24 (42)	29 (76)	47 (76)	16 (73)	25 (81)	<b>141 (67)</b>
	Yes	25 (44)	8 (21)	14 (23)	1 (5)	6 (19)	<b>54 (26)</b>
	Missing	8 (14)	1 (3)	1 (2)	5 (23)	0	<b>15 (7)</b>

**Table 7.1 Demographic of first Adult Lung transplant recipients by centre, from 1 April 2013 to 31 March 2014**

		Newcastle N (%)	Papworth N (%)	Harefield N (%)	Birmingham N (%)	Manchester N (%)	<b>TOTAL N (%)</b>
Donor past diabetes	No	56 (98)	37 (97)	58 (94)	22 (100)	29 (94)	<b>202 (96)</b>
	Yes	1 (2)	1 (3)	3 (5)	0	2 (6)	<b>7 (3)</b>
	Missing	0	0	1 (2)	0	0	<b>1 (1)</b>
Donor past hypertension	No	46 (81)	34 (89)	43 (69)	11 (50)	24 (77)	<b>158 (75)</b>
	Yes	11 (19)	4 (11)	16 (26)	11 (50)	7 (23)	<b>49 (23)</b>
	Missing	0	0	3 (5)	0	0	<b>3 (1)</b>
Donor past tumour	No	55 (96)	35 (92)	57 (92)	22 (100)	30 (97)	<b>199 (95)</b>
	Yes	2 (4)	3 (8)	3 (5)	0	0	<b>8 (4)</b>
	Missing	0	0	2 (3)	0	1 (3)	<b>3 (1)</b>
Donor past smoker	No	28 (49)	25 (66)	40 (65)	8 (36)	14 (45)	<b>115 (55)</b>
	Yes	29 (51)	13 (34)	21 (34)	14 (64)	17 (55)	<b>94 (45)</b>
	Missing	0	0	1 (2)	0	0	<b>1 (1)</b>

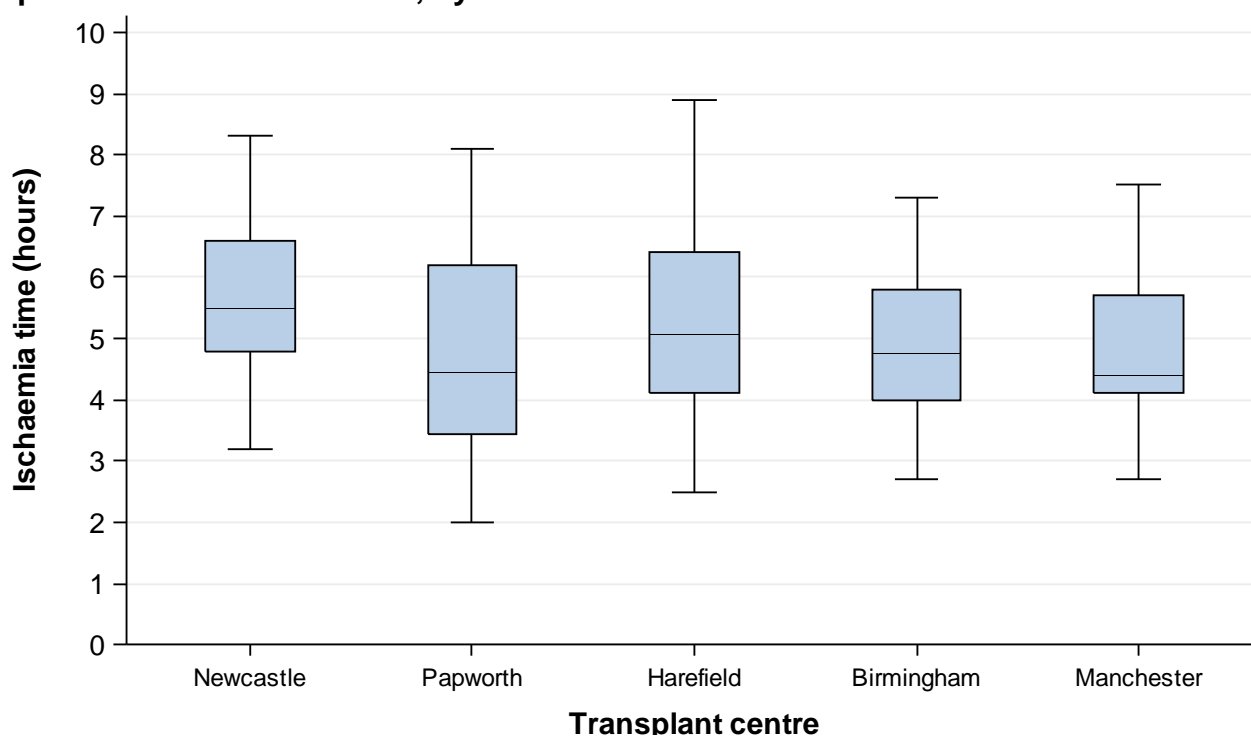
**Figure 7.4** shows the [median](#) total ischaemia time in adult [DBD](#) donor lung transplants over the last 10 years. The median total ischaemia time has remained fairly constant in the last 10 years.

**Figure 7.4 Median cold total ischaemia time in adult DBD donor lung transplants, 1 April 2004 to 31 March 2014**

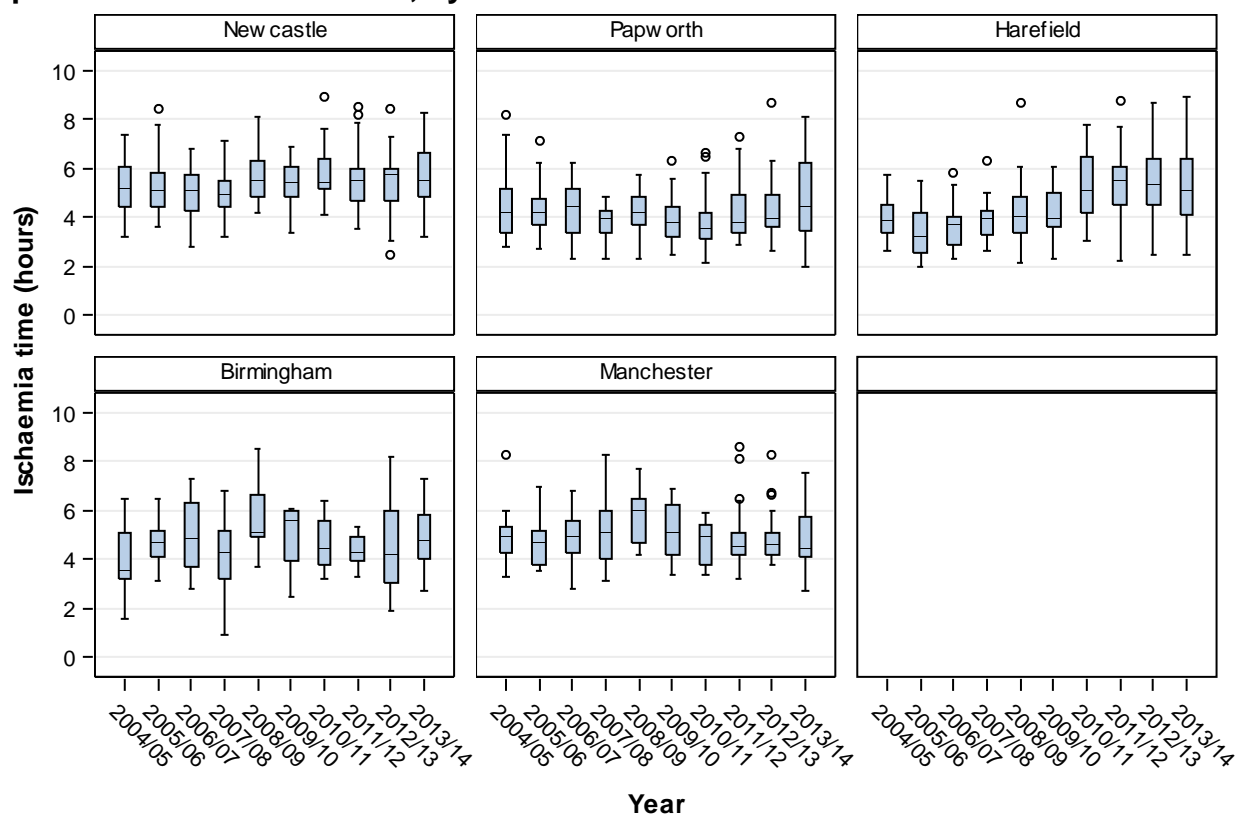


**Figure 7.5** and **7.6** show the [median](#) total ischaemia time in adult [DBD](#) donor lung transplants over the last 10 years and in the latest financial year (2013-2014) and by centre, respectively. This analysis does not take into account the use of donor organ maintenance systems for some transplants. These enable warm blood perfusion to continue ex-vivo during transportation. For such transplants, the definition of total ischemia time used here (cross-clamp to reperfusion) over-estimates the true ischaemia time because the heart is not subject to ischaemia during transportation.

**Figure 7.5 Median cold total ischaemia time in adult DBD donor lung transplants, 1 April 2013 to 31 March 2014, by centre**



**Figure 7.6 Median cold total ischaemia time in adult DBD donor lung transplants, 1 April 2004 to 31 March 2014, by centre**



# **ADULT LUNG TRANSPLANTATION**

## **Post-Transplant Survival**



The survival analysis results presented in this section exclude;

- [Multi organ transplants](#)
- Second (or greater) graft transplants
- Partial lung transplants

90-day and 1-year [survival rates](#) are based on transplants performed in the period 1 April 2008 to 31 March 2013 while 3-year and 5-year survival rates are based on transplants performed in the period 1 April 2003 to 31 March 2013.

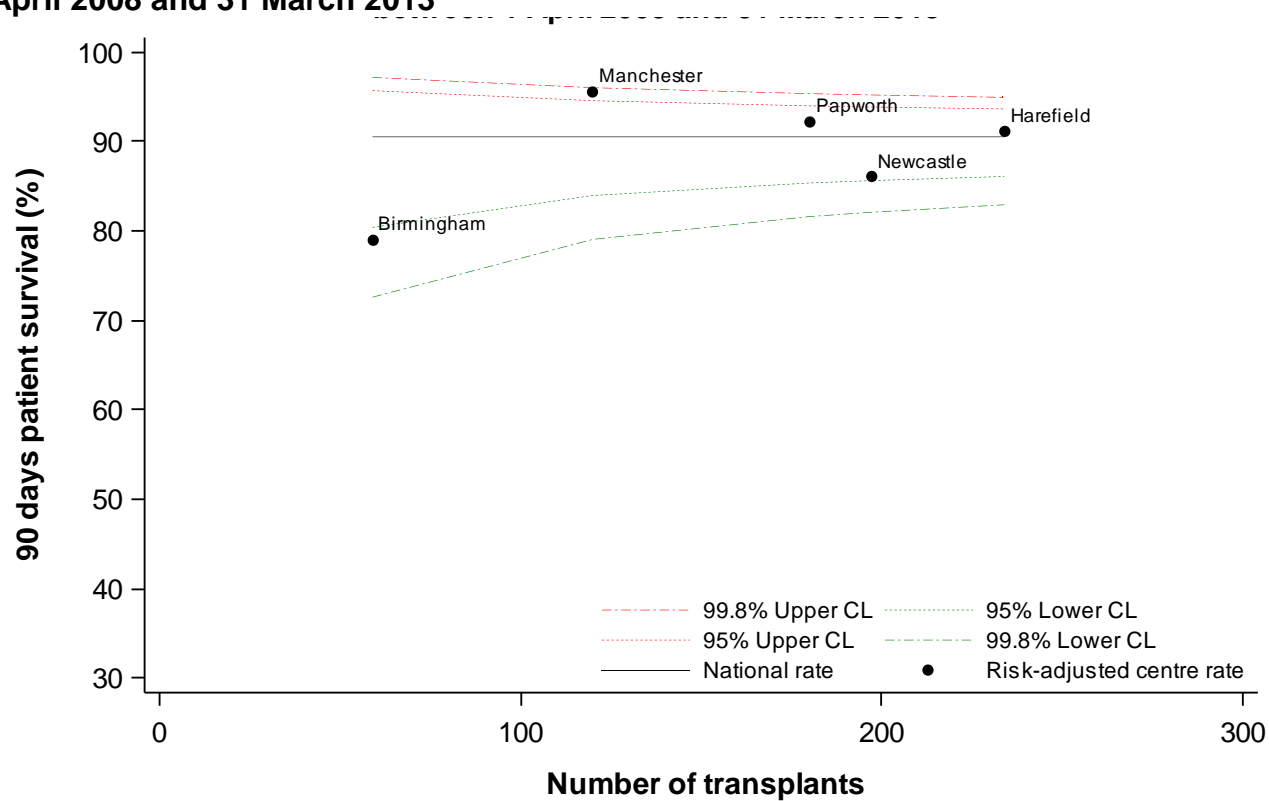
For the 800 lung transplants that were performed in the period 1 April 2008 to 31 March 2013, ninety-day outcome information was known for 791 patients. Ninety day [unadjusted](#) and [risk-adjusted](#) patient survival for these patients is shown in **Table 8.1**. Ninety day survival rates at Birmingham and Manchester fell outside of the 95% [confidence limits](#) but both centres were within the 99.8% confidence limits.

**Table 8.1 Ninety day patient survival for adult first lung transplants, between 1 April 2008 and 31 March 2013**

Centre	Number of transplants		90 day survival % (95% CI)		
			Unadjusted		Risk adjusted
Birmingham	58	81	(68.4 - 89.0)	78.9	(61.9 - 88.3)
Harefield	224	91	(86.4 - 94.1)	91.2	(86.7 - 94.2)
Manchester	117	96.6	(91.1 - 98.7)	95.6	(89.5 - 98.2)
Newcastle	234	87.7	(82.7 - 91.3)	86.1	(79.9 - 90.4)
Papworth	167	92.8	(87.7 - 95.9)	92.2	(86.2 - 95.5)
<b>UK</b>	<b>800</b>	<b>90.5</b>	<b>(88.3 - 92.4)</b>		



**Figure 8.1 Risk-adjusted 90 day patient survival for adult lung transplants between 1 April 2008 and 31 March 2013**

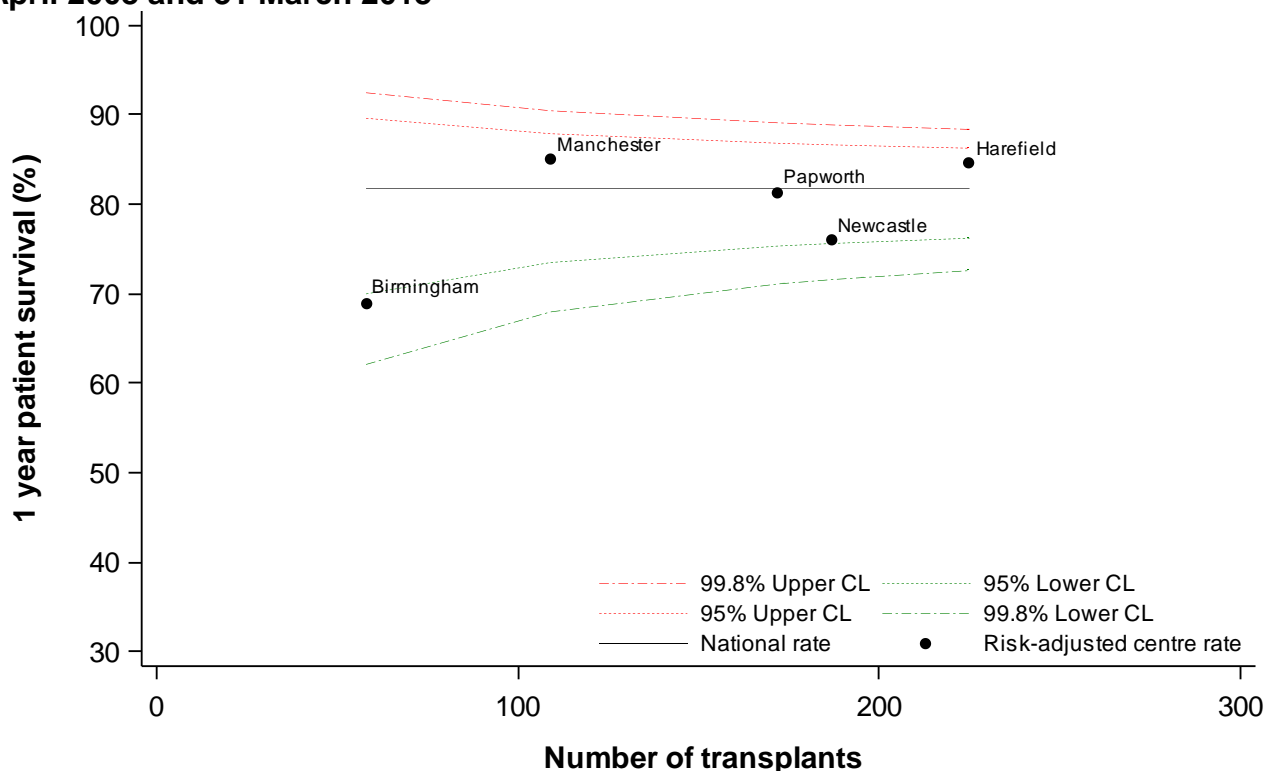


For the 800 lung transplants were performed in the period 1 April 2008 to 31 March 2013, one-year outcome information was known for 694 patients. One year [unadjusted](#) and [risk-adjusted](#) patient survival for these patients is shown in **Table 8.2**. None of the centres were statistically significantly different to the national rate, as shown in the funnel plot in **Figure 8.2**. The one year [survival rate](#) at Birmingham fell below the 95% lower [confidence limit](#) but was within the 99.8% confidence limit.

**Table 8.2 One year patient survival for adult first lung transplants, between 1 April 2008 and 31 March 2013**

Centre	Number of transplants	1 year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Birmingham	58	69	(55.4 - 79.2)	68.9	(50.7 - 80.4)
Harefield	224	84.3	(78.8 - 88.4)	84.7	(78.5 - 89.1)
Manchester	117	84.3	(76.2 - 89.8)	85.1	(76.0 - 90.7)
Newcastle	234	79.1	(73.1 - 83.8)	76	(67.9 - 82.1)
Papworth	167	84.7	(78.2 - 89.4)	81.3	(72.7 - 87.2)
<b>UK</b>	<b>800</b>	<b>81.8</b>	<b>(78.9 - 84.3)</b>		

**Figure 8.2 Risk-adjusted 1 year patient survival for adult lung transplants between 1 April 2008 and 31 March 2013**

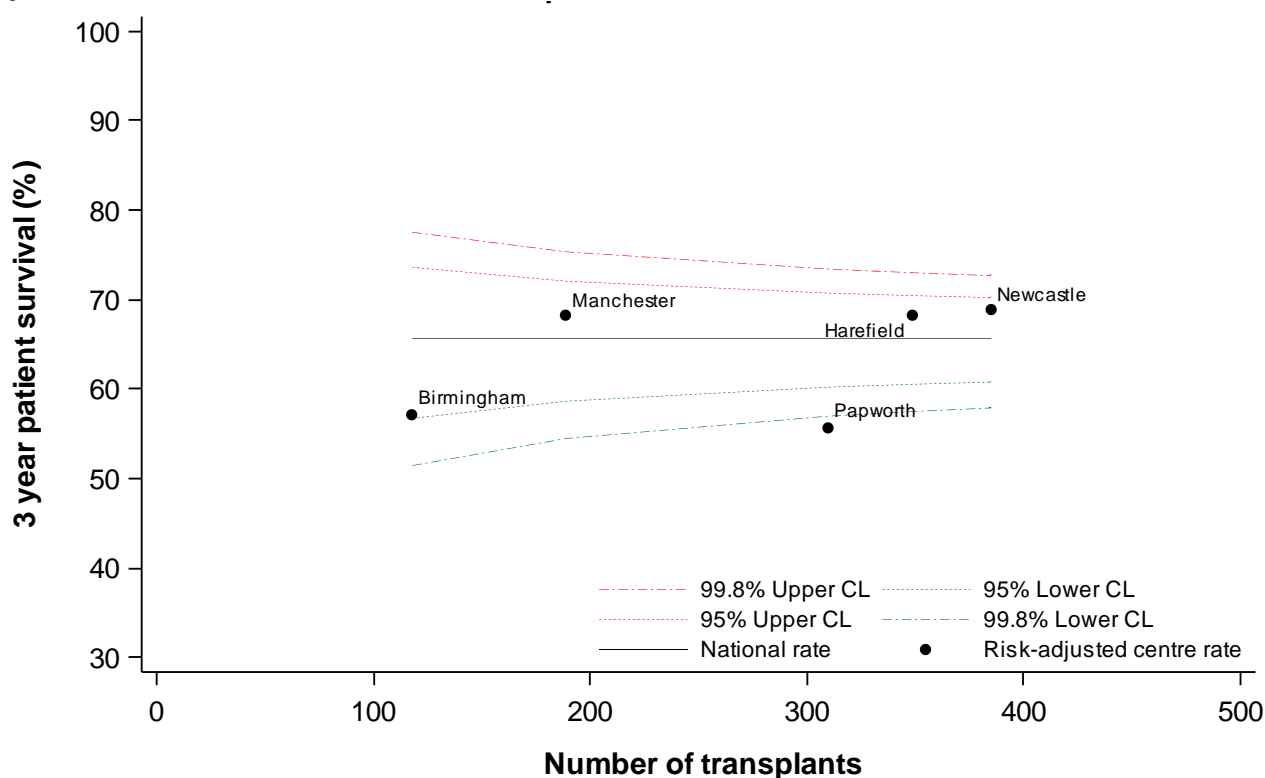


For the 1425 lung transplants that were performed in the period 1 April 2003 to 31 March 2013, three-year outcome information was known for 1057 patients. Three year [unadjusted](#) and [risk-adjusted](#) patient survival for these patients is shown in **Table 8.3**. The three-year [survival rate](#) at Papworth fell below the 99.8% lower [confidence limit](#) which indicates that three-year survival at Papworth was significantly lower than the national average over this period.

**Table 8.3 Three year patient survival for adult first lung transplants, between 1 April 2003 and 31 March 2013**

Centre	Number of transplants	3 year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Birmingham	122	57.4	(47.8 - 65.9)	57.2	(43.1 - 67.7)
Harefield	345	68.8	(63.2 - 73.7)	68.2	(61.4 - 73.8)
Manchester	206	64.7	(57.4 - 71.1)	68.3	(59.4 - 75.2)
Newcastle	445	70.2	(65.4 - 74.5)	69	(62.7 - 74.2)
Papworth	307	60.2	(54.1 - 65.8)	55.7	(46.9 - 63.1)
<b>UK</b>	<b>1425</b>	<b>65.7</b>	<b>(63.0 - 68.2)</b>		

**Figure 8.3 Risk-adjusted 3 year patient survival for adult lung transplants between 1 April 2003 and 31 March 2013**



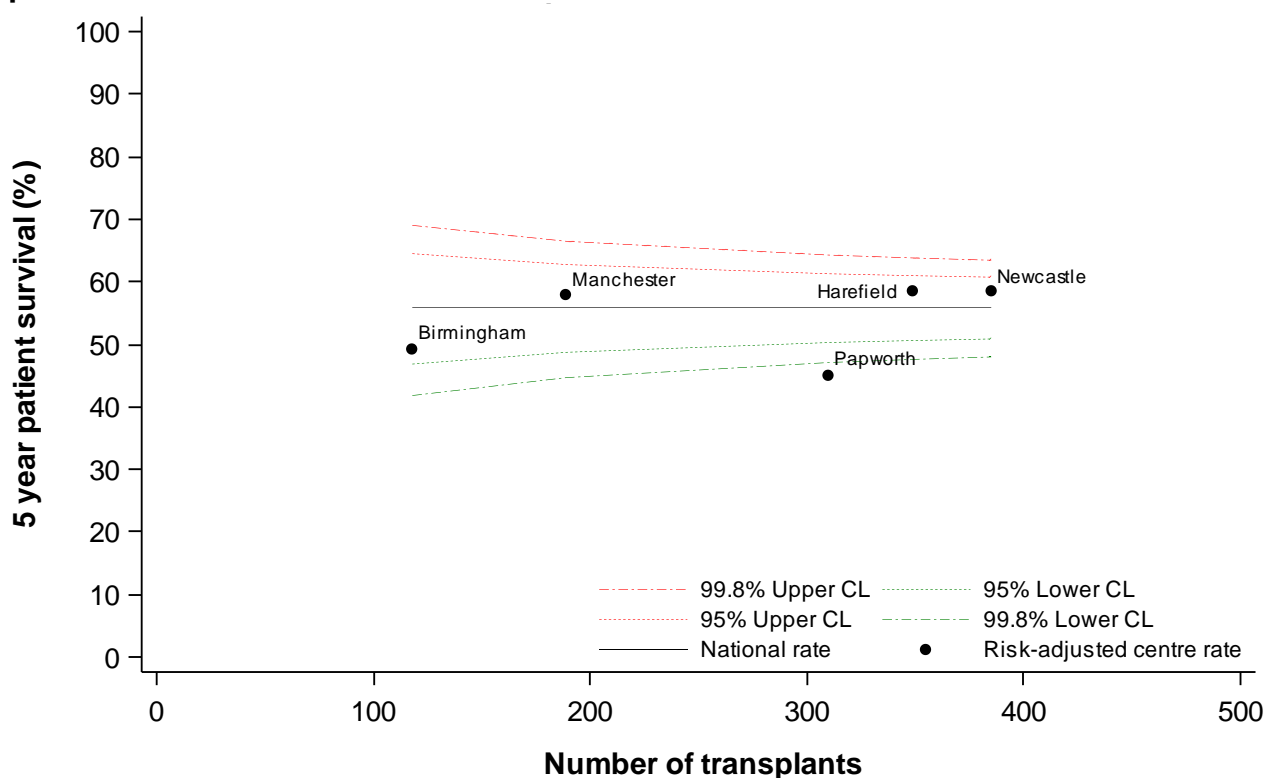
For the 1425 lung transplants were performed in the period 1 April 2003 to 31 March 2013, five-year outcome information was known for 875 patients. Five year [unadjusted](#) and [risk-adjusted](#) patient survival for these patients is shown in **Table 8.4**. The five-year [survival rate](#) for Papworth fell below the 99.8% lower [confidence limit](#) which indicates that five-year survival at Papworth was significantly lower than the national average over this period. Three-year and five-year survival rates at Papworth have, however, been adversely affected by unusually high mortality early in the time period, which has now been reduced.

**Table 8.4**

**Five year patient survival for adult lung first transplants, between 1 April 2003 and 31 March 2013**

Centre	Number of transplants	5 year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Birmingham	122	53.3	(43.3 - 62.3)	49.2	(33.1 - 61.4)
Harefield	345	58.5	(51.9 - 64.5)	58.4	(50.3 - 65.3)
Manchester	206	52.4	(44.3 - 59.8)	57.9	(47.3 - 66.3)
Newcastle	445	58.1	(52.3 - 63.5)	58.6	(51.2 - 64.9)
Papworth	307	53.3	(46.7 - 59.4)	45.1	(34.7 - 53.9)
<b>UK</b>	<b>1425</b>	<b>55.9</b>	<b>(52.8 - 58.8)</b>		

**Figure 8.4 Risk-adjusted 5 year patient survival for adult lung transplants between 1 April 2003 and 31 March 2013**



# **ADULT LUNG TRANSPLANTATION**

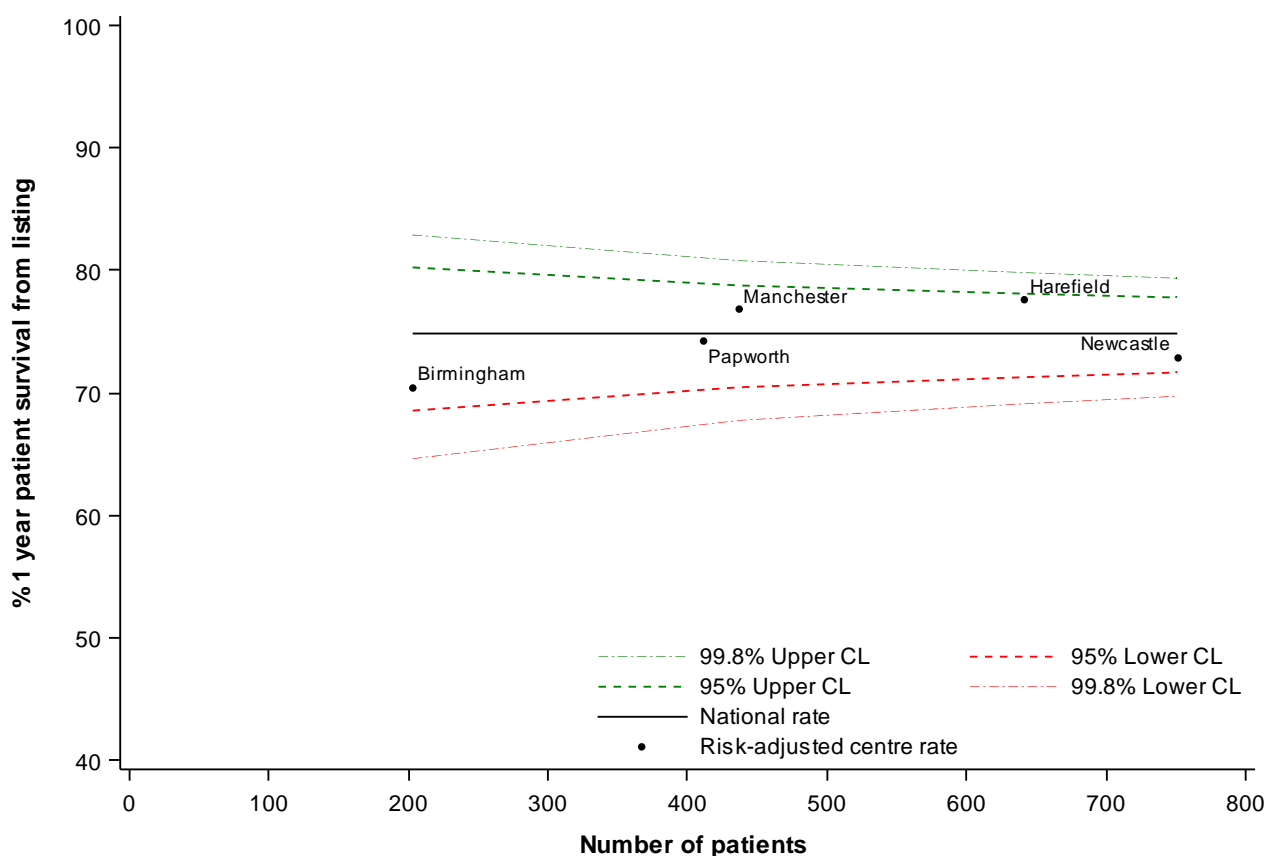
## **Survival from Listing**

Survival from listing was analysed for patients  $\geq 18$  years registered for the first time for a lung transplant between 1 January 2002 and 31 December 2013. One, five and ten year [risk-adjusted survival rates](#) from the point of lung transplant listing are shown by centre in **Figure 9.1, 9.2 and 9.3** respectively. Unlike previous lung sections, heart-lung transplants are not included in this analysis.

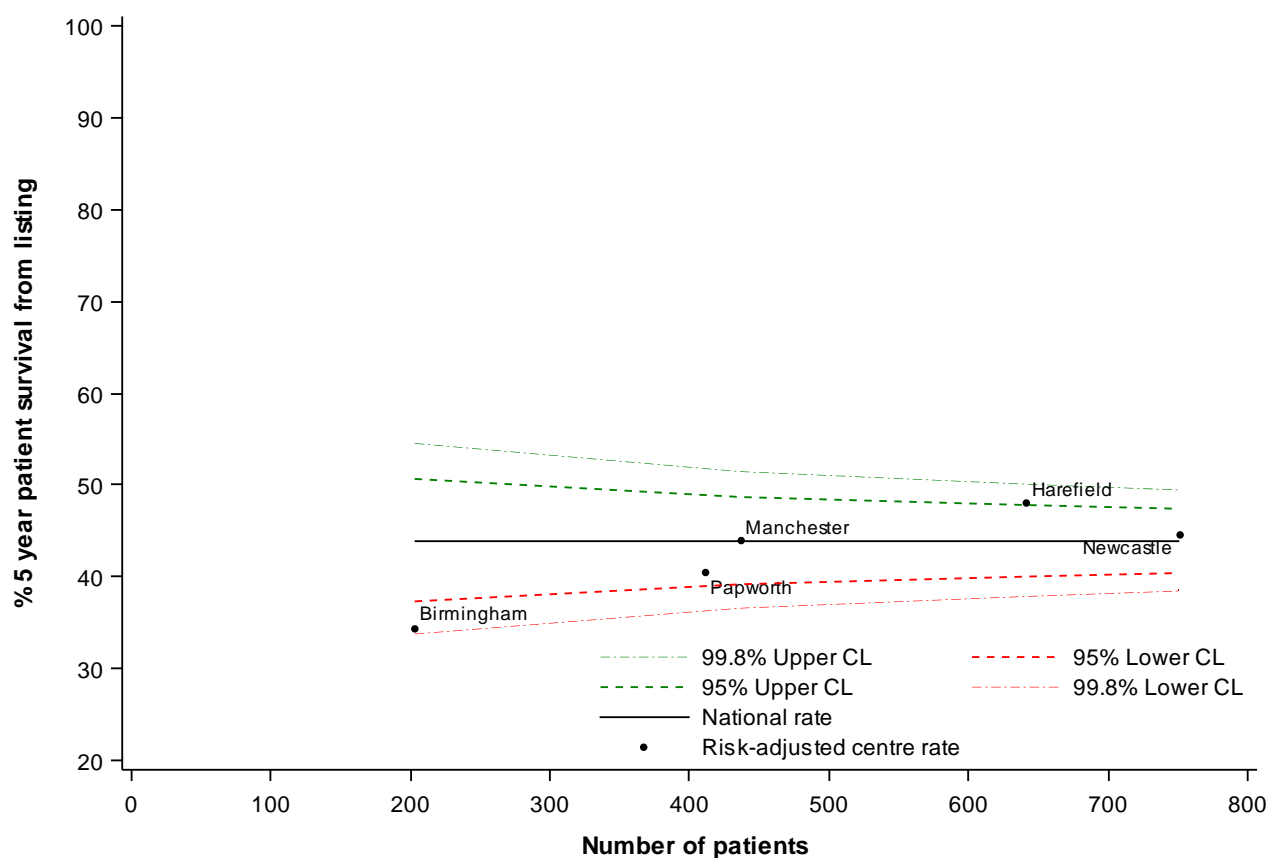
In terms of one year survival rates, three centres fell below, and two above, the national average, although none were statistically significantly different to the national average. However, for 10 year survival from listing, Birmingham fell below the 99.8% lower [confidence limit](#). This suggests that 10 year survival from listing at Birmingham may be significantly lower than the national rate.

At one year, centre-specific risk adjusted lung survival rates range between 70% (95% CI 62-77%) and 78% (95% CI 74-81%). At five years, centre-specific risk adjusted lung survival rates range between 34% (95% CI 21-46%) and 48% (95% CI 42-54%). At ten years, centre-specific risk adjusted lung survival rates range between 19% (95% CI 3-33%) and 34% (95% CI 26-41%).

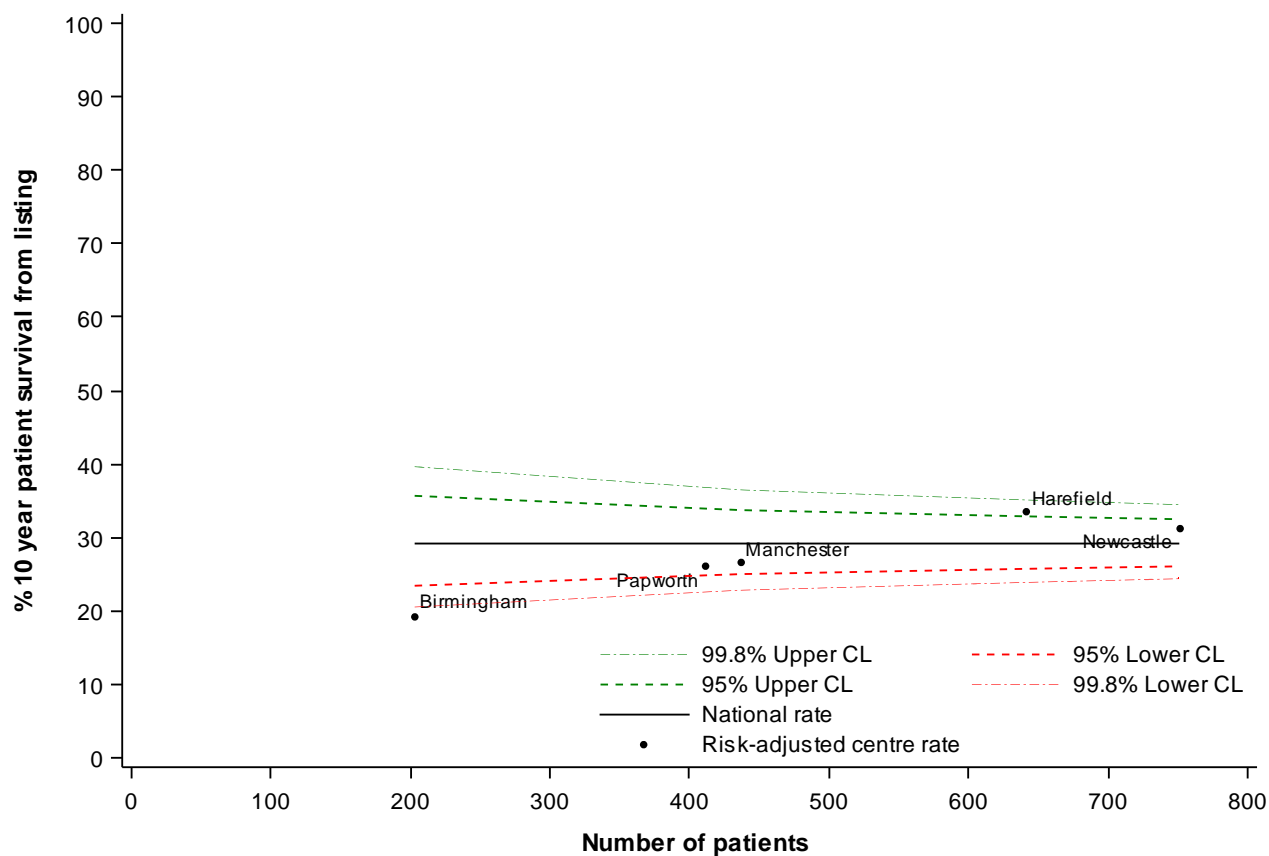
**Figure 9.1 One year patient survival from listing**



**Figure 9.2 Five year patient survival from listing**



**Figure 9.3 Ten year patient survival from listing**



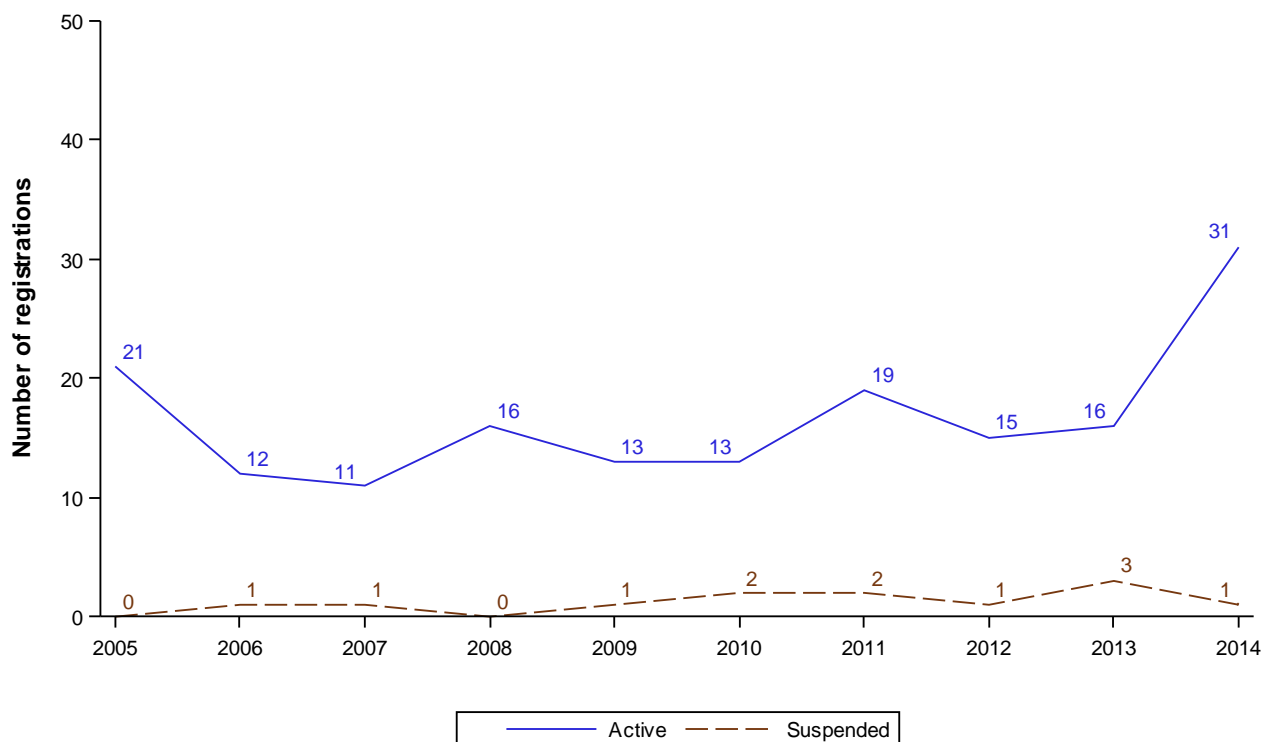
# **PAEDIATRIC HEART TRANSPLANTATION**

## **Transplant List**



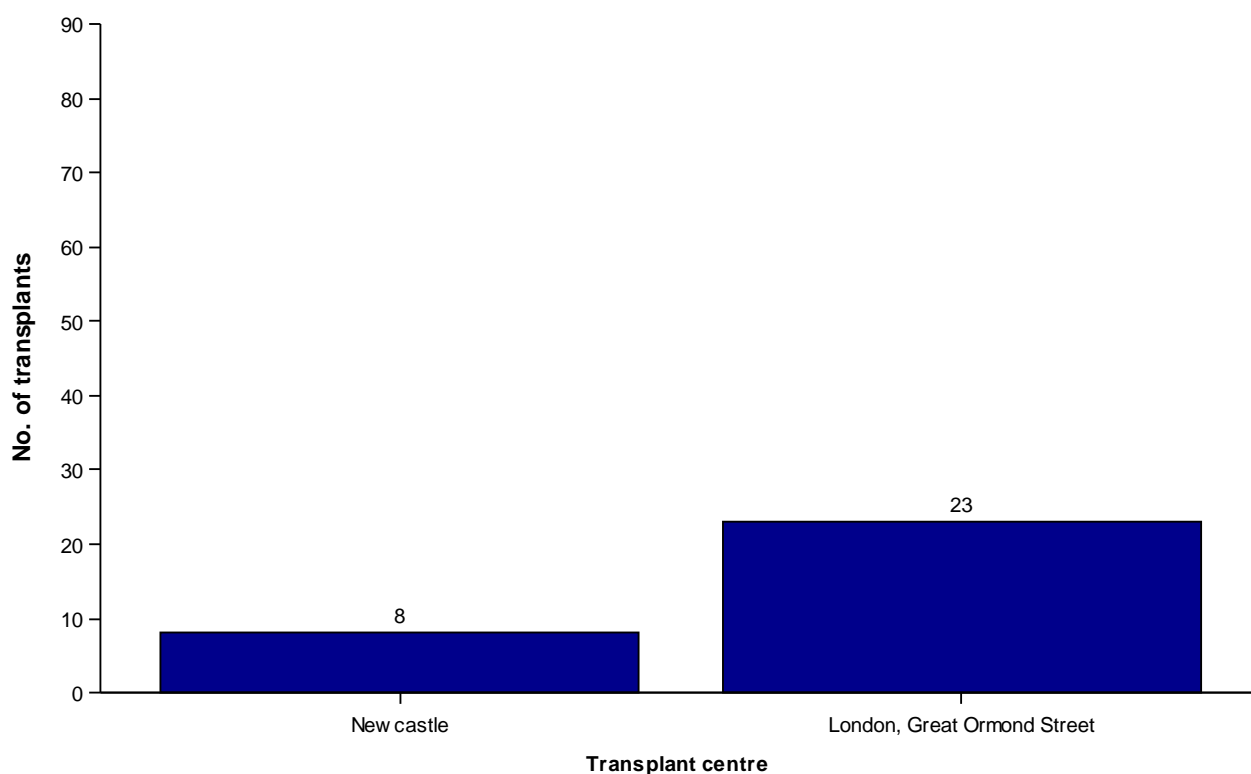
**Figure 10.1** shows the number of paediatric patients on the heart only transplant list at 31 March each year between 2005 and 2014. The number of paediatric patients actively waiting for a heart transplant increased substantially in the last year from 16 in 2013 to 31 in 2014.

**Figure 10.1 Paediatric heart patients on the cardiothoracic transplant lists at 31 March for the last 10 years, by year**



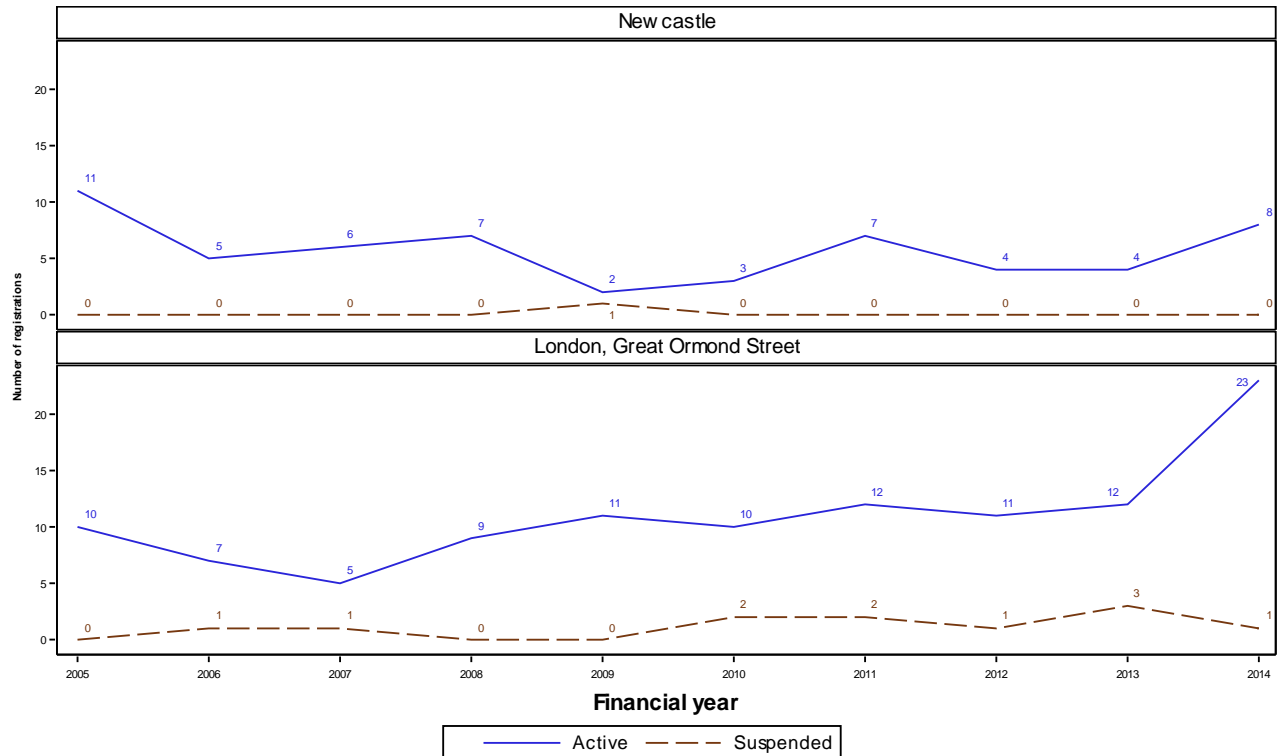
**Figure 10.2** shows the number of paediatric patients on the [active heart only transplant list](#) at 31 March 2014 by centre. In total, there were 31 paediatric patients. Great Ormond street had the greater proportion (74%) of the transplant list.

**Figure 10.2 Paediatric patients on the active heart transplant list at 31 March 2014, by centre**



**Figure 10.3** shows the number of paediatric patients on the transplant list at 31 March each year between 2005 and 2014 for each transplant centre.

**Figure 10.3 Paediatric patients on the heart transplant list at 31 March for the last 10 years, by year and by centre**



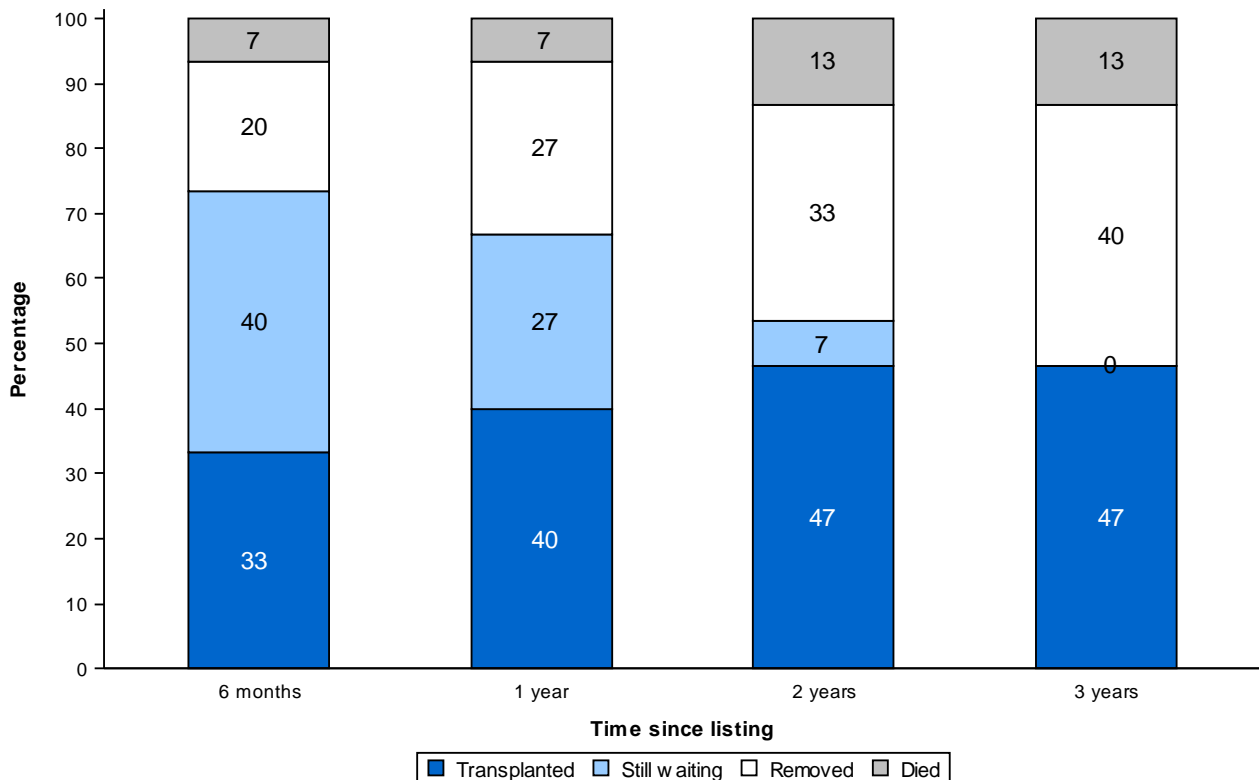
The demographic characteristics of the 31 paediatric patients on the [active heart transplant list](#) in the latest year are shown by centre and overall in **Table 10.1**. 71% of these recipients were male and the [median](#) age was 6 years. For some characteristics, due to rounding, percentages may not add up to 100.

Table 10.1      Demographic characteristics of Paediatric Heart active transplant list patients at 31 March 2014, by centre				
		Newcastle	Great Ormond Street	TOTAL
		N (%)	N (%)	N (%)
Number		8	23	31 (100)
Recipient sex	Male	5 (63)	17 (74)	22 (71)
	Female	3 (38)	6 (26)	9 (29)
Recipient ethnicity	White	3 (38)	18 (78)	21 (68)
	Non-white	4 (50)	5 (22)	9 (29)
	Missing	1 (13)	0	1 (3)
Recipient age	Median ( <a href="#">IQR</a> )	2 (1,3)	7 (4,11)	6 (2,10)
	Missing	0	0	0
Primary Disease	Cardiomyopathy	2 (25)	3 (13)	5 (16)
	Congenital heart disease	3 (38)	7 (30)	10 (32)
	Other heart disease	0	1 (4)	1 (3)
	Others	3 (38)	12 (52)	15 (48)
Previous open heart surgery	None	1 (13)	12 (52)	13 (42)
	One	5 (63)	0	5 (16)
	More than one	1 (13)	5 (22)	6 (19)
	Missing	1 (13)	6 (26)	7 (23)
Previous thoracotomy	No	7 (88)	17 (74)	24 (77)
	Yes	0	2 (9)	2 (7)
	Missing	1(12)	4 (17)	5 (16)

Table 10.1 Demographic characteristics of Paediatric Heart active transplant list patients at 31 March 2014, by centre				
		Newcastle	Great Ormond Street	TOTAL
		N (%)	N (%)	N (%)
Serum Bilirubin umol/l	Median ( <a href="#">IQR</a> )	8.00 (5.00,12.50)	12.00 (7.00,18.00)	<b>12.00 (6.00,17.00)</b>
	Missing	0	6	<b>6</b>
Serum Creatinine umol/l	Median ( <a href="#">IQR</a> )	40.50 (23.50,46.50)	41.00 (30.00,54.00)	<b>41.00 (29.00,49.00)</b>
	Missing	0	6	<b>6</b>

An indication of outcomes for paediatric patients listed for a heart transplant is summarised in **Figure 10.4**. This shows the proportion of patients transplanted or still waiting six months, one, two and three years after joining the list. It also shows the proportion removed from the transplant list (typically because they become too unwell for transplant) and those dying while on the transplant list. 33% of patients are transplanted within six months, while three years after listing 47% of patients have received a transplant.

**Figure 10.4 Post-registration outcome for 15 new non-urgent paediatric heart only registrations made in the UK, 1 April 2010 to 31 March 2011**



The [median](#) waiting time to transplant for paediatric patients on the [active heart transplant list](#) between 1 April 2008 and 31 March 2011 was too small to present meaningful summary statistics regarding patient waiting time.

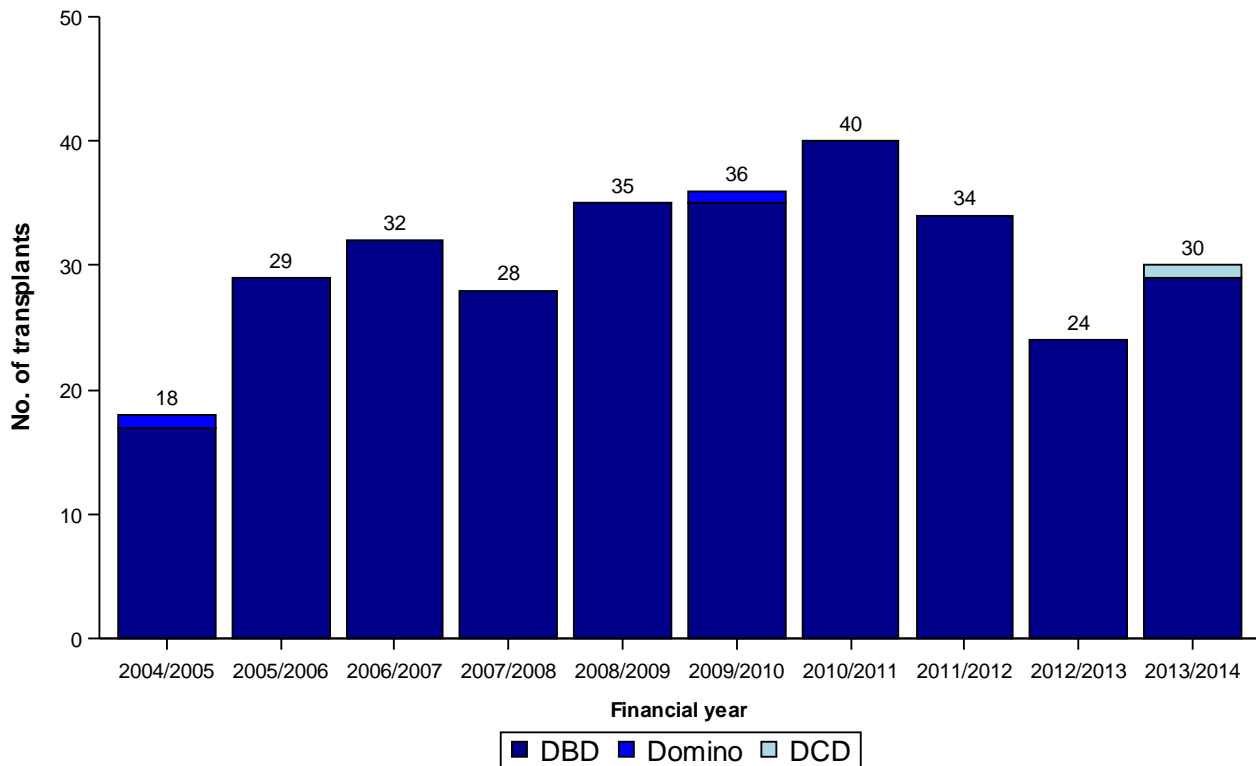
# **PAEDIATRIC HEART TRANSPLANTATION**

## **Transplants**



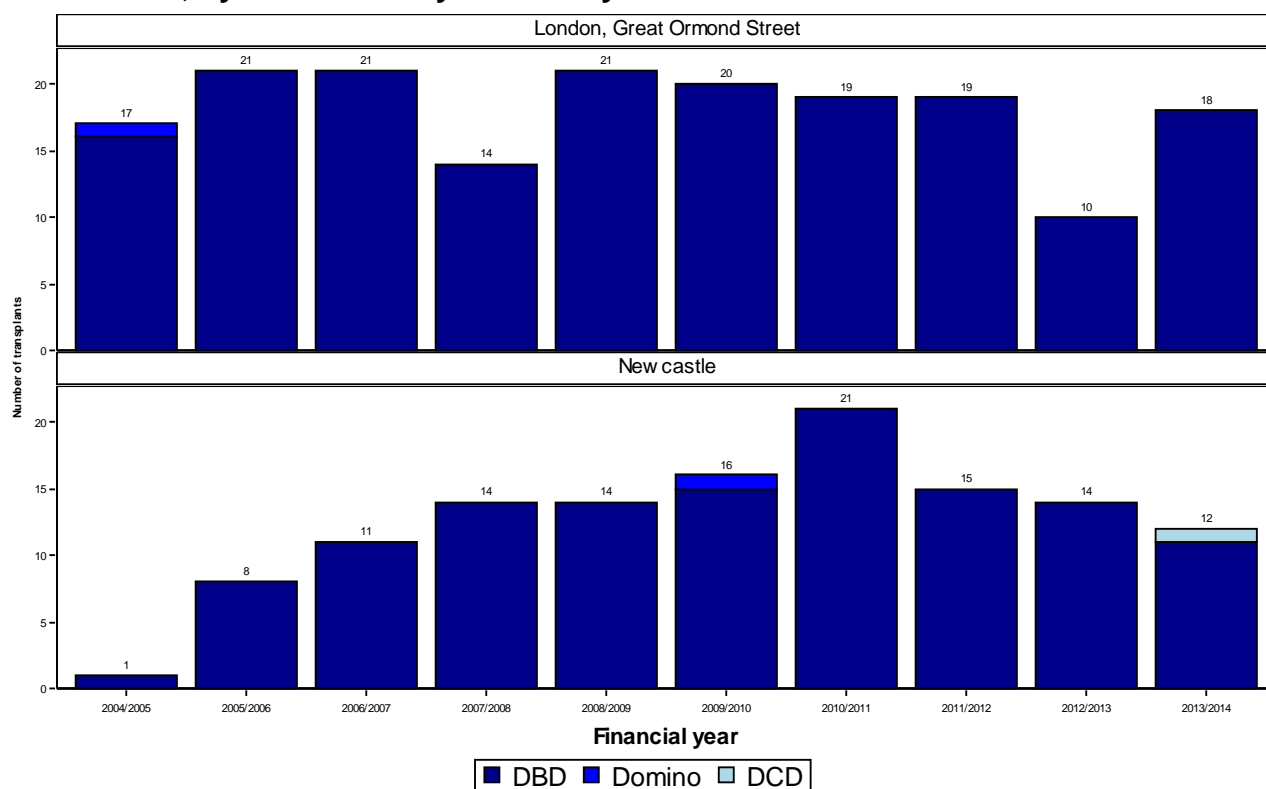
**Figure 11.1** and **11.2** show the total number of paediatric heart only transplants performed in the last ten years overall and by centre, respectively. The number of transplants fell from 40 in 2010/2011 to 24 in 2012/13 and has since risen to 30 in 2013/14 which includes 1 transplant from a donor after circulatory death ([DCD](#)). The number of paediatric heart transplants in the latest financial year (2013-2014) is shown by centre in **Figure 11.3**.

**Figure 11.1 Number of paediatric heart transplants in the UK, 1 April 2004 to 31 March 2014, by financial year**

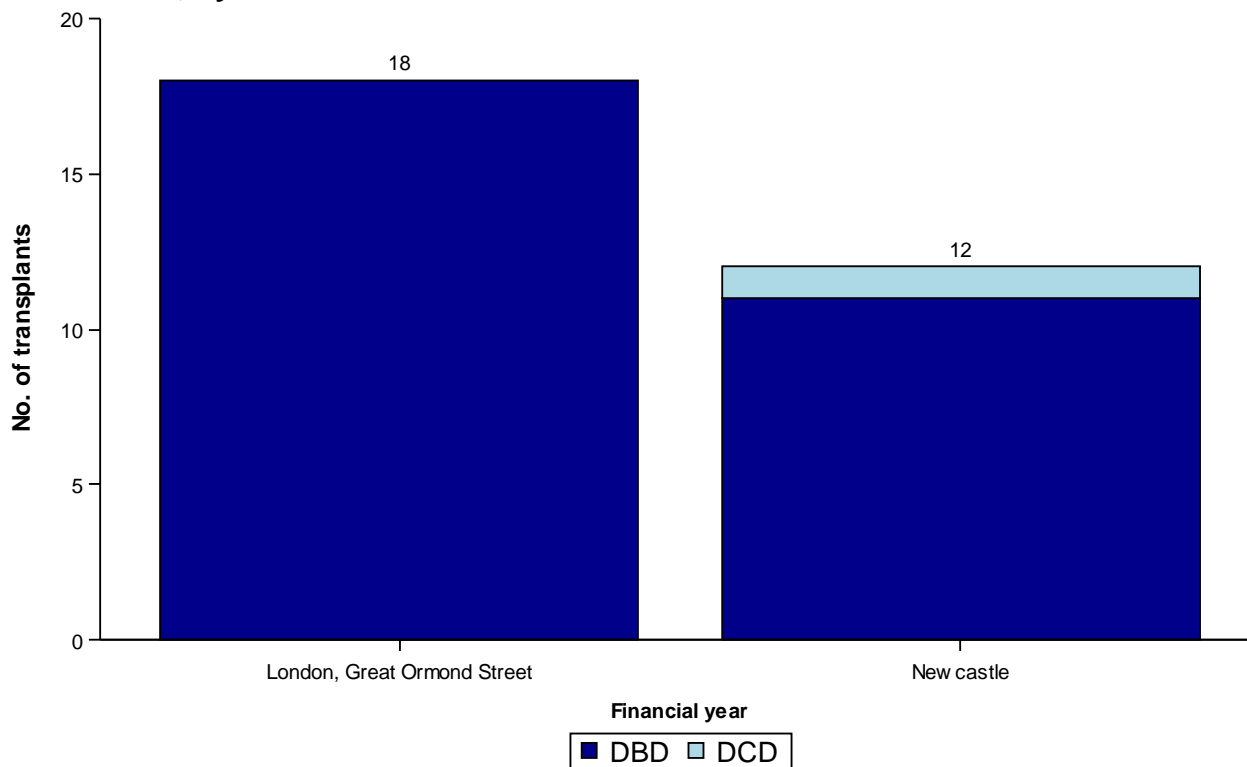




**Figure 11.2 Number of paediatric heart transplants in the UK, 1 April 2004 to 31 March 2014, by centre and by financial year**



**Figure 11.3 Number of paediatric heart transplants in the UK, 1 April 2004 to 31 March 2014, by centre**



The demographic characteristics of 30 paediatric heart transplant recipients in the latest year are shown by centre and overall in **Table 11.1**. 47% of these recipients were male and the [median](#) age was 6 years. For some characteristics, due to rounding, percentages may not add up to 100.

Table 11.1 Demographic of first Paediatric Heart transplant recipients by centre, from 1 April 2013 to 31 March 2014				
		Newcastle N (%)	Great Ormond Street N (%)	TOTAL N (%)
Recipient sex	Male	4 (33)	10 (56)	14 (47)
	Female	8 (67)	8 (44)	16 (53)
Recipient ethnicity	White	8 (67)	15 (83)	23 (77)
	Non-white	4 (33)	1 (6)	5 (17)
	Missing	0	2 (11)	2 (7)
Recipient age	Median ( <a href="#">IQR</a> )	4 (1,7)	12 (1,14)	6 (1,14)
	Missing	0	0	
Recipient weight	Median ( <a href="#">IQR</a> )	13 (7,20)	31 (10,53)	20 (8,37)
	Missing	0	0	
NYHA class	I	0	2 (11)	2 (7)
	II	0	3 (17)	3 (10)
	III	2 (17)	1 (6)	3 (10)
	IV	10 (83)	12 (67)	22 (73)
Recipient on ventilator	No	6 (50)	12 (67)	18 (60)
	Yes	4 (33)	2 (11)	6 (20)
	Missing	2 (17)	4 (22)	6 (20)
Recipient on inotropes	No	3 (25)	6 (33)	9 (30)
	Yes	7 (58)	11 (61)	18 (60)
	Missing	2 (17)	1 (6)	3 (10)
Recipient IABP	No	10 (83)	15 (83)	25 (83)
	Yes	0	2 (11)	2 (7)
	Missing	2 (17)	1 (6)	3 (10)

**Table 11.1 Demographic of first Paediatric Heart transplant recipients by centre, from 1 April 2013 to 31 March 2014**

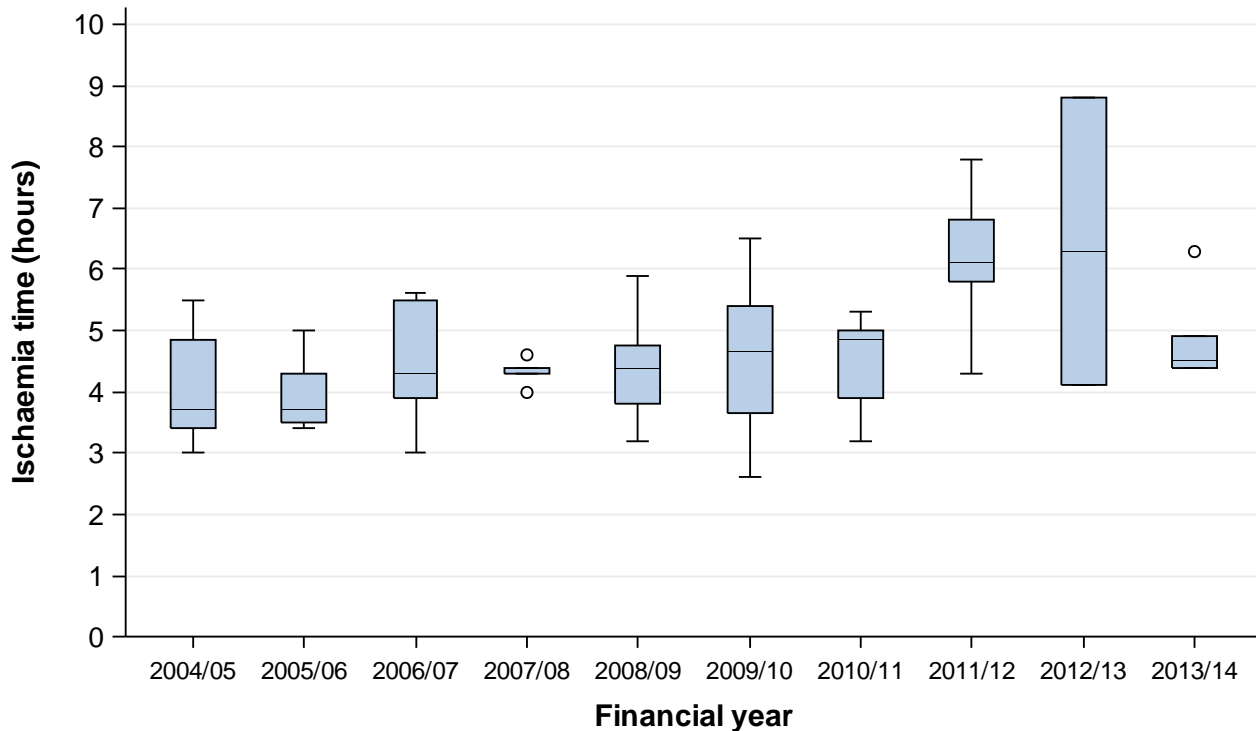
		Newcastle N (%)	Great Ormond Street N (%)	TOTAL N (%)
Recipient VAD	None	5 (42)	14 (78)	19 (63)
	Left	1 (8)	0	1 (3)
	Right	0	1 (6)	1 (3)
	Both	4 (33)	1 (6)	5 (17)
	Missing	2 (17)	2 (11)	4 (13)
Recipient TAH	No	10 (83)	17 (94)	27 (90)
	Missing	2 (17)	1 (6)	3 (10)
Recipient ECMO	No	8 (67)	16 (89)	24 (80)
	Yes	2 (17)	1 (6)	3 (10)
	Missing	2 (17)	1 (6)	3 (10)
Recipient CMV status	No	4 (33)	10 (56)	14 (47)
	Yes	5 (42)	3 (17)	8 (27)
	Missing	3 (25)	5 (27)	8 (27)
Recipient HCV status	No	9 (75)	14 (78)	23 (77)
	Missing	3 (25)	4 (22)	7 (23)
Recipient HBV status	No	12 (100)	18 (100)	30 (100)
Recipient HIV status	No	9 (75)	14 (78)	23 (77)
	Missing	3 (25)	4 (22)	7 (23)
Recipient Serum Creatinine umol/l	Median ( <a href="#">IQR</a> )	29 (18,48)	29 (0,59)	39 (24,64)
	Missing	0	6	21
Donor sex	Male	5 (42)	8 (44)	13 (43)
	Female	7 (58)	10 (56)	17 (57)
Donor ethnicity	White	8 (67)	13 (72)	21 (70)
	Non-white	1 (8)	0	1 (3)
	Missing	3 (25)	5 (28)	8 (27)

**Table 11.1 Demographic of first Paediatric Heart transplant recipients by centre, from 1 April 2013 to 31 March 2014**

		Newcastle N (%)	Great Ormond Street N (%)	TOTAL N (%)
Donor age	Median ( <a href="#">IQR</a> )	7 (1,15)	23 (3,34)	13 (1,30)
	Missing	0	0	
Donor BMI	Median ( <a href="#">IQR</a> )	18 (15,21)	22 (18,27)	20 (16,25)
	Missing	0	0	
Donor Cause of Death	CVA	6 (50)	9 (50)	15 (50)
	Trauma	4 (33)	4 (22)	8 (27)
	Others	2 (17)	5 (28)	7 (23)
Donor hypotension (less than 70mmHg systolic)	No	6 (50)	12 (67)	18 (60)
	Yes	6 (50)	5 (28)	11 (37)
	Missing	0	1 (6)	1 (3)
Donor past diabetes	No	12 (100)	18 (100)	30 (100)
Donor cardiac arrest	No	8 (67)	14 (78)	22 (73)
	Yes	3 (25)	3 (17)	6 (20)
	Missing	1 (8)	1 (6)	2 (7)
Donor past hypertension	No	12 (100)	16 (89)	28 (93)
	Yes	0	2 (11)	2 (7)
Donor past tumour	No	10 (83)	18 (100)	28 (93)
	Yes	2 (17)	0	2 (7)
Donor past smoker	No	12 (100)	15 (83)	27 (90)
	Yes	0	3 (17)	3 (10)

**Figure 11.4** shows the [median](#) total ischaemia time in paediatric [DBD](#) donor heart transplants over the last 10 years.

**Figure 11.4 Median total ischaemia time in paediatric DBD donor heart transplants, 1 April 2004 to 31 March 2014**



**Table 11.5** shows the [median](#) total ischaemia time in paediatric [DBD](#) donor heart transplants by centre, over the last 10 years. This analysis does not take into account the use of donor organ maintenance systems for some transplants. These enable warm blood perfusion to continue ex-vivo during transportation. For such transplants, the definition of total ischemia time used here (cross-clamp to reperfusion) over-estimates the true ischaemia time because the heart is not subject to ischaemia during transportation.

**Table 11.5 Median total ischaemia time in paediatric DBD heart donor heart transplants**

Centre by financial year		Total ischaemia time (hours)		
		Number of transplants	<u>Median</u>	<u>Interquartile range</u>
Newcastle	2004/2005	1	4.4	-
	2005/2006	8	3.7	(3.3 - 4.3)
	2006/2007	11	3.6	(3.3 - 4.3)
	2007/2008	10	3.2	(3.0 - 3.6)
	2008/2009	13	3.5	(2.9 - 3.9)
	2009/2010	13	3.6	(3.5 - 4.3)
	2010/2011	17	3.3	(2.8 - 4.3)
	2011/2012	15	3.8	(3.4 - 4.1)
	2012/2013	13	3.4	(3.0 - 3.6)
	2013/2014	10	3.3	(3.2 - 3.5)
	<b>Total</b>	<b>111</b>	<b>3.5</b>	<b>(3.2 - 4.0)</b>
London, Great Ormond Street	2004/2005	16	3.7	(3.4 - 4.3)
	2005/2006	20	4.4	(3.6 - 5.1)
	2006/2007	15	4.0	(3.6 - 4.6)
	2007/2008	13	4.3	(2.6 - 4.5)
	2008/2009	12	3.9	(3.4 - 4.3)
	2009/2010	18	4.0	(2.3 - 4.3)
	2010/2011	7	4.1	(3.8 - 4.6)
	2011/2012	6	3.0	(2.3 - 4.0)
	2012/2013	4	3.6	-
	2013/2014	6	4.0	(3.3 - 5.3)
	<b>Total</b>	<b>117</b>	<b>4.0</b>	<b>(3.3 - 4.5)</b>

# **PAEDIATRIC HEART TRANSPLANTATION**

## **Post-Transplant Survival**



The survival analysis results presented in this section exclude;

- [Multi organ transplants](#)
- Second (or higher) graft transplants

30-day and 1-year [survival rates](#) are based on transplants performed in the period 1 April 2008 to 31 March 2013 while 3-year and 5-year survival rates are based on transplants performed in the period 1 April 2003 to 31 March 2013.

For the 164 paediatric heart transplants that were performed in the period 1 April 2008 to 31 March 2013, 30-day outcome information was known for all patients. 30-day [unadjusted](#) patient survival for these patients is shown in **Table 12.1**. As the 95% [confidence intervals](#) for Great Ormond Street and Newcastle overlap, this suggests there is no statistically significant difference between centres.

<b>Table 12.1 30 day patient survival for paediatric heart first transplants , between 1 April 2008 and 31 March 2013</b>				
Centre	Number of transplants	Number of deaths	30 day survival % (95% CI)	
			Unadjusted	
London, Great Ormond Street	87	4	95.4	(88.2 - 98.2)
Newcastle	77	2	97.4	(90.0 - 99.3)
<b>UK</b>	<b>164</b>	<b>6</b>	<b>96.3</b>	<b>(92.0 - 98.3)</b>

For the 164 paediatric heart transplants that were performed in the period 1 April 2008 to 31 March 2013, outcome information was known for 153 patients. One year [unadjusted](#) patient survival for these patients is shown in **Table 12.2**. As the 95% [confidence intervals](#) for Great Ormond Street and Newcastle overlap, this suggests there is no statistically significant difference between centres.

<b>Table 12.2 One year patient survival for paediatric heart first transplants, between 1 April 2008 and 31 March 2013</b>				
Centre	Number of transplants	Number of deaths	1 year survival % (95% CI)	
			Unadjusted	
London, Great Ormond Street	87	7	92	(83.9 - 96.1)
Newcastle	77	7	90.9	(81.9 - 95.6)
<b>UK</b>	<b>164</b>	<b>14</b>	<b>91.5</b>	<b>(86.0 - 94.9)</b>



For the 297 paediatric heart transplants that were performed in the period 1 April 2003 to 31 March 2013, three-year outcome information was known for 219 patients. Three year [unadjusted](#) patient survival for these patients is shown in **Table 12.3**. As the 95% [confidence intervals](#) for Great Ormond Street and Newcastle overlap, this suggests there is no statistically significant difference between centres.

<b>Table 12.3 Three year patient survival for paediatric heart first transplants, between 1 April 2003 and 31 March 2013</b>				
Centre	Number of transplants	Number of deaths	3 year survival % (95% CI)	
			Unadjusted	
London, Great Ormond Street	177	18	89.2	(83.4 - 93.1)
Newcastle	120	13	88.3	(80.5 - 93.1)
<b>UK</b>	<b>297</b>	<b>31</b>	<b>88.8</b>	<b>(84.5 - 92.0)</b>

For the 297 heart transplants that were performed in the period 1 April 2003 to 31 March 2013, 5-year outcome information was known for 160 patients. Five year [unadjusted](#) patient survival for these patients is shown in **Table 12.4**. As the 95% [confidence intervals](#) for Great Ormond Street and Newcastle overlap, this suggests there is no statistically significant difference between centres.

<b>Table 12.4 Five year patient survival for paediatric heart first transplants, between 1 April 2003 and 31 March 2013</b>				
Centre	Number of transplants	Number of deaths	5 year survival % (95% CI)	
			Unadjusted	
London, Great Ormond Street	177	21	86.6	(80.1 - 91.1)
Newcastle	120	13	88.3	(80.5 - 93.1)
<b>UK</b>	<b>297</b>	<b>34</b>	<b>87.1</b>	<b>(82.3 - 90.7)</b>

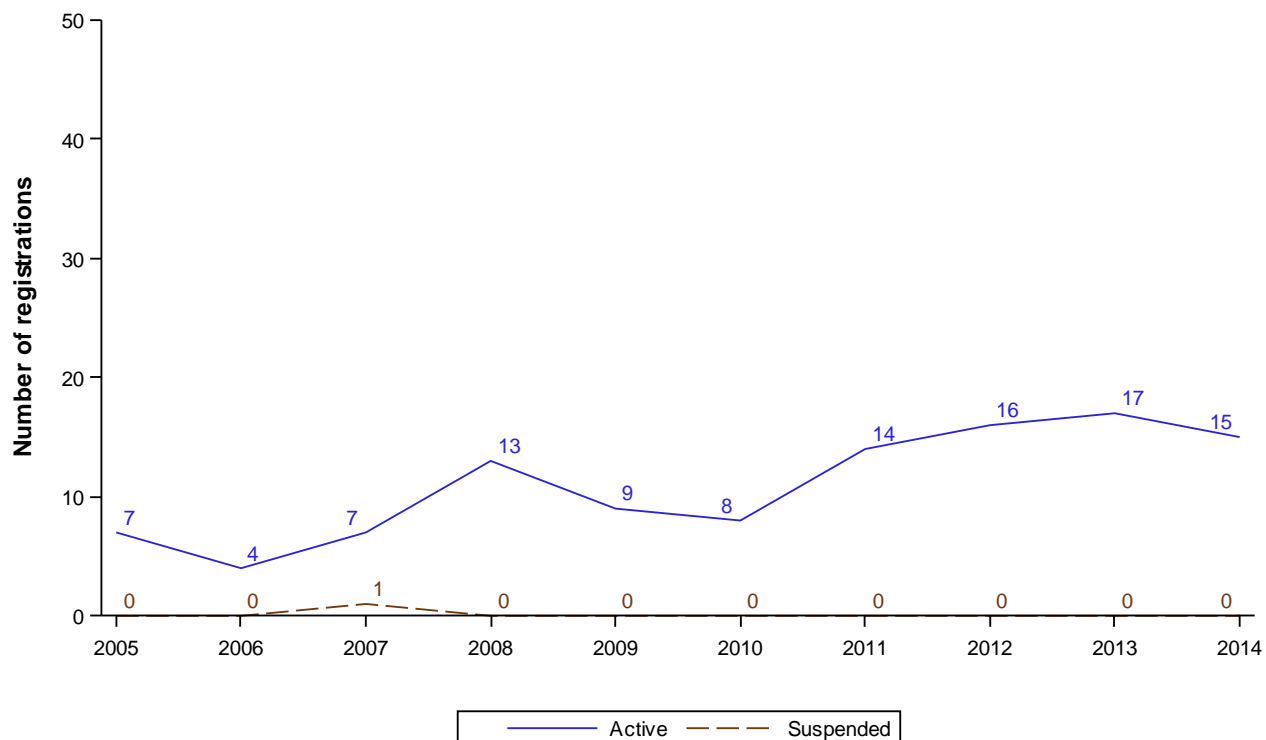
# **PAEDIATRIC LUNG TRANSPLANTATION**

## **Transplant List**



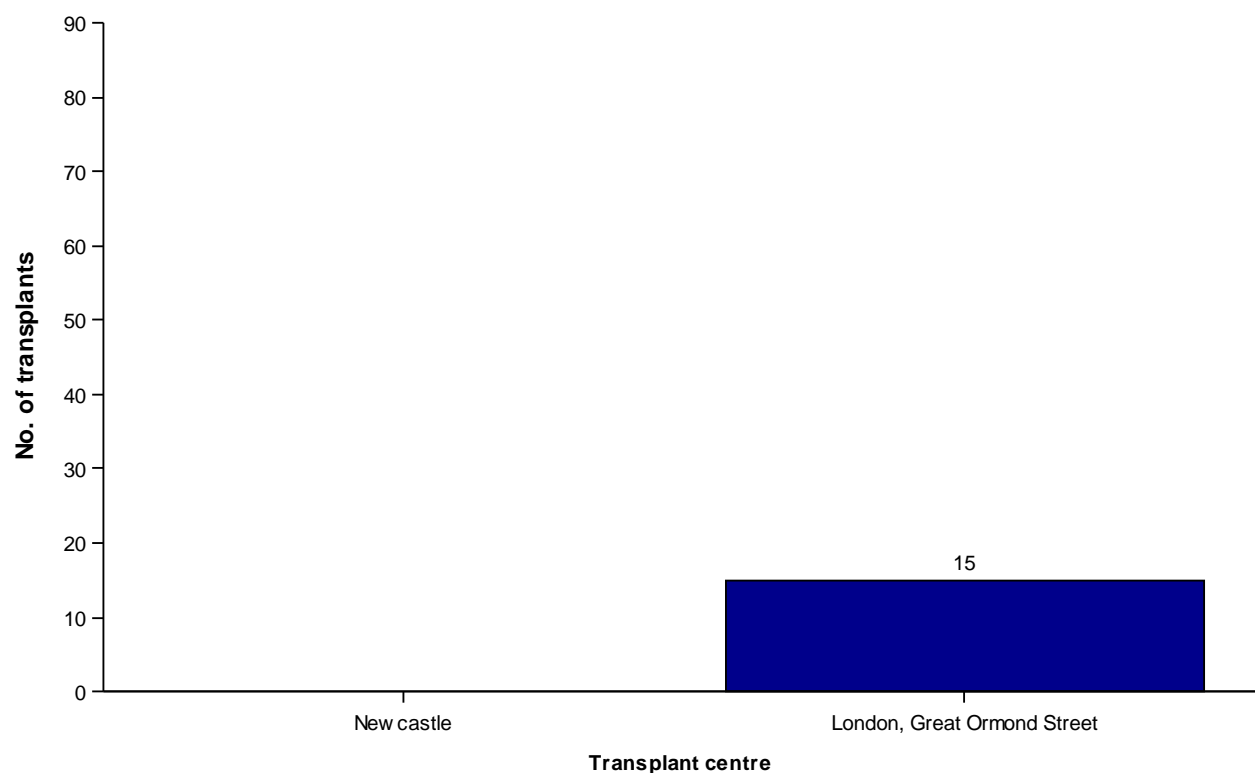
**Figure 13.1** shows the number of paediatric patients on the lung transplant list at 31 March each year between 2005 and 2014. The number of patients actively waiting for a lung transplant increased from 8 in 2010 to 17 in 2013 and has since fallen to 15 in 2014.

**Figure 13.1 Paediatric lung patients on the lung transplant lists at 31 March for the last 10 years, by year**



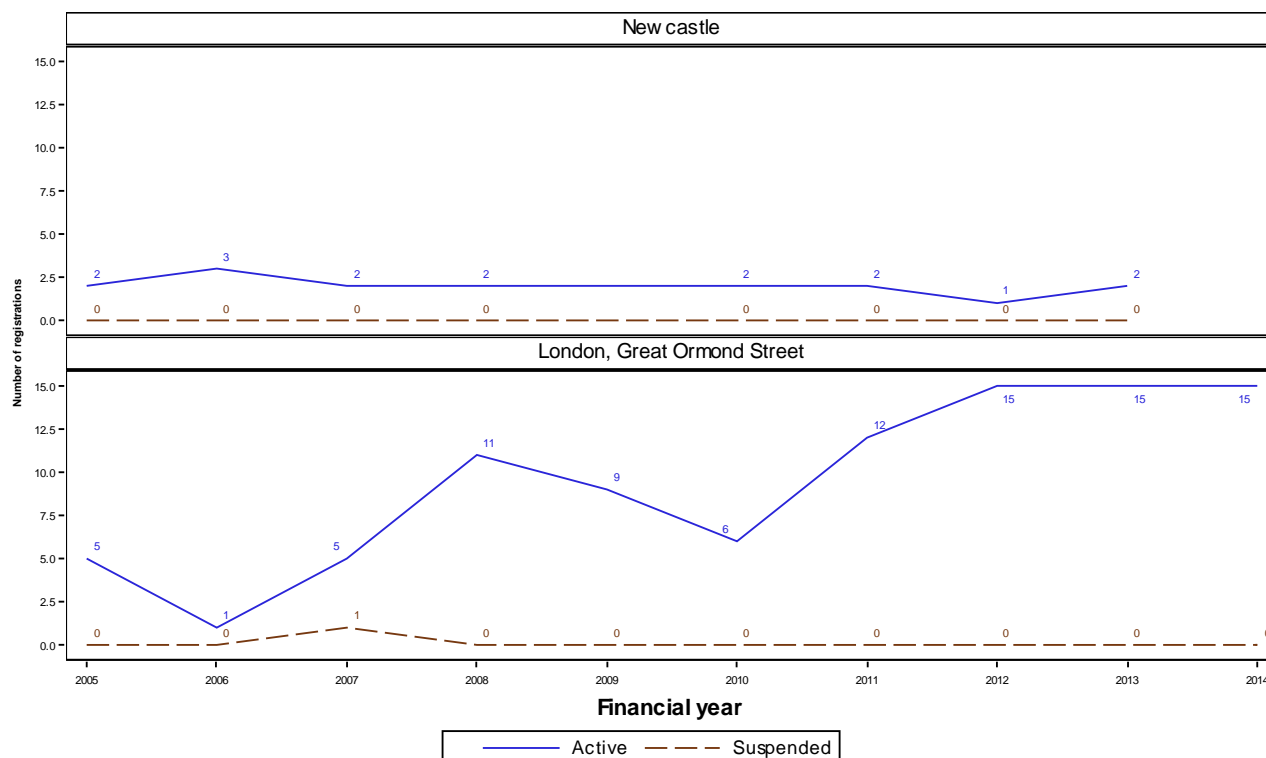
**Figure 13.2** shows the number of paediatric patients on the [active lung transplant list](#) at 31 March 2014 by centre. There were no paediatric patients in Newcastle on the active lung transplant list at 31 March 2014.

**Figure 13.2 Paediatric patients on the active lung transplant list at 31 March 2014, by centre**



**Figure 13.3** shows the number of paediatric patients on the lung transplant list at 31 March each year between 2005 and 2014 for each transplant centre.

**Figure 13.3 Paediatric patients on the lung transplant lists at 31 March for the last 10 years, by centre**



The demographic characteristics of the 15 paediatric patients on the [active lung transplant list](#) in the latest year are shown by centre and overall in **Table 13.1**. 33% of these recipients were male and the [median](#) age was 12 years. For some characteristics, due to rounding, percentages may not add up to 100.

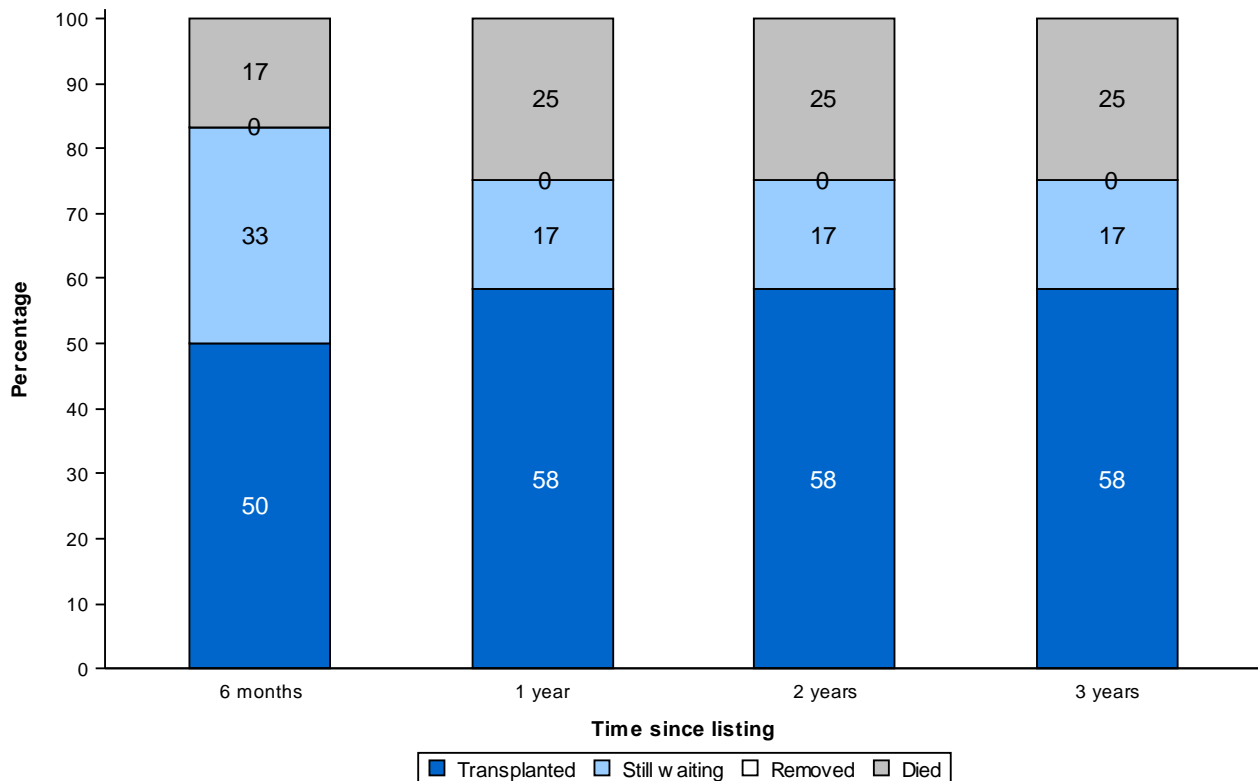
<b>Table 13.1 Demographic characteristics of Paediatric Lung active transplant list patients at 31 March 2014, by centre</b>				
		Newcastle	Great Ormond Street	<b>TOTAL</b>
		N (%)	N (%)	N (%)
Number		0	15	<b>15 (100)</b>
Recipient sex	Male	-	5 (33)	<b>5 (33)</b>
	Female	-	10 (67)	<b>10 (67)</b>
Recipient ethnicity	White	-	14 (93)	<b>14 (93)</b>
	Missing	-	1 (7)	<b>1 (7)</b>
Recipient age	Median ( <a href="#">IQR</a> )	-	12 (6,15)	<b>12 (6,15)</b>
	Missing	-	0	<b>0</b>
Primary Disease	Congenital heart disease	-	1 (7)	<b>1 (7)</b>
	Cystic fibrosis	-	7 (47)	<b>7 (47)</b>
	Other heart/lung disease	-	3 (20)	<b>3 (20)</b>
	Others	-	4 (27)	<b>4 (27)</b>
Smoker	No	-	14 (93)	<b>14 (93)</b>
	Unknown	-	1 (7)	<b>1 (7)</b>
Lung function - FEV	Median ( <a href="#">IQR</a> )	-	9.99 (5.88,9.99)	<b>9.99 (5.88,9.99)</b>
	Missing	-	3	<b>3</b>

**Table 13.1 Demographic characteristics of Paediatric Lung active transplant list patients at 31 March 2014, by centre**

		Newcastle	Great Ormond Street	TOTAL
		N (%)	N (%)	N (%)
Lung function - FVC	Median ( <a href="#">IQR</a> )	-	9.99 (6.06,9.99)	<b>9.99 (6.06,9.99)</b>
	Missing	-	3	<b>3</b>
Lung function - VO2(max)	Median ( <a href="#">IQR</a> )	-	0 (0,0)	<b>0 (0,0)</b>
	Missing	-	15	<b>15</b>

An indication of outcomes for paediatric patients listed for a lung transplant is summarised in **Figure 13.4**. This shows the proportion of patients transplanted or still waiting six months, one, two and three years after joining the list. It also shows the proportion removed from the transplant list (typically because they become too unwell for transplant) and those dying while on the transplant list. Within six months of listing, 50% of lung patients are transplanted while 17% have died waiting. Three years after listing, 58% have received a transplant.

**Figure 13.4 Post-registration outcome for 12 new paediatric lung only registrations made in the UK, 1 April 2010 to 31 March 2011**



The [median](#) waiting time to transplant for paediatric patients on the [active heart transplant list](#) between 1 April 2008 and 31 March 2011 was too small to present meaningful summary statistics regarding patient waiting time.



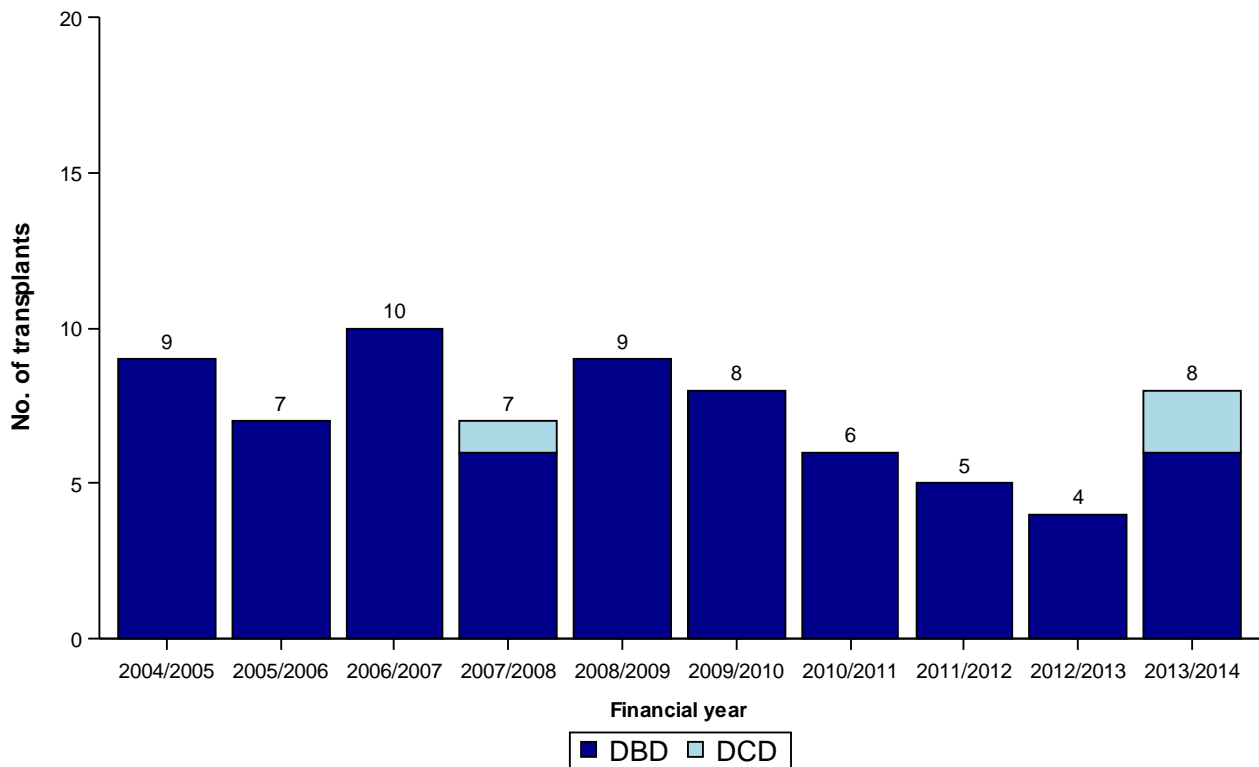
# **PAEDIATRIC LUNG TRANSPLANTATION**

## **Transplants**

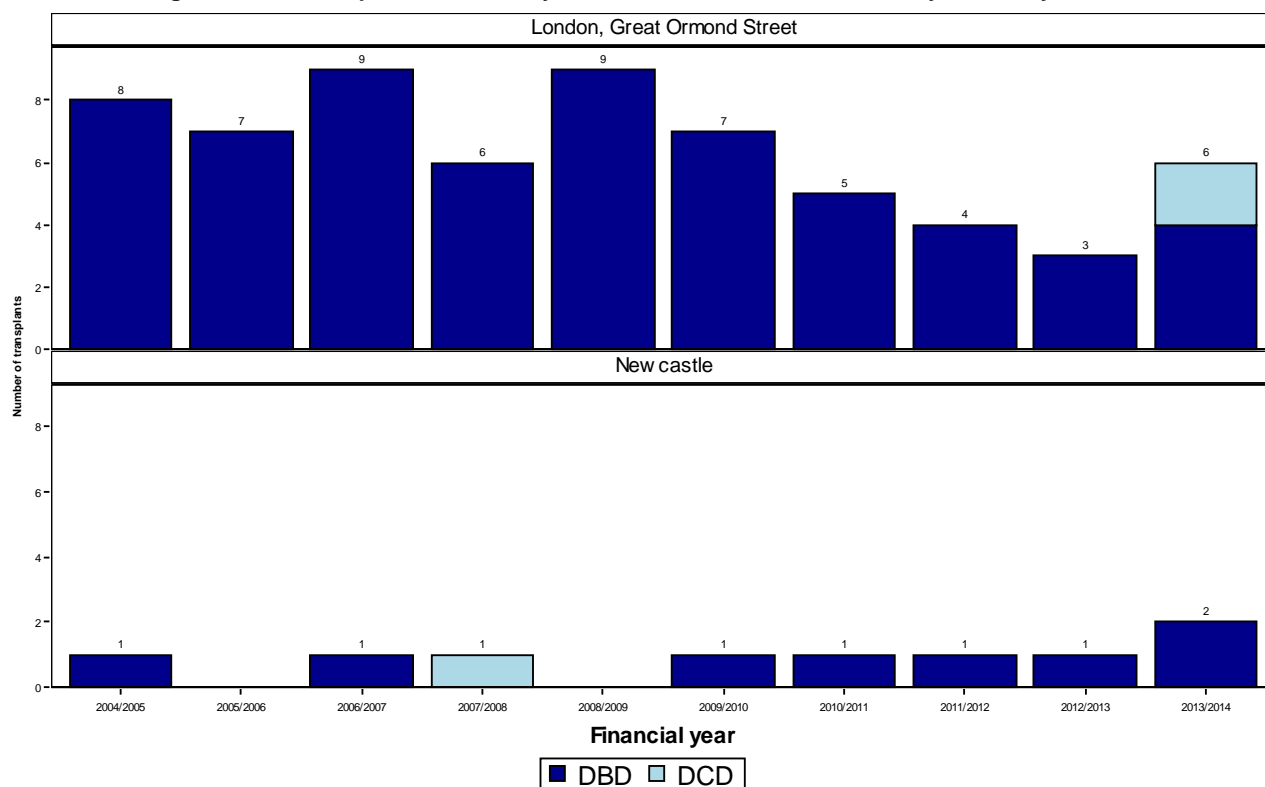


**Figures 14.1 and 14.2** show the total number of paediatric lung transplants performed in the last ten years overall and by centre, respectively. The number of transplants decreased each year from 9 in 2008/09 to 4 in 2012/13 but has since risen to 8 in the last financial year. The number of transplants in the latest financial year (2013-2014) is shown by centre in **Figure 14.3**.

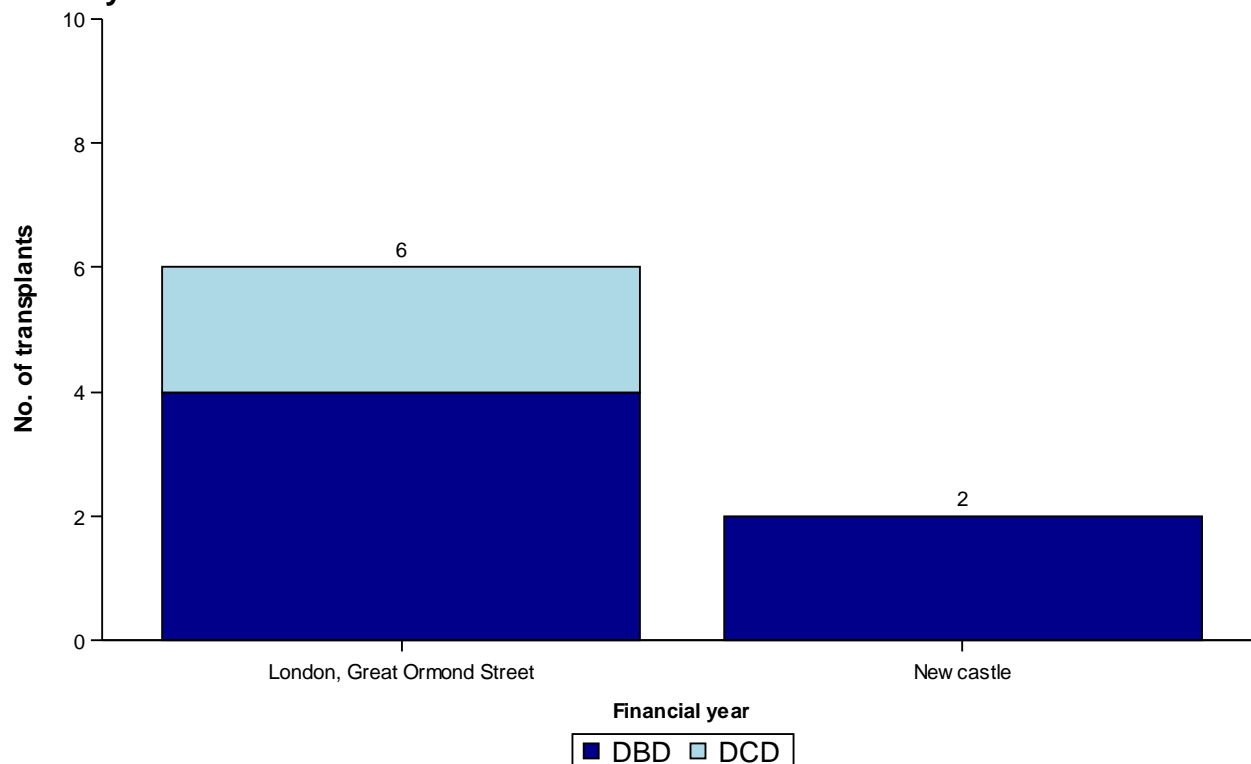
**Figure 14.1 Number of paediatric lung transplants in the UK, 1 April 2004 to 31 March 2014, by financial year**



**Figure 14.2 Number of paediatric lung transplants in the UK, 1 April 2004 to 31 March 2014, by centre and by financial year**



**Figure 14.3 Number of paediatric lung transplants in the UK, 1 April 2004 to 31 March 2014 by centre**



The demographic characteristics of 8 paediatric lung transplant recipients in the latest year are shown by centre and overall in **Table 14.1**. 4 of these recipients were male and the [median](#) age was 14 years. For some characteristics, due to rounding, percentages may not add up to 100.

Table 14.1 Demographic of first paediatric lung transplant recipients by centre, from 1 April 2013 to 31 March 2014				
		Newcastle N (%)	Great Ormond Street N (%)	TOTAL N (%)
Recipient sex	Male	1 (50)	3 (50)	4 (50)
	Female	1 (50)	3 (50)	4 (50)
Recipient ethnicity	White	1 (50)	5 (83)	6 (75)
	Non-white	1 (50)	1 (17)	2 (25)
Recipient age	Median ( <a href="#">IQR</a> )	14 (13,15)	12 (6,14)	14 (8,15)
	Missing	0	0	
Recipient weight	Median ( <a href="#">IQR</a> )	41 (35,46)	27 (12,39)	31 (20,42)
	Missing	0	0	
NYHA class	I	0	2 (33)	2 (25)
	III	0	1 (17)	1 (13)
	IV	2 (100)	2 (33)	4 (50)
	Missing	0	1 (17)	1 (13)
Recipient on ventilator	No	2 (100)	4 (67)	6 (75)
	Missing	0	2 (33)	2 (25)
Recipient on inotropes	No	1 (50)	5 (83)	6 (75)
	Yes	1 (50)	0	1 (13)
	Missing	0	1 (17)	1 (13)
Recipient CMV status	No	1 (50)	2 (33)	3 (38)
	Yes	1 (50)	3 (50)	4 (50)
	Missing	0	1 (17)	1 (13)

Table 14.1 Demographic of first paediatric lung transplant recipients by centre, from 1 April 2013 to 31 March 2014				
		Newcastle N (%)	Great Ormond Street N (%)	TOTAL N (%)
Recipient HCV status	No	2 (100)	5 (83)	7 (88)
	Missing	0	1 (17)	1 (13)
Recipient HBV status	No	2 (100)	6 (100)	8 (100)
Recipient HIV status	No	2 (100)	5 (83)	7 (88)
	Missing	0	1 (17)	1 (13)
Recipient Serum Creatinine umol/l	Median ( <a href="#">IQR</a> )	46 (33,58)	11 (0,33)	33 (33,35)
	Missing	0	3	21
Donor sex	Male	0	5 (83)	5 (63)
	Female	2 (100)	1 (17)	3 (38)
Donor ethnicity	White	1 (50)	4 (67)	5 (63)
	Missing	1 (50)	2 (33)	3 (38)
Donor age	Median ( <a href="#">IQR</a> )	15 (7,23)	10 (1,14)	10 (4,19)
	Missing	0	0	
Donor BMI	Median ( <a href="#">IQR</a> )	20 (16,24)	16 (14,19)	16 (15,21)
	Missing	0	0	
Donor Cause of Death	CVA	2 (100)	1 (17)	3 (38)
	Trauma	0	1 (17)	1 (13)
	Others	0	4 (67)	4 (50)

**Table 14.1 Demographic of first paediatric lung transplant recipients by centre, from 1 April 2013 to 31 March 2014**

		Newcastle	Great Ormond Street	TOTAL
		N (%)	N (%)	N (%)
Donor hypotension (less than 70mmHg systolic)	No	2 (100)	3 (50)	5 (63)
	Yes	0	1 (17)	1 (13)
	Missing	0	2 (33)	2 (25)
Donor past diabetes	No	2 (100)	5 (83)	7 (88)
	Missing	0	1 (17)	1 (13)
Donor past hypertension	No	2 (100)	4 (67)	6 (75)
	Yes	0	1 (17)	1 (13)
	Missing	0	1 (17)	1 (13)
Donor past tumour	No	2 (100)	5 (83)	7 (88)
	Missing	0	1 (17)	1 (13)
Donor past smoker	No	2 (100)	5 (83)	7 (88)
	Missing	0	1 (17)	1 (13)

**Table 14.2** shows the [median](#) total ischaemia time in paediatric donor heart transplants by centre, over the last 10 years. This analysis does not take into account the use of donor organ maintenance systems for some transplants. These enable warm blood perfusion to continue ex-vivo during transportation. For such transplants, the definition of total ischemia time used here (cross-clamp to reperfusion) over-estimates the true ischaemia time because the heart is not subject to ischaemia during transportation.

**Table 14.2 Median total ischaemia time in paediatric DBD donor lung transplants, 1 April 2013 to 31 March 2014, by centre**

Center by financial year		Ischaemic time (hours)		
		Number of transplants	<a href="#">Median</a>	<a href="#">Interquartile range</a>
Newcastle	2004/2005	1	5.1	-
	2006/2007	1	4.8	-
	2009/2010	1	5.8	-
	2010/2011	1	4.8	-
	2011/2012	1	7.8	-
	2012/2013	1	8.8	-
	2013/2014	2	5.4	-
	<b>Total</b>	<b>8</b>	<b>5.5</b>	<b>(4.8 - 7.1)</b>
London, Great Ormond Street	2004/2005	7	3.7	(3.3 - 4.6)
	2005/2006	7	3.7	(3.5 - 4.3)
	2006/2007	8	4.1	(3.9 - 5.6)
	2007/2008	5	4.3	(4.3 - 4.4)
	2008/2009	8	4.4	(3.8 - 4.8)
	2009/2010	7	4.6	(2.8 - 5.0)
	2010/2011	5	4.9	(3.9 - 5.0)
	2011/2012	4	6.0	-
	2012/2013	2	5.2	-
	2013/2014	3	4.5	-
	<b>Total</b>	<b>56</b>	<b>4.3</b>	<b>(3.7 - 5.0)</b>

# **PAEDIATRIC LUNG TRANSPLANTATION**

## **Post-Transplant Survival**





The survival analysis results presented in this section exclude;

- [Multi organ transplants](#)
- Second (or higher) graft transplants
- Partial lung transplants

90-day and 1-year [survival rates](#) are based on transplants performed in the period 1 April 2008 to 31 March 2013 while 3-year and 5-year survival rates are based on transplants performed in the period 1 April 2003 to 31 March 2013.

For the 30 lung transplants that were performed in the period 1 April 2008 to 31 March 2013, 90-day outcome information was known for all patients. Ninety day [unadjusted](#) patient survival for these patients is shown in **Table 15.1**. As there were no deaths within 90 days at Newcastle, a centre specific estimate for this centre could not be calculated.

<b>Table 15.1 90 day patient survival for paediatric lung first transplants, between 1 April 2008 and 31 March 2013</b>				
Centre	Number of transplants	Number of deaths	90 day survival % (95% CI)	
			Unadjusted	
London, Great Ormond Street	27	2	92.6	(73.5 - 98.1)
Newcastle	3	0	-	
<b>UK</b>	<b>30</b>	<b>2</b>	<b>93.3</b>	<b>(75.9 - 98.3)</b>

For the 30 lung transplants that were performed in the period between 1 April 2008 and 31 March 2013, one-year outcome information was known for 28 patients. One year [unadjusted](#) patient survival for these patients is shown in **Table 15.2**. As there were no deaths within one year at Newcastle, a centre specific estimate for this centre could not be calculated.

<b>Table 15.2 One year patient survival for paediatric lung first transplants, between 1 April 2003 and 31 March 2013</b>				
Centre	Number of transplants	Number of deaths	1 year survival % (95% CI)	
			Unadjusted	
London, Great Ormond Street	27	2	92.6	(73.5 - 98.1)
Newcastle	3	0	-	
<b>UK</b>	<b>30</b>	<b>2</b>	<b>93.3</b>	<b>(75.9 - 98.3)</b>

For the 71 lung transplants that were performed in the period 1 April 2003 to 31 March 2013, three-year outcome information was known for 61 patients. Three year [unadjusted](#) patient survival for these patients is shown in **Table 15.3**. As the 95% [confidence intervals](#) for Great Ormond Street and Newcastle overlap, this suggests there is no statistically significant difference between centres.

<b>Table 15.3 Three year patient survival for paediatric lung first transplants, between 1 April 2003 and 31 March 2013</b>				
Centre	Number of transplants	Number of deaths	3 year survival % (95% CI)	
			Unadjusted	
London, Great Ormond Street	64	11	81.6	(69.2 - 89.4)
Newcastle	7	1	83.3	(27.3 - 97.5)
<b>UK</b>	<b>71</b>	<b>12</b>	<b>81.8</b>	<b>(70.2 - 89.3)</b>

For the 71 lung transplants that were performed in the period 1 April 2003 to 31 March 2013, five-year outcome information was known for 48 patients. Five year [unadjusted](#) patient survival for these patients is shown in **Table 15.4**. As the 95% [confidence intervals](#) for Great Ormond Street and Newcastle overlap, this suggests there is no statistically significant difference between centres.

<b>Table 15.4 Five year patient survival for paediatric lung first transplants, between 1 April 2003 and 31 March 2013</b>				
Centre	Number of transplants	Number of deaths	5 year survival % (95% CI)	
			Unadjusted	
London, Great Ormond Street	64	17	69.1	(54.7 - 79.7)
Newcastle	7	2	55.6	(7.3 - 87.6)
<b>UK</b>	<b>71</b>	<b>19</b>	<b>68.2</b>	<b>(54.4 - 78.6)</b>

# **CONTINUOUS MONITORING OF CENTRE OUTCOMES**

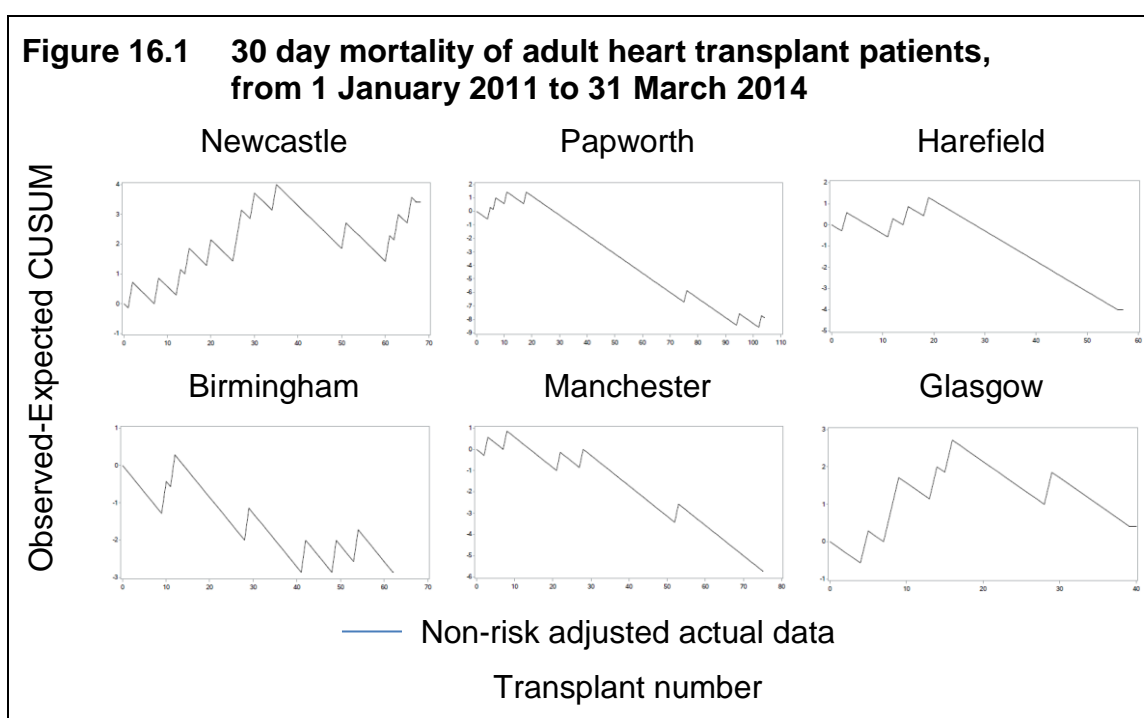


The continuous monitoring performed combines the use of two types of cumulative sum (CUSUM) chart; the 'Observed – Expected' (O-E) chart and the tabular CUSUM of centre outcomes. The methodology behind CUSUM monitoring is described in the Appendix.

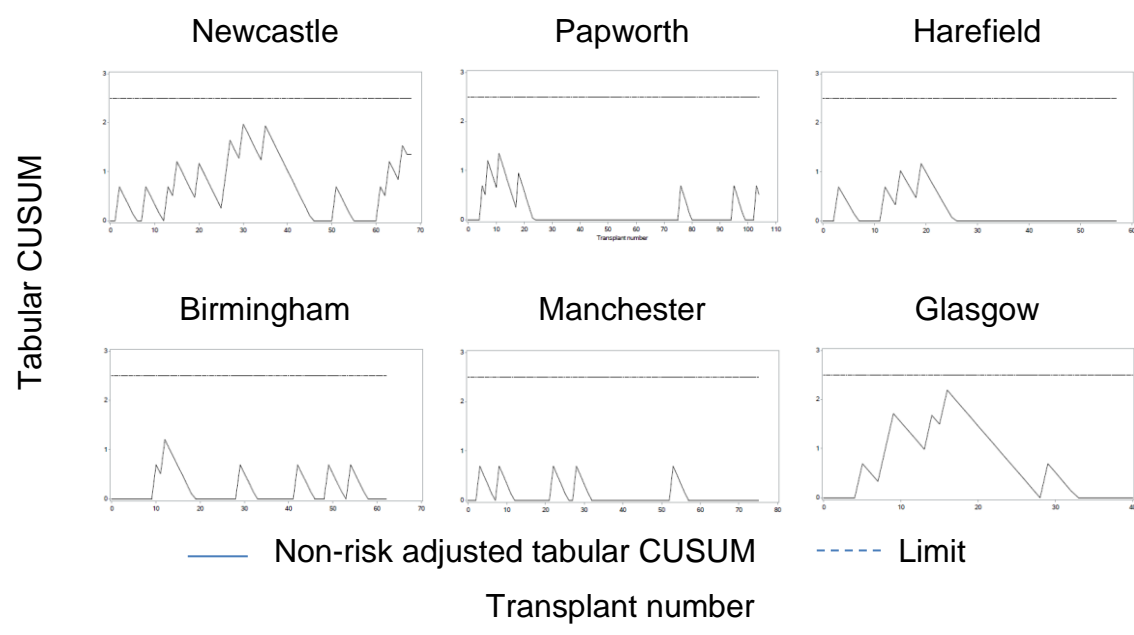
## ADULT HEART TRANSPLANTATION

The O-E charts for 30-day mortality after adult heart transplantation are shown in **Figure 16.1**. The corresponding tabular CUSUM charts are given in **Figure 16.2**. Note these charts include data from 1 January 2011.

The CUSUM charts show that 30-day mortality rates following adult heart transplantation were consistent with the national average at all centres and there have been no signals over this period.



**Figure 16.2 Tabular CUSUM for 30 day mortality of adult heart transplant patients, from 1 January 2011 to 31 March 2014**

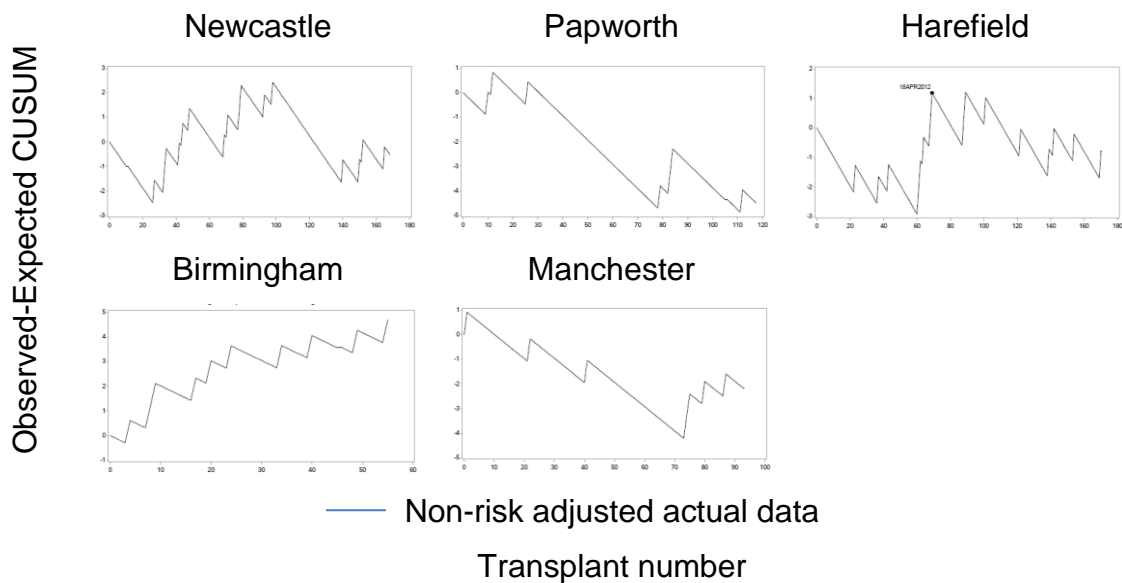


## ADULT LUNG TRANSPLANTATION

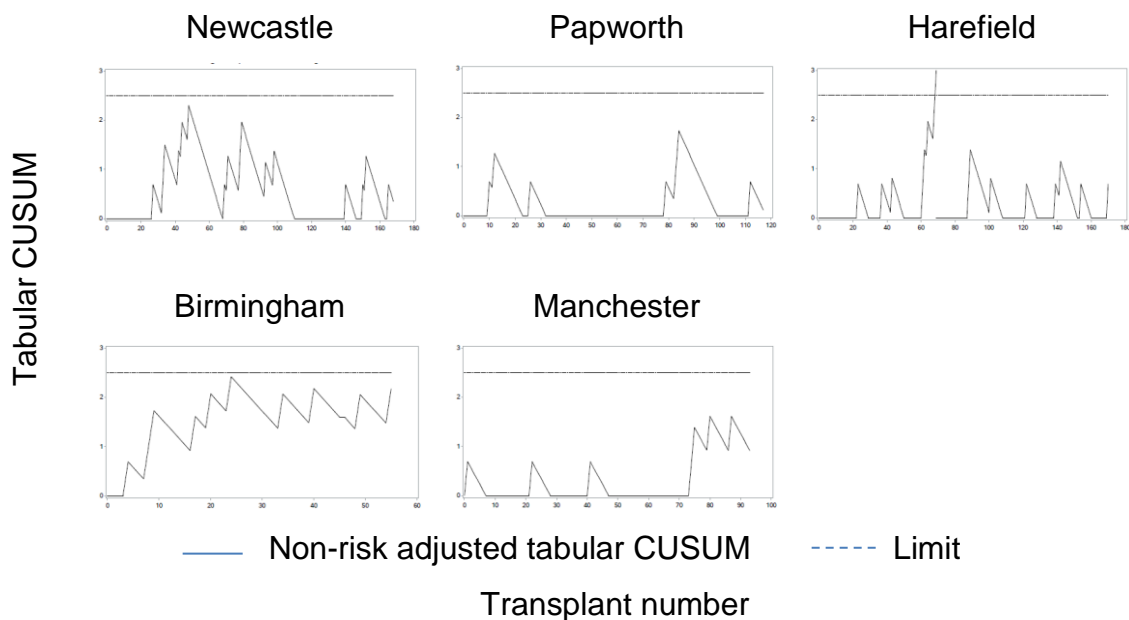
The O-E charts for 90-day mortality after adult lung transplantation are shown in **Figure 16.3**. The corresponding tabular CUSUM charts are given in **Figure 16.4**.

The CUSUM charts show that 90-day mortality rates following adult heart transplantation were consistent with the national average at all centres other than Harefield. A historical signal in 90-day mortality occurred at Harefield on 18 April 2012 however at this time CUSUM monitoring for lung transplantation was based on 30-day mortality rates. NHSBT moved to 90-day mortality CUSUM monitoring in April 2014 and so this signal has not been investigated retrospectively.

**Figure 16.3 90 day mortality of adult lung transplant patients, from 1 January 2011 to 31 March 2014**



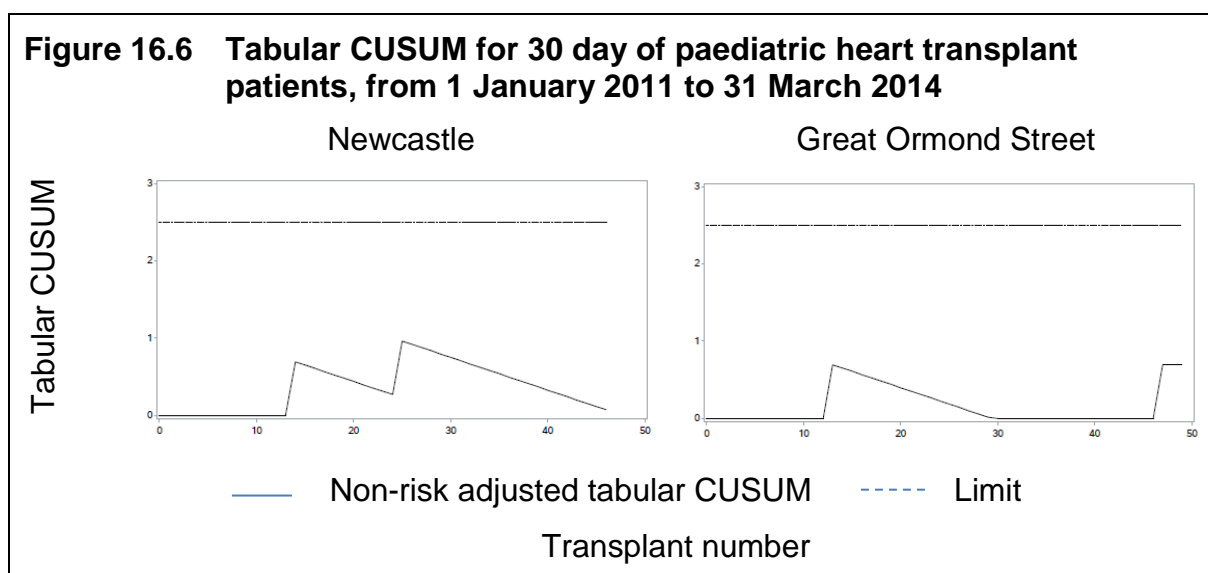
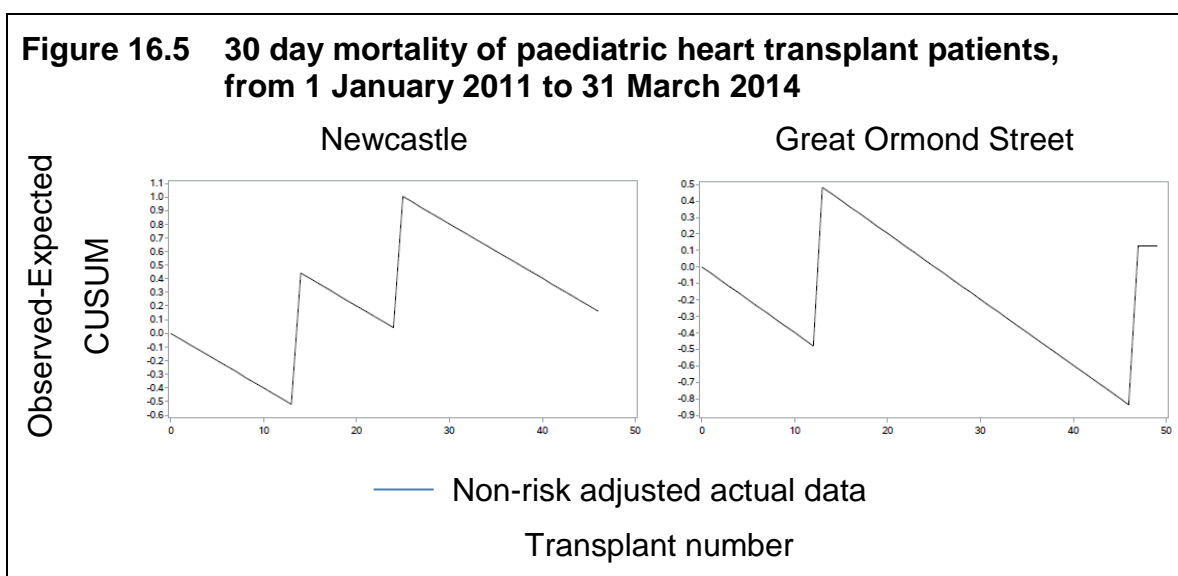
**Figure 16.4 Tabular CUSUM for 90 day mortality of adult lung transplant patients, from 1 January 2011 to 31 March 2014**



## PAEDIATRIC HEART TRANSPLANTATION

The O-E charts for 30-day mortality after paediatric heart transplantation are shown in **Figure 16.5**. The corresponding tabular CUSUM charts are given in **Figure 16.6**.

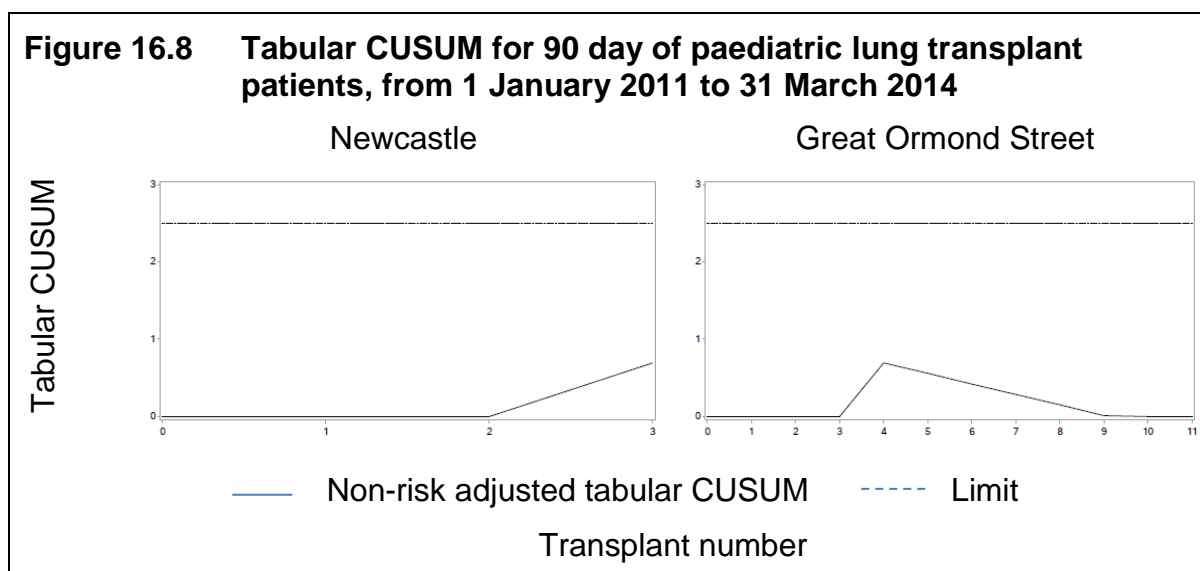
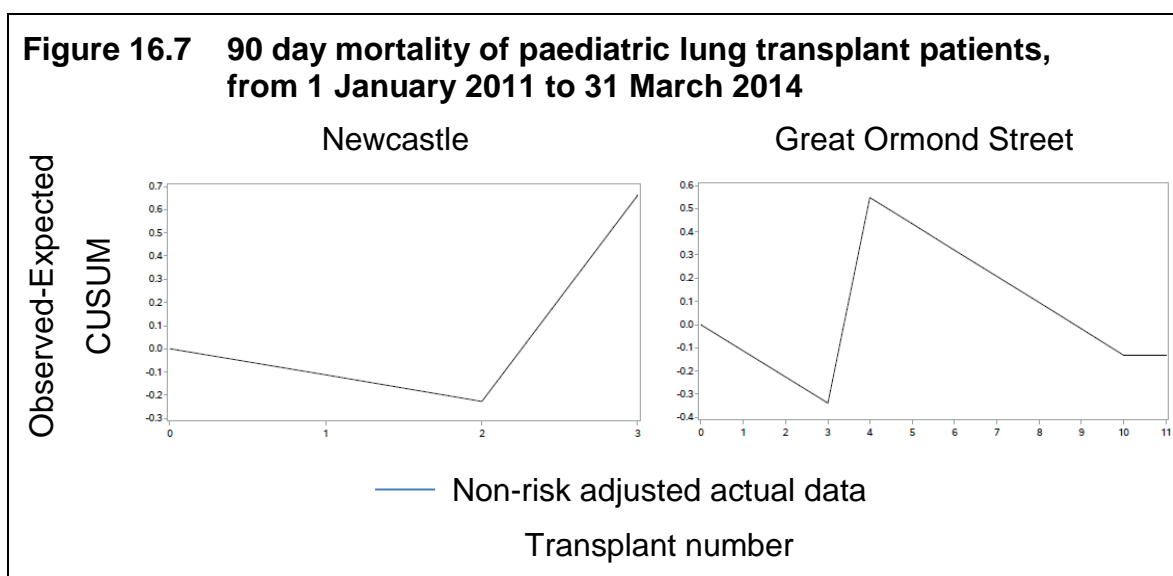
The CUSUM charts show that 30-day mortality rates following paediatric heart transplantation were consistent with the national average at all centres and there have been no signals over this period.



## PAEDIATRIC LUNG TRANSPLANTATION

The O-E charts for 90-day mortality after paediatric lung transplantation are shown in **Figure 16.7**. The corresponding tabular CUSUM charts are given in **Figure 16.8**.

The CUSUM charts show that 90-day mortality rates following paediatric heart transplantation were consistent with the national average at all centres and there have been no signals over this period.





# APPENDIX



## A1: NUMBER OF PATIENTS ANALYSED

The cohort of patients in this report varies by section/analysis. Tables A1.1 and A1.2 below summarise the number of adult and paediatric (respectively) transplants in each cohort and the section this applies to. For the survival from listing analysis, see the Methods section in A3 below.

Table A1.1 Adult transplants analysed				
Time period	Report Section	Exclusion criteria	No.heart transplants	No. lung (+ heart/lung) transplants
1 April 2004 – 31 March 2014	• Introduction	None	1140	1502
1 April 2004 – 31 March 2014	• Transplants	• Multi-organ transplants	1130	1499
1 April 2008 – 31 March 2013	Post-transplant survival – • 30/90-day • 1-year survival	• Multi-organ transplants • Partial lung transplants • Second (or more) graft transplants	488	800
1 April 2003 – 31 March 2013	Post-transplant survival – • 3-year • 5-year survival	• Multi-organ transplants • Partial lung transplants • Second (or more) graft transplants	1075	1425

**Table A1.2 Paediatric transplants analysed**

<b>Time period</b>	<b>Report Section</b>	<b>Exclusion criteria</b>	<b>No.heart transplants</b>	<b>No. lung (+ heart/lung) transplants</b>
1 April 2004 – 31 March 2014	Introduction	None	306	73
1 April 2004 – 31 March 2014	Transplants	Multi-organ transplants	306	73
1 April 2008 – 31 March 2013	Post-transplant survival – 30/90-day 1-year survival	Multi-organ transplants Partial lung transplants Second (or more) graft transplants	164	30
1 April 2003 – 31 March 2013	Post-transplant survival – 3-year 5-year survival	Multi-organ transplants Partial lung transplants Second (or more) graft transplants	297	71

## A2: METHODS

### Unadjusted post-transplant survival rates

[Kaplan-Meier](#) methods were used to estimate the unadjusted 30-day patient [survival rates](#) for hearts and 90-day patient survival rates for lungs. Patients can be included in this method of analysis irrespective of the length of follow-up recorded. If a patient is alive at the end of the follow-up then information about the survival of the patient is censored.

### Risk-adjusted post-transplant survival rates

A risk-adjusted [survival rate](#) is an estimate of what the survival rate at a centre would have been if they had had the same mix of patients as that seen nationally. The risk-adjusted rate therefore presents estimates in which differences in patient mix across centres have been removed as much as possible. For that reason, it is valid to only compare centres using risk-adjusted rather than unadjusted rates, as differences among the latter can be attributed to differences in patient mix.

Risk-adjusted survival estimates were obtained through indirect standardisation. A [Cox Proportional Hazards model](#) was used to determine the probability of survival for each patient based on their individual risk factor values. The sum of these probabilities for all patients at a centre gives the number, E, of patients or grafts expected to survive at least one year or five years after transplant at that centre. The number of patients who actually survive the given time period is given by O. The risk-adjusted estimate is then calculated by multiplying the ratio O/E by the overall unadjusted survival rate across all centres. The risk-adjustment models used were based on results from previous studies that looked at factors affecting the survival rates of interest. The factors included in the models are shown in the tables below.

The funnel plot is a graphical method to show how consistent the survival rates of the different transplant centres are compared to the national rate. The graph shows for each centre, a survival rate plotted against the number of transplants undertaken, with the national rate and [confidence limits](#) around this national rate superimposed. In this report, 95% and 99.8% confidence limits were used. Units that lie within the confidence limits have survival rates that are statistically consistent with the national rate. When a unit is close to or outside the limits, this is an indication that the centre may have a rate that is considerably different from the national rate.

### Survival from listing

Data were obtained for all patients  $\geq 18$  years registered for the first time for a heart or lung transplant between 1 January 2002 and 31 December 2013. Survival time was defined as the time from joining the transplant list to death, regardless of the length of time on the transplant list, whether or not the patient was transplanted and any factors associated with such a transplant eg donor type. Survival time was censored at either the date of removal from the list, or at the last known follow up date post-transplant when no death date was recorded, or at 10 August 2014 if the patient was on the transplant list at time of analysis.

Exclusions from the analysis:

- patients with intestinal failure and liver disease (IFALD),
- patients with ethnic group not reported

- patients with unknown gender
- patient registered for a heart-lung block or other [multi-organ transplant](#)
- patients who were not listed prior to transplant
- patients first registered on another transplant list (e.g. kidney list)
- patients registered outside the UK or not entitled to NHS treatment
- adult patients registered at paediatric centres
- patients with missing BMI

Patients registered for a heart transplant who were non-urgent and then urgently listed on the same day (or vice-versa) were recorded as urgent at registration. Patients who received a VAD and were registered on the transplant list on the same day were assumed to have received the VAD prior to registration.

In [risk-adjusted](#) survival analysis, factors recorded at time of transplant listing were adjusted for. These are detailed in **Table A1** and were included in the modelling whether or not statistically significant.

Table A2.1 Factors used in risk-adjusted models for patient survival from listing	
Heart	Age, gender, ethnicity, blood group, BMI, urgency status, primary disease, previous heart surgery, in hospital at registration, on VAD/ECMO support at registration
Lung	Age, gender, ethnicity, blood group, BMI, primary disease, previous thoracotomy, in hospital at registration

[Survival rates](#) at one, five and ten years post registration were calculated from the risk adjusted survival rate (RASR), obtained as  $1 - \{\text{observed number of deaths in follow up period} / \text{expected number}\} \times \text{national mortality rate}$ . The expected survival rates were estimated from fitting a [Cox model](#) to the national data, excluding transplant centre, evaluated at each patient's observed survival time. Interval estimates for one, five and ten year rates, and the significance of differences between them across centres, were found using Poisson regression models for the logarithm of the observed number of deaths, with centre as a random effect.

### Continuous monitoring of centre outcomes

The continuous monitoring performed combines the use of two types of cumulative sum (CUSUM) chart; the 'Observed – Expected' (O-E) chart and the tabular CUSUM of centre outcomes.

The O-E chart is a useful tool for observing centre performance over time. A downward trend indicates a lower than expected rate of mortality compared with the baseline period (i.e. improved performance), whereas an upward trend points to an observed mortality rate that is higher than expected (i.e. inferior performance). From the O-E chart, it is not possible to determine when a significant change in the mortality rate has occurred. To identify

statistically significant changes the tabular CUSUM chart is used to complement the O-E chart. A significant shift in the underlying mortality rate is evident when the chart crosses the limit and generates a signal.

The O-E chart plots the cumulative difference between the observed and expected patient mortality. Expected mortality has been determined from an [unadjusted](#) national average mortality rate based on transplants in the baseline period (between 2008 and 2011), with more recent transplants given greater weight. The chart is not reset but continues to monitor each successive transplant in the monitoring period. For transplants with a positive 30-day outcome the chart goes down a small step ( $p$ ;  $0 \leq p \leq 1$ ), while for each patient death the chart goes up by a larger step ( $1-p$ ). The step sizes reflect that there is a small probability of death ( $p$ ). For example, if the expected death rate in the centre is 10%, each transplant that is functioning at 30 days will cause the chart to go down by 0.1 and each patient death within 30 days will cause the chart to go up by 0.9.

### A3: RISK MODELS

Table A3.1 <a href="#">Risk factors</a> and categories used in the adult heart risk adjusted 30-day survival model	
Recipient creatinine clearance (μmo/l)	<= 50 > 50
Ischaemia time (mins)	<120 120 - 179 180 - 239 ≥ 240
Recipient diabetes	Yes No
Adult congenital heart disease	Yes No
Previous open heart surgery	Yes No
Donor age (years)	<26 26 - 40 41 - 55 >55
Ventilated at registration	Yes No

Table A3.2 <a href="#">Risk factors</a> and categories used in the adult heart risk adjusted 1-year, 3-year and 5-year survival models	
Recipient creatinine clearance (μmo/l)	<= 50 > 50
Ischaemia time (mins)	<120 120 - 179 180 - 239 ≥ 240
Recipient diabetes	Yes No
Previous open heart surgery	Yes No
Donor age (years)	<26 26 - 40 41 - 55 >55
Ventilated at registration	Yes No
Recipient diagnosis (IHD/DC/Congenital/Other)	Yes No
Recipient Age	16-39 40-49 50-54 55-59 60+

Table A3.2 <u>Risk factors</u> and categories used in the adult heart risk adjusted 1-year, 3-year and 5-year survival models	
Recipient gender	Male Female
Recipient in hospital pre-transplant	Yes No
Recipient BMI	(modelled as continuous variable)
Recipient antiarrhythmics	Yes No
Recipient AICD	Yes No
Large male recipient (Body surface area > 2.3m <sup>2</sup> )	Yes No
Donor gender	Male Female
Donor Cause of Death	Intracranial haemorrhage Hypoxic brain damage – all causes  Trauma accident
Donor diabetic	Yes No
Donor history of drug abuse	Yes No
Donor:Recipient size mis-match (donor body surface area<80% recipient body surface area)	Yes No
Donor CMV+ : Recipient CMV-	Yes No

Table A3.3 <u>Risk factors</u> and categories used in the adult lung risk adjusted 90-day survival model	
Recipient diagnosis	Suppurative Fibrosis – single lung transplant Fibrosis – bilateral lung transplant COPD- single lung transplant COPD- bilateral lung transplant Other
Recipient bilirubin (µmo/l)	(modelled as continuous variable)
Transplant type	Single lung Bilateral sequential lung Heart lung
Donor:recipient height mis-match (cm)	(modelled as continuous variable)
Ischaemia time (mins)	<180 180 - 239 ≥240



Table A3.4 <u>Risk factors</u> and categories used in the adult lung risk adjusted 1-year, 3-year and 5-year survival model	
Recipient diagnosis	Suppurative Fibrosis – single lung transplant Fibrosis – bilateral lung transplant COPD- single lung transplant COPD- bilateral lung transplant Other
Recipient bilirubin (μmo/l)	(modelled as continuous variable)
Transplant type	Single lung Bilateral sequential lung Heart lung
Donor: recipient height mis-match (cm)	(modelled as continuous variable)
Ischaemia time (mins)	<180 180 - 239 ≥240
Recipient diabetic	Yes No
Recipient forced vital capacity (FVC) at listing	(modelled as continuous variable)
Ventilated at registration	Yes No
Donor CMV + : Recipient CMV-	Yes No
Recipient age	16-39 40-49 50-54 55-59 60+

## **A4: GLOSSARY OF TERMS**

### **Active transplant list**

When a patient is registered for a transplant, they are registered on what is called the 'active' transplant list. This means that when a donor organ becomes available, the patient is included among those who are matched against the donor to determine whether or not the organ is suitable for them. It may sometimes be necessary to take a patient off the transplant list, either temporarily or permanently. This may be done, for example, if someone becomes too ill to receive a transplant. The patient is told about the decision to suspend them from the list and is informed whether the suspension is temporary or permanent. If a patient is suspended from the list, they are not included in the matching of any donor organs that become available.

### **Case mix**

The types of patients treated at a unit for a common condition. This can vary across units depending on the facilities available at the unit as well as the types of people in the catchment area of the unit. The definition of what type of patient a person is depends on the patient characteristics that influence the outcome of the treatment.

### **Confidence interval (CI)**

When an estimate of a quantity such as a [survival rate](#) is obtained from data, the value of the estimate depends on the set of patients whose data were used. If, by chance, data from a different set of patients had been used, the value of the estimate may have been different. There is therefore some uncertainty linked with any estimate. A confidence interval is a range of values whose width gives an indication of the uncertainty or precision of an estimate. The number of transplants or patients analysed influences the width of a confidence interval. Smaller data sets tend to lead to wider confidence intervals compared to larger data sets. Estimates from larger data sets are therefore more precise than those from smaller data sets. Confidence intervals are calculated with a stated probability, usually 95%. We then say that there is a 95% chance that the confidence interval includes the true value of the quantity we wish to estimate.

### **Confidence limit**

The upper and lower bounds of a confidence interval.

### **Cox Proportional Hazards model**

A statistical model that relates the instantaneous risk (hazard) of an event occurring at a given time point to the [risk factors](#) that influence the length of time it takes for the event to occur. This model can be used to compare the hazard of an event of interest, such as patient death, across different groups of patients.

**Donor after brain death (DBD)**

A donor whose heart is still beating when their entire brain has stopped working so that they cannot survive without the use of a ventilator. Organs for transplant are removed from the donor while their heart is still beating, but only after extensive tests determine that the brain cannot recover and they have been certified dead.

**Donor after circulatory death (DCD)**

A donor whose heart stops beating before their brain stops working and who is then certified dead. The organs are then removed.

**Funnel plot**

A graphical method that shows how consistent the rates, such as [survival rates](#) or decline rates, of the different transplant units are compared to the national rate. For survival rates, the graph shows for each unit, a survival rate plotted against the number of transplants undertaken, with the national rate and [confidence limits](#) around this national rate superimposed. In this report, 95% and 99.8% confidence limits were used. Units that lie within the confidence limits have survival rates that are statistically consistent with the national rate. When a unit is close to or outside the limits, this is an indication that the centre may have a rate that is considerably different from the national rate.

**Inter-quartile range**

The values between which the middle 50% of the data fall. The lower boundary is the lower quartile, the upper boundary the upper quartile.

**Kaplan-Meier method**

A method that allows patients with incomplete follow-up information to be included in estimating [survival rates](#). For example, when estimating one year patient survival rates, a patient may be followed up for only nine months before they relocate. If we calculated a crude survival estimate using the number of patients who survived for at least a year, this patient would have to be excluded as it is not known whether or not the patient was still alive at one year after transplant. The Kaplan-Meier method allows information about such patients to be used for the length of time that they are followed-up, when this information would otherwise be discarded. Such instances of incomplete follow-up are not uncommon and the Kaplan-Meier method allows the computation of estimates that are more meaningful in these cases.

**Median**

The midpoint in a series of numbers, so that half the data values are larger than the median, and half are smaller.

**Multi-organ transplant**

A transplant in which the patient receives more than one organ. For example, a patient may undergo a transplant of a heart and kidney.

**Patient survival rate**

The percentage of patients who are still alive (whether the graft is still functioning or not). This is usually specified for a given time period after transplant. For example, a five-year patient survival rate is the percentage of patients who are still alive five years after their first transplant.

**p value**

In the context of comparing [survival rates](#) across centres, the  $p$  value is the probability that the differences observed in the rates across centres occurred by chance. As this is a probability, it takes values between 0 and 1. If the  $p$  value is small, say less than 0.05, this implies that the differences are unlikely to be due to chance and there may be some identifiable cause for these differences. If the  $p$  value is large, say greater than 0.1, then it is quite likely that any differences seen are due to chance.

**Risk-adjusted survival rate**

Some transplants have a higher chance than others of failing at any given time. The differences in expected survival times arise due to differences in certain factors, the [risk factors](#), among patients. A risk-adjusted [survival rate](#) for a centre is the expected survival rate for that centre given the [case mix](#) of their patients. Adjusting for case mix in estimating centre-specific survival rates allows valid comparison of these rates across centres and to the national rate.

**Risk factors**

These are the characteristics of a patient, transplant or donor that influence the length of time that a graft is likely to function or a patient is likely to survive following a transplant. For example, when all else is equal, a transplant from a younger donor is expected to survive longer than that from an older donor and so donor age is a risk factor.

**Unadjusted survival rate**

Unadjusted [survival rates](#) do not take account of [risk factors](#) and are based only on the number of transplants at a given centre and the number and timing of those that fail within the post-transplant period of interest. In this case, unlike for risk-adjusted rates, all transplants are assumed to be equally likely to fail at any given time. However, some centres may have lower unadjusted survival rates than others simply because they tend to undertake transplants that have increased risks of failure. Comparison of unadjusted survival rates across centres and to the national rate is therefore inappropriate.

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