



**Blood and Transplant**

# **ANNUAL REPORT ON HEART TRANSPLANTATION**

**REPORT FOR 2023/2024  
(1 APRIL 2014 – 31 MARCH 2024)**

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**PRODUCED IN COLLABORATION WITH NHS ENGLAND**



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# **EXECUTIVE SUMMARY**



## 1. Executive Summary

This report presents key data about heart transplantation in the UK. The period reported covers 10 years, from 1 April 2014 to 31 March 2024. The data include number of people listed for a transplant, number of transplants performed and [survival rates](#) following heart transplantation; both on a national and centre-specific basis. Data were extracted on 15 July 2024.

### Key findings

#### ADULT HEART TRANSPLANTATION

- On 31 March 2024 there were 248 adults waiting for a heart transplant: 218 non-urgent, 24 urgent and 6 super-urgent. This was similar to 31 March 2023, except with a higher number of super-urgent adults waiting in March 2024.
- Of the 248 adults waiting, 48% were on long-term [VAD](#) support.
- One year mortality (including removals due to deteriorating condition) was 7% on the non-urgent waiting list, 9% on the urgent waiting list and 12% on the super-urgent waiting list.
- Median waiting time to heart transplant was 867 days from non-urgent registration, 43 days from urgent registration and 15 days from super-urgent registration.
- During 2023/2024 there were 200 adult heart transplants performed of which 29% were from [DCD](#) donors. This was 9% higher than the previous year in which there were 184 transplants. Overall, 76% of transplants were urgent or super-urgent.
- The national rate of patient survival following adult heart transplant was 92.0% at 90 days, 87.7% at 1 year and 74.0% at 5 years (including both DBD and DCD heart transplants).

#### PAEDIATRIC HEART TRANSPLANTATION

- On 31 March 2024 there were 35 paediatric patients waiting for a heart transplant: 24 non-urgent, 11 urgent and 0 super-urgent. Although this is 30% lower than on 31 March 2023, the number has increased over the decade and 14% of those waiting were on mechanical circulatory support.
- Median waiting time to transplant was 917 days from non-urgent registration and 204 days from urgent registration.
- During 2023/2024 there were 37 paediatric heart transplants (9 more than the previous year) of which 7 were from DCD donors. A total of 26 of the 37 transplants were either urgent or super-urgent.
- The national rate of patient survival following paediatric heart transplant was 92.2% at 90 days, 89.2% at 1 year and 86.0% at 5 years (including both DBD and DCD heart transplants).

Use of the contents of this report should be acknowledged as follows: *Annual Report on Heart Transplantation 2023/2024, NHS Blood and Transplant*

# INTRODUCTION



## 2. Introduction

This report presents data on activity and outcomes of heart transplant candidates and recipients between 1 April 2014 and 31 March 2024, for all centres performing heart transplantation in the UK. Data were obtained from the UK Transplant Registry at NHS Blood and Transplant which holds information relating to donors, recipients and outcomes for all heart transplants performed in the UK.

Heart activity results are described separately for adults (aged 16 years or over) and paediatric patients (aged less than 16 years). There are seven heart transplant centres in the UK; six in England and one in Scotland. Five of the seven centres specialise in adult transplantation, one in paediatric transplantation (Great Ormond Street Hospital) and one in both adult and paediatric transplantation (Newcastle). Any transplants carried out at Great Ormond Street Hospital in recipients aged 16 or over are included in the paediatric analysis, and any transplants carried out at adult only centres in recipients less than 16 are included in the adult analysis.

[Multi-organ transplants](#) are presented separately in [Section 6.5](#) and are excluded from the rest of the main report.

The time period of analysis covers the introduction of the super-urgent heart allocation scheme in October 2016 (later expanded to paediatric patients in October 2020).

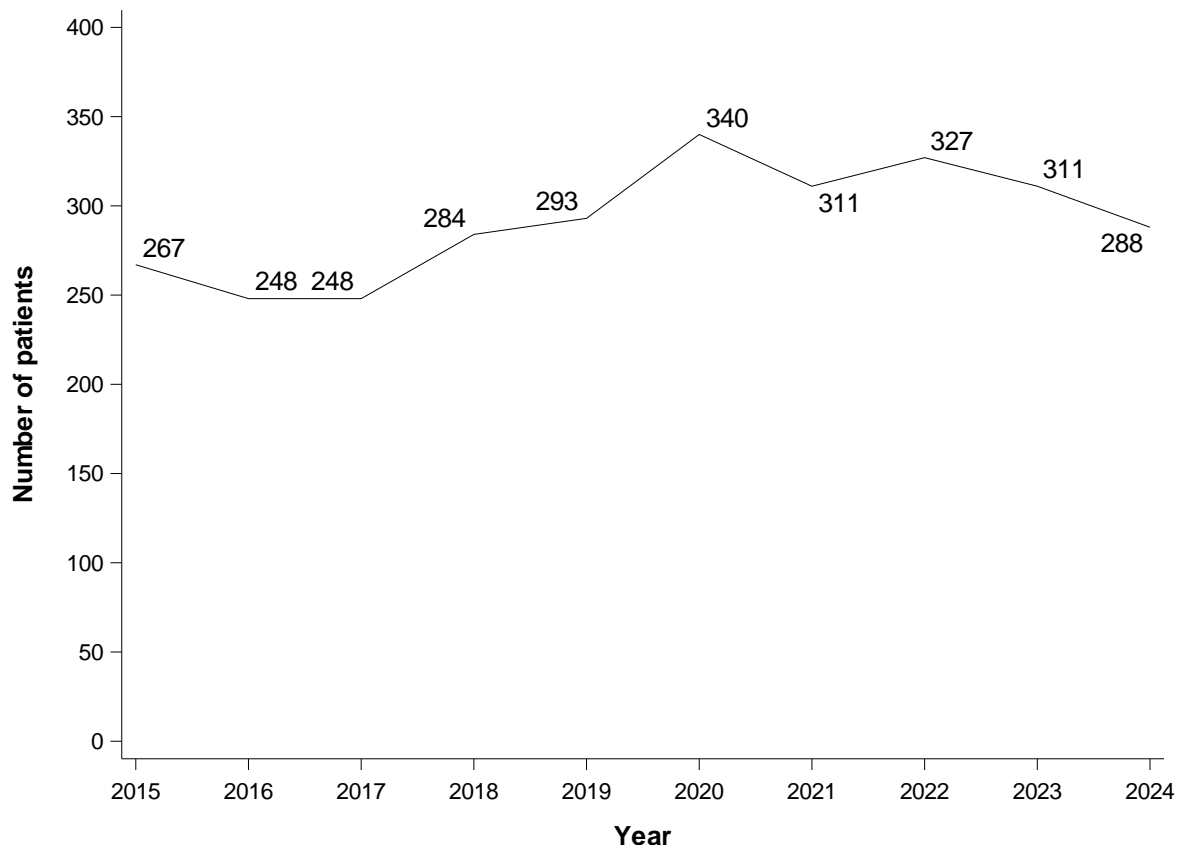
Methods used are described in the [Appendix](#). The centre specific adult [survival rates](#) are adjusted for differences in [risk factors](#) between the centres. The risk models used are described in the [Appendix](#). The adult heart risk model was revised in August 2022 in consultation with the clinical community.



## 2.1 Overview

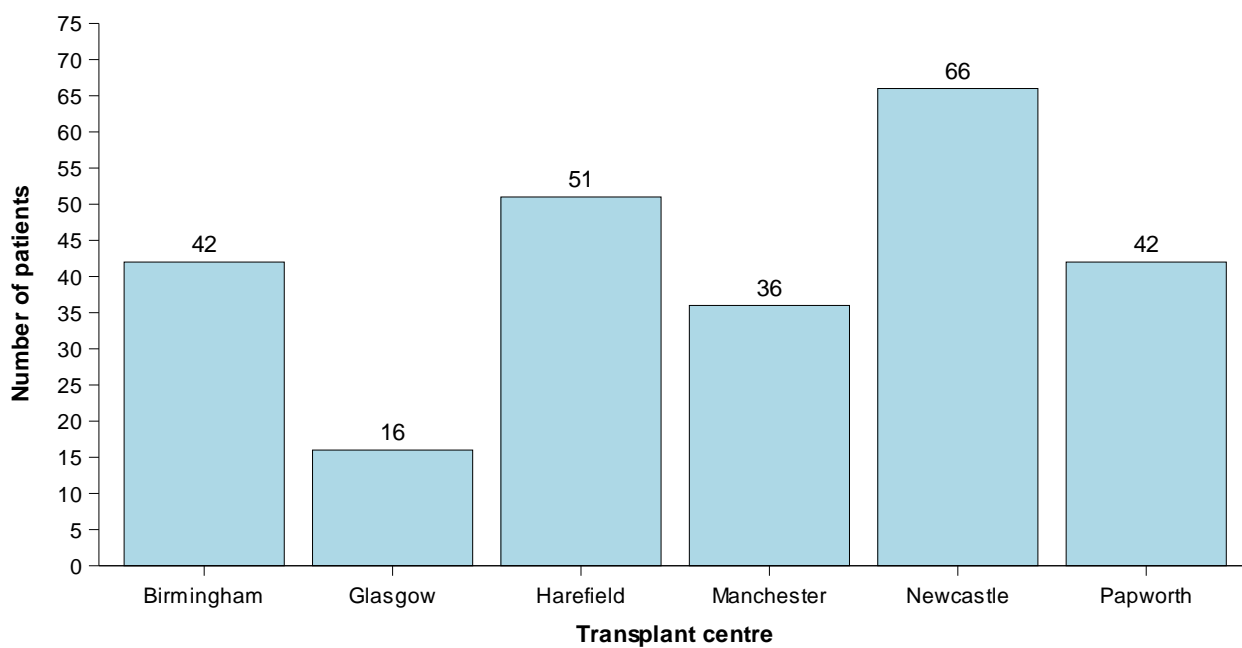
**Figure 2.1** shows the number of transplant candidates on the [active transplant list](#) at financial year end between 2015 and 2024. The number of people waiting for a heart transplant increased significantly between 2016 and 2020, from 248 to 340. The number fell to 288 on 31 March 2024.

**Figure 2.1** Number of people on the national active heart transplant list on 31 March each year, 2015 to 2024

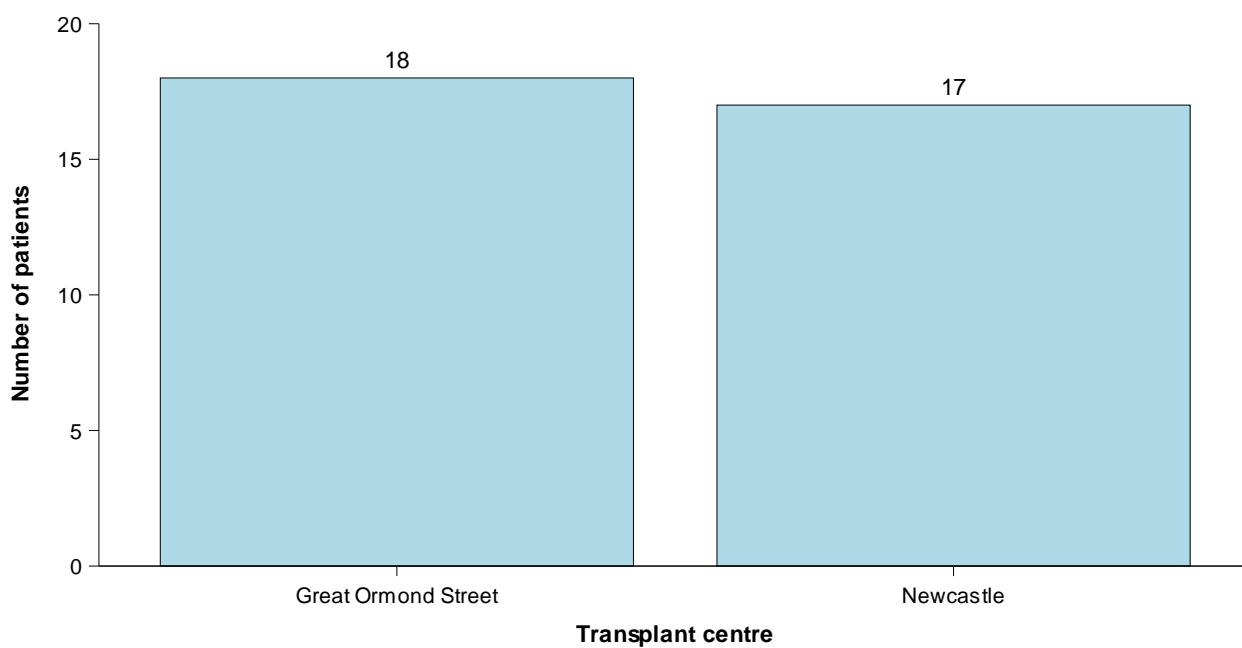


**Figure 2.2** and **Figure 2.3** show the number of adult and paediatric patients on the [active transplant list](#) on 31 March 2024 at each centre. In total, there were 253 adults and 35 paediatric patients waiting for a heart transplant. Newcastle had the highest number of adults on the heart transplant list. Great Ormond Street Hospital had the highest number of paediatric patients on the heart transplant list. These numbers include 5 people waiting for a multi-organ transplant (3 heart and liver and 2 heart and kidney).

**Figure 2.2** Number of adults on the active heart transplant list on 31 March 2024, by centre

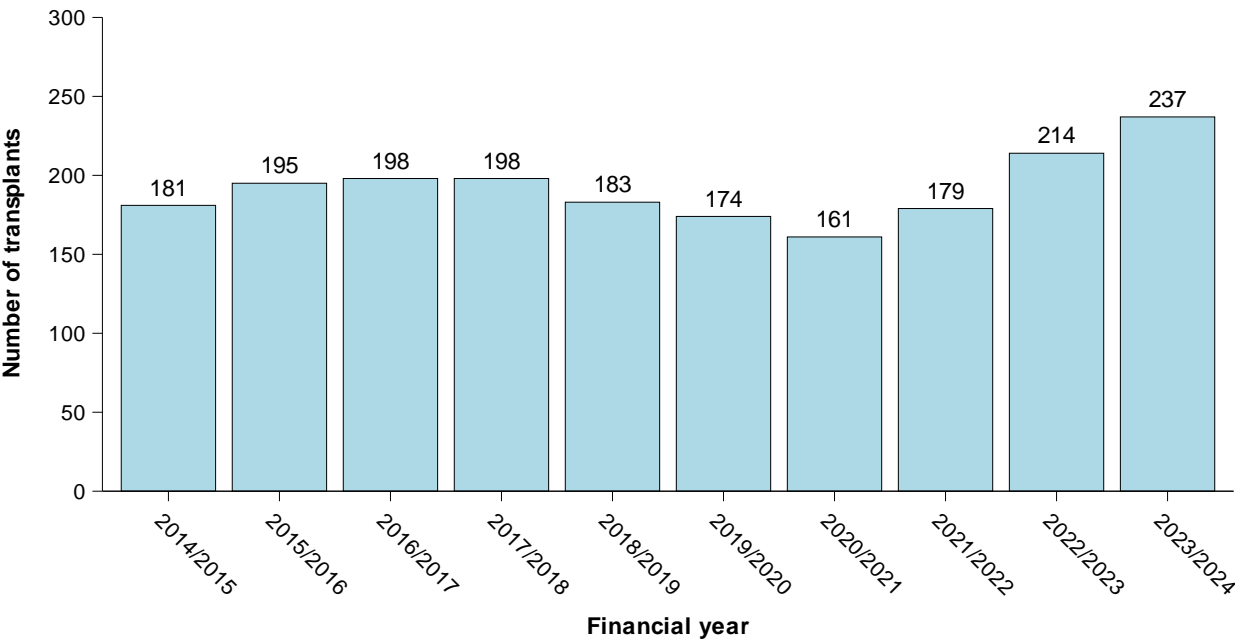


**Figure 2.3** Number of paediatric patients on the active heart transplant list on 31 March 2024, by centre



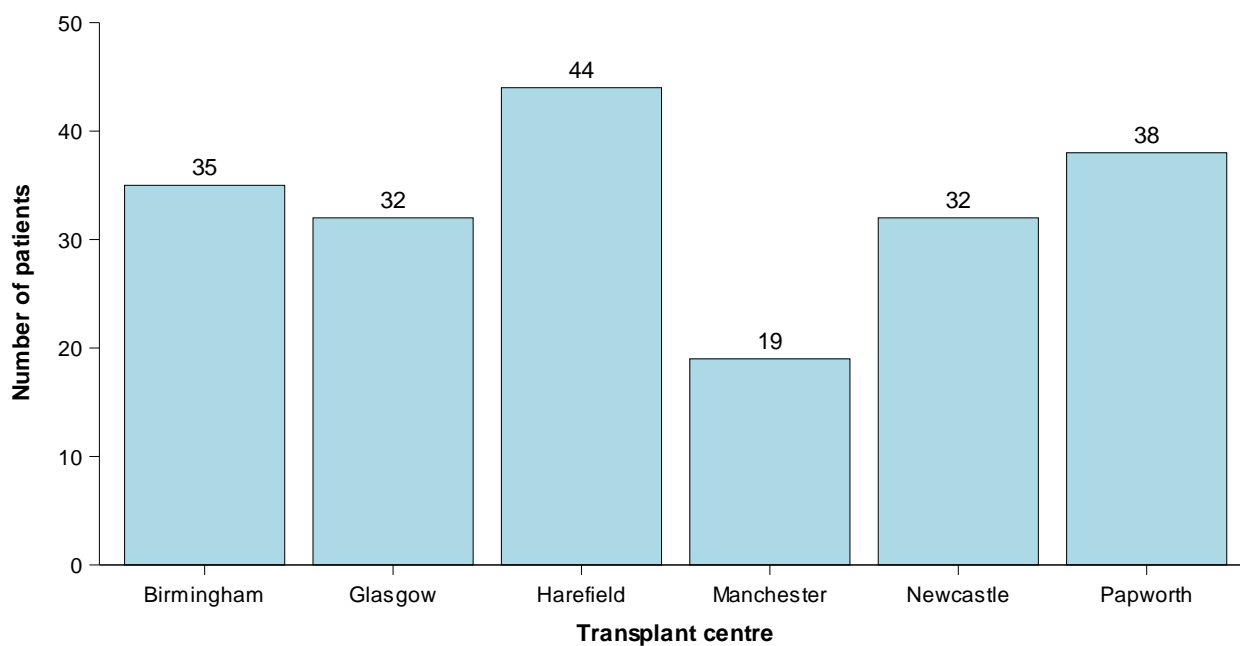
**Figure 2.4** shows the total number of transplants performed in each of the last ten financial years. The number of transplants last year was 237, 11% higher than in 2022/2023.

**Figure 2.4    Number of heart transplants in the UK, by financial year, 1 April 2014 to 31 March 2024**

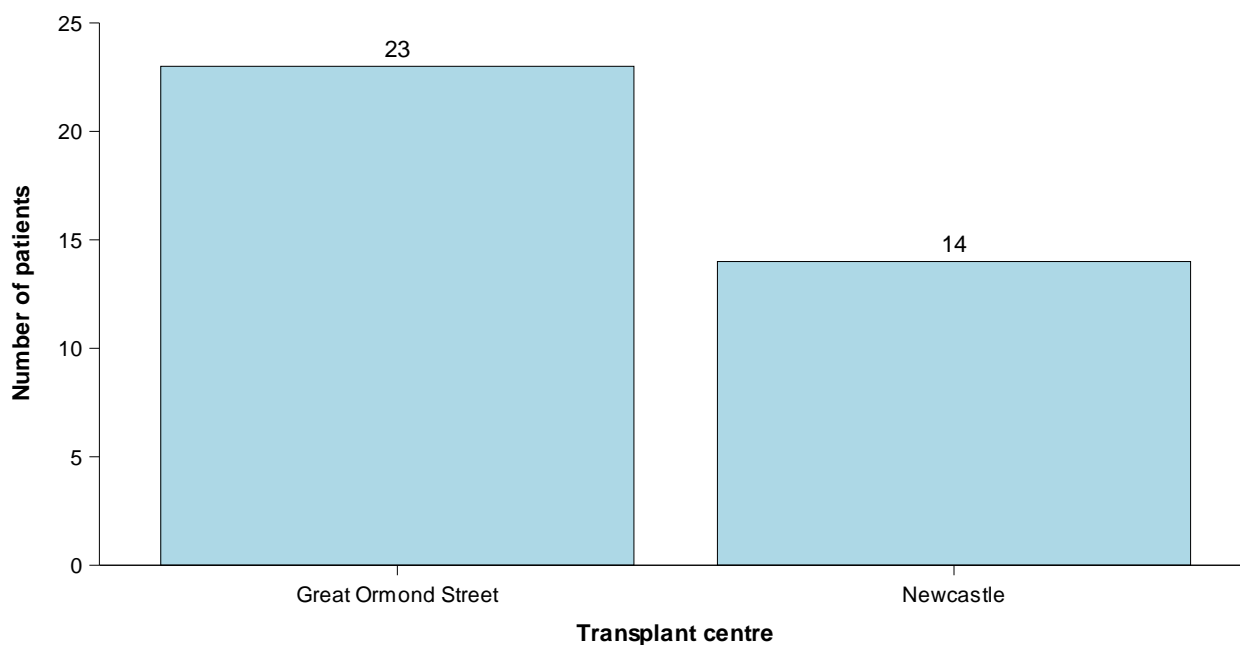


**Figure 2.5** and **Figure 2.6** show the number of adult and paediatric transplants carried out in the most recent financial year at each centre. Harefield performed the highest number of adult transplants. Great Ormond Street Hospital performed the highest number of paediatric transplants.

**Figure 2.5** Number of adult heart transplants in the UK, by centre, 1 April 2023 to 31 March 2024

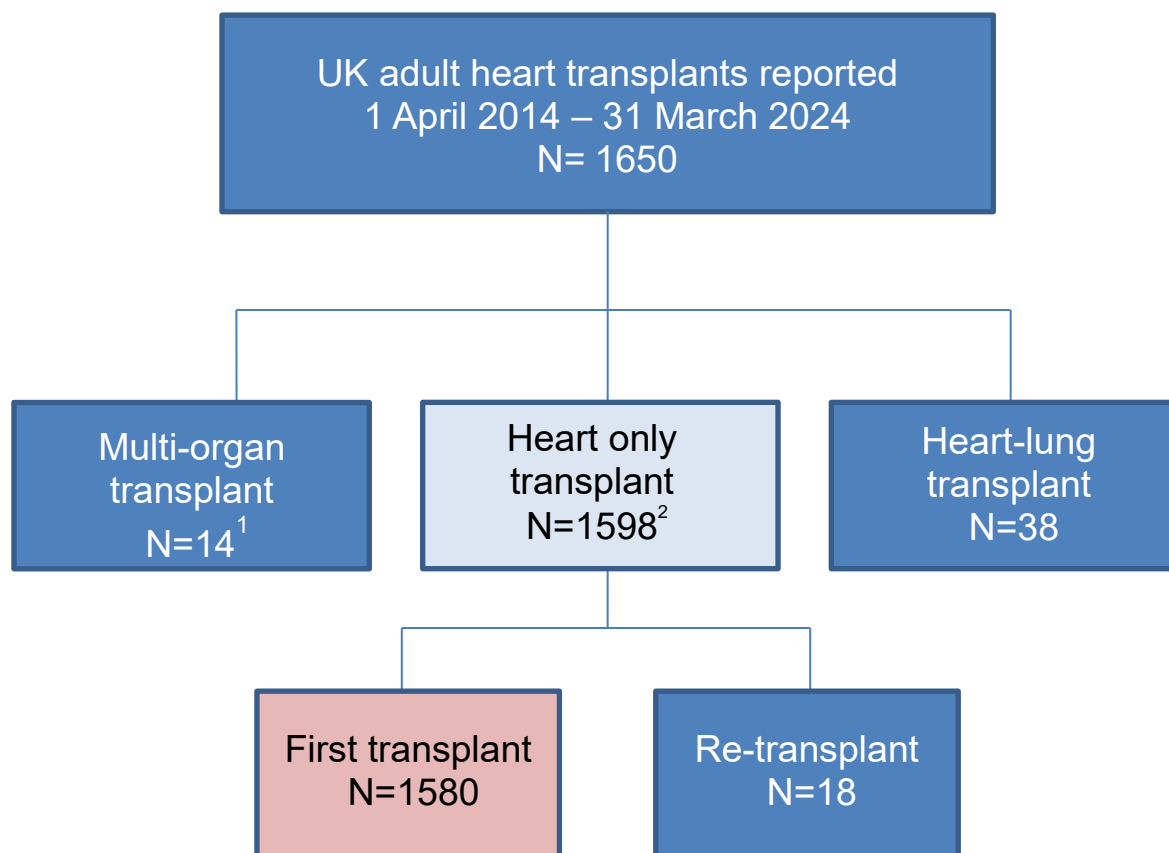


**Figure 2.6** Number of paediatric heart transplants in the UK, by centre, 1 April 2023 to 31 March 2024



**Figure 2.7** shows a breakdown of the 1,650 adult heart transplants performed in the UK in the ten-year period while **Figure 2.8** shows a similar breakdown for the 311 paediatric transplants performed during the same period. Re-transplants are included in the transplant activity sections of this report but excluded from the survival analysis sections. [Multi-organ transplants](#) are excluded from the rest of the report apart from the separate multi-organ outcome sections ([Section 6.5](#)). Heart-lung transplants are considered in the Annual Report on Lung Transplantation.

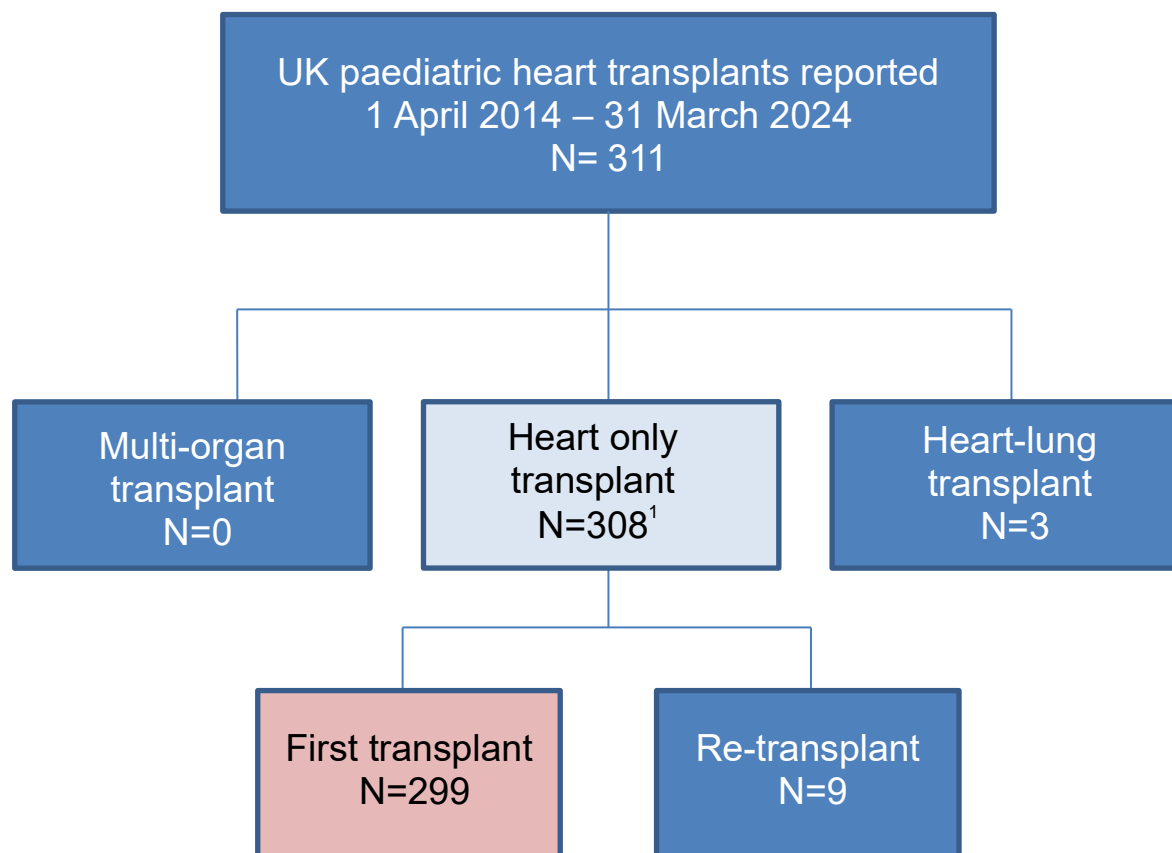
**Figure 2.7 Adult heart transplants performed in the UK, 1 April 2014 to 31 March 2024**



<sup>1</sup> Includes 5 heart and kidney, 9 heart and liver

<sup>2</sup> Includes 273 DCD heart transplants

**Figure 2.8 Paediatric heart transplants performed in the UK, 1 April 2014 to 31 March 2024**



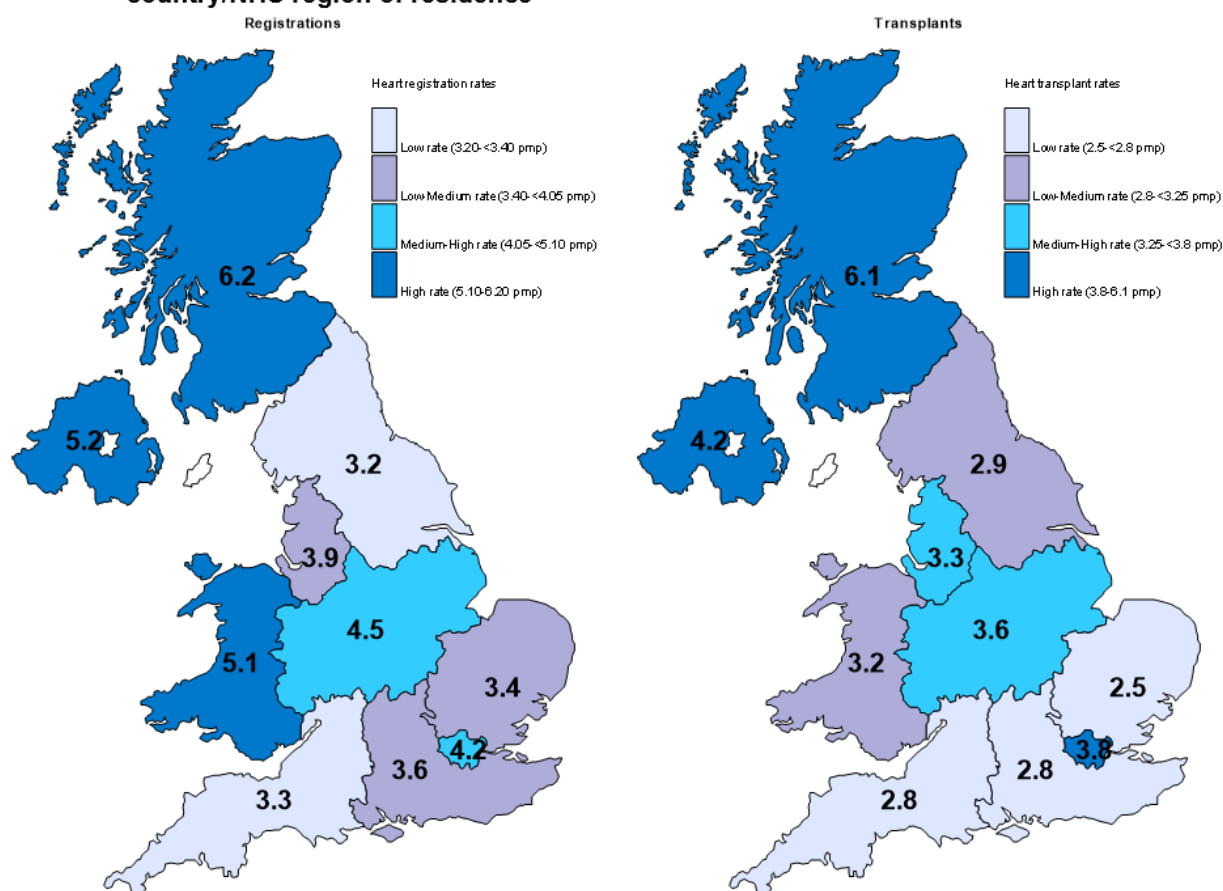
<sup>1</sup> Includes 24 DCD heart transplants

## 2.2 Geographical variation in registration and transplant rates

**Figure 2.9** shows rates of registration to the heart transplant list per million population (pmp) between 1 April 2023 and 31 March 2024 compared with heart transplant rates pmp for the same time period, by recipient country/NHS region of residence. **Table 2.1** shows the actual numbers as well as rates. If a patient has had more than one registration/transplant in the period, each registration/transplant is considered. Note that this analysis only considered NHS Group 1 patients. The UK heart registration and transplant rates are 4.1 pmp and 3.5 pmp respectively.

Since there will inevitably be some random variation in rates between areas, the systematic coefficient component of variation (SCV) was used to identify if the variation is more (or less) than a random effect for the different NHS regions in England only. Only first registrations and transplants in this period were considered. The larger the SCV the greater the evidence of a high level of systematic variation between areas. Registration and transplant rates yielded an SCV of 0 (p-value = 0.999) and 0 (p-value = 0.999), respectively. The p-value shows the probability that an SCV of this size (or higher) would be observed by chance if only random variation existed and therefore no evidence of geographical variation beyond what would be expected at random. No adjustment has been made for area-specific demographic characteristics that may impact the rates of registration to the transplant list and transplantation such as age and sex. Therefore, these results should be interpreted with caution.

**Figure 2.9 Comparison of heart registration rates (pmp) with transplant rates (pmp) by recipient country/NHS region of residence**



<b>Table 2.1 Heart registration and transplant rates per million population (pmp) in the UK, 1 April 2023 - 31 March 2024, by Country/NHS region</b>				
<b>Country/ NHS region</b>	<b>Registrations (pmp)</b>		<b>Transplants (pmp)</b>	
North East and Yorkshire	26	(3.2)	24	(2.9)
North West	29	(3.9)	25	(3.3)
Midlands	49	(4.5)	39	(3.6)
East of England	22	(3.4)	16	(2.5)
London	37	(4.2)	34	(3.8)
South East	34	(3.6)	26	(2.8)
South West	19	(3.3)	16	(2.8)
<b>England</b>	<b>216</b>	<b>(3.8)</b>	<b>180</b>	<b>(3.2)</b>
<b>Isle of Man</b>	<b>1</b>	<b>(12.5)</b>	<b>1</b>	<b>(12.5)</b>
<b>Channel Islands</b>	<b>0</b>	<b>(0.0)</b>	<b>1</b>	<b>(5.9)</b>
<b>Wales</b>	<b>16</b>	<b>(5.1)</b>	<b>10</b>	<b>(3.2)</b>
<b>Scotland</b>	<b>34</b>	<b>(6.2)</b>	<b>33</b>	<b>(6.1)</b>
<b>Northern Ireland</b>	<b>10</b>	<b>(5.2)</b>	<b>8</b>	<b>(4.2)</b>
<b>TOTAL <sup>1,2</sup></b>	<b>280</b>	<b>(4.1)</b>	<b>234</b>	<b>(3.5)</b>
<sup>1</sup> Registrations include 3 recipients whose postcodes were unknown and excludes 5 recipients who reside in the Republic of Ireland.				
<sup>2</sup> Transplants include 1 recipient whose postcode was unknown and excludes 3 recipients who reside in the Republic of Ireland.				



# **ADULT HEART TRANSPLANTATION**

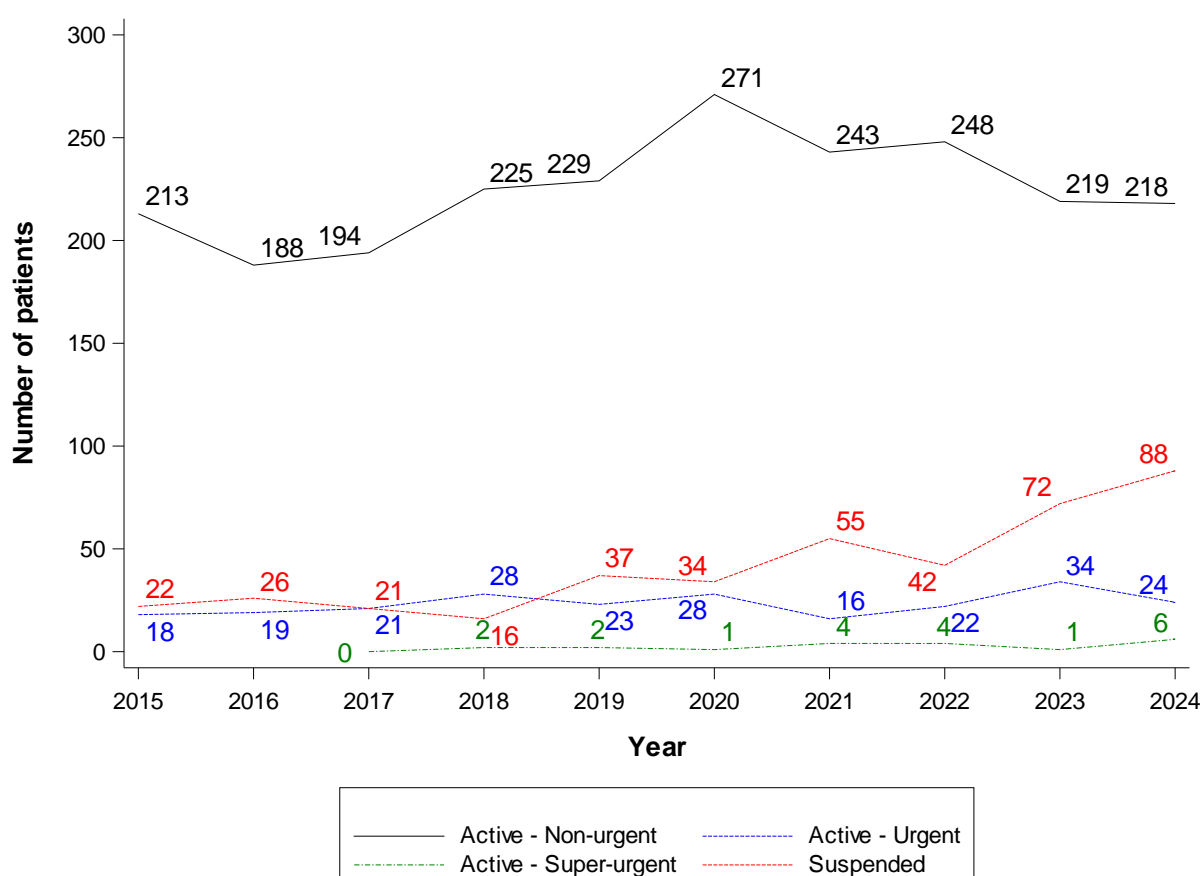
## **Transplant List**



### 3.1 Adult heart only transplant list on 31 March, 2015 – 2024

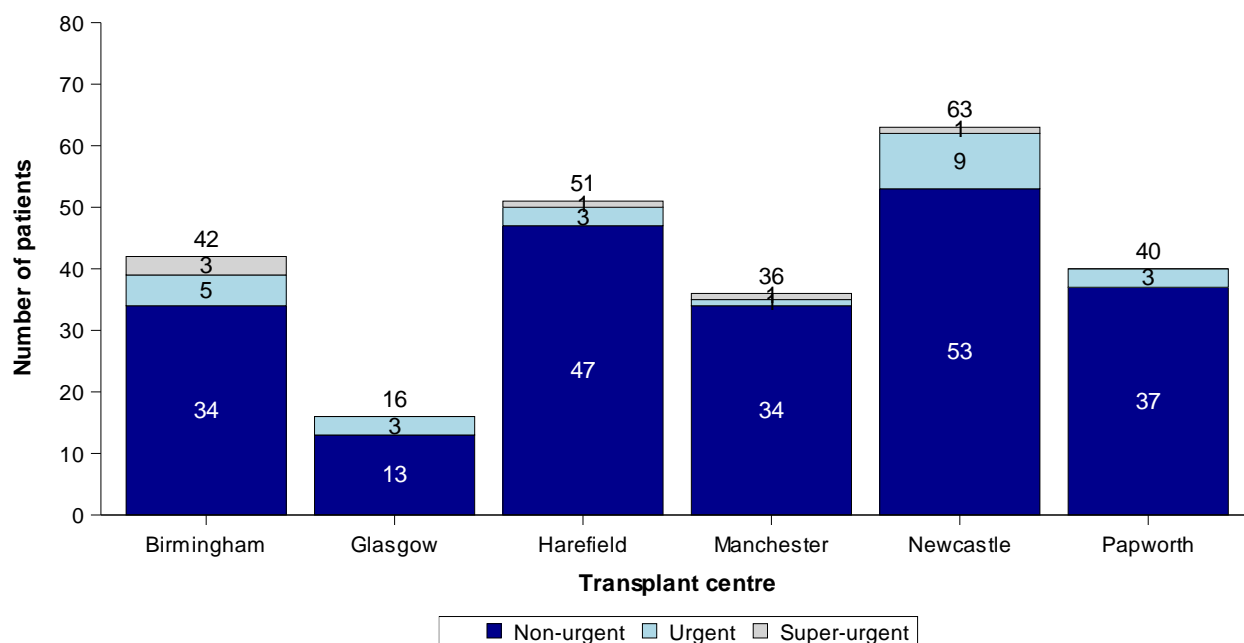
**Figure 3.1** shows the number of adult patients on the heart transplant list on 31 March each year between 2015 and 2024, split by urgency status of the patient. The number of adults on the active non-urgent heart transplant list has increased over the decade, from 188 in 2016 up to 271 in 2020, but has since decreased to 218 in 2024. The number of adults on the urgent list increased from 18 in 2015 to 24 in 2024. The super-urgent list was introduced in October 2016 and there were 6 adults waiting on this list on 31 March 2024. There has been a recent increase in the number of adults suspended from the heart waiting list.

**Figure 3.1 Number of adults on the heart transplant list on 31 March each year, by urgency status**

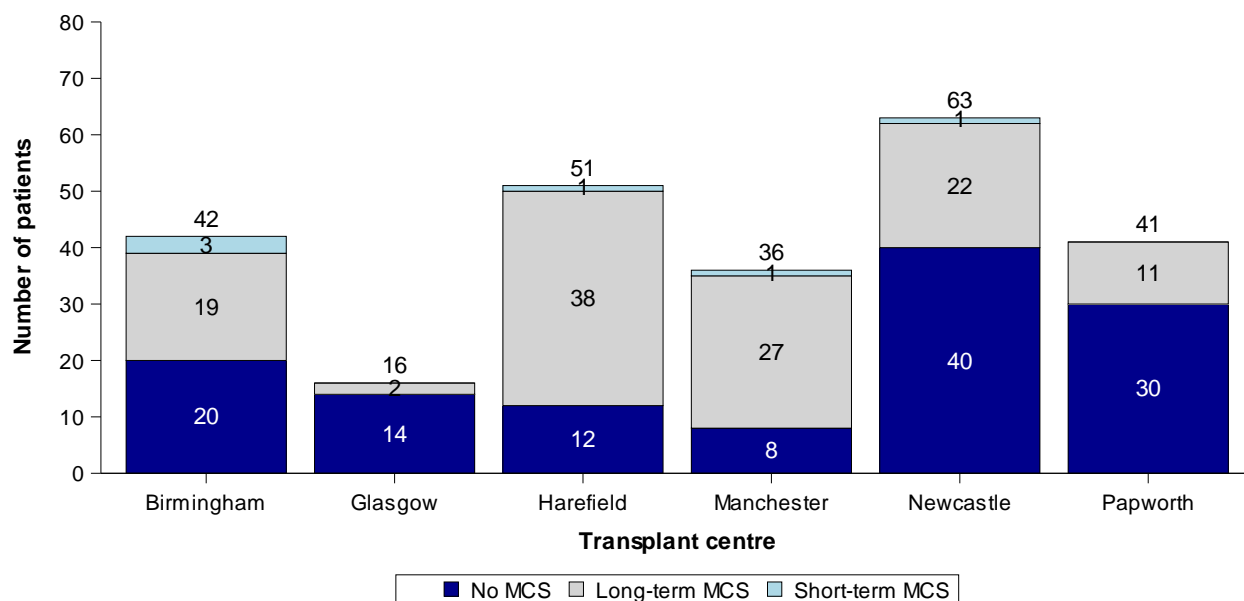


**Figure 3.2** shows the number of adults on the [active heart transplant list](#) on 31 March 2024, by centre and urgency. **Figure 3.3** provides a similar breakdown by centre and mechanical circulatory support ([MCS](#)) status. In total, there were 248 adults waiting for a heart. The number on the urgent transplant list on 31 March 2024 ranged from 1 at Manchester to 9 at Newcastle. Birmingham had 3 adults on the super-urgent transplant list, while Harefield, Manchester, and Newcastle each had 1. A total of 119 patients were on long-term [MCS](#) (including implantable [VADs](#) for left, right and biventricular support), representing 48% of the national waiting list, but varying between 13% and 75% across centres.

**Figure 3.2 Number of adults on the active heart transplant list on 31 March 2024, by centre and urgency**

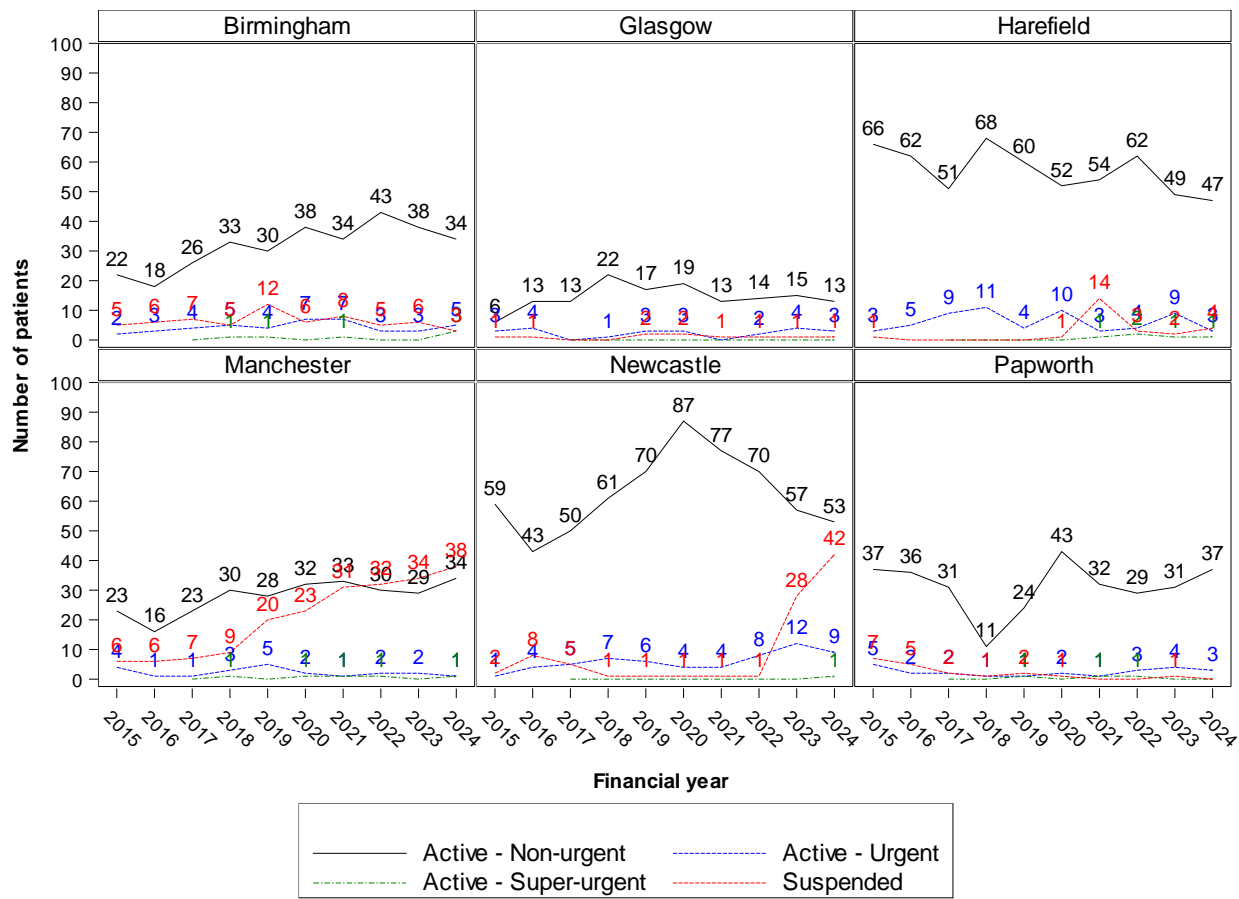


**Figure 3.3 Number of adults on the active heart transplant list on 31 March 2024, by centre and mechanical circulatory support status**



**Figure 3.4** shows the trend over time in the number of adults on the heart transplant list on 31 March each year across centres. Birmingham and Manchester have experienced increases in their heart lists over the decade, whilst Harefield and Newcastle have experienced recent decreases. Manchester and Newcastle have both had a noticeable increase in suspended patients in recent years.

**Figure 3.4    Number of adults on the heart transplant list on 31 March each year, for the last 10 years, by centre**



### 3.2 Demographic characteristics, 1 April 2023 – 31 March 2024

There were 248 adult registrations onto the heart transplant list between 1 April 2023 and 31 March 2024. Demographic characteristics of these patients are shown by centre and overall, in **Table 3.1**. Nationally, 73% were male and the [median](#) age was 49 years. The most common primary disease group was cardiomyopathy. For some characteristics, due to rounding, percentages may not add up to 100.

<b>Table 3.1 Demographic characteristics of adult patient registrations onto the heart transplant list between 1 April 2023 and 31 March 2024, by centre</b>								
		Birmingham N (%)	Glasgow N (%)	Harefield N (%)	Manchester N (%)	Newcastle N (%)	Papworth N (%)	<b>TOTAL N (%)</b>
Number of registrations		45 (100)	31 (100)	56 (100)	34 (100)	34 (100)	48 (100)	<b>248 (100)</b>
Highest urgency during registration	Non-urgent	12 (27)	7 (23)	18 (32)	19 (56)	10 (29)	30 (63)	<b>96 (39)</b>
	Urgent	20 (44)	16 (52)	23 (41)	3 (9)	20 (59)	11 (23)	<b>93 (38)</b>
	Super-urgent	13 (29)	8 (26)	15 (27)	12 (35)	4 (12)	7 (15)	<b>59 (24)</b>
Recipient sex	Male	32 (71)	26 (84)	45 (80)	26 (76)	21 (62)	32 (67)	<b>182 (73)</b>
	Female	13 (29)	5 (16)	11 (20)	8 (24)	13 (38)	16 (33)	<b>66 (27)</b>
Recipient ethnicity	White	27 (60)	29 (94)	33 (59)	29 (85)	31 (91)	33 (69)	<b>182 (73)</b>
	Asian	10 (22)	0 (0)	15 (27)	3 (9)	1 (3)	9 (19)	<b>38 (15)</b>
	Black	6 (13)	0 (0)	8 (14)	1 (3)	0 (0)	3 (6)	<b>18 (7)</b>
	Other	2 (4)	1 (3)	0 (0)	0 (0)	2 (6)	1 (2)	<b>6 (2)</b>
	Missing	0 (0)	1 (3)	0 (0)	1 (3)	0 (0)	2 (4)	<b>4 (2)</b>
Recipient age (years)	Median (IQR)	48 (37, 55)	56 (42, 60)	49 (38, 58)	43 (33, 57)	46 (32, 51)	50 (38, 56)	<b>49 (37, 56)</b>
	Missing	0	0	0	0	0	0	<b>0</b>
Primary Disease	Coronary heart disease	10 (22)	7 (23)	12 (21)	3 (9)	4 (12)	7 (15)	<b>43 (17)</b>
	Cardiomyopathy	28 (62)	22 (71)	37 (66)	27 (79)	21 (62)	31 (65)	<b>166 (67)</b>
	Congenital heart disease	1 (2)	0 (0)	5 (9)	1 (3)	9 (26)	2 (4)	<b>18 (7)</b>
	Other/Not reported	6 (13)	2 (6)	2 (4)	3 (9)	0 (0)	8 (17)	<b>21 (9)</b>

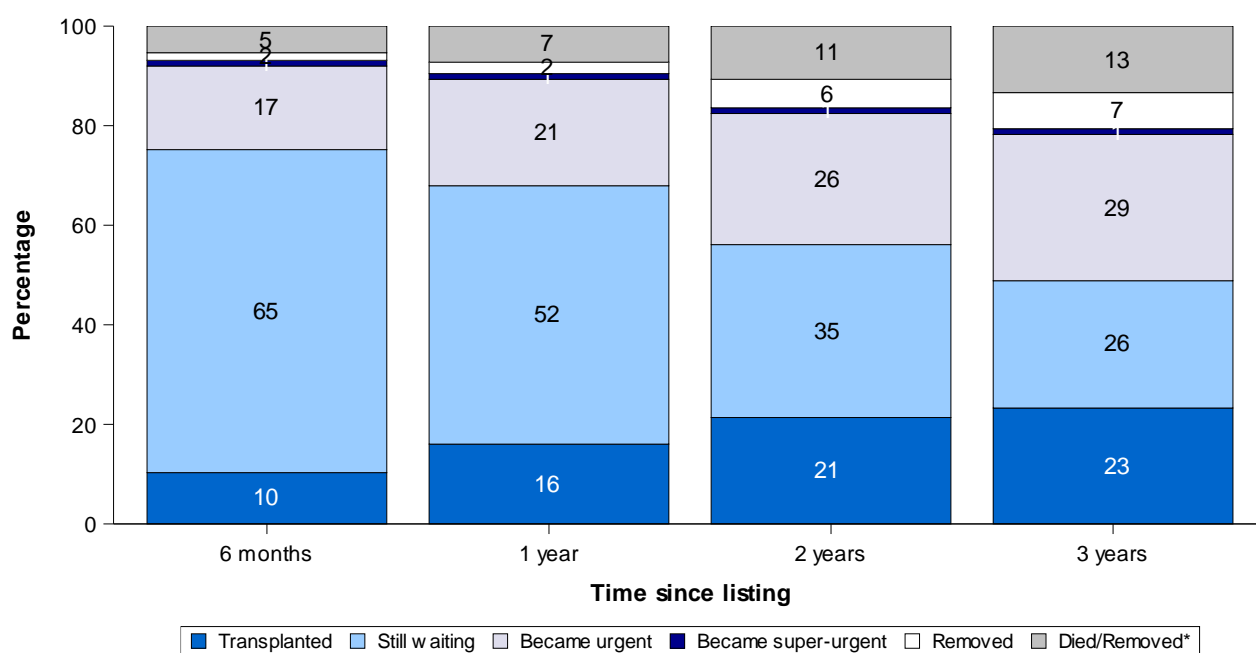
<b>Table 3.1 Demographic characteristics of adult patient registrations onto the heart transplant list between 1 April 2023 and 31 March 2024, by centre</b>								
		Birmingham N (%)	Glasgow N (%)	Harefield N (%)	Manchester N (%)	Newcastle N (%)	Papworth N (%)	<b>TOTAL N (%)</b>
Previous open heart surgery	None	31 (69)	21 (68)	28 (50)	20 (59)	18 (53)	43 (90)	<b>161 (65)</b>
	One	11 (24)	5 (16)	25 (45)	13 (38)	10 (29)	4 (8)	<b>68 (27)</b>
	More than one	1 (2)	0 (0)	3 (5)	1 (3)	6 (18)	1 (2)	<b>12 (5)</b>
	Missing	2 (4)	5 (16)	0 (0)	0 (0)	0 (0)	0 (0)	<b>7 (3)</b>
Serum bilirubin (umol/l)	Median (IQR)	21 (11, 34)	11 (7, 18)	14 (8, 27)	18 (11, 24)	16 (8, 18)	13 (8, 20)	<b>15 (9, 24)</b>
	Missing	2	3	0	0	0	2	<b>7</b>
Serum creatinine (umol/l)	Median (IQR)	92 (64, 118)	103 (74, 128)	104 (84, 130)	86 (73, 107)	95 (79, 118)	111 (80, 126)	<b>97 (74, 123)</b>
	Missing	2	4	0	0	0	0	<b>6</b>

### 3.3 Post-registration outcomes, 1 April 2019 – 31 March 2021

The registration outcomes of adults listed for a heart transplant between 1 April 2019 and 31 March 2021 are summarised in **Figures 3.5 - 3.9**, nationally and by centre, for non-urgent, urgent and super-urgent registrations respectively. The possible outcomes on the list include receiving a transplant, removal from the list, moving lists, dying on the list, or remaining on the list at a given time point post-registration. Removals from the list due to deteriorating condition are grouped with deaths in this analysis. In these figures, the *first* outcome is considered, so if an individual was transplanted then died their registration outcome would be “transplanted”. If they moved lists, e.g. from the non-urgent to the urgent list, they would be included in both the non-urgent and the urgent charts.

**Figure 3.5** shows the non-urgent post-registration outcomes; within six months of listing 10% of non-urgent heart registrations resulted in transplant and 5% had died on the list, while after three years 23% had been transplanted and 13% had died on the list. Also, 17% had moved to the urgent heart list within 6 months, reaching 29% by three years. Removals from the list not due to deteriorating condition were for a variety of reasons, most commonly due to improving condition or contra-indication to transplant.

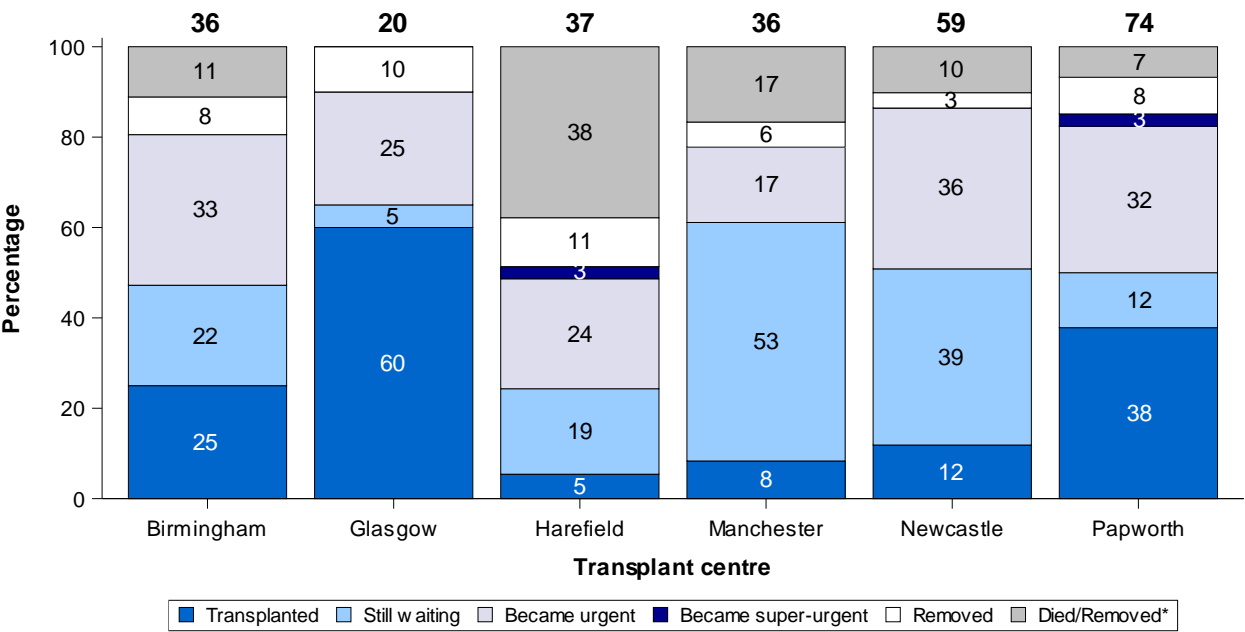
**Figure 3.5 Post-registration outcome for 262 non-urgent heart only registrations made in the UK, 1 April 2019 to 31 March 2021**



\*Removals due to condition deteriorating

**Figure 3.6** shows the three year non-urgent registration outcomes by centre. The non-urgent transplant rate at three years was highest at Glasgow (60%) and lowest at Harefield (5%). The mortality rate (including removals due to deteriorating condition) was highest at Harefield (38%) and lowest at Glasgow (0%).

**Figure 3.6 3 year post-registration outcomes for 262 non-urgent heart only registrations made in the UK, by centre, 1 April 2019 to 31 March 2021**

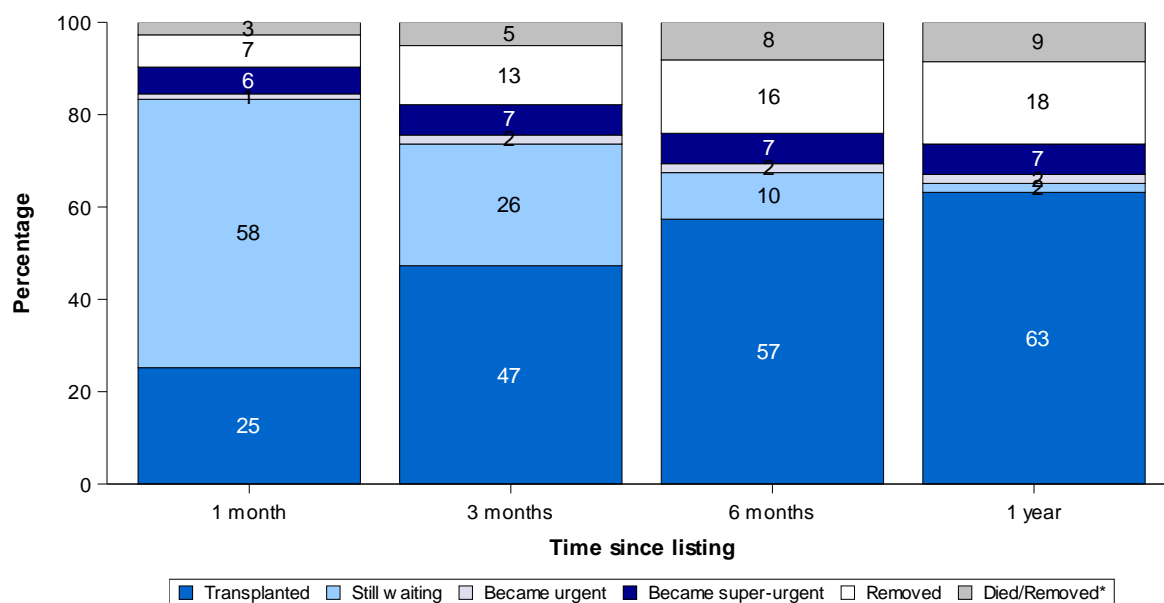


\*Removals due to condition deteriorating

**Figure 3.7** shows outcomes on the urgent heart list. The chance of transplant is much higher from the urgent list compared with the non-urgent list; within 6 months, 57% had been transplanted, 8% had died on the list and 16% were removed for other reasons (including the patient receiving an LVAD or contra-indication to transplant).



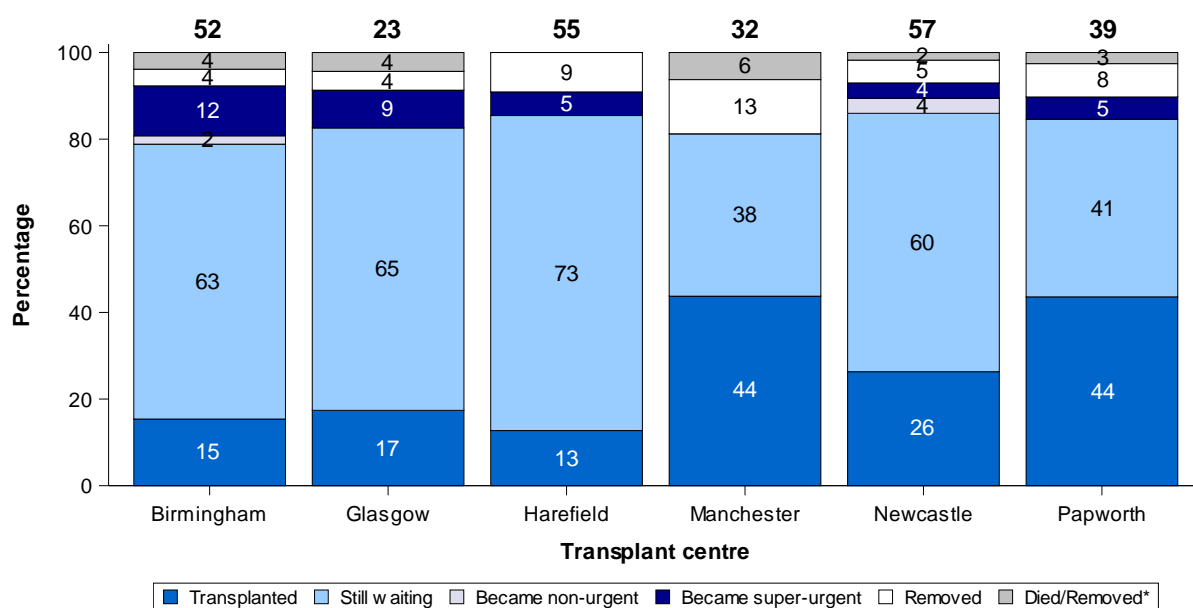
**Figure 3.7 Post-registration outcome for 258 urgent heart only registrations made in the UK, 1 April 2019 to 31 March 2021**



\*Removals due to condition deteriorating

**Figure 3.8** shows the one month urgent registration outcomes by centre. The urgent transplant rate at one month was highest at Manchester and Papworth (44%) and lowest at Harefield (13%).

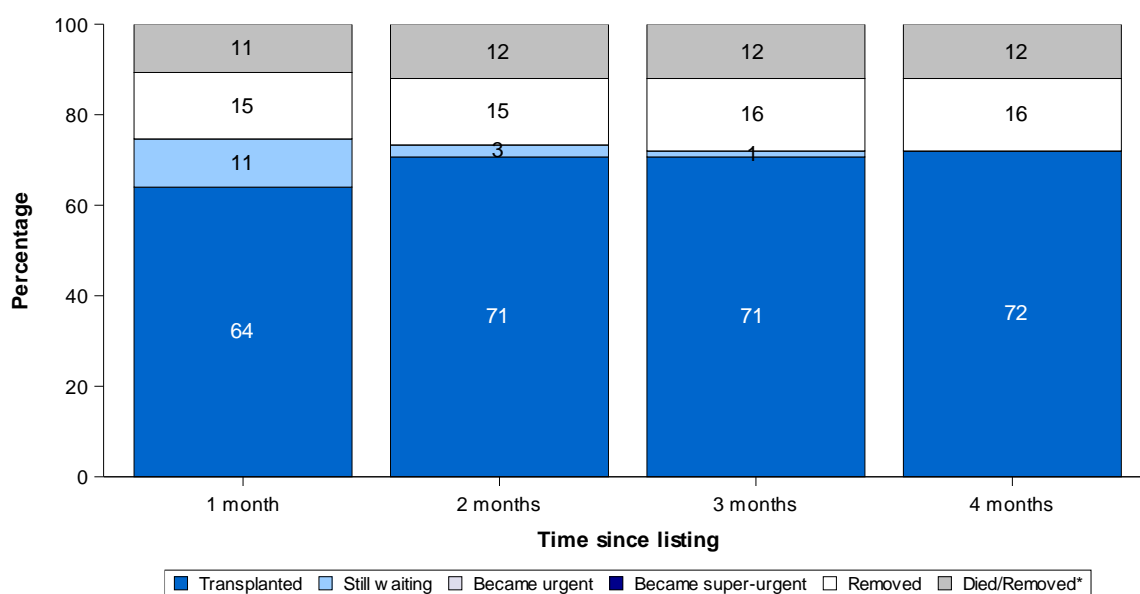
**Figure 3.8 1 month post-registration outcomes for 258 urgent heart only registrations made in the UK, by centre, 1 April 2019 to 31 March 2021**



\*Removals due to condition deteriorating

**Figure 3.9** shows outcomes on the super-urgent list. The chance of transplant is much higher from the super-urgent list compared with the non-urgent and urgent lists; within 3 months, 71% had been transplanted, 16% were removed and 12% had died on the list (including removals due to deteriorating condition). Please note that there is no break down by centre due to the small numbers.

**Figure 3.9 Post-registration outcome for 75 super-urgent heart only registrations made in the UK, 1 April 2019 to 31 March 2021**



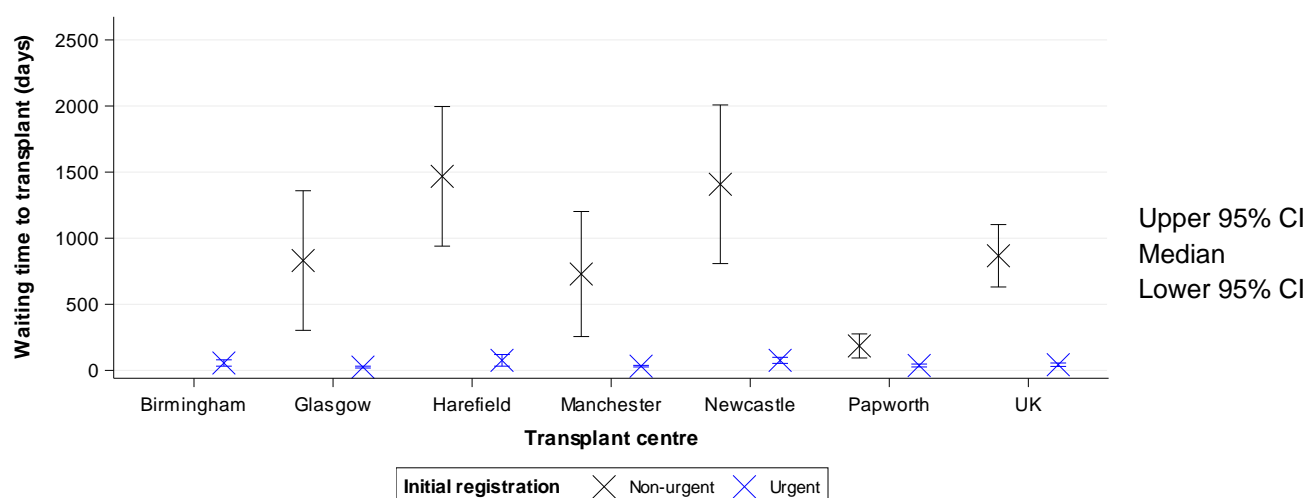
\*Removals due to condition deteriorating

### 3.4 Median waiting time to transplant, 1 April 2017 - 31 March 2023

The [median](#) waiting time to heart transplant from registration for adults is shown in **Figure 3.10** and **Table 3.2**. This is estimated using the [Kaplan Meier](#) method for non-urgent registrations onto the heart only transplant list between 1 April 2017 and 31 March 2020 and urgent and super-urgent registrations between 1 April 2020 and 31 March 2023. The urgency groups are defined by urgency at initial registration and all waiting time from initial registration is considered, regardless of any change in urgency. Any suspended time is discounted.

The overall national [median](#) waiting time to transplant from non-urgent registration was 867 days (2.4 years) and ranged from 185 days at Papworth to 1468 days at Harefield but could not be calculated for Birmingham due to low transplant rate. For urgent registrations, the national [median](#) waiting time was 43 days and ranged from 25 days at Glasgow to 76 days at Harefield and Newcastle. The national [median](#) waiting time for super-urgent registrations was 15 days. The 95% [confidence intervals](#) for some of these medians are very wide, indicating the imprecision of some of the estimates..

**Figure 3.10 Median active waiting time to heart transplant for adults registered on the non-urgent transplant list (1 April 2017 to 31 March 2020) or urgent transplant list (1 April 2020 to 31 March 2023), by centre and urgency status at registration**



Note: Median waiting times could not be estimated for non-urgent registrations at Birmingham due to low transplant rate

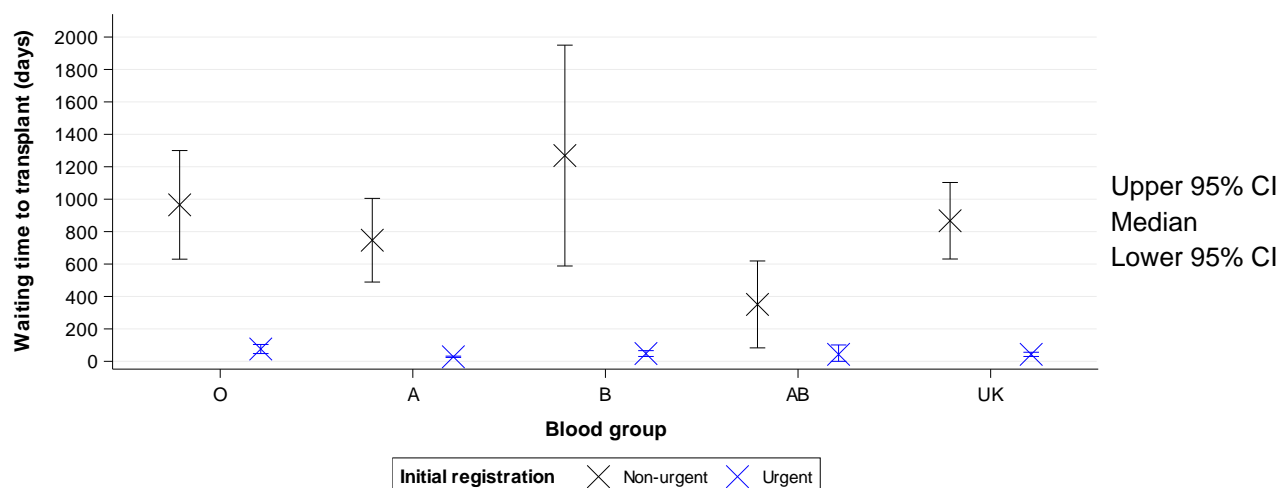
**Table 3.2 Median active waiting time to heart transplant for adult patients registered on the non-urgent transplant list (1 April 2017 to 31 March 2020) or urgent/super-urgent transplant list (1 April 2020 to 31 March 2023), by centre**

Transplant centre	Number of patients registered	Number transplanted	Median	Waiting time (days) 95% Confidence interval
<b>Non-urgent at initial registration</b>				
Birmingham <sup>1</sup>	59	20	-	-
Glasgow	27	17	831	303 - 1359
Harefield	94	33	1468	940 - 1996
Manchester	66	30	729	256 - 1202
Newcastle	100	42	1408	808 - 2008
Papworth	111	83	185	94 - 276
<b>UK</b>	<b>457</b>	<b>225</b>	<b>867</b>	<b>631 - 1103</b>
<b>Urgent at initial registration</b>				
Birmingham	37	29	56	32 - 80
Glasgow	44	40	25	18 - 32
Harefield	67	44	76	32 - 120
Manchester	38	24	32	26 - 38
Newcastle	61	44	76	53 - 99
Papworth	20	15	37	26 - 48
<b>UK</b>	<b>267</b>	<b>196</b>	<b>43</b>	<b>30 - 56</b>
<b>Super-urgent at initial registration</b>				
Birmingham	13	11	18	2 - 34
Glasgow	12	12	4	2 - 6
Harefield	21	14	23	4 - 42
Manchester	11	7	19	12 - 26
Newcastle	12	6	12	0 - 28
Papworth	26	22	16	10 - 22
<b>UK</b>	<b>95</b>	<b>72</b>	<b>15</b>	<b>11 - 19</b>

<sup>1</sup> Medians and 95% confidence intervals could not be calculated due to low transplant rate

The [median](#) waiting time to heart transplant for adults is also considered by blood group. This is shown in **Figure 3.11** and **Table 3.3** by both blood group and urgency status at registration. For non-urgent registrations, blood group B has the longest average wait compared with the other blood groups and for urgent registrations, blood group O has the longest wait.

**Figure 3.11 Median active waiting time to heart transplant for adults registered on the non-urgent transplant list (1 April 2017 to 31 March 2020) or urgent transplant list (1 April 2020 to 31 March 2023), by blood group and urgency status at registration**



**Table 3.3 Median active waiting time to heart transplant for adult patients registered on the non-urgent transplant list (1 April 2017 to 31 March 2020) or urgent/super-urgent transplant list (1 April 2020 to 31 March 2023), by blood group**

Blood Group	Number of patients registered	Number transplanted	Median	Waiting time (days) 95% Confidence interval
<b>Non-urgent at initial registration</b>				
O	199	94	965	630 - 1300
A	200	102	747	489 - 1005
B	44	19	1269	588 - 1950
AB	14	10	351	83 - 619
<b>UK</b>	<b>457</b>	<b>225</b>	<b>867</b>	<b>631 - 1103</b>
<b>Urgent at initial registration</b>				
O	114	74	76	48 - 104
A	102	83	28	24 - 32
B	38	30	48	30 - 66
AB	13	9	43	0 - 101
<b>UK</b>	<b>267</b>	<b>196</b>	<b>43</b>	<b>30 - 56</b>
<b>Super-urgent at initial registration</b>				
O	38	23	16	6 - 26
A	44	40	10	3 - 17
B	10	7	14	5 - 23
AB <sup>1</sup>	3	2	-	-

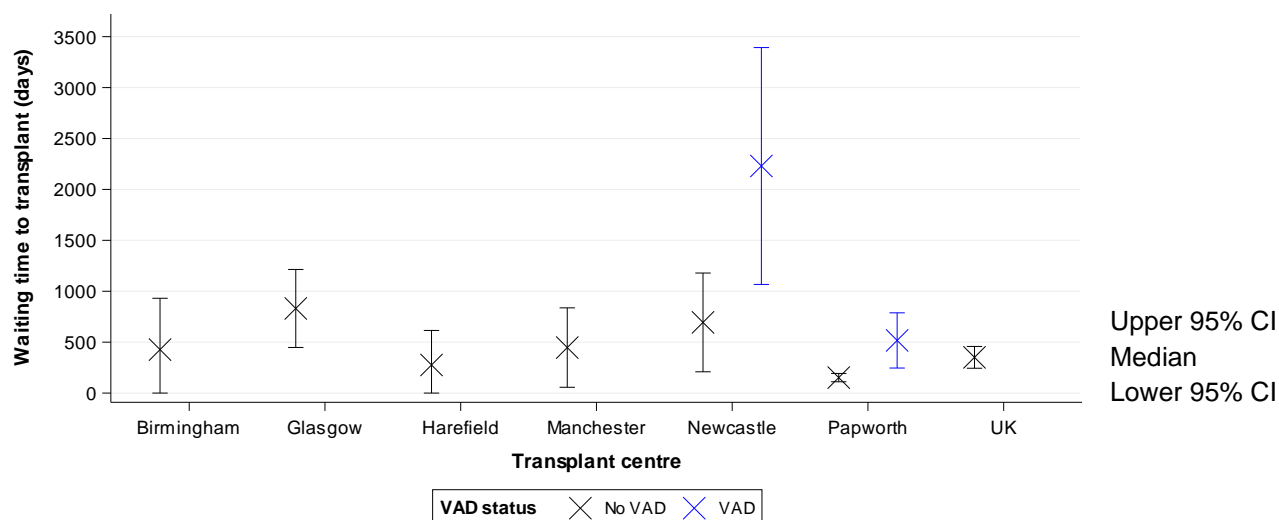
**Table 3.3** Median active waiting time to heart transplant for adult patients registered on the non-urgent transplant list (1 April 2017 to 31 March 2020) or urgent/super-urgent transplant list (1 April 2020 to 31 March 2023), by blood group

Blood Group	Number of patients registered	Number transplanted	Median	Waiting time (days) 95% Confidence interval
<b>UK</b>	<b>95</b>	<b>72</b>	<b>15</b>	<b>11 - 19</b>

<sup>1</sup> Median waiting time for groups with less than 10 are not presented due to small numbers

The [median](#) waiting time to heart transplant for adults is shown by [VAD](#) status in **Figure 3.12** and **Table 3.4**. This considers whether a patient ever had an implantable left-ventricular assist device (LVAD) as a bridge to heart transplant compared with not and is restricted to those who were initially non-urgent. Median waiting time for those on LVAD support could not be estimated for most centres, nor on a national basis, as not enough patients had been transplanted in this group at time of analysis. However, the national median for those not on LVAD support (351 days) was substantially lower than the overall median for non-urgent patients (867 days).

**Figure 3.12** Median active waiting time to heart transplant for adults registered on the non-urgent transplant list between 1 April 2017 and 31 March 2020, by centre and VAD status



Note: Median waiting times for those on LVAD support could only be estimated for Newcastle and Papworth

**Table 3.4 Median active waiting time to heart transplant for adult patients registered on the non-urgent transplant list, by centre and whether the patient had an implantable left-ventricular assist device (LVAD), 1 April 2017 to 31 March 2020**

Transplant centre	Number of patients registered	Number transplanted	Waiting time (days)	
			Median	95% Confidence interval
Never on LVAD support				
Birmingham	29	19	427	0 - 931
Glasgow	26	16	831	448 - 1214
Harefield	36	20	276	0 - 615
Manchester	29	21	447	57 - 837
Newcastle	45	27	694	209 - 1179
Papworth	87	66	152	111 - 193
UK	252	169	351	244 - 458
Ever on LVAD support				
Birmingham <sup>1</sup>	30	1	-	-
Glasgow <sup>2</sup>	1	1	-	-
Harefield <sup>1</sup>	58	13	-	-
Manchester <sup>1</sup>	37	9	-	-
Newcastle	55	15	2230	1067 - 3393
Papworth	24	17	517	246 - 788
UK <sup>1</sup>	205	56	-	-

<sup>1</sup> Medians and 95% confidence intervals could not be calculated due to low transplant rate

<sup>2</sup> Median waiting time for groups with less than 10 are not presented due to small numbers

# **ADULT HEART TRANSPLANTATION**

## **Response to Offers**



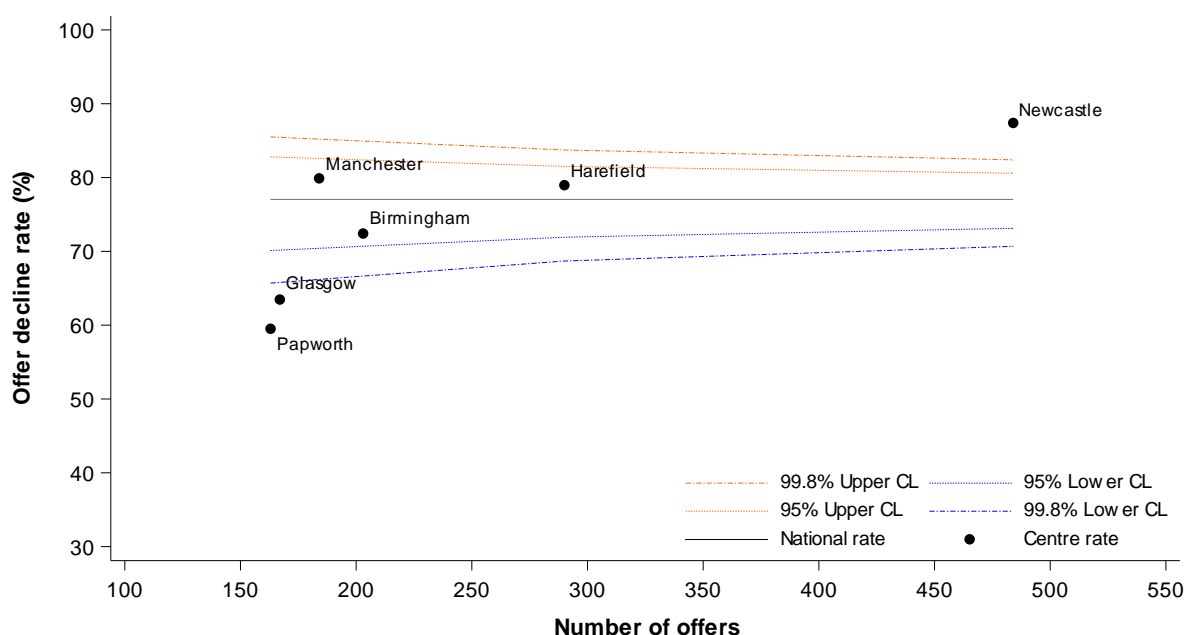
## 4. Response to Offers

This section presents an analysis of adult DBD donor heart offer decline rates. This only considers offers of hearts between 1 April 2021 and 31 March 2024 that were eventually transplanted and excludes all fast track offers. Hearts offered as part of a heart-lung block are included. Super-urgent, urgent and non-urgent offers are all considered. Offers to paediatric patients at Newcastle are excluded.

In 2017, group offering for non-urgent cardiothoracic organ offers was introduced, where all centres receive a simultaneous offer for their non-urgent patients but acceptance is determined by a centre's position in the allocation sequence. In this analysis, adjustments have been made to count any centre who is ranked above the accepting centre in the allocation sequence for that donor as declining the heart, even if they did not respond to the group offer, and any declines recorded for a centre ranked below the accepting centre were discounted.

**Figure 4.1** compares individual centre decline rates with the national rate using a [funnel plot](#). The offer decline rate for Newcastle is above the upper 99.8% [confidence limit](#), indicating a significantly higher decline rate than the national rate. The offer decline rates for both Glasgow and Papworth are below the lower 99.8% [confidence limit](#), indicating a significantly lower decline rate than the national rate. The offer decline rates for Birmingham, Harefield and Manchester are consistent with the national rate.

**Figure 4.1 UK adult DBD donor heart offer decline rates by centre, 1 April 2021 to 31 March 2024**



**Table 4.1** shows a breakdown of each centre's decline rate across the three years analysed. Nationally, the number of offers was highest in the latest year (for hearts that were eventually transplanted), but the offer decline rate was lowest in the previous year.

<b>Table 4.1 Adult Heart (including cardiac block) offer results by transplant centre, between 1 April 2021 and 31 March 2024</b>								
Centre	2021/22		2022/23		2023/24		Overall	
	No. offers	Decline rate (%)	No. offers	Decline rate (%)	No. offers	Decline rate (%)	No. offers	Decline rate (%)
Birmingham	53	(81.1)	59	(64.4)	91	(72.5)	203	(72.4)
Glasgow	42	(64.3)	59	(54.2)	66	(71.2)	167	(63.5)
Harefield	81	(86.4)	87	(77.0)	122	(75.4)	290	(79.0)
Manchester	61	(78.7)	39	(74.4)	84	(83.3)	184	(79.9)
Newcastle	161	(87.6)	137	(85.4)	186	(88.7)	484	(87.4)
Papworth	48	(56.3)	53	(58.5)	62	(62.9)	163	(59.5)
<b>UK</b>	<b>446</b>	<b>(79.8)</b>	<b>434</b>	<b>(72.4)</b>	<b>611</b>	<b>(78.4)</b>	<b>1491</b>	<b>(77.1)</b>
<div> <div></div>Centre has reached the upper 99.8% confidence limit         </div> <div> <div></div>Centre has reached the upper 95% confidence limit         </div> <div> <div></div>Centre has reached the lower 95% confidence limit         </div> <div> <div></div>Centre has reached the lower 99.8% confidence limit         </div>								

# **ADULT HEART TRANSPLANTATION**

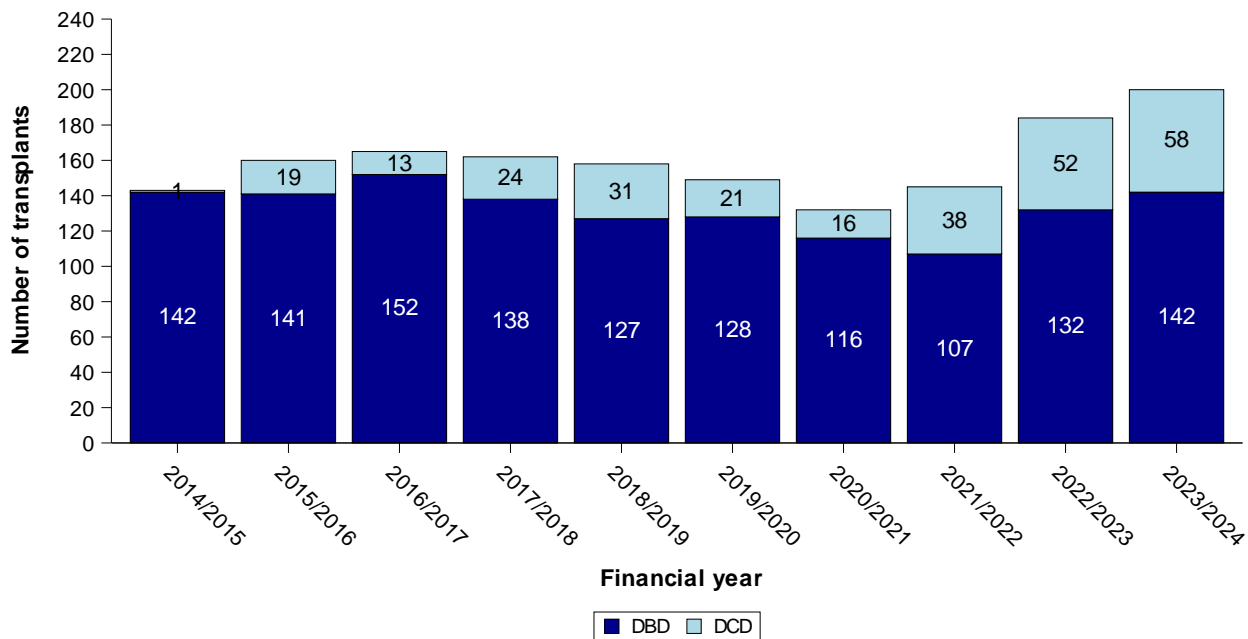
## **Transplants**



## 5.1 Adult heart transplants, 1 April 2014 – 31 March 2024

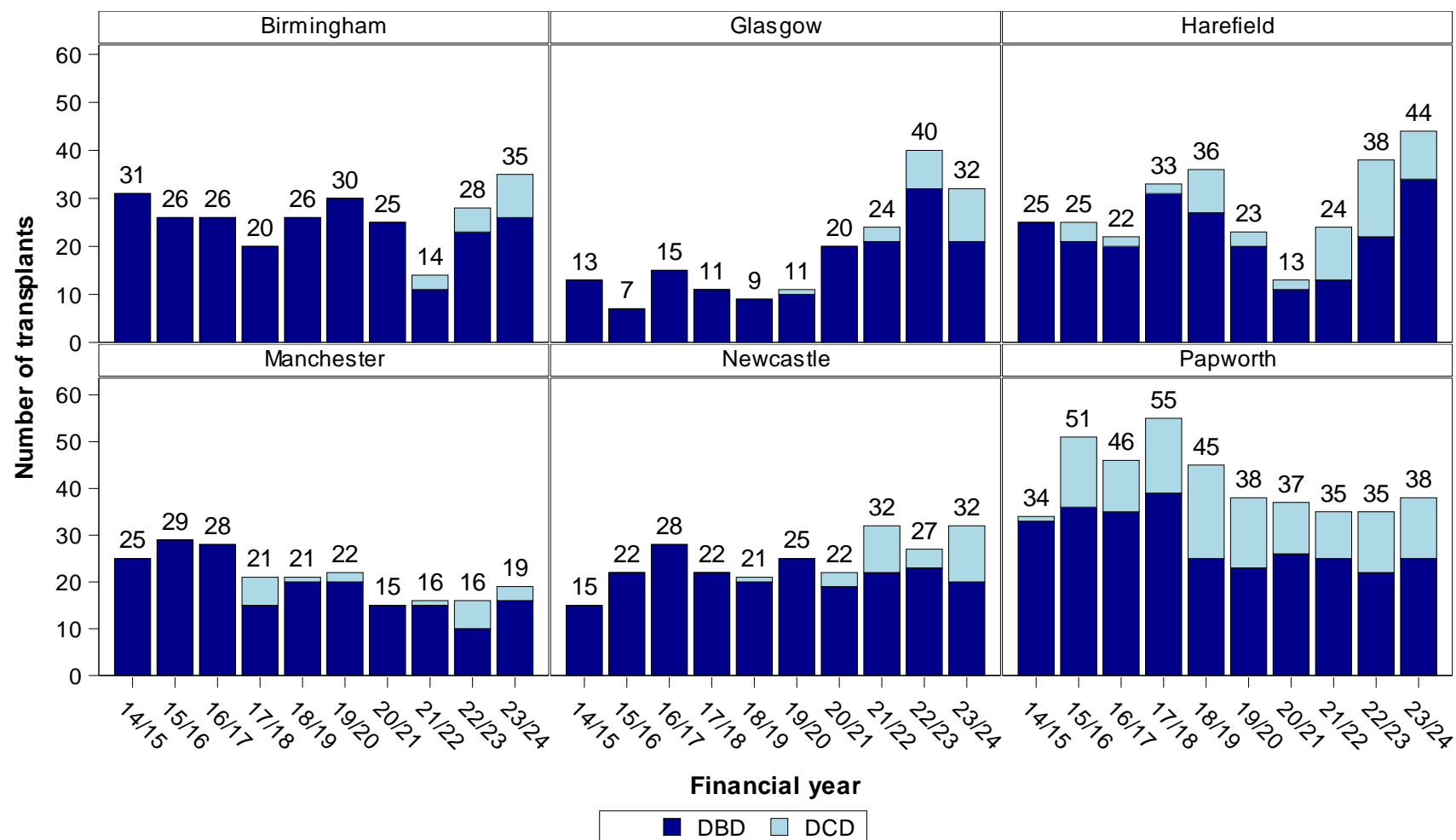
**Figure 5.1** shows the number of adult heart transplants performed per year over the last ten years, by donor type. Last year there were 200 adult heart transplants nationally, 16 more than the previous year and the most active year over the last decade, with DCD heart transplants comprising 29%.

**Figure 5.1** Number of adult heart transplants in the UK, by financial year and donor type, 1 April 2014 to 31 March 2024



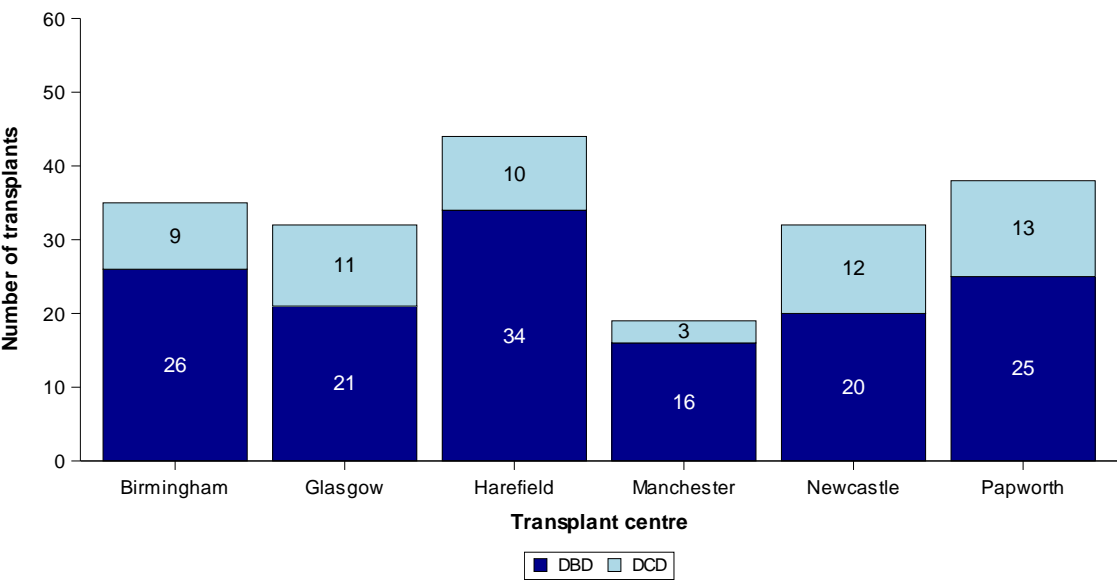
**Figure 5.2** shows the number of adult heart transplants performed per centre, per year, over the last ten years, by donor type. Harefield, Glasgow and Newcastle have had recent increases in the annual number of transplants performed.

**Figure 5.2 Number of adult heart transplants in the UK, by financial year, centre and donor type, 1 April 2014 to 31 March 2024**



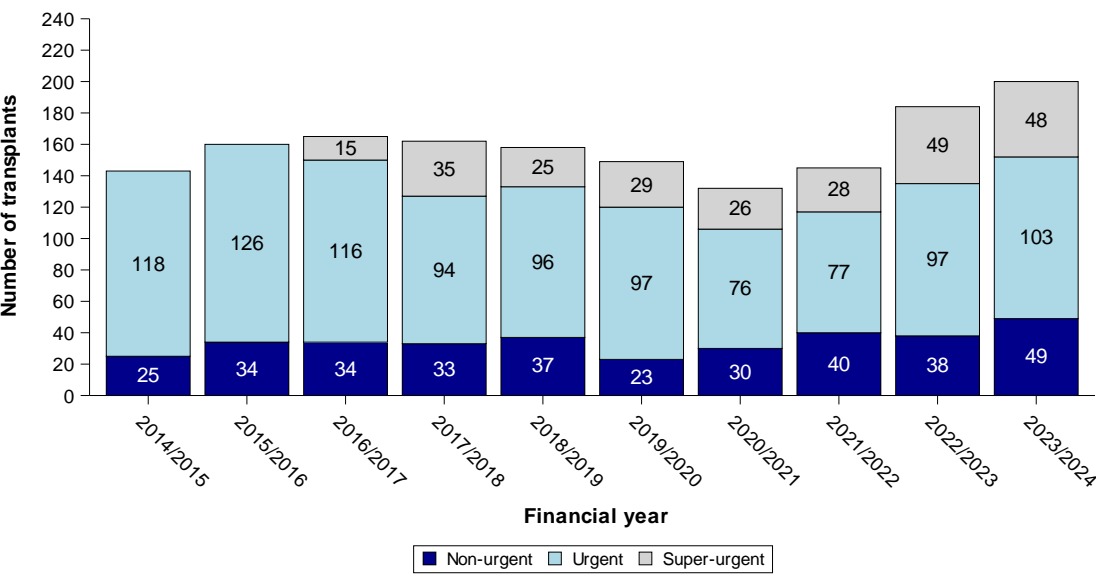
Last year’s activity is shown by centre and donor type in **Figure 5.3**. The highest number of DBD transplants were performed by Harefield and the highest number of DCD transplants were performed by Papworth.

**Figure 5.3** Number of adult heart transplants in the UK, by centre and donor type, 1 April 2023 to 31 March 2024

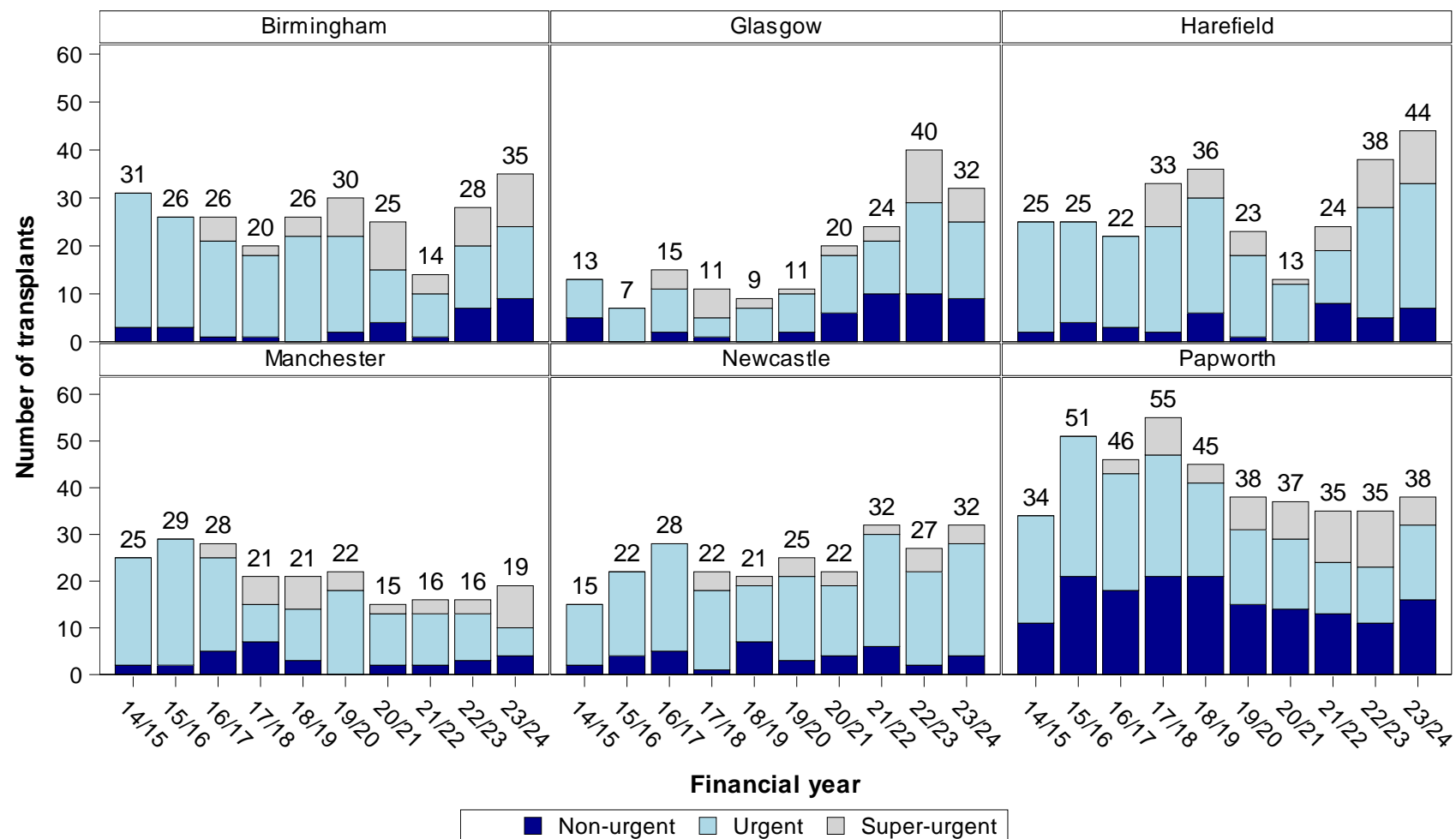


**Figure 5.4** and **5.5** show the number of adult heart transplants performed in the last ten years, by urgency status of recipient, nationally and by centre, respectively. Over the decade, the proportion of non-urgent transplants has increased slightly; from 17% in 2014/2015 to 24% in 2023/2024. Papworth performed the highest number of non-urgent transplants over the time period.

**Figure 5.4** Number of adult heart transplants in the UK, by financial year and urgency status, 1 April 2014 to 31 March 2024

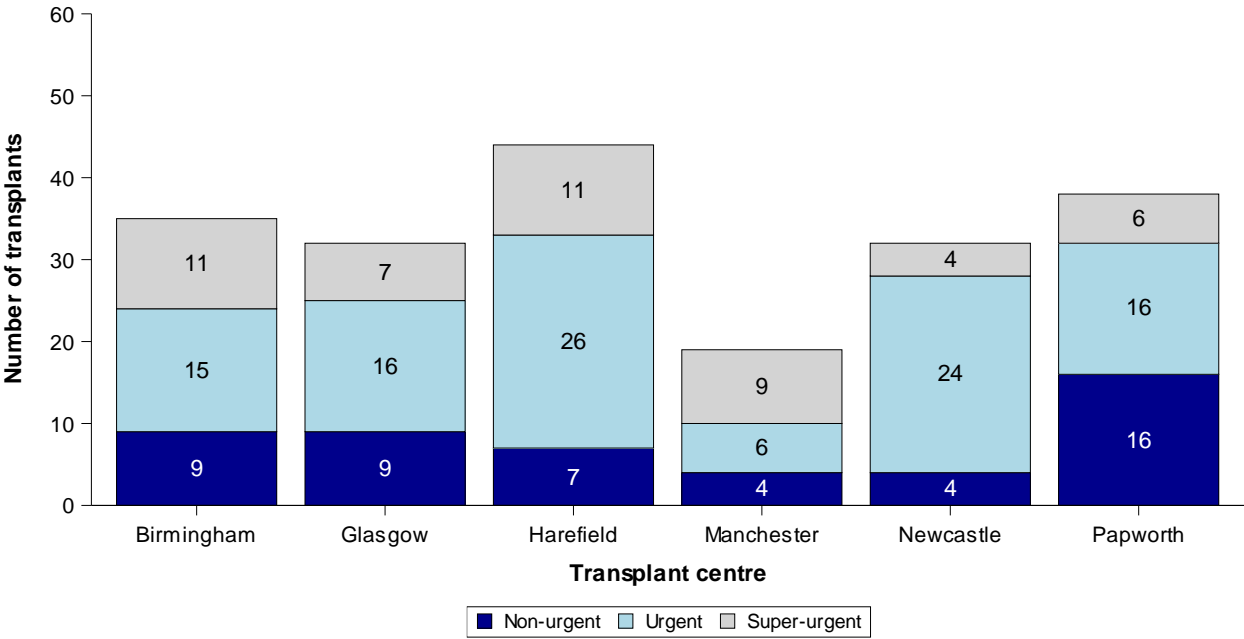


**Figure 5.5 Number of adult heart transplants in the UK, by financial year centre and urgency status, 1 April 2014 to 31 March 2024**



Last year’s activity is shown by centre and urgency status in **Figure 5.6**. Birmingham and Harefield performed the highest number of super-urgent transplants.

**Figure 5.6    Number of adult heart transplants in the UK, by centre and urgency status, 1 April 2023 to 31 March 2024**





## 5.2 Demographic characteristics of transplants, 1 April 2023 – 31 March 2024

The demographic characteristics of the 200 adult heart transplant recipients and donors in the latest year are shown by centre and overall, in **Table 5.1**. Nationally, 74% of heart recipients were male and the [median](#) age was 49 years while the median age of donors was 37 years. For some characteristics, due to rounding, percentages may not add up to 100.

<b>Table 5.1 Demographic characteristics of UK adult heart transplants performed between 1 April 2023 and 31 March 2024, by centre</b>								
		Birmingham N (%)	Glasgow N (%)	Harefield N (%)	Manchester N (%)	Newcastle N (%)	Papworth N (%)	TOTAL N (%)
Number of transplants		35 (100)	32 (100)	44 (100)	19 (100)	32 (100)	38 (100)	<b>200 (100)</b>
Urgency status at transplant	Non-urgent	9 (26)	9 (28)	7 (16)	4 (21)	4 (13)	16 (42)	<b>49 (25)</b>
	Urgent	15 (43)	16 (50)	26 (59)	6 (32)	24 (75)	16 (42)	<b>103 (52)</b>
	Super-urgent	11 (31)	7 (22)	11 (25)	9 (47)	4 (13)	6 (16)	<b>48 (24)</b>
Recipient sex	Male	24 (69)	26 (81)	36 (82)	15 (79)	21 (66)	25 (66)	<b>147 (74)</b>
	Female	11 (31)	6 (19)	8 (18)	4 (21)	11 (34)	13 (34)	<b>53 (27)</b>
Recipient ethnicity	White	26 (74)	30 (94)	25 (57)	17 (89)	29 (91)	27 (71)	<b>154 (77)</b>
	Asian	6 (17)	0 (0)	13 (30)	1 (5)	3 (9)	6 (16)	<b>29 (15)</b>
	Black	2 (6)	0 (0)	5 (11)	1 (5)	0 (0)	3 (8)	<b>11 (6)</b>
	Other	1 (3)	1 (3)	1 (2)	0 (0)	0 (0)	1 (3)	<b>4 (2)</b>
	Missing	0 (0)	1 (3)	0 (0)	0 (0)	0 (0)	1 (3)	<b>2 (1)</b>
Recipient age (years)	Median (IQR)	50 (39, 58)	53 (43, 60)	48 (39, 57)	42 (29, 53)	49 (38, 54)	51 (40, 56)	<b>49 (39, 56)</b>
	Missing	0	0	0	0	0	0	<b>0</b>
Recipient weight (kg)	Median (IQR)	75 (66, 84)	84 (76, 92)	77 (68, 87)	79 (69, 87)	70 (62, 84)	76 (64, 83)	<b>78 (67, 86)</b>
	Missing	0	0	0	1	0	0	<b>1</b>
Recipient primary disease	Coronary heart disease	6 (17)	6 (19)	6 (14)	3 (16)	2 (6)	4 (11)	<b>27 (14)</b>
	Cardiomyopathy	23 (66)	24 (75)	30 (68)	14 (74)	16 (50)	28 (74)	<b>135 (68)</b>
	Congenital heart disease	2 (6)	0 (0)	5 (11)	0 (0)	13 (41)	2 (5)	<b>22 (11)</b>
	Other	4 (11)	2 (6)	3 (7)	2 (11)	1 (3)	4 (11)	<b>16 (8)</b>

Table 5.1		Demographic characteristics of UK adult heart transplants performed between 1 April 2023 and 31 March 2024, by centre						
		Birmingham N (%)	Glasgow N (%)	Harefield N (%)	Manchester N (%)	Newcastle N (%)	Papworth N (%)	TOTAL N (%)
NYHA class	II	0 (0)	0 (0)	2 (5)	0 (0)	0 (0)	1 (3)	3 (2)
	III	6 (17)	16 (50)	28 (64)	1 (5)	10 (31)	18 (47)	79 (40)
	IV	27 (77)	15 (47)	14 (32)	14 (74)	22 (69)	19 (50)	111 (56)
	Missing	2 (6)	1 (3)	0 (0)	4 (21)	0 (0)	0 (0)	7 (4)
Recipient in hospital	No	9 (26)	8 (25)	9 (20)	4 (21)	8 (25)	14 (37)	52 (26)
	Yes	26 (74)	24 (75)	35 (80)	15 (79)	24 (75)	24 (63)	148 (74)
In hospital, recipient on ventilator	No	26 (100)	24 (100)	34 (97)	15 (100)	24 (100)	24 (100)	147 (99)
In hospital, recipient VAD	None	16 (62)	21 (88)	25 (71)	4 (27)	20 (83)	16 (67)	102 (69)
	Left	2 (8)	1 (4)	1 (3)	2 (13)	3 (13)	2 (8)	11 (7)
	Right	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)	0 (0)	1 (1)
	Both	8 (31)	2 (8)	8 (23)	9 (60)	1 (4)	6 (25)	34 (23)
In hospital, recipient TAH	No	26 (100)	24 (100)	35 (100)	15 (100)	24 (100)	24 (100)	148 (100)
In hospital, recipient ECMO	No	25 (96)	20 (83)	35 (100)	15 (100)	24 (100)	24 (100)	143 (97)
	Yes	1 (4)	4 (17)	0 (0)	0 (0)	0 (0)	0 (0)	5 (3)
In hospital, recipient on inotropes	No	6 (23)	0 (0)	7 (20)	9 (60)	3 (13)	8 (33)	33 (22)
	Yes	19 (73)	24 (100)	28 (80)	5 (33)	21 (88)	16 (67)	113 (76)
	Missing	1 (4)	0 (0)	0 (0)	1 (7)	0 (0)	0 (0)	2 (1)
In hospital, recipient IABP	No	26 (100)	16 (67)	35 (100)	14 (93)	24 (100)	24 (100)	139 (94)
	Yes	0 (0)	8 (33)	0 (0)	1 (7)	0 (0)	0 (0)	9 (6)
Recipient CMV status	Negative	16 (46)	10 (31)	16 (36)	13 (68)	16 (50)	15 (39)	86 (43)
	Positive	19 (54)	22 (69)	28 (64)	6 (32)	16 (50)	22 (58)	113 (57)
	Missing	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3)	1 (1)
Recipient HCV status	Negative	35 (100)	32 (100)	44 (100)	18 (95)	32 (100)	38 (100)	199 (100)
	Missing	0 (0)	0 (0)	0 (0)	1 (5)	0 (0)	0 (0)	1 (1)

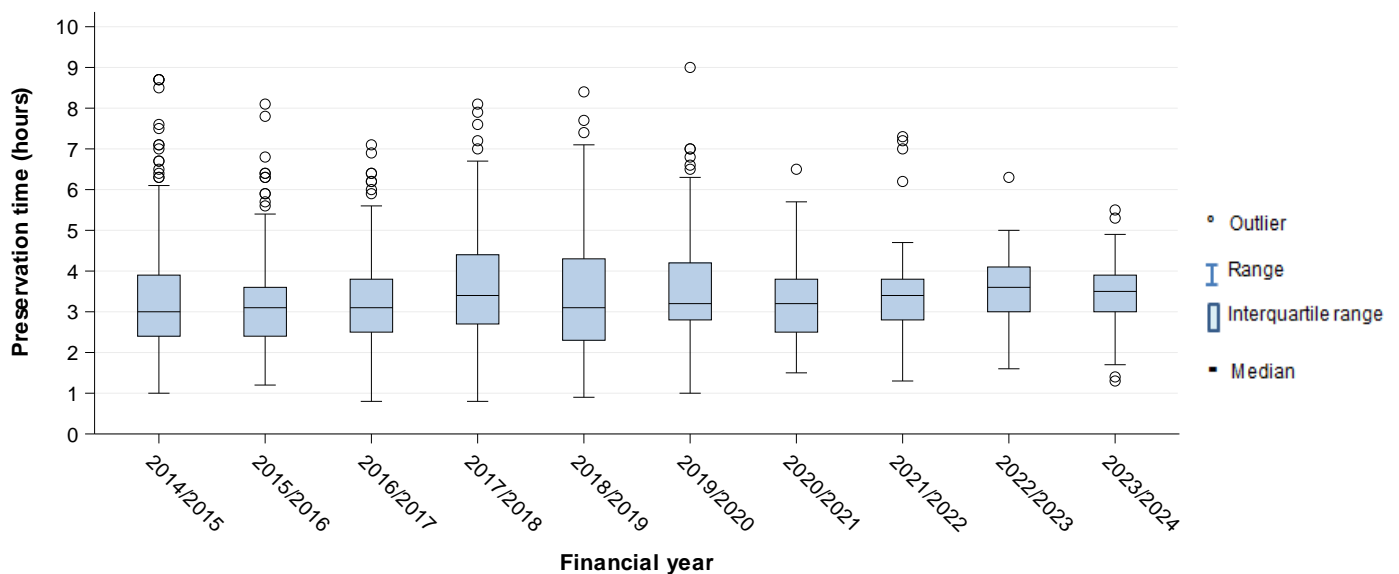
Table 5.1 Demographic characteristics of UK adult heart transplants performed between 1 April 2023 and 31 March 2024, by centre								
		Birmingham N (%)	Glasgow N (%)	Harefield N (%)	Manchester N (%)	Newcastle N (%)	Papworth N (%)	TOTAL N (%)
Recipient HBV status	Negative	34 (97)	32 (100)	44 (100)	18 (95)	32 (100)	38 (100)	<b>198 (99)</b>
	Positive	1 (3)	0 (0)	0 (0)	1 (5)	0 (0)	0 (0)	<b>2 (1)</b>
Recipient HIV status	Negative	35 (100)	32 (100)	44 (100)	19 (100)	32 (100)	38 (100)	<b>200 (100)</b>
Recipient serum creatinine (umol/l)	Median (IQR)	80 (59, 106)	105 (88, 123)	114 (80, 130)	61 (46, 96)	110 (79, 131)	104 (73, 144)	<b>98 (72, 123)</b>
	Missing	0	1	0	0	0	0	<b>1</b>
Donor sex	Male	21 (60)	18 (56)	28 (64)	13 (68)	23 (72)	27 (71)	<b>130 (65)</b>
	Female	14 (40)	14 (44)	16 (36)	6 (32)	9 (28)	11 (29)	<b>70 (35)</b>
Donor ethnicity	White	31 (89)	32 (100)	41 (93)	16 (84)	28 (88)	32 (84)	<b>180 (90)</b>
	Asian	2 (6)	0 (0)	2 (5)	1 (5)	1 (3)	0 (0)	<b>6 (3)</b>
	Black	0 (0)	0 (0)	0 (0)	0 (0)	2 (6)	2 (5)	<b>4 (2)</b>
	Other	1 (3)	0 (0)	1 (2)	1 (5)	0 (0)	3 (8)	<b>6 (3)</b>
	Missing	1 (3)	0 (0)	0 (0)	1 (5)	1 (3)	1 (3)	<b>4 (2)</b>
Donor age (years)	Median (IQR)	40 (27, 50)	38 (26, 49)	38 (27, 51)	38 (32, 44)	33 (24, 39)	36 (26, 44)	<b>37 (27, 47)</b>
	Missing	0	0	0	0	0	0	<b>0</b>
Donor BMI (kg/m <sup>2</sup> )	Median (IQR)	26 (24, 30)	27 (26, 31)	25 (22, 29)	25 (22, 26)	25 (22, 28)	27 (24, 31)	<b>26 (23, 29)</b>
	Missing	0	0	0	0	0	0	<b>0</b>
Donor cause of death	Intracranial/CVA	28 (80)	27 (84)	37 (84)	17 (89)	28 (88)	34 (89)	<b>171 (86)</b>
	Trauma	3 (9)	0 (0)	1 (2)	1 (5)	4 (13)	2 (5)	<b>11 (6)</b>
	Others	4 (11)	5 (16)	6 (14)	1 (5)	0 (0)	2 (5)	<b>18 (9)</b>
Donor hypotension	No	27 (77)	27 (84)	42 (95)	10 (53)	9 (28)	33 (87)	<b>148 (74)</b>
	Yes	6 (17)	2 (6)	1 (2)	8 (42)	6 (19)	4 (11)	<b>27 (14)</b>
	Missing	2 (6)	3 (9)	1 (2)	1 (5)	17 (53)	1 (3)	<b>25 (13)</b>
Donor history of diabetes	No	33 (94)	31 (97)	44 (100)	18 (95)	32 (100)	37 (97)	<b>195 (98)</b>
	Yes	1 (3)	1 (3)	0 (0)	1 (5)	0 (0)	1 (3)	<b>4 (2)</b>
	Missing	1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<b>1 (1)</b>

Table 5.1 Demographic characteristics of UK adult heart transplants performed between 1 April 2023 and 31 March 2024, by centre								
		Birmingham N (%)	Glasgow N (%)	Harefield N (%)	Manchester N (%)	Newcastle N (%)	Papworth N (%)	TOTAL N (%)
Donor history of cardiac disease	No	35 (100)	32 (100)	43 (98)	18 (95)	29 (91)	37 (97)	<b>194 (97)</b>
	Yes	0 (0)	0 (0)	1 (2)	1 (5)	2 (6)	1 (3)	<b>5 (3)</b>
	Missing	0 (0)	0 (0)	0 (0)	0 (0)	1 (3)	0 (0)	<b>1 (1)</b>
Donor history of hypertension	No	30 (86)	28 (88)	41 (93)	16 (84)	31 (97)	35 (92)	<b>181 (91)</b>
	Yes	3 (9)	4 (13)	3 (7)	2 (11)	1 (3)	3 (8)	<b>16 (8)</b>
	Missing	2 (6)	0 (0)	0 (0)	1 (5)	0 (0)	0 (0)	<b>3 (2)</b>
Donor history of cancer/malignancy	No	34 (97)	32 (100)	44 (100)	17 (89)	30 (94)	37 (97)	<b>194 (97)</b>
	Yes	1 (3)	0 (0)	0 (0)	2 (11)	2 (6)	1 (3)	<b>6 (3)</b>
Donor current/past smoker	No	17 (49)	14 (44)	16 (36)	8 (42)	18 (56)	16 (42)	<b>89 (45)</b>
	Yes	18 (51)	18 (56)	28 (64)	10 (53)	14 (44)	22 (58)	<b>110 (55)</b>
	Missing	0 (0)	0 (0)	0 (0)	1 (5)	0 (0)	0 (0)	<b>1 (1)</b>
Total preservation time <sup>1</sup> (hours)	Median (IQR)	4.0 (3.4, 4.5)	3.4 (2.7, 4.4)	3.8 (3.0, 4.8)	3.8 (3.3, 4.3)	3.7 (3.2, 4.9)	4.1 (3.5, 4.7)	<b>3.8 (3.3, 4.7)</b>
	Missing	4	2	1	0	1	0	<b>8</b>
<sup>1</sup> Time from cross clamp in the donor to reperfusion in the recipient, regardless of donor type								

### 5.3 Total preservation time, 1 April 2014 – 31 March 2024

**Figure 5.7** shows [boxplots](#) of the total preservation time for [DBD](#) donor hearts transplanted into adult recipients over the last 10 years. The total preservation time is the difference between donor cross-clamp and recipient reperfusion and can be considered the out of body time. In cases where organ maintenance systems were used (13%) not all this time duration is ischaemic, and no adjustment has been made for this. The national [median](#) total preservation time has remained reasonably consistent over the last decade.

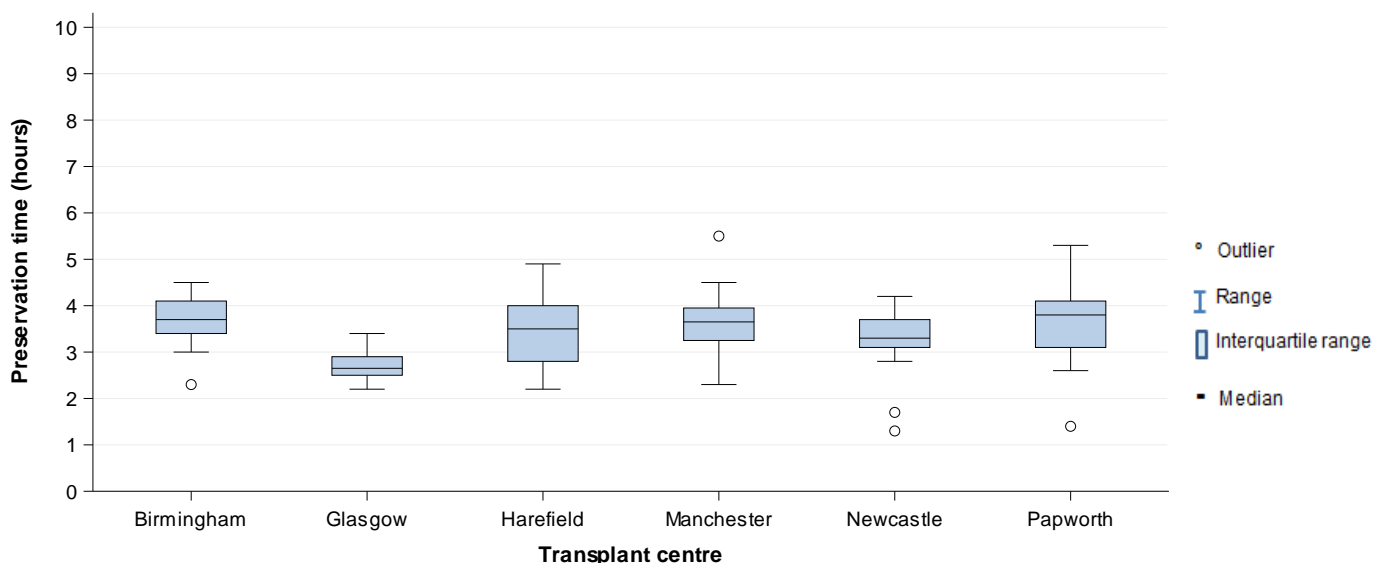
**Figure 5.7** Boxplots of total preservation time for DBD donor hearts transplanted into adult recipients, by financial year, 1 April 2014 to 31 March 2024



Note: Does not take into account use of donor organ maintenance systems which have been in use since 2014/2015

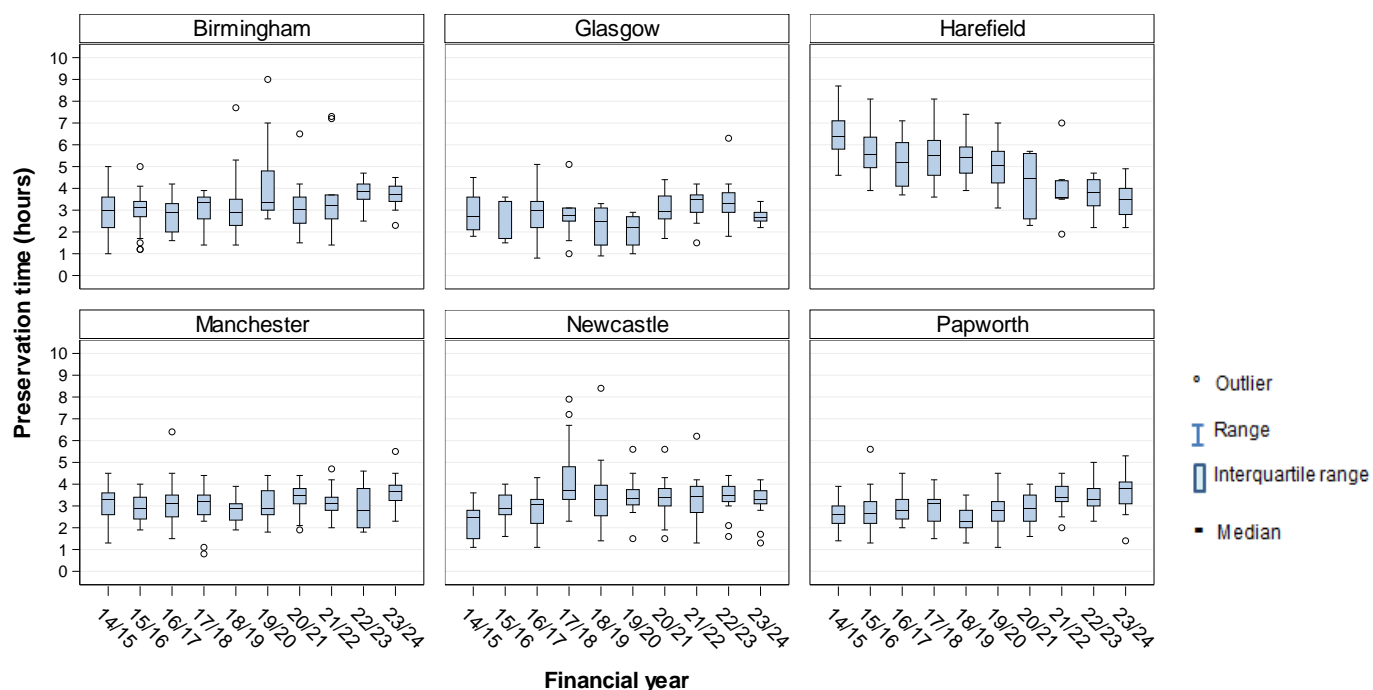
**Figure 5.8** and **Figure 5.9** show [boxplots](#) of total preservation time by centre in the latest financial year and over the last 10 years, respectively. Between 2014/2015 and 2019/2020, Harefield used the Organ Care System (OCS) for 100% of DBD hearts transplanted, explaining their longer total preservation times, compared with 1%-6% for other centres. In 2023/2024, hypothermic oxygenated perfusion (using XVIVO Heart Assist Transport™) was used in one [DBD](#) heart transplant performed at Papworth as part of a randomised controlled trial (ClinicalTrials.gov ID NCT03991923).

**Figure 5.8** Boxplots of total preservation time for DBD donor hearts transplanted into adult recipients, by transplant centre, 1 April 2023 to 31 March 2024



Hypothermic oxygenated perfusion was used in one DBD heart transplant at Papworth in this time period

**Figure 5.9** Boxplots of total preservation time for DBD donor hearts transplanted into adult recipients, by transplant centre and financial year, 1 April 2014 to 31 March 2024



Includes time on the Organ Care System (OCS), where most centres used the OCS in a small proportion of transplants, except Harefield who used the OCS in 100% of transplants from 2014/2015 to 2019/2020. Hypothermic oxygenated perfusion was used in one DBD heart transplant performed at Papworth in 2023/2024.

# **ADULT HEART TRANSPLANTATION**

## **Post-Transplant Survival**



## 6. Post-Transplant Survival


This section presents survival post adult heart transplantation. [Funnel plots](#) are used to compare the [risk-adjusted](#) survival rate at each centre with the national rate. The [risk-adjusted](#) rates seek to compare centre performance after accounting for differences in [case mix](#) across centres. The [unadjusted survival rates](#) are also presented in the tables, showing the observed survival experience at that centre. The [risk factors](#) used to produce the [risk-adjusted survival rates](#) are listed in [Appendix A3](#).

The survival analyses in **Section 6.1-6.3** include all first-time heart only transplants for the unadjusted analyses, and first time DBD heart only transplants for the risk-adjusted analyses. Ninety-day and 1-year [survival rates](#) are based on transplants performed in the period 1 April 2019 to 31 March 2023 while 5-year [survival rates](#) are based on transplants performed in the period 1 April 2015 to 31 March 2019. [Survival rates](#) are presented by transplant centre in **Tables 6.1-6.3** and **Figures 6.1-6.3**, by disease group in **Tables 6.4-6.5** and by [VAD](#) status at time of transplant in **Table 6.6**. Survival following DCD heart transplantation is provided separately in **Section 6.4** and survival outcomes following [multi-organ](#) heart transplantation are summarised in **Section 6.5**.

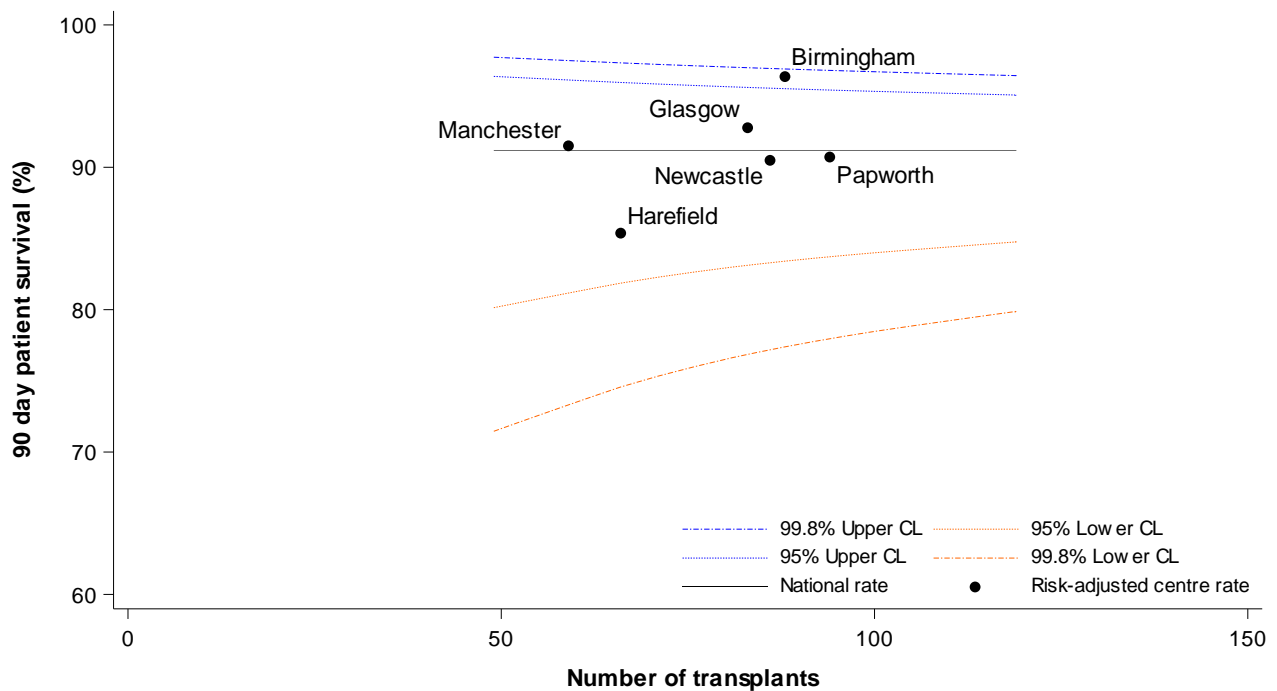


## 6.1 Survival by centre

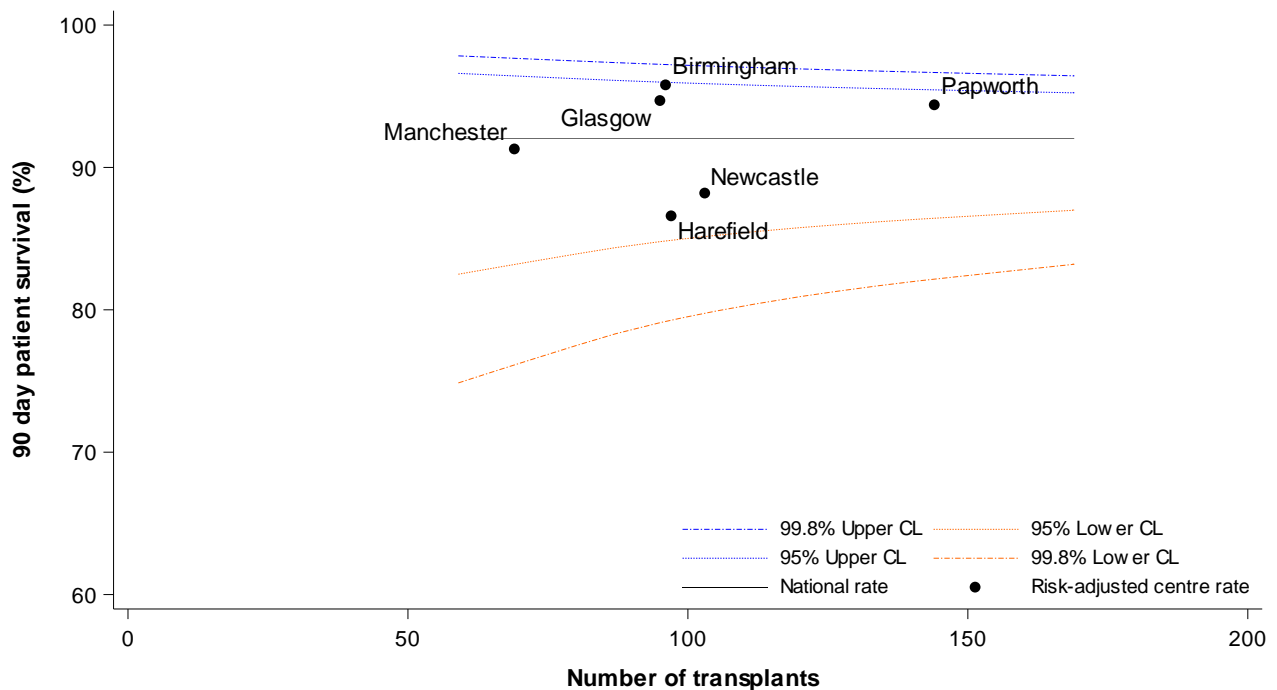
**Table 6.1, Figure 6.1a, and Figure 6.1b**, show the 90-day post-transplant [unadjusted](#) (DBD and DCD transplants) and [risk-adjusted](#) (DBD transplants only) patient [survival rates](#) for each centre and nationally for the 604 (478 DBD) first adult heart only transplants in the period 1 April 2019 to 31 March 2023. There was some evidence that Birmingham had a higher DBD patient survival rate at this time point, all other centres' DBD patient survival rates were statistically consistent with the national DBD rate of survival which was 91.2%. The overall (DBD and DCD) national patient survival rate at 90 days post-transplant was 92.0%.

<b>Table 6.1 90 day patient survival after first adult heart transplant, by centre, 1 April 2019 and 31 March 2023</b>						
Centre	Number of transplants	Unadjusted % 90 day survival (95% CI)		DBD transplants	Risk-adjusted % 90 day survival (95% CI)	
Birmingham	96	95.8	(89.3 - 98.4)	88	96.4	(88.7 - 98.8)
Glasgow	95	94.7	(87.8 - 97.8)	83	92.8	(82.6 - 97.0)
Harefield	97	86.6	(78.0 - 92.0)	66	85.4	(73.6 - 91.9)
Manchester	69	91.3	(81.7 - 96.0)	60	91.5	(79.6 - 96.5)
Newcastle	103	88.2	(80.2 - 93.1)	86	90.5	(82.8 - 94.7)
Papworth	144	94.4	(89.2 - 97.2)	95	90.7	(80.5 - 95.6)
<b>UK</b>	<b>604</b>	<b>92.0</b>	<b>(89.6 - 93.9)</b>	<b>478</b>	<b>91.2</b>	<b>(88.1 - 93.5)</b>
 <div> <p>Centre has reached the lower 99.8% confidence limit</p> <p>Centre has reached the lower 95% confidence limit</p> <p>Centre has reached the upper 95% confidence limit</p> <p>Centre has reached the upper 99.8% confidence limit</p> </div>						


**Figure 6.1a Risk-adjusted 90 day patient survival rates for adult DBD heart transplants, by centre, 1 April 2019 to 31 March 2023**



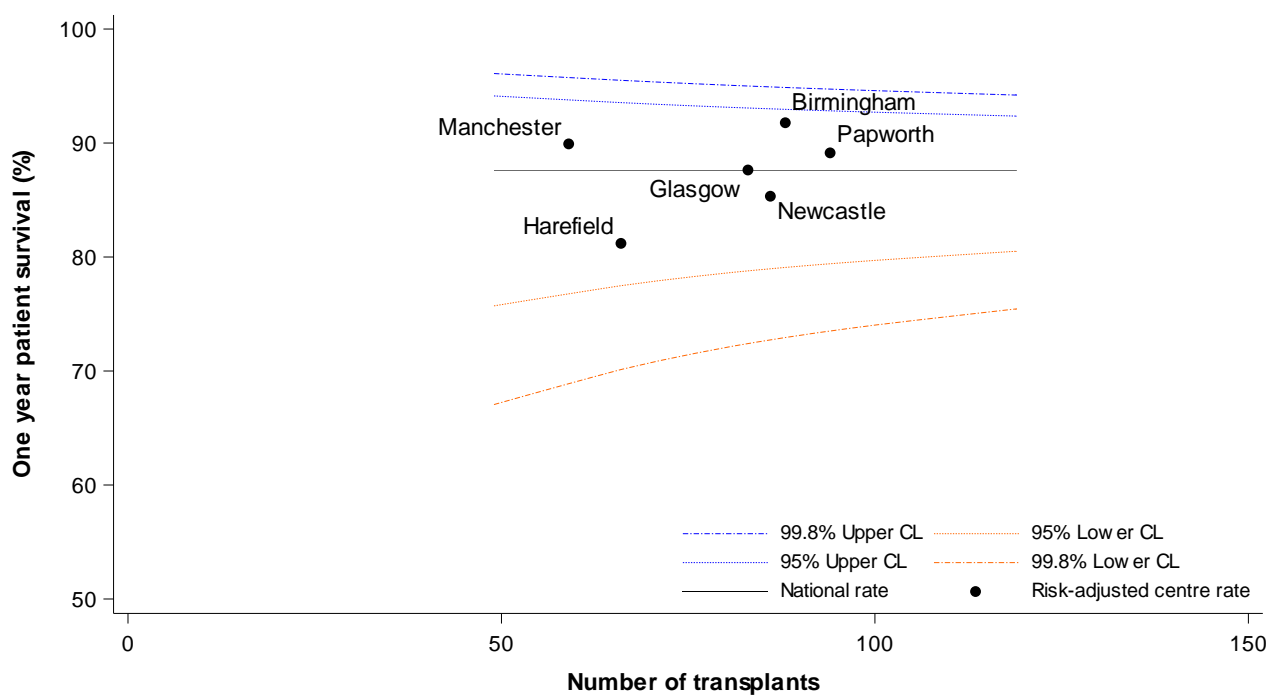
**Figure 6.1b Unadjusted 90 day patient survival rates for adult heart transplants, by centre, 1 April 2019 to 31 March 2023**



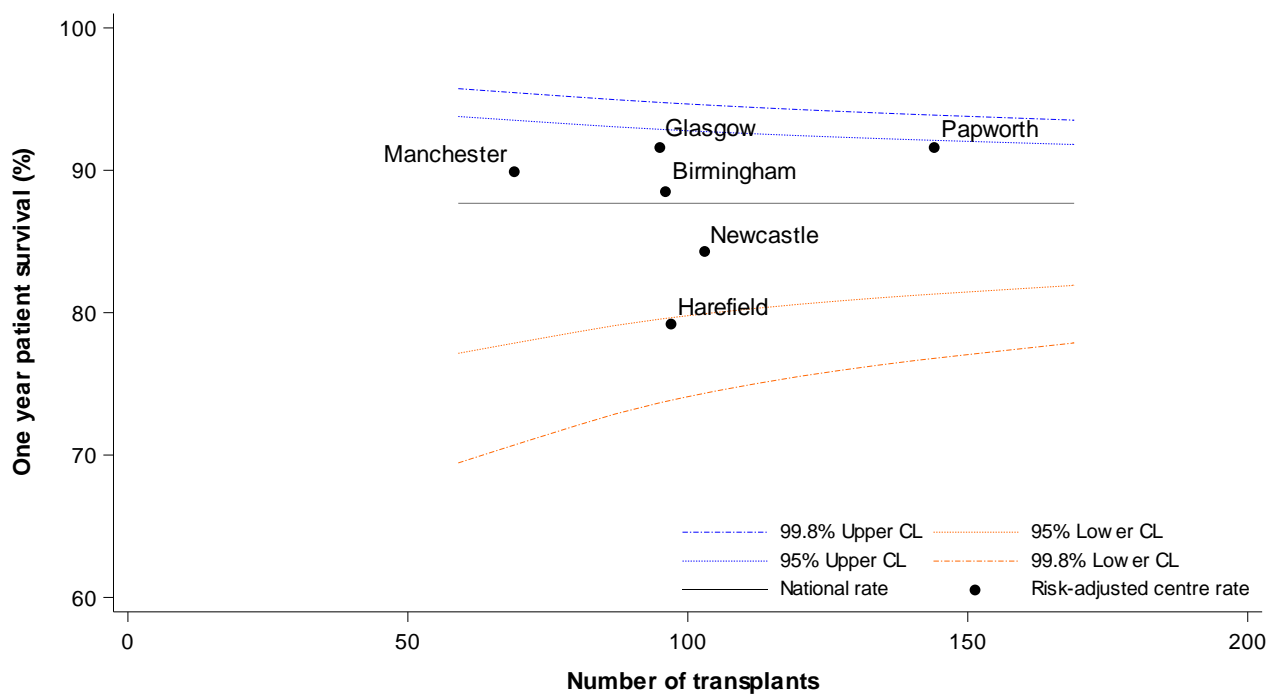
**Table 6.2, Figure 6.2a, and Figure 6.2b**, show the 1-year post-transplant [unadjusted](#) (DBD and DCD transplants) and [risk-adjusted](#) (DBD transplants only) patient [survival rates](#) for each centre and nationally for the 604 (478 DBD) first adult heart only transplants in the period 1 April 2019 to 31 March 2023. All centres' DBD patient survival rates were statistically consistent with the national DBD rate of survival which was 87.6%. The overall (DBD and DCD) national patient survival rate at 1 year post-transplant was 87.7%.

<b>Table 6.2 1 year patient survival after first adult heart transplant, by centre, 1 April 2019 and 31 March 2023</b>						
Centre	Number of transplants	Unadjusted % 1 year survival (95% CI)		DBD transplants	Risk-adjusted % 1 year survival (95% CI)	
Birmingham	96	88.5	(80.1 - 93.4)	88	91.8	(83.6 - 95.9)
Glasgow	95	91.6	(83.9 - 95.7)	83	87.6	(75.3 - 93.8)
Harefield	97	79.2	(69.6 - 86.1)	66	81.2	(67.6 - 89.1)
Manchester	69	89.9	(79.9 - 95.0)	60	89.9	(77.6 - 95.5)
Newcastle	103	84.3	(75.6 - 90.0)	86	85.3	(75.7 - 91.2)
Papworth	144	91.6	(85.8 - 95.2)	95	89.1	(79.1 - 94.3)
<b>UK</b>	<b>604</b>	<b>87.7</b>	<b>(84.8 - 90.1)</b>	<b>478</b>	<b>87.6</b>	<b>(84.0 - 90.4)</b>
 <div> <p>Centre has reached the lower 99.8% confidence limit</p> <p>Centre has reached the lower 95% confidence limit</p> <p>Centre has reached the upper 95% confidence limit</p> <p>Centre has reached the upper 99.8% confidence limit</p> </div>						


**Figure 6.2a Risk-adjusted one year patient survival rates for adult DBD heart transplants, by centre, 1 April 2019 to 31 March 2023**



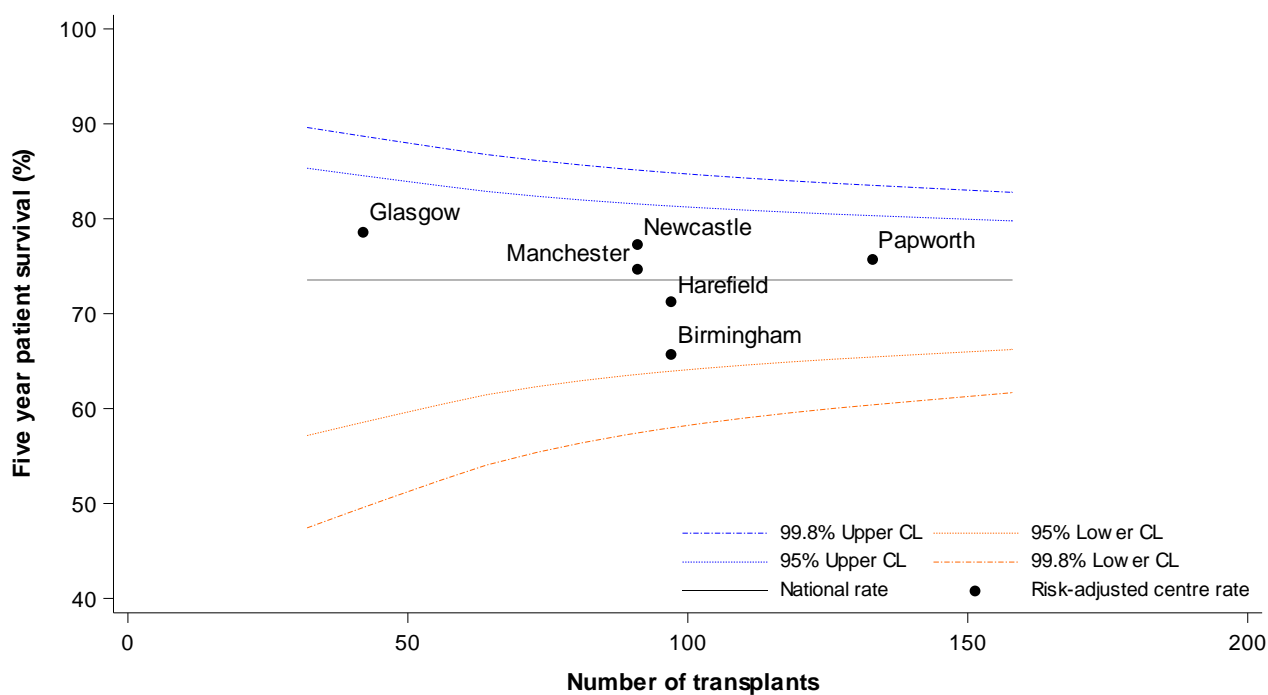
**Figure 6.2b Unadjusted one year patient survival rates for adult heart transplants, by centre, 1 April 2019 to 31 March 2023**



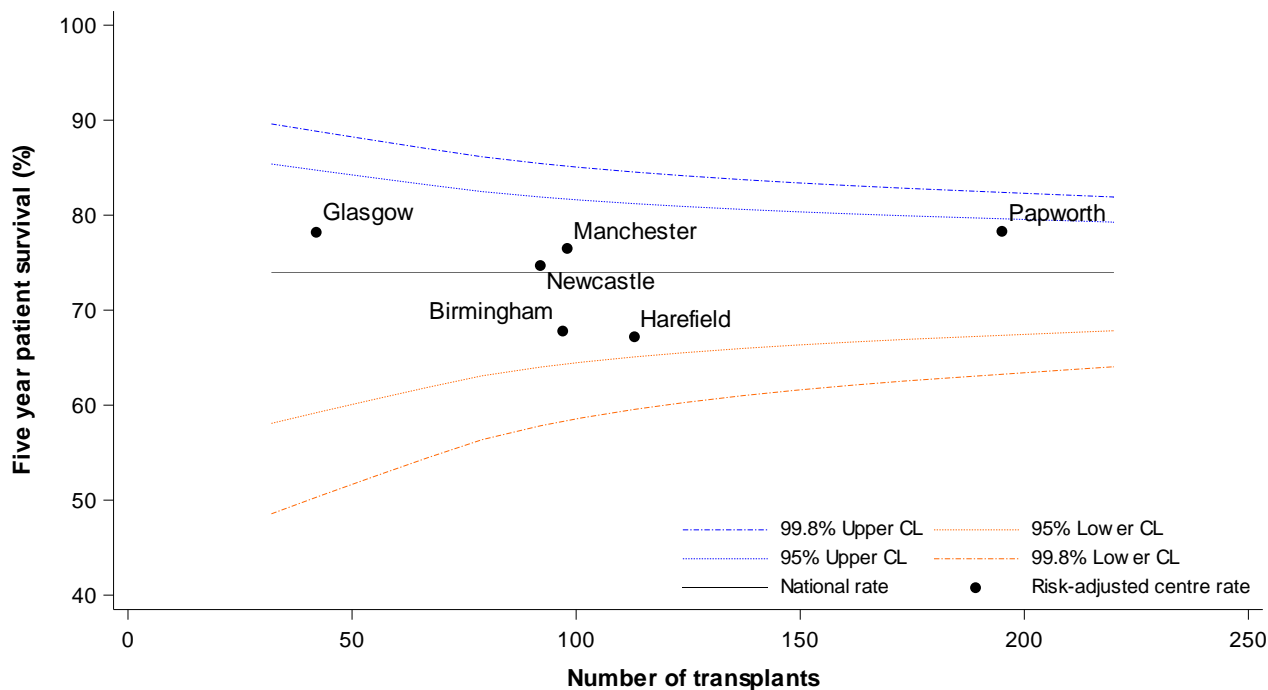
**Table 6.3, Figure 6.3a, and Figure 6.3b**, show the 5-year post-transplant [unadjusted](#) (DBD and DCD transplants) and [risk-adjusted](#) (DBD transplants only) patient [survival rates](#) for each centre and nationally for the 637 (551 DBD) first adult heart only transplants in the period 1 April 2015 to 31 March 2019. All centres' DBD patient survival rates were statistically consistent with the national DBD rate of survival which was 73.5%. The overall (DBD and DCD) national patient survival rate at 5 years post-transplant was 74.0%.

<b>Table 6.3 5 year patient survival after first adult heart transplant, by centre, 1 April 2015 and 31 March 2019</b>						
Centre	Number of transplants	Unadjusted % 5 year survival (95% CI)		DBD transplants	Risk-adjusted % 5 year survival (95% CI)	
Birmingham	97	67.8	(57.5 - 76.2)	97	65.7	(51.2 - 75.9)
Glasgow	42	78.2	(62.2 - 88.0)	42	78.6	(58.8 - 88.9)
Harefield	113	67.2	(57.7 - 75.0)	97	71.3	(59.1 - 79.8)
Manchester	98	76.5	(66.8 - 83.7)	91	74.7	(60.8 - 83.7)
Newcastle	92	74.7	(64.4 - 82.4)	91	77.3	(65.8 - 84.9)
Papworth	195	78.3	(71.8 - 83.5)	133	75.7	(65.5 - 82.9)
<b>UK</b>	<b>637</b>	<b>74.0</b>	<b>(70.3 - 77.2)</b>	<b>551</b>	<b>73.5</b>	<b>(68.9 - 77.5)</b>
 <div> <p>Centre has reached the lower 99.8% confidence limit</p> <p>Centre has reached the lower 95% confidence limit</p> <p>Centre has reached the upper 95% confidence limit</p> <p>Centre has reached the upper 99.8% confidence limit</p> </div>						

**Figure 6.3a Risk-adjusted five year patient survival rates for adult DBD heart transplants, by centre, 1 April 2015 to 31 March 2019**



**Figure 6.3b Unadjusted five year patient survival rates for adult heart transplants, by centre, 1 April 2015 to 31 March 2019**



## 6.2 Survival by disease group

Tables 6.4 and 6.5 present [unadjusted](#) and [risk-adjusted survival rates](#) by primary disease group, at 1 year and 5 years post-transplant, respectively. The [risk factors](#) used to produce the [risk-adjusted survival rates](#) are listed in [Appendix A3](#) (except centre was used in place of disease group). Recipients in the congenital heart disease group had a lower than average [risk-adjusted survival rate](#) at 5 years.

Table 6.4 1 year patient survival after first adult DBD heart transplant, by disease group, 1 April 2019 to 31 March 2023					
Disease group	Number of transplants	% 1 year survival (95% CI)			
		<a href="#">Unadjusted</a>		<a href="#">Risk-adjusted</a>	
Cardiomyopathy	346	86.9	(82.9 - 90.1)	86.6	(82.1 - 90.0)
Congenital heart disease	32	84.1	(66.0 - 93.1)	86.4	(67.3 - 94.3)
Coronary heart disease	88	90.9	(82.6 - 95.3)	91.5	(82.9 - 95.7)
Other/not reported	12	91.7	(53.9 - 98.8)	88.4	(17.7 - 98.4)
<b>UK</b>	<b>478</b>	<b>87.6</b>	<b>(84.3 - 90.3)</b>		

Table 6.5 5 year patient survival after first adult DBD heart transplant, by disease group, 1 April 2015 to 31 March 2019					
Disease group	Number of transplants	% 5 year survival (95% CI)			
		<a href="#">Unadjusted</a>		<a href="#">Risk-adjusted</a>	
Cardiomyopathy	400	75.1	(70.6 - 79.1)	75.2	(69.8 - 79.6)
Congenital heart disease	42	66.7	(50.3 - 78.7)	59.7	(32.0 - 76.1)
Coronary heart disease	80	68.6	(57.2 - 77.6)	70.7	(56.6 - 80.2)
Other/Not reported	29	75.6	(55.4 - 87.5)	76.3	(50.2 - 88.7)
<b>UK</b>	<b>551</b>	<b>73.5</b>	<b>(69.6 - 77.0)</b>		

### 6.3 Survival by VAD status

**Table 6.6** presents [unadjusted survival rates](#) by mechanical circulatory support ([MCS](#)) status at time of transplant at 90 days, and 1 year post-transplant, respectively. Short-term [MCS](#) includes CentriMag, percutaneous [VADs](#) and extracorporeal membrane oxygenation and long-term [MCS](#) includes implantable [VADs](#) for left, right and biventricular support and total artificial hearts. There was a significant difference in 90-day, and 1-year survival rates across [MCS](#) status in this [unadjusted](#) analysis (log-rank  $p < 0.0001$ ,  $p < 0.0001$ , and  $p = 0.0006$  respectively), with those on long-term support at time of transplant having inferior survival.

**Table 6.6 Unadjusted patient survival rates after first adult DBD heart transplant, by mechanical support status, 1 April 2019 and 31 March 2023**

Mechanical support status	Number of transplants	% 30 day survival (95% CI) <a href="#">Unadjusted</a>		% 90 day survival (95% CI) <a href="#">Unadjusted</a>		% 1 year survival (95% CI) <a href="#">Unadjusted</a>	
Short-term support	104	95.2	(88.8 – 98.0)	93.3	(86.4 - 96.7)	91.3	(84.0 - 95.4)
Long-term support	56	80.4	(67.3 - 88.6)	73.2	(59.6 - 82.9)	73.2	(59.6 - 82.9)
No support	318	95.6	(92.7 - 97.4)	93.7	(90.4 - 95.9)	88.9	(84.9 - 91.9)
<b>UK</b>	<b>478</b>	<b>93.7</b>	<b>(91.1 - 95.6)</b>	<b>91.2</b>	<b>(88.3 - 93.4)</b>	<b>87.6</b>	<b>(84.3 - 90.3)</b>



## 6.4 Survival post DCD heart transplant

Tables 6.7 - 6.8 present short-term patient [survival rates](#) following DCD heart only transplant, by centre and nationally, for the period 1 April 2015 to 31 March 2023.

**Table 6.7 90 day patient survival after first DCD adult heart transplant, by centre, 1 April 2015 and 31 March 2023**

Centre	Number of patients	Number of deaths	% 90 day survival (95% CI) ( <a href="#">unadjusted</a> )	
Birmingham <sup>1</sup>	8	1	-	-
Glasgow	12	0	100.0	-
Harefield	47	5	89.4	(76.3 - 95.4)
Manchester	16	2	87.5	(58.6 - 96.7)
Newcastle	18	1	94.4	(66.6 - 99.2)
Papworth	111	5	95.5	(89.5 - 98.1)
<b>UK</b>	<b>212</b>	<b>14</b>	<b>93.4</b>	<b>(89.1 – 96.0)</b>

<sup>1</sup> Survival rates for groups with less than 10 patients are not presented due to small numbers

**Table 6.8 1 year patient survival rates after first adult DCD heart only transplant, by centre, 1 April 2015 and 31 March 2023**

Centre	Number of patients	Number of deaths	% 1 year survival (95% CI) ( <a href="#">unadjusted</a> )	
Birmingham <sup>1</sup>	8	3	-	-
Glasgow	12	0	100.0	-
Harefield	47	12	74.1	(58.9 - 84.4)
Manchester	16	3	81.3	(52.5 - 93.5)
Newcastle	18	1	94.4	(66.6 - 99.2)
Papworth	111	9	91.9	(85.0 - 95.7)
<b>UK</b>	<b>212</b>	<b>28</b>	<b>86.7</b>	<b>(81.4 - 90.7)</b>

<sup>1</sup> Survival rates for groups with less than 10 patients are not presented due to small numbers

## 6.5 Survival post multi-organ heart transplant

The survival outcomes of the small number of recipients of multi-organ heart transplants are reported in **Table 6.9**, at 90 days and 1 year post transplant. This includes all first-time multi-organ transplants involving the heart, from DBD or DCD donors, between 1 April 2015 and 31 March 2023. It does not include heart-lung transplants which are reported in the Annual Report on Lung Transplantation.

<b>Table 6.9      Survival outcomes following multi-organ heart transplant performed between 1 April 2015 and 31 March 2023</b>			
Transplant type	Number of transplants	Number of patients alive at 90 days post-transplant	Number of patients alive at 1 year post-transplant
	N	N	N
Heart & kidney	4	3	3
Heart & liver	9	6	6

# **ADULT HEART TRANSPLANTATION**

## **Survival from Listing**



## 7. Survival from Listing

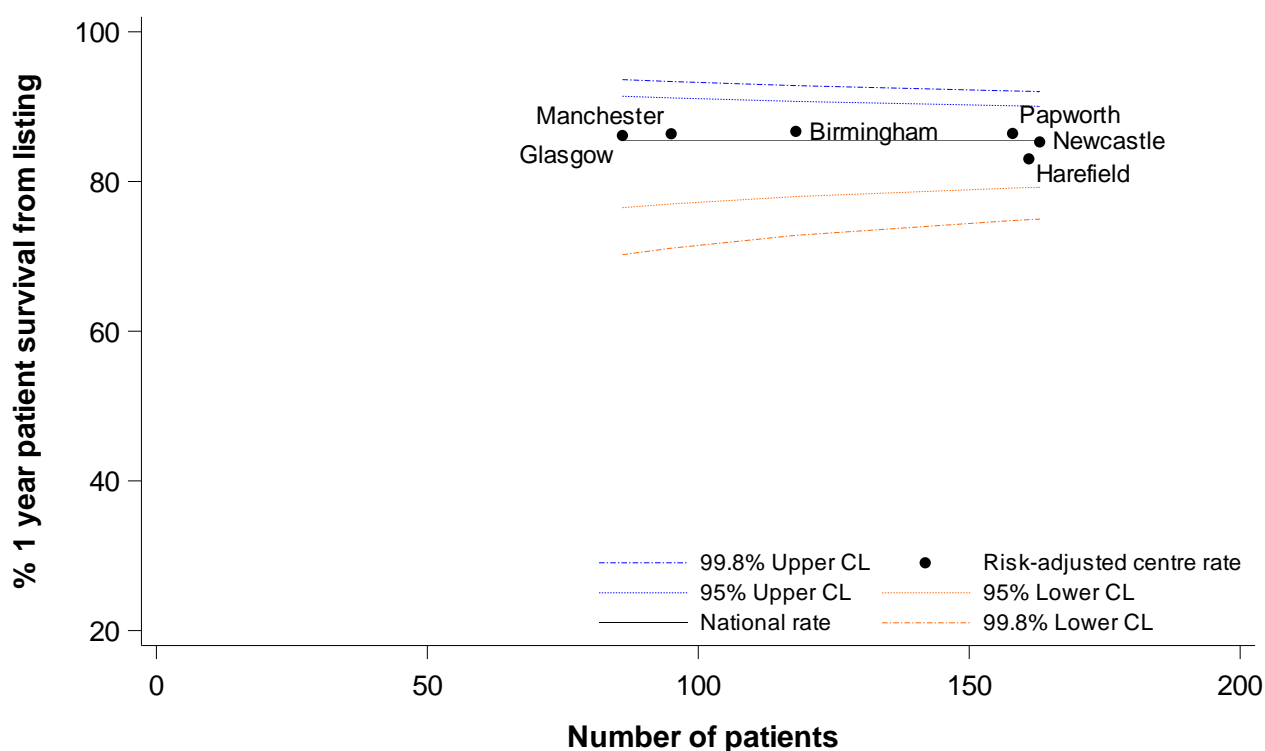
Survival from listing was analysed for patients 18 years or older registered for the first time for a heart transplant between 1 April 2019 and 31 March 2023 for one year survival, and 1 April 2015 and 31 March 2019 for five-year survival. Survival time was defined as the time from joining the transplant 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 e.g. donor type. Survival time was censored at the last known follow-up date post-transplant when no death date was recorded, or at time of analysis if the patient was still active on the transplant list, or at date of removal from the list for patients not receiving a transplant (unless removed due to deteriorating condition, in which case this was classed as an event). A review of the [risk factors](#) included in the survival from listing model was conducted in 2024 and the factors used to produce the [risk-adjusted survival rates](#) are listed in [Appendix A2.1](#).

One and five year [risk-adjusted survival rates](#) from the point of heart transplant listing are shown as [funnel plots](#) in **Figures 7.1** and **7.2**, respectively. These rates are also shown in **Tables 7.1** and **7.2**, respectively, along with the unadjusted rates. Note that the rates for one year and five-year survival are calculated from disjoint cohorts of patients, to allow for the full one- and five-year follow-up periods to elapse.

The rates of one year survival from listing for all centres was consistent with the national rate. The five-year survival rate for Papworth fell above the upper 95% [confidence limits](#), indicating somewhat higher five-year survival from listing at this centre. Newcastle's five-year survival rate fell below the lower 95% [confidence limits](#), indicating somewhat lower five-year survival from listing at this centre. All other centres had five-year survival from listing rates that were consistent with the national rate.

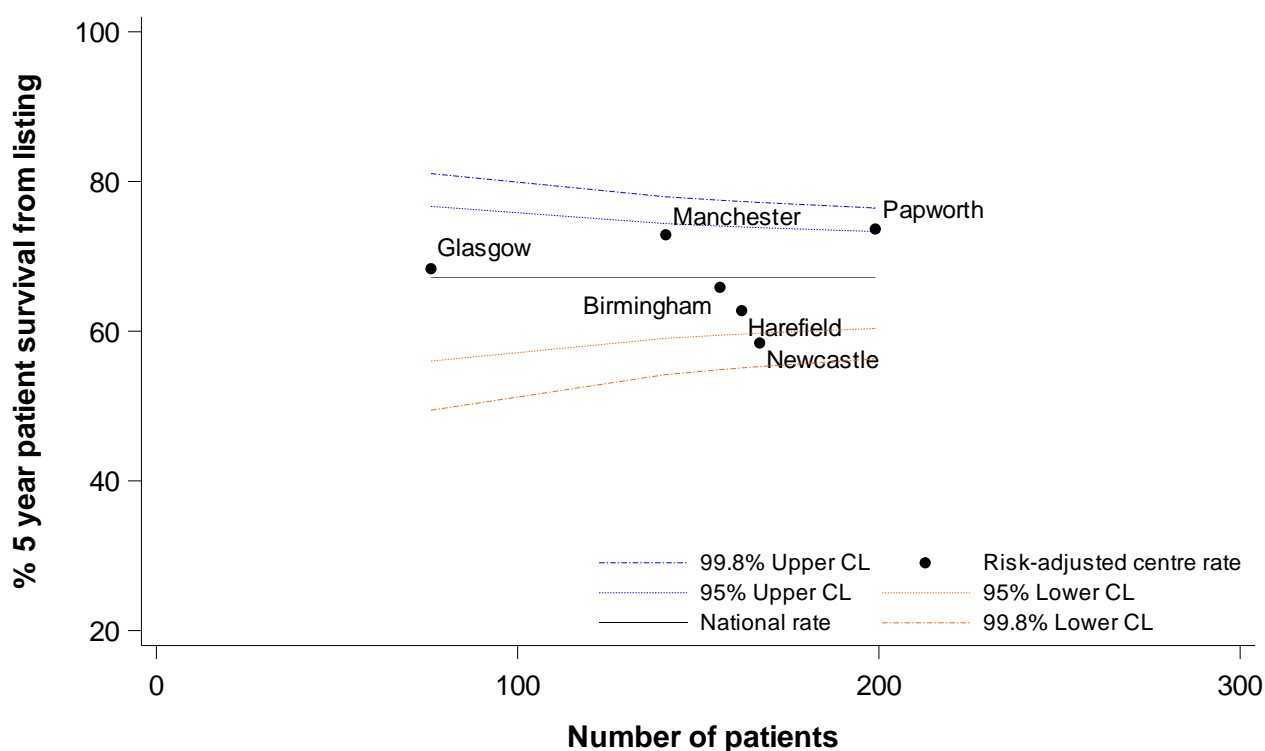
<b>Table 7.1      1 year patient survival from listing for patients registered between 1 April 2019 to 31 March 2023</b>					
Centre	Number of patients	Unadjusted % 1 year survival (95% CI)		Risk-adjusted % 1 year survival (95% CI)	
Birmingham	118	86.9	(79.2 - 91.9)	86.7	(80.9 - 90.7)
Glasgow	86	89.4	(80.6 - 94.3)	86.1	(80.4 - 90.2)
Harefield	161	78.4	(70.9 - 84.1)	83.0	(73.7 - 89.0)
Manchester	95	88.2	(79.7 - 93.3)	86.4	(80.6 - 90.4)
Newcastle	163	85.2	(78.6 - 89.9)	85.3	(80.4 - 89.0)
Papworth	158	87.8	(81.6 - 92.1)	86.4	(81.2 - 90.2)
<b>UK</b>	<b>781</b>	<b>85.5</b>	<b>(82.7 - 87.8)</b>		
<div style="display: flex; align-items: center;"> <div style="width: 20px; height: 10px; background-color: orange; margin-right: 5px;"></div> <div>Centre has reached the lower 99.8% confidence limit</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 10px; background-color: lightorange; margin-right: 5px;"></div> <div>Centre has reached the lower 95% confidence limit</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 10px; background-color: lightblue; margin-right: 5px;"></div> <div>Centre has reached the upper 95% confidence limit</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 10px; background-color: blue; margin-right: 5px;"></div> <div>Centre has reached the upper 99.8% confidence limit</div> </div>					

**Figure 7.1      Risk-adjusted one year patient survival rates from listing by centre, 1 April 2019 to 31 March 2023**



<b>Table 7.2      5 year patient survival from listing for patients registered between 1 April 2015 to 31 March 2019</b>					
Centre	Number of patients	Unadjusted % 5 year survival (95% CI)		Risk-adjusted % 5 year survival (95% CI)	
Birmingham	156	65.0	(56.4 - 72.3)	65.9	(56.5 - 73.2)
Glasgow	76	74.1	(62.5 - 82.7)	68.4	(56.5 - 77.0)
Harefield	162	59.2	(50.7 - 66.7)	62.7	(52.9 - 70.6)
Manchester	141	73.2	(64.9 - 79.8)	72.9	(64.2 - 79.5)
Newcastle	167	57.9	(49.9 - 65.1)	58.4	(46.8 - 67.5)
Papworth	199	75.6	(68.9 - 81.1)	73.7	(65.8 - 79.7)
<b>UK</b>	<b>901</b>	<b>67.2</b>	<b>(63.9 - 70.2)</b>		
<div style="display: flex; align-items: center;"> <div style="width: 20px; height: 10px; background-color: orange; margin-right: 5px;"></div> <div>Centre has reached the lower 99.8% confidence limit</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 10px; background-color: lightorange; margin-right: 5px;"></div> <div>Centre has reached the lower 95% confidence limit</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 10px; background-color: lightblue; margin-right: 5px;"></div> <div>Centre has reached the upper 95% confidence limit</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 20px; height: 10px; background-color: blue; margin-right: 5px;"></div> <div>Centre has reached the upper 99.8% confidence limit</div> </div>					

**Figure 7.2      Risk-adjusted five year patient survival rates from listing by centre, 1 April 2015 to 31 March 2019**



# **ADULT HEART TRANSPLANTATION**

## **Form Return Rates**



## 8. Adult heart form return rates, 1 January 2023 – 31 December 2023

Form return rates are reported in **Table 8.1** for the cardiothoracic transplant record and the three month and 1 year follow up form, along with lifetime follow up (2 years or more). These include all adult heart transplants between 1 January and 31 December 2023 for the transplant record, and all follow up forms issued in this time period. Centres highlighted are the currently active transplant centres. All active centres have a 95% or greater return rate for this period. Note that any skipped follow-up forms are counted as not returned.

Centre	Transplant record %		3 month follow-up %		1 year follow-up %		Lifetime follow-up %	
	N	Returned	N	Returned	N	Returned	N	Returned
Belfast, Belfast City Hospital	-	-	-	-	-	-	2	0
Birmingham, Queen Elizabeth Hospital	33	100	33	100	23	100	277	97
Exeter, Royal Devon And Exeter Hospital	-	-	-	-	-	-	1	0
Glasgow, Golden Jubilee Hospital	37	100	36	100	34	100	173	99
Harefield, Harefield Hospital	43	100	41	100	29	100	512	97
Manchester, Wythenshawe Hospital	14	100	13	100	16	100	275	99
Newcastle, Freeman Hospital	39	100	32	100	22	100	314	98
Oxford, John Radcliffe Hospital	-	-	-	-	-	-	1	100
Papworth, Papworth Hospital	35	100	37	100	33	100	633	96
Plymouth, Derriford Hospital	-	-	-	-	-	-	2	0
Sheffield, Northern General Hospital	-	-	-	-	-	-	32	97
Truro, Royal Cornwall Hospital	-	-	-	-	-	-	2	100
<b>Overall</b>	<b>201</b>	<b>100</b>	<b>192</b>	<b>100</b>	<b>157</b>	<b>100</b>	<b>2224</b>	<b>97</b>



# **PAEDIATRIC HEART TRANSPLANTATION**

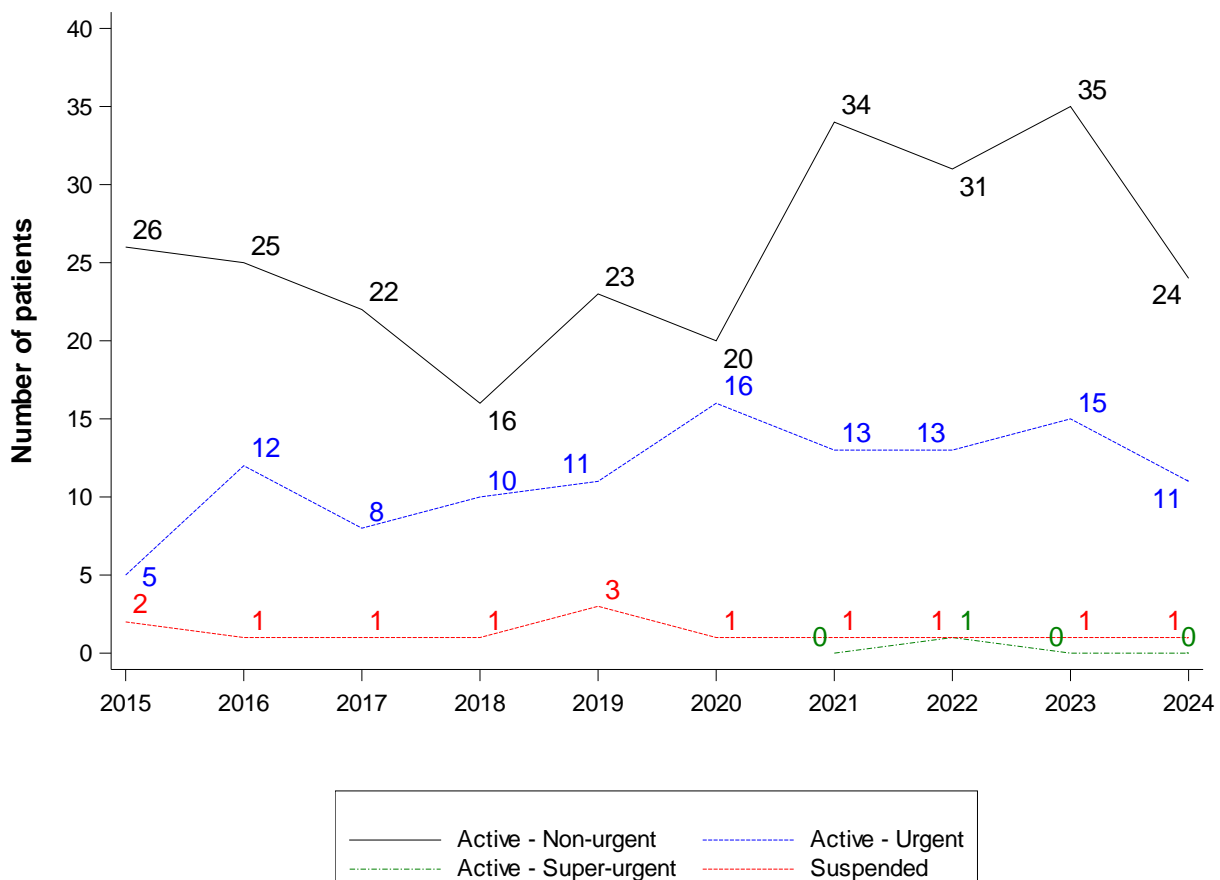
## **Transplant List**



## 9.1 Paediatric heart only transplant list on 31 March, 2015 – 2024

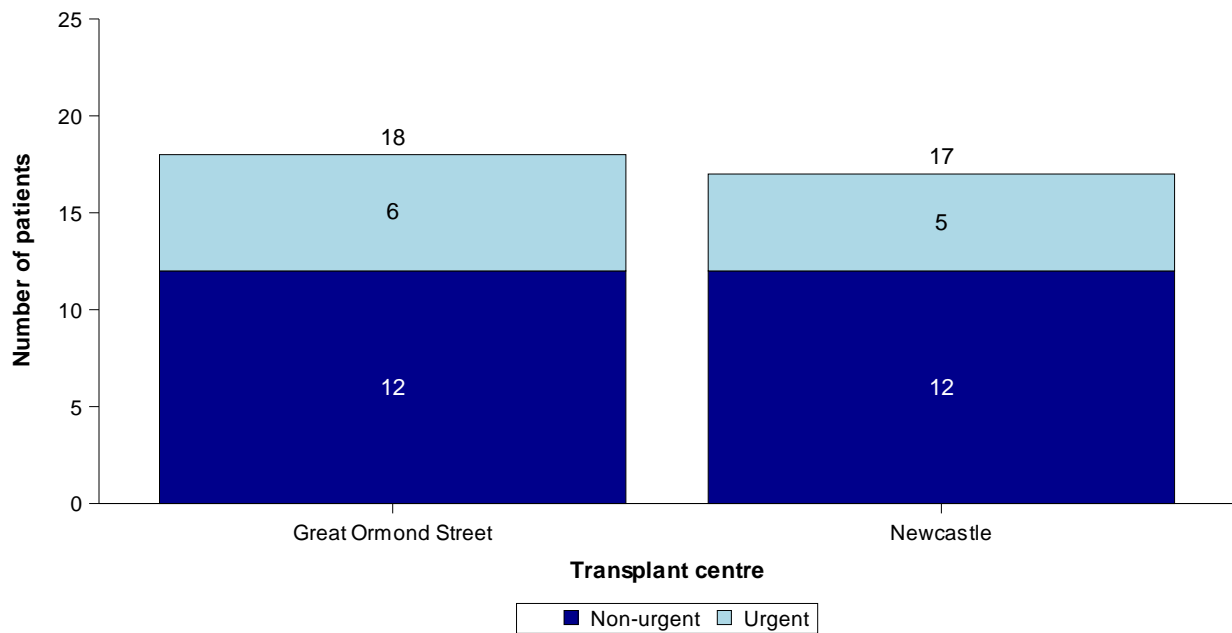
**Figure 9.1** shows the number of paediatric patients on the heart transplant list on 31 March each year between 2015 and 2024 split by urgency status. The number on the active non-urgent heart transplant list has generally increased over the decade but fell in the latest year, reaching 24 on 31 March 2024. There has also been a similar trend in the number on the urgent transplant list, with 11 urgent paediatric patients waiting on 31 March 2024. The paediatric super-urgent list was introduced in October 2020 and there were no paediatric patients waiting on this list on 31 March 2024.

**Figure 9.1 Number of paediatric patients on the heart transplant list at 31 March each year, by urgency status**

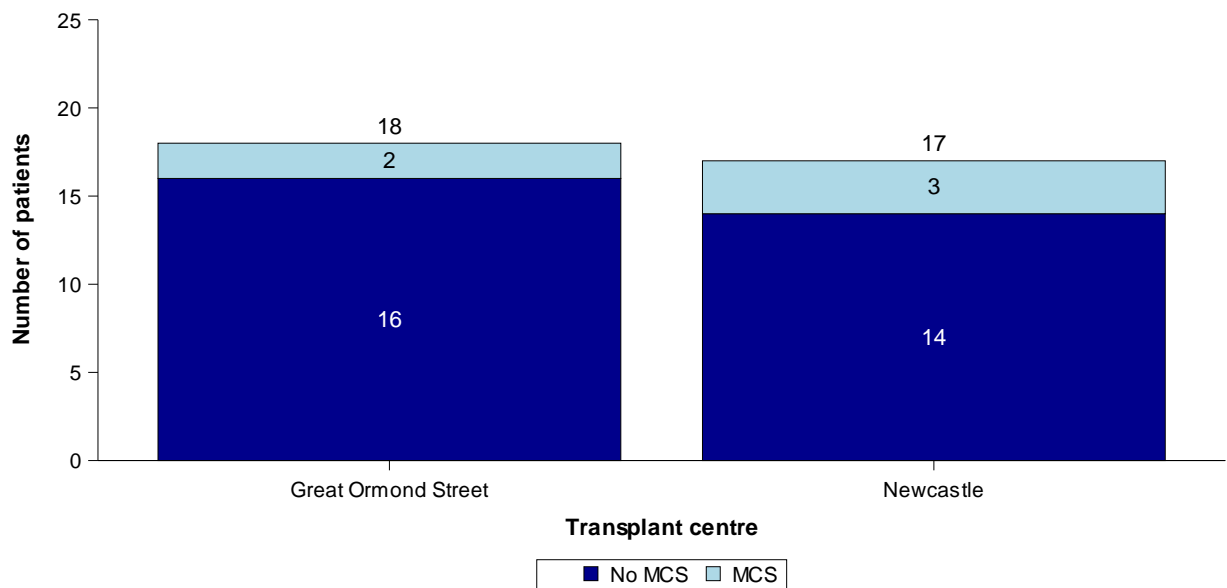


**Figure 9.2** shows the number of paediatric patients on the [active heart transplant list](#) at 31 March 2024 by centre and urgency. In total, there were 35 paediatric patients waiting; 18 at Great Ormond Street Hospital and 17 at Newcastle. **Figure 9.3** shows the number split by centre and mechanical circulatory support ([MCS](#)) status where [MCS](#) includes ventricular assist devices and extracorporeal membrane oxygenation. A total of 5 (14%) patients on the paediatric heart list were on [MCS](#) on 31 March 2024.

**Figure 9.2** Number of paediatric patients on the active heart transplant list at 31 March 2024, by centre and urgency

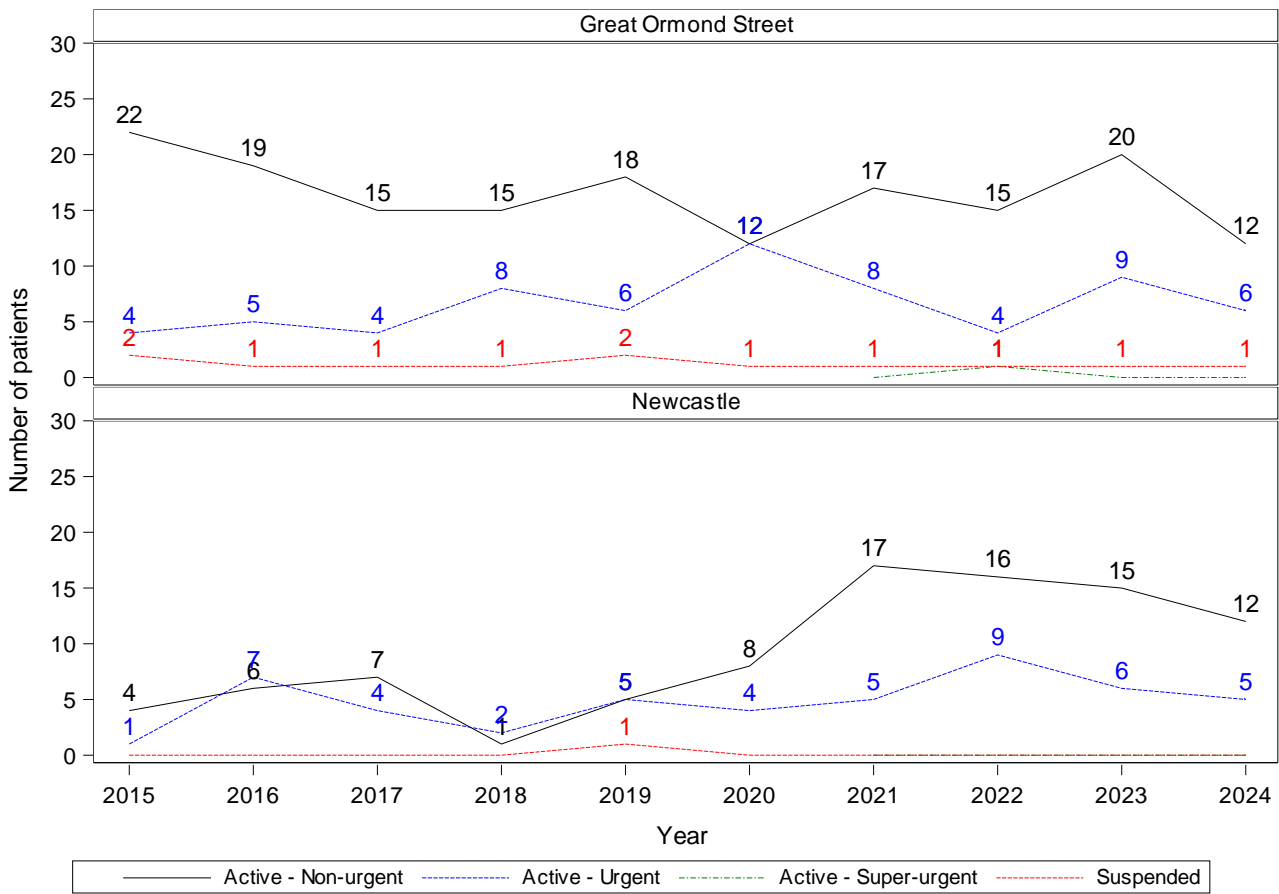


**Figure 9.3** Number of paediatric patients on the active heart transplant list at 31 March 2024, by centre and mechanical circulatory support status



**Figure 9.4** shows the trend over time in the number of paediatric patients on the heart transplant list on 31 March each year across each centre. Great Ormond Street Hospital's non-urgent list has reduced compared with 10 years ago, while their urgent list reached a peak in 2020 and has since fallen. Newcastle have seen a dramatic increase in their non-urgent list in recent years and their urgent list has also increased over the decade.

**Figure 9.4    Number of paediatric patients on the heart transplant list at 31 March each year, for the last 10 years, by centre and urgency status**



## 9.2 Demographic characteristics, 1 April 2023 – 31 March 2024

There were 35 paediatric registrations onto the heart transplant list between 1 April 2023 and 31 March 2024. Demographic characteristics of these individuals are shown by centre and overall, in **Table 9.1**. Nationally, 51% were male and the [median](#) age was 8 years. The most common primary disease group was cardiomyopathy. For some characteristics, due to rounding, percentages may not add up to 100.

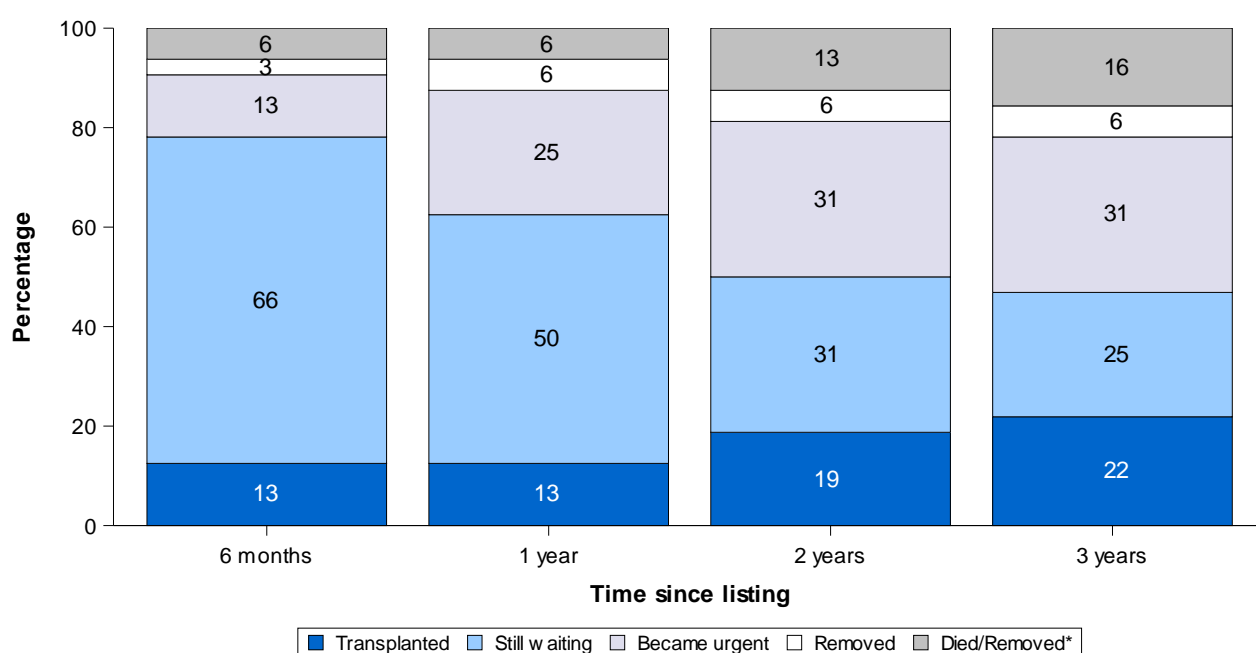
		Great Ormond Street N (%)	Newcastle N (%)	TOTAL N (%)
Number of registrations		18 (100)	17 (100)	35 (100)
Highest urgency during registration	Non-urgent	2 (11)	5 (29)	7 (20)
	Urgent	13 (72)	9 (53)	22 (63)
	Super-urgent	3 (17)	3 (18)	6 (17)
Recipient sex	Male	9 (50)	9 (53)	18 (51)
	Female	9 (50)	8 (47)	17 (49)
Recipient ethnicity	White	8 (44)	9 (53)	17 (49)
	Asian	6 (33)	3 (18)	9 (26)
	Black	3 (17)	3 (18)	6 (17)
	Other	1 (6)	1 (6)	2 (6)
	Missing	0 (0)	1 (6)	1 (3)
Recipient age (years)	Median (IQR)	12 (3, 13)	7 (2, 10)	8 (3, 13)
	Missing	0	0	0
Height (cm)	Median (IQR)	148 (97, 162)	122 (80, 137)	125 (84, 158)
	Missing	0	0	0
Weight (kg)	Median (IQR)	35 (13, 45)	21 (9, 25)	23 (11, 43)
	Missing	0	0	0
Primary Disease	Coronary heart disease	0 (0)	1 (6)	1 (3)
	Cardiomyopathy	13 (72)	9 (53)	22 (63)
	Congenital heart disease	4 (22)	7 (41)	11 (31)
	Other/Not reported	1 (6)	0 (0)	1 (3)
Previous open heart surgery	None	12 (67)	8 (47)	20 (57)
	One	0 (0)	3 (18)	3 (9)
	More than one	1 (6)	6 (35)	7 (20)
	Missing	5 (28)	0 (0)	5 (14)
Serum Bilirubin (umol/l)	Median (IQR)	15 (9, 28)	9 (8, 12)	11 (8, 24)
	Missing	6	0	6
Serum Creatinine (umol/l)	Median (IQR)	53 (30, 72)	45 (24, 66)	48 (26, 71)
	Missing	6	0	6

### 9.3 Post-registration outcomes, 1 April 2019 – 31 March 2021

The registration outcomes of paediatric patients listed for a heart transplant between 1 April 2019 and 31 March 2021 are summarised in **Figure 9.5** and **Figure 9.6**, for non-urgent and urgent registrations, respectively (super-urgent registration outcomes are not presented due to small numbers). The possible outcomes on the non-urgent or urgent list include receiving a transplant, removal from the list, moving lists, dying on the list, or remaining on the list at a given time point post-registration. Removals from the list due to deteriorating condition are grouped with deaths in this analysis. In these figures, the *first* outcome is used, so if an individual was transplanted then died their registration outcome would be “transplanted”. If they moved lists, e.g. from the non-urgent to the urgent list, they would be included in both the non-urgent and the urgent charts.

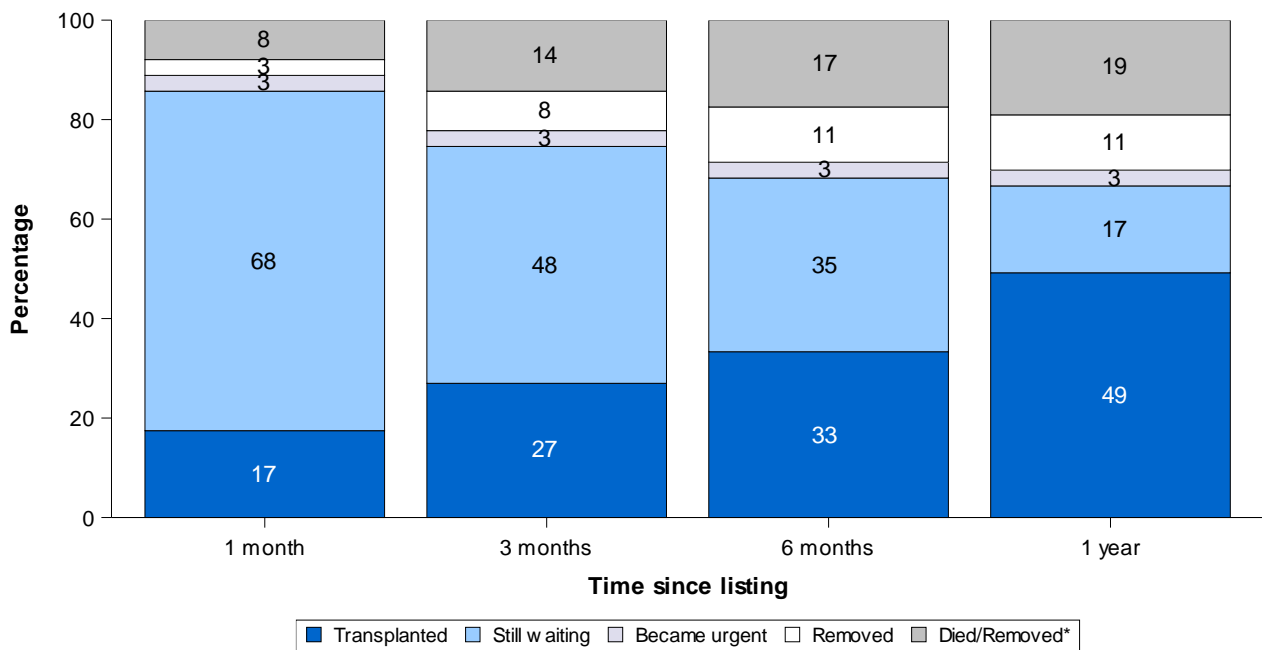
Within the first 6 months of listing, it is shown that 13% had received a transplant, 66% had been moved to the urgent list, 13% had been added to the urgent list, 3% had been removed from the list and 6% had died. At 3 years, 22% had been transplanted, 25% had been moved to the urgent list, 31% had been added to the urgent list, 6% had been removed from the list and 16% had died. As can be seen in **Figure 9.6**, paediatric patients have a greater chance of transplant on the urgent heart list compared to the non-urgent list, with 33% receiving a transplant by 6 months. Removals from the urgent list were mainly due to improved condition (excluding those removals due to deteriorating condition which are grouped with deaths).

**Figure 9.5 Post-registration outcome for 32 new non-urgent heart only registrations made in the UK, 1 April 2019 to 31 March 2021**



\*Removals due to condition deteriorating

**Figure 9.6 Post-registration outcome for 63 new urgent heart only registrations made in the UK, 1 April 2019 to 31 March 2021**



\*Removals due to condition deteriorating

## 9.4 Median waiting time to transplant, 1 April 2020 - 31 March 2023

**Table 9.2** shows the [median](#) waiting time to heart transplant from listing for paediatric patients registered between 1 April 2020 and 31 March 2023. This is estimated using the [Kaplan Meier](#) method and is split by urgency at initial registration; non-urgent or urgent. All waiting time from initial registration is considered, regardless of any change in urgency. Any suspended time is discounted.

The national [median](#) waiting time to paediatric heart transplant was 917 days from non-urgent registration and 204 days from urgent registration. The [median](#) waiting time to heart transplant for paediatric patients is also considered by blood group in **Table 9.3**. Median waiting time to super-urgent transplant is not presented due to small numbers.

<b>Table 9.2 Median active waiting time to heart transplant for paediatric patients registered on the transplant list, by urgency at registration and centre, 1 April 2020 to 31 March 2023</b>				
Transplant centre	Number registered	Number transplanted	Median	Waiting time (days) 95% Confidence interval
<b>Non-urgent at initial registration</b>				
Great Ormond Street	30	16	714	125 - 1303
Newcastle	22	10	960	881 - 1039
<b>UK</b>	<b>52</b>	<b>26</b>	<b>917</b>	<b>651 - 1183</b>
<b>Urgent at initial registration</b>				
Great Ormond Street	36	26	227	123 - 331
Newcastle	35	21	191	115 - 267
<b>UK</b>	<b>71</b>	<b>47</b>	<b>204</b>	<b>119 - 289</b>



**Table 9.3 Median active waiting time to heart transplant for paediatric patients registered on the transplant list, by urgency at registration and blood group, 1 April 2020 to 31 March 2023**

Blood Group	Number registered	Number transplanted	Waiting time (days)	
			Median	95% Confidence interval
Non-urgent at initial registration				
O <sup>1</sup>	29	10	-	-
A	12	10	320	142 - 498
B <sup>2</sup>	9	5	-	-
AB <sup>2</sup>	2	1	-	-
UK	52	26	917	651 - 1183
Urgent at initial registration				
O	30	19	277	161 - 393
A	27	19	191	0 - 428
B <sup>2</sup>	9	6	-	-
AB <sup>2</sup>	5	3	-	-
UK	71	47	204	119 - 289

<sup>1</sup> Median and 95% confidence intervals could not be calculated due to low transplant rate

<sup>2</sup> Median waiting time for groups with less than 10 are not presented due to small numbers

# **PAEDIATRIC HEART TRANSPLANTATION**

## **Response to Offers**



## 10. Response to Offers

**Table 10.1** compares individual centre paediatric heart offer decline rates over the three years between 1 April 2021 and 31 March 2024. This only considers offers of hearts from UK DBDs aged less than 16 that were eventually transplanted and excludes fast track offers. Hearts offered as part of a heart-lung block are included, which may be cases where just the heart was declined or where both the heart and lungs were declined. Non-urgent, urgent and super-urgent offers are all considered. Offers to adults at Newcastle are excluded.

The number of offers received per year from paediatric donors whose heart was donated is small. In 2023/2024, the overall decline rate for paediatric offers was 77.4%.

<b>Table 10.1 UK paediatric DBD donor heart offer decline rates by transplant centre and year, 1 April 2021 to 31 March 2024</b>								
Centre	2021/22		2022/23		2023/24		Overall	
	No. offers	Decline rate (%)	No. offers	Decline rate (%)	No. offers	Decline rate (%)	No. offers	Decline rate (%)
Great Ormond Street Hospital	15	(60.0)	14	(64.3)	17	(76.5)	46	(67.4)
Newcastle	14	(78.6)	10	(40.0)	14	(78.6)	38	(68.4)
<b>UK</b>	<b>29</b>	<b>(69.0)</b>	<b>24</b>	<b>(54.2)</b>	<b>31</b>	<b>(77.4)</b>	<b>84</b>	<b>(67.9)</b>

# **PAEDIATRIC HEART TRANSPLANTATION**

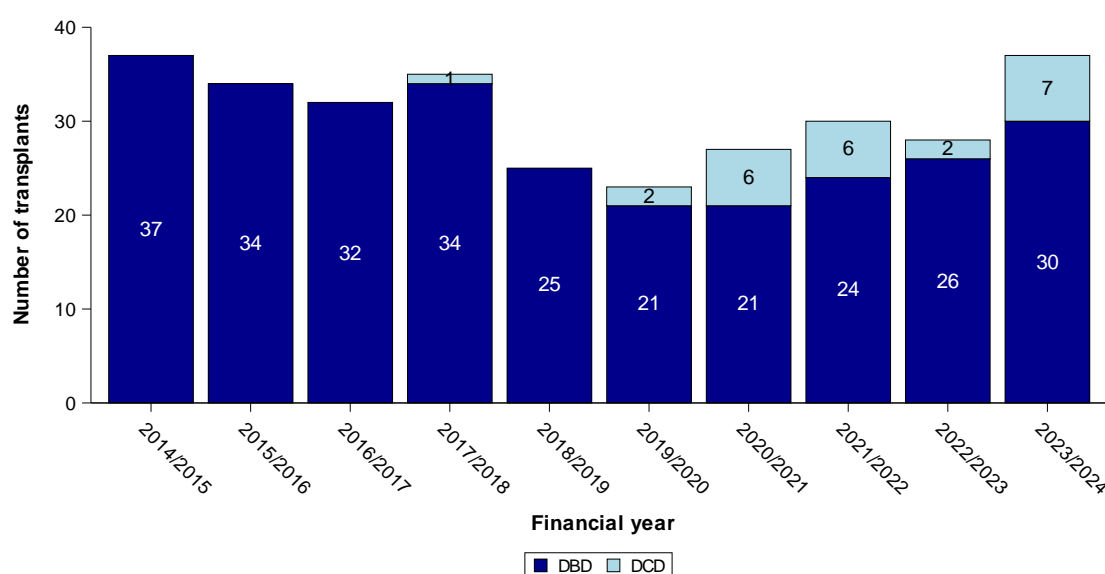
**Transplants**



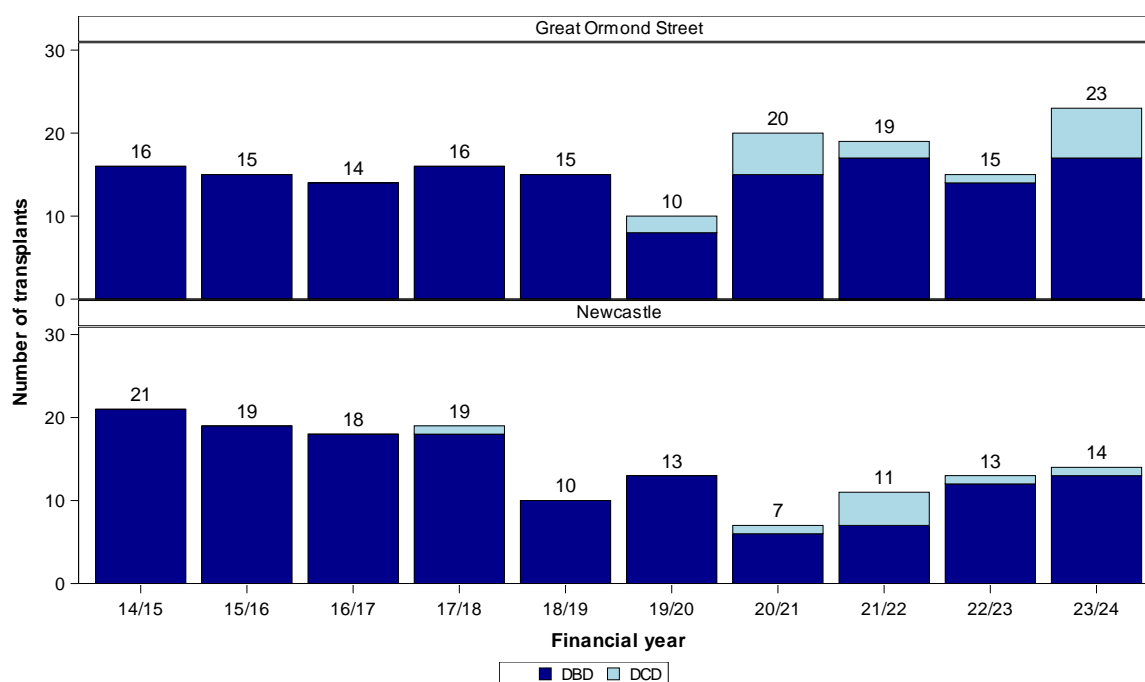
## 11.1 Paediatric heart transplants, 1 April 2014 – 31 March 2024

**Figure 11.1** and **11.2** show the number of paediatric heart transplants performed in the last ten years by donor type, nationally and by centre, respectively. An equivalently high number of transplants were performed in 2023/2024 compared with 10 years ago (37), while the lowest number was in 2019/2020 (23). Last year's activity is shown by centre in **Figure 11.3**. The 37 transplants carried out in 2023/2024 comprised 23 at Great Ormond Street Hospital and 14 at Newcastle, and there was a total of 7 DCD heart transplants.

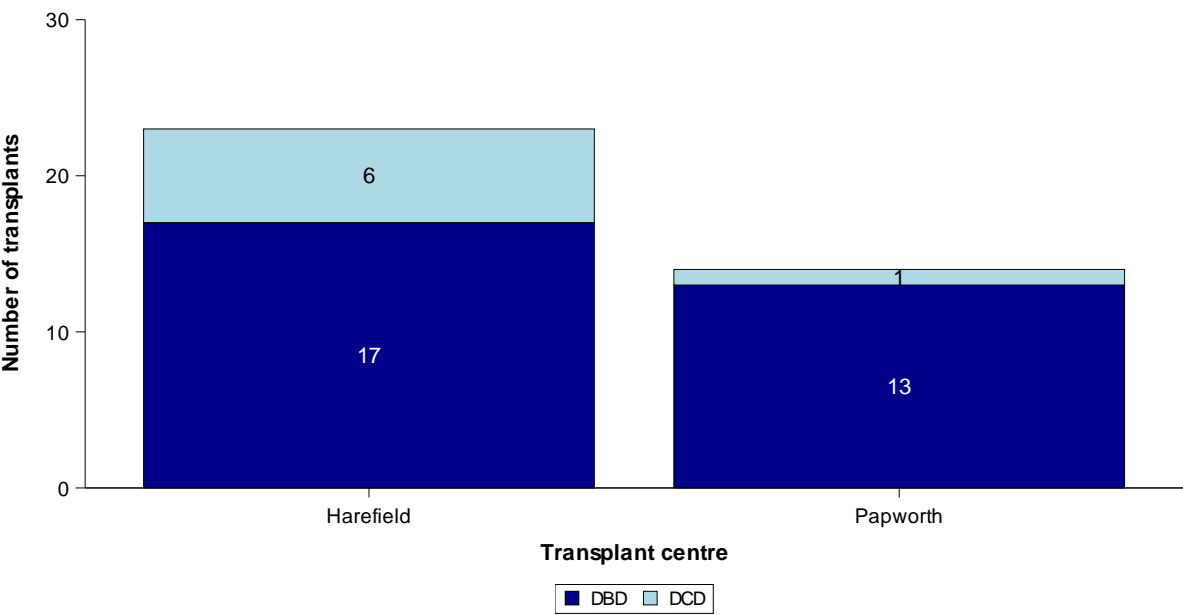
**Figure 11.1 Number of paediatric heart transplants in the UK, by financial year and donor type, 1 April 2014 to 31 March 2024**



**Figure 11.2 Number of paediatric heart transplants in the UK, by financial year, centre and donor type, 1 April 2014 to 31 March 2024**

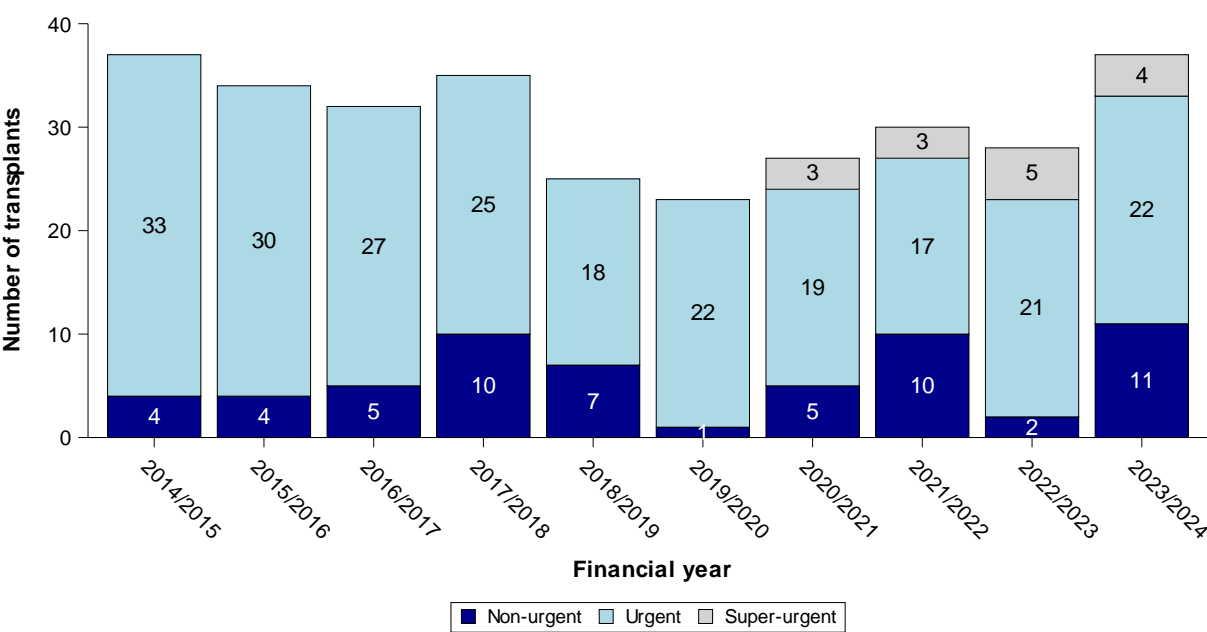


**Figure 11.3** Number of paediatric heart transplants in the UK, by centre and donor type, 1 April 2023 to 31 March 2024

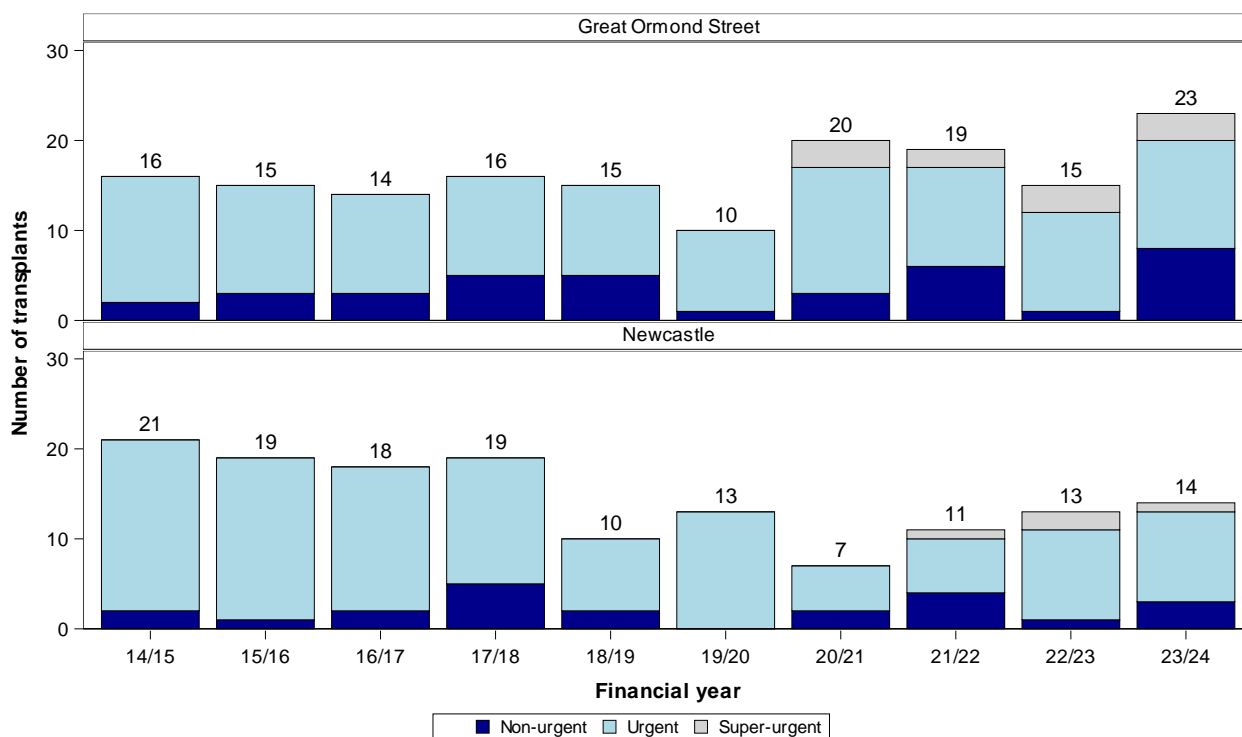


**Figure 11.4** and **11.5** show the number of paediatric heart transplants performed in the last ten years, by urgency status of recipient, nationally and by centre, respectively. The majority of transplants were urgent, but in the last year, there were four super-urgent transplants. Last year’s activity is shown by centre and urgency status in **Figure 11.6**.

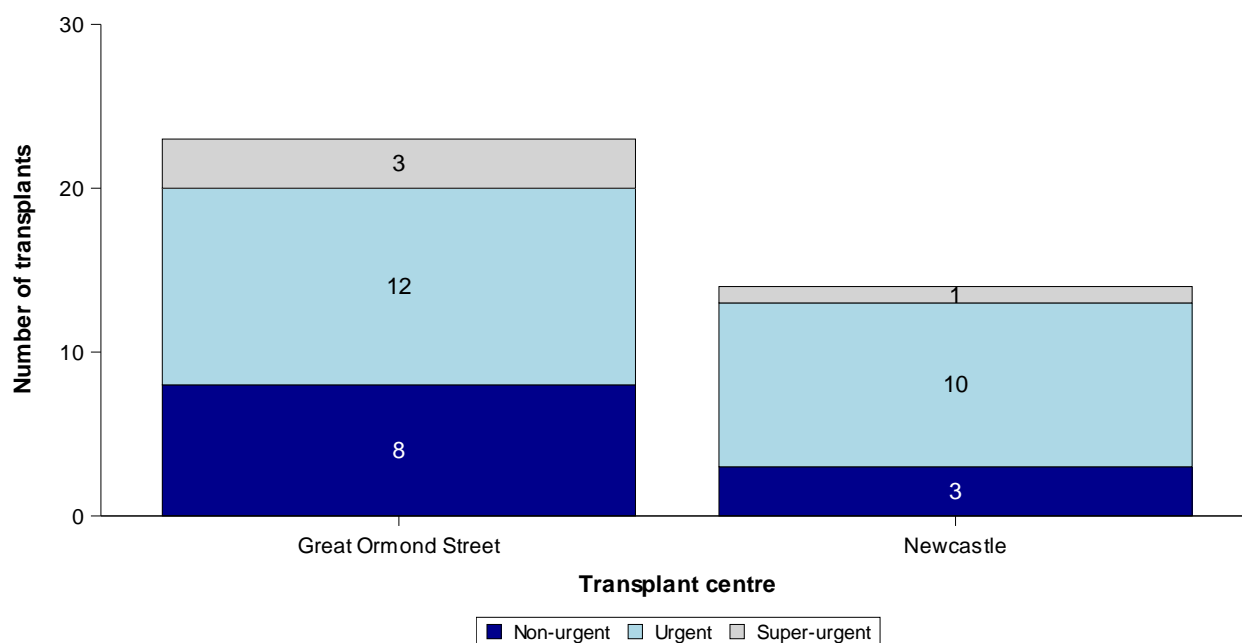
**Figure 11.4** Number of paediatric heart transplants in the UK, by financial year and urgency status, 1 April 2014 to 31 March 2024



**Figure 11.5** Number of paediatric heart transplants in the UK, by financial year, centre and urgency status, 1 April 2014 to 31 March 2024



**Figure 11.6** Number of paediatric heart transplants in the UK, by centre and urgency status, 1 April 2023 to 31 March 2024



## 11.2 Demographic characteristics of transplants, 1 April 2023 – 31 March 2024

The demographic characteristics of the 37 paediatric heart transplant recipients and donors in the latest year are shown by centre and overall in **Table 11.1**. Nationally, 54% of heart recipients were female and the [median](#) age was 8 years, while the median donor age was 15 years. For some characteristics, due to rounding, percentages may not add up to 100.

<b>Table 11.1 Demographic characteristics of UK paediatric heart transplants performed between 1 April 2023 and 31 March 2024, by centre</b>				
		Great Ormond Street N (%)	Newcastle N (%)	TOTAL N (%)
Number of transplants		23 (100)	14 (100)	37 (100)
Urgency status at transplant	Non-urgent	8 (35)	3 (21)	11 (30)
	Urgent	12 (52)	10 (71)	22 (60)
	Super-urgent	3 (13)	1 (7)	4 (11)
Recipient sex	Male	14 (61)	3 (21)	17 (46)
	Female	9 (39)	11 (79)	20 (54)
Recipient ethnicity	White	16 (70)	11 (79)	27 (73)
	Asian	4 (17)	1 (7)	5 (14)
	Black	2 (9)	1 (7)	3 (8)
	Other	1 (4)	1 (7)	2 (5)
Recipient age (years)	Median (IQR)	9 (3, 14)	8 (3, 13)	8 (3, 13)
	Missing	0	0	0
Recipient weight (kg)	Median (IQR)	33 (12, 44)	20 (13, 48)	24 (13, 44)
	Missing	0	0	0
Recipient primary disease	Coronary heart disease	1 (4)	1 (7)	2 (5)
	Cardiomyopathy	15 (65)	8 (57)	23 (62)
	Congenital heart disease	6 (26)	5 (36)	11 (30)
	Other	1 (4)	0 (0)	1 (3)
NYHA class	I	1 (4)	0 (0)	1 (3)
	III	5 (22)	4 (29)	9 (24)
	IV	9 (39)	10 (71)	19 (51)
	Missing	8 (35)	0 (0)	8 (22)
Recipient in hospital	No	6 (26)	4 (29)	10 (27)
	Yes	14 (61)	10 (71)	24 (65)
	Missing	3 (13)	0 (0)	3 (8)
In hospital, recipient on ventilator	No	10 (71)	8 (80)	18 (75)
	Yes	4 (29)	2 (20)	6 (25)
In hospital, recipient VAD	None	9 (64)	6 (60)	15 (63)
	Left	5 (36)	2 (20)	7 (29)
	Both	0 (0)	2 (20)	2 (8)
In hospital, recipient TAH	No	14 (100)	10 (100)	24 (100)
In hospital, recipient ECMO	No	12 (86)	9 (90)	21 (88)
	Yes	2 (14)	1 (10)	3 (13)



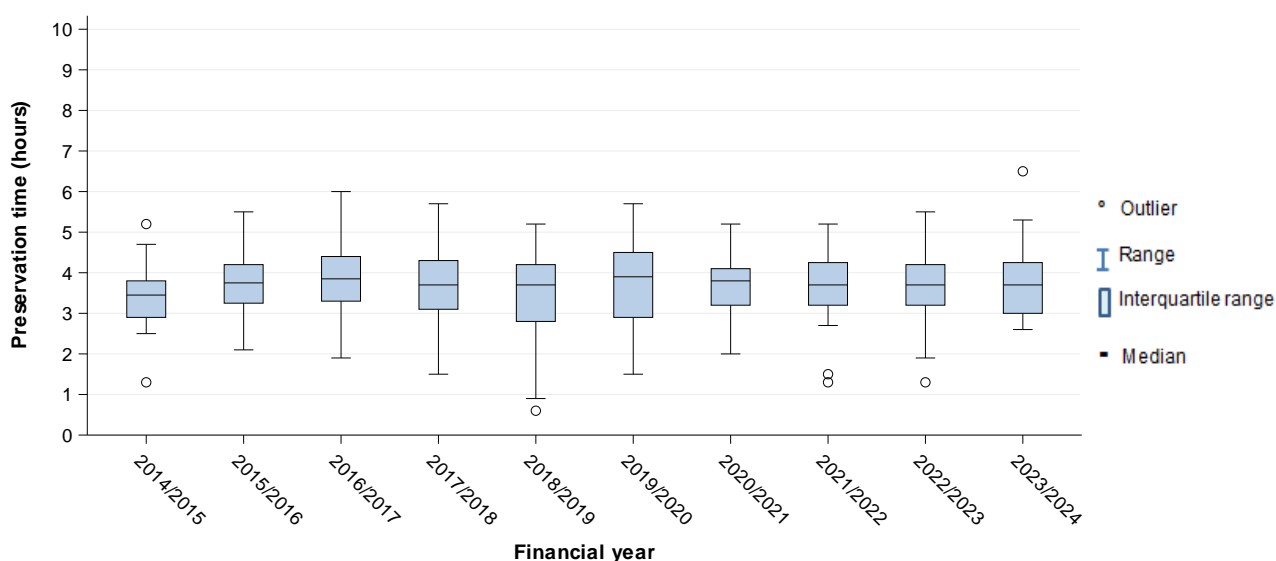
<b>Table 11.1 Demographic characteristics of UK paediatric heart transplants performed between 1 April 2023 and 31 March 2024, by centre</b>				
		Great Ormond Street N (%)	Newcastle N (%)	TOTAL N (%)
In hospital, recipient on inotropes	No	5 (36)	1 (10)	<b>6 (25)</b>
	Yes	9 (64)	9 (90)	<b>18 (75)</b>
In hospital, recipient IABP	No	14 (100)	10 (100)	<b>24 (100)</b>
Recipient CMV status	Negative	12 (52)	12 (86)	<b>24 (65)</b>
	Positive	11 (48)	2 (14)	<b>13 (35)</b>
Recipient HCV status	Negative	20 (87)	14 (100)	<b>34 (92)</b>
	Missing	3 (13)	0 (0)	<b>3 (8)</b>
Recipient HBV status	Negative	20 (87)	14 (100)	<b>34 (92)</b>
	Missing	3 (13)	0 (0)	<b>3 (8)</b>
Recipient HIV status	Negative	20 (87)	14 (100)	<b>34 (92)</b>
	Missing	3 (13)	0 (0)	<b>3 (8)</b>
Recipient serum creatinine (umol/l)	Median (IQR)	55 (30, 79)	36 (20, 57)	<b>48 (26, 69)</b>
	Missing	3	0	<b>3</b>
Donor sex	Male	12 (52)	7 (50)	<b>19 (51)</b>
	Female	11 (48)	7 (50)	<b>18 (49)</b>
Donor ethnicity	White	16 (70)	10 (71)	<b>26 (70)</b>
	Asian	2 (9)	0 (0)	<b>2 (5)</b>
	Other	1 (4)	1 (7)	<b>2 (5)</b>
	Missing	4 (17)	3 (21)	<b>7 (19)</b>
Donor age (years)	Median (IQR)	18 (9, 34)	14 (5, 21)	<b>15 (8, 25)</b>
	Missing	0	0	<b>0</b>
Donor BMI (kg/m <sup>2</sup> )	Median (IQR)	20 (17, 27)	20 (17, 23)	<b>20 (17, 24)</b>
	Missing	0	0	<b>0</b>
Donor cause of death	Intracranial/CVA	13 (57)	9 (64)	<b>22 (60)</b>
	Trauma	3 (13)	0 (0)	<b>3 (8)</b>
	Others	7 (30)	5 (36)	<b>12 (32)</b>
Donor hypotension	No	14 (61)	5 (36)	<b>19 (51)</b>
	Yes	5 (22)	4 (29)	<b>9 (24)</b>
	Missing	4 (17)	5 (36)	<b>9 (24)</b>
Donor history of diabetes	No	20 (87)	14 (100)	<b>34 (92)</b>
	Missing	3 (13)	0 (0)	<b>3 (8)</b>
Donor history of cardiac disease	No	18 (78)	11 (79)	<b>29 (78)</b>
	Yes	1 (4)	0 (0)	<b>1 (3)</b>
	Missing	4 (17)	3 (21)	<b>7 (19)</b>
Donor history of hypertension	No	19 (83)	14 (100)	<b>33 (89)</b>
	Yes	1 (4)	0 (0)	<b>1 (3)</b>
	Missing	3 (13)	0 (0)	<b>3 (8)</b>

<b>Table 11.1    Demographic characteristics of UK paediatric heart transplants performed between 1 April 2023 and 31 March 2024, by centre</b>				
		Great Ormond Street N (%)	Newcastle N (%)	<b>TOTAL N (%)</b>
Donor history of cancer/malignancy	No	19 (83)	14 (100)	<b>33 (89)</b>
	Yes	1 (4)	0 (0)	<b>1 (3)</b>
	Missing	3 (13)	0 (0)	<b>3 (8)</b>
Donor past/current smoker	No	16 (70)	10 (71)	<b>26 (70)</b>
	Yes	4 (17)	4 (29)	<b>8 (22)</b>
	Missing	3 (13)	0 (0)	<b>3 (8)</b>
Total preservation time <sup>1</sup> (hours)	Median (IQR)	4.2 (3.7, 5.9)	3.4 (2.9, 4.1)	<b>3.9 (3.1, 4.9)</b>
	Missing	3	0	<b>3</b>
<sup>1</sup> Time from cross clamp in the donor to reperfusion in the recipient, regardless of donor type				

### 11.3 Total preservation time, 1 April 2014 – 31 March 2024

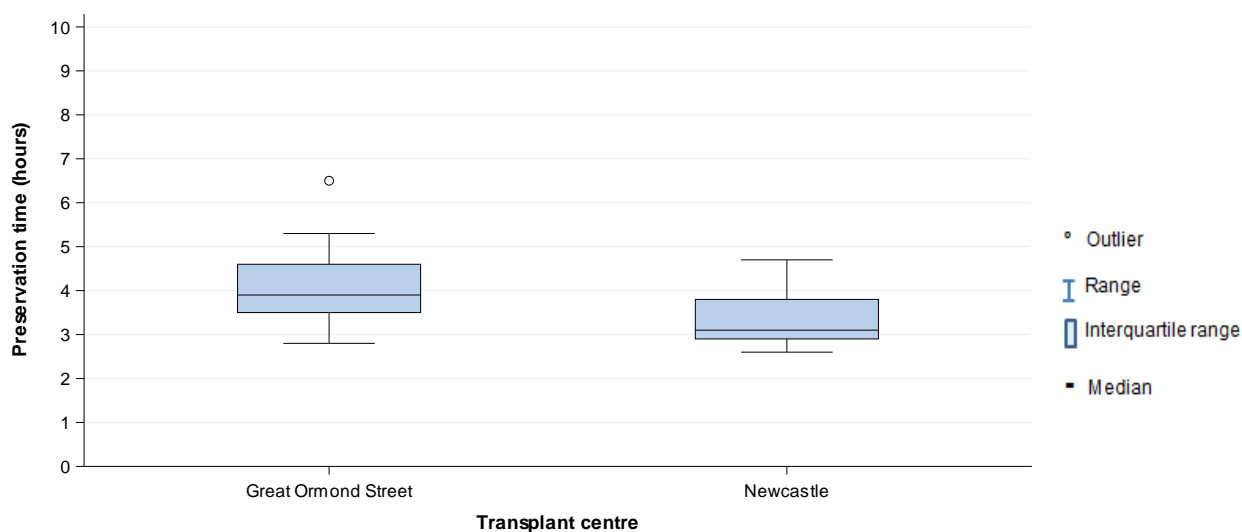
**Figure 11.7** shows [boxplots](#) of total preservation time for [DBD](#) donor hearts transplanted into paediatric recipients over the last 10 years. The total preservation time is the difference between donor cross-clamp and recipient reperfusion and can be considered the out of body time. The national [median](#) total preservation time varied between 3.5 and 3.9 hours over the decade with no upward or downward trend.

**Figure 11.7** Boxplots of total preservation time for DBD donor hearts transplanted into paediatric recipients, by financial year, 1 April 2014 to 31 March 2024



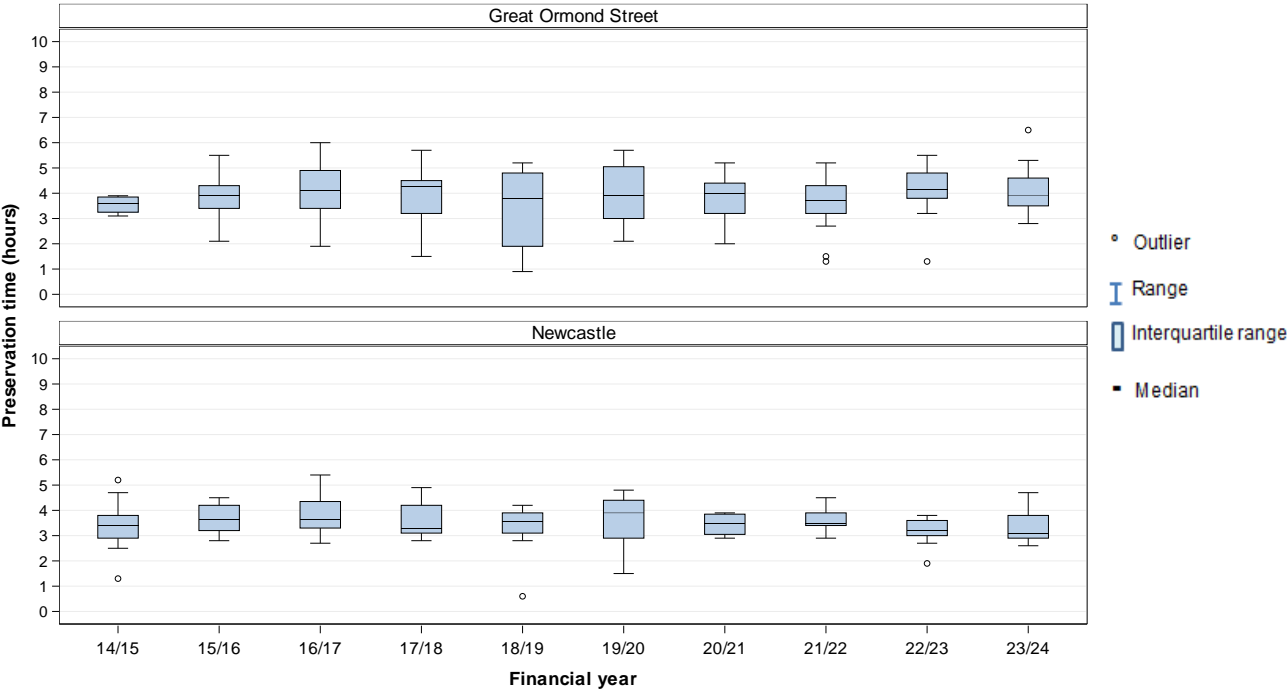
**Figure 11.8** and **Figure 11.9** show [boxplots](#) of total preservation time by centre in the latest financial year (2023/2024) and over the last 10 years, respectively.

**Figure 11.8** Boxplots of total preservation time for DBD donor hearts transplanted into paediatric recipients, by transplant centre, 1 April 2023 to 31 March 2024



The Organ Care System (OCS) was not used in any paediatric DBD heart transplants in 2023/2024

**Figure 11.9** Boxplots of total preservation time for DBD donor hearts transplanted into paediatric recipients, by transplant centre and financial year, 1 April 2014 to 31 March 2024



Includes time on the Organ Care System (OCS) for one transplant performed at Newcastle in 2017/2018

# **PAEDIATRIC HEART TRANSPLANTATION**

## **Post-Transplant Survival**



## 12. Post-Transplant Survival

The survival analyses presented in this section exclude [multi-organ transplants](#) and include first time transplants only. **Section 12.1** includes [DBD](#) and [DCD](#) heart transplants where ninety-day and one-year [survival rates](#) are based on transplants performed in the period 1 April 2019 to 31 March 2023 and 5-year [survival rates](#) are based on transplants performed in the period 1 April 2015 to 31 March 2019. **Section 12.2** summarises survival following [DCD](#) heart transplant for the small number of paediatric recipients of DCD hearts.

### 12.1 Survival post heart transplant

The 90-day post-transplant [unadjusted](#) patient survival rates for each centre and nationally are shown in **Table 12.1** for the 103 first paediatric heart only transplants in the period 1 April 2019 to 31 March 2023.

Table 12.1 90 day patient survival after first paediatric heart transplant, by centre, 1 April 2019 and 31 March 2023				
Centre	Number of transplants	Number of deaths	% 90 day survival (95% CI) ( <a href="#">unadjusted</a> )	
Great Ormond Street	63	2	96.8	(87.9 - 99.2)
Newcastle	40	6	85.0	(69.6 - 93.0)
<b>UK</b>	<b>103</b>	<b>8</b>	<b>92.2</b>	<b>(85.1 - 96.0)</b>

The one year post-transplant [unadjusted survival rates](#) are shown in **Table 12.3**. There is evidence that Great Ormond Street Hospital's unadjusted survival rate is higher than Newcastle's (log-rank  $p=0.04$ ).

Table 12.2 1 year patient survival after first paediatric heart transplant, by centre, 1 April 2019 and 31 March 2023				
Centre	Number of transplants	Number of deaths	% 1 year survival (95% CI) ( <a href="#">unadjusted</a> )	
Great Ormond Street	63	3	95.1	(85.5 - 98.4)
Newcastle	40	8	79.9	(63.8 - 89.4)
<b>UK</b>	<b>103</b>	<b>11</b>	<b>89.2</b>	<b>(81.3 - 93.9)</b>

Five year [survival rates](#) were estimated from the 123 first paediatric heart only transplants performed in the period 1 April 2015 to 31 March 2019. The [unadjusted](#) patient [survival rates](#) are shown in **Table 12.3**.

**Table 12.3 5 year patient survival after first paediatric heart transplant, by centre,  
1 April 2015 and 31 March 2019**

Centre	Number of transplants	Number of deaths	% 5 year survival (95% CI) ( <a href="#">unadjusted</a> )	
Great Ormond Street	59	6	89.5	(78.0 - 95.1)
Newcastle	64	11	82.8	(71.1 - 90.1)
<b>UK</b>	<b>123</b>	<b>17</b>	<b>86.0</b>	<b>(78.5 - 91.1)</b>

## 12.2 Survival post DCD heart transplant

The survival outcomes of paediatric recipients of DCD heart only transplants in the period 1 April 2015 to 31 March 2023 are summarised in **Table 12.4**, at 90 days and 1 year post-transplant.

<b>Table 12.4 Survival outcomes after first DCD paediatric heart only transplant, by centre, 1 April 2015 to 31 March 2023</b>			
Centre	Number of patients	Number of patients alive at 90 days post-transplant <sup>1</sup>	Number of patients alive at 1 year post-transplant <sup>1</sup>
Great Ormond Street Hospital	<b>9</b>	<b>8</b>	<b>8</b>
Newcastle	<b>6</b>	<b>5</b>	<b>5</b>
<b>UK</b>	<b>15</b>	<b>13</b>	<b>13</b>
<sup>1</sup> Patients reported alive after 75 days post-transplant assumed alive at 90 days			
<sup>2</sup> Patients reported alive after 10 months post-transplant assumed alive at 1 year			



# **PAEDIATRIC HEART TRANSPLANTATION**

**Form Return Rates**



### 13. Paediatric heart form return rates, 1 January – 31 December 2023

Form return rates are reported in **Table 13.1** for the cardiothoracic transplant record and the three month and 1 year follow up form, along with lifetime follow up (2 years or more). These include all paediatric heart transplants between 1 January and 31 December 2023 for the transplant record, and all follow up forms issued in this time period. There was a small number of lifetime follow-up forms outstanding.

**Table 13.1 Form return rates for paediatric heart transplants, 1 January 2023 to 31 December 2023**

Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	No. requested	% returned	No. requested	% returned	No. requested	% returned	No. requested	% returned
Great Ormond Street Hospital	22	100	18	100	13	100	109	92
Newcastle, Freeman Hospital	11	100	11	100	10	100	206	99
<b>Overall</b>	<b>33</b>	<b>100</b>	<b>29</b>	<b>100</b>	<b>23</b>	<b>100</b>	<b>315</b>	<b>97</b>

# 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 [A2](#) below.

Table A1.1 Adult transplants analysed			
Time period	Report Section	Exclusion criteria	No. heart transplants
1 April 2014 – 31 March 2024	• Introduction	None	1650
1 April 2014 – 31 March 2024	• Transplants	• <a href="#">Multi-organ transplants</a>	1598
1 April 2019 – 31 March 2023	Post-transplant survival – <ul style="list-style-type: none"> <li>• 90-day</li> <li>• 1-year survival</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Multi-organ transplants</a></li> <li>• DCD heart transplants excluded from risk-adjusted analysis</li> <li>• Heart-lung transplants</li> <li>• Second (or more) transplants</li> <li>• Group 2 transplants</li> </ul>	604 (478 DBD)
1 April 2015 – 31 March 2019	Post-transplant survival – <ul style="list-style-type: none"> <li>• 5-year survival</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Multi-organ transplants</a></li> <li>• DCD heart transplants excluded from risk-adjusted analysis</li> <li>• Heart-lung transplants</li> <li>• Second (or more) transplants</li> <li>• Group 2 transplants</li> </ul>	637 (551 DBD)

Table A1.2 Paediatric transplants analysed			
Time period	Report Section	Exclusion criteria	No. heart transplants
1 April 2014 – 31 March 2024	• Introduction	None	311
1 April 2014 – 31 March 2024	• Transplants	• <a href="#">Multi-organ transplants</a>	308
1 April 2019 – 31 March 2023	Post-transplant survival – <ul style="list-style-type: none"> <li>• 90-day</li> <li>• 1-year survival</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Multi-organ transplants</a></li> <li>• Heart-lung transplants</li> <li>• Second (or more) transplants</li> <li>• Group 2 transplants</li> </ul>	103
1 April 2015 – 31 March 2019	Post-transplant survival – <ul style="list-style-type: none"> <li>• 5-year survival</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Multi-organ transplants</a></li> <li>• Heart-lung transplants</li> <li>• Second (or more) transplants</li> <li>• Group 2 transplants</li> </ul>	123

## **Geographical variation analysis**

### **Registration rates**

All NHS group 1 patients who were registered onto the heart transplant list with an active status between 1 April 2023 and 31 March 2024 were extracted from the UK Transplant Registry on 21 July 2024 (numerator). Patients registered for a heart-lung block were excluded. Patients were assigned to NHS regions in England using their postcode of residence, as reported at registration. The number of registrations per million population (pmp) by NHS region was obtained using mid-2022 population estimates based on the Office for National Statistics (ONS) 2021 Census figures (denominator). No NHS region age- or sex-specific standardisation of rates was performed.

The registration rates pmp were categorised into four groups – low, low-medium, medium-high and high – based on the quartiles of their distribution and visualised in a map using contrasting colours.

### **Transplant rates**

Transplant rates pmp were obtained as the number of heart transplants on NHS group 1 recipients between 1 April 2023 and 31 March 2024 (numerator), divided by the mid-2022 population estimates from the ONS (denominator). Patients who received a heart-lung block transplant were excluded. Transplant rates pmp were categorised and visualised in a map as done for the registration rates.

### **Systematic component of variation**

Only registrations or transplants in England between 1 April 2023 and 31 March 2024 were included. If a patient was re-registered during the time period, only the first registration was considered. If a patient underwent more than one heart transplant in the time period, only the first transplant was considered.

## A2: Methods

### Offer decline rates

The offer decline rate analysis was limited to heart offers from [DBD](#) donors who died at a UK hospital and the heart was eventually accepted and transplanted. Any offers from DCD donors were excluded.

[Funnel plots](#) were used to compare centre specific offer decline rates and indicate how consistent the rates of the individual transplant centres are with the national rate. The overall national offer decline rate is shown by the solid line while the 95% and 99.8% confidence lines are indicated via a thin and thick dotted line, respectively. Each dot in the plot represents an individual transplant centre. Centres that are positioned above the upper limits indicate an offer decline rate that is higher than the national rate, while centres positioned below the lower limits indicate an offer decline

### Unadjusted post-transplant survival rates

[Kaplan-Meier](#) methods were used to estimate the [unadjusted](#) patient [survival rates](#). 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 developed in consultation with clinicians and were based on statistical significance as well as previous studies of factors affecting the [survival rates](#) of interest. The factors included in the models are shown in [A3](#).

Missing values for [risk factors](#) were imputed using simple imputation of the median or most common group for the adult heart model (where missing values represented <10% of the cohort). Missing ischaemia time (5% of cohort) was imputed with a centre and year specific median

## Funnel plots

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.

## Systematic component of variation

For a given individual who is a resident in a given NHS region, registration to the transplant list is modelled as a Bernoulli trial. At the whole area level, this becomes a Binomial process which can be approximated by a Poisson distribution when rare events are modelled. Transplant counts follow similar assumptions.

To allow for the possibility that, even after allowing for area-specific Poisson rates, area differences remain, introduce an additional multiplicative rate factor which varies from area to area. Postulate a non-parametric distribution for the multiplicative factor, with variance  $\sigma^2$ . If the factor is one for all areas, then area differences are fully explained by the area-specific Poisson rate. If the factor varies with a nonzero variance,  $\sigma^2$ , then we conclude that there are unexplained area differences.

The systematic component of variation (SCV; McPherson *et al.*, *N Engl J Med* 1982, **307**: 1310-4) is the moment estimator of  $\sigma^2$ . Under the null hypothesis of homogeneity across areas, the SCV would be zero. The SCV, therefore, allows us to detect variability across areas beyond that expected by chance; the larger the SCV, the greater the evidence of systematic variation across areas.

## Survival from listing

Data were obtained for all patients  $\geq 18$  years registered for the first time for a heart transplant between 1 April 2019 and 31 March 2023 for one-year survival, and 1 April 2015 and 31 March 2019 for five-year survival. 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 e.g. 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 on 21 July 2024 if the patient was on the transplant list at time of analysis. However, removals due to deteriorating condition were classed as events.

Exclusions from the analysis:

- 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 GOSH

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 A2.1** and were included in the modelling whether or not statistically significant. Missing data for these risk factors have been imputed using the median or modal value to ensure that cases with missing data are not excluded from the risk-adjusted analysis.

Table A2.1 Factors used in risk-adjusted model for patient survival from listing	
Heart	Age, blood group, urgency status (non-urgent vs urgent/super-urgent), Mechanical Circulatory Support (MCS) at registration (none/long-term/short-term), diabetes, height, bilirubin (logarithm)

[Survival rates](#) at one and five 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 and five 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.



### A3: Risk models

Table A3.1 <a href="#">Risk factors</a> and categories used in the adult heart risk adjusted 90-day, 1-year and 5-year survival models	
Donor age	(modelled as continuous variable)
Recipient age 60 or over	Yes No
Recipient CMV status	Positive Negative
Recipient bilirubin at registration	(continuous, logged)
VAD at transplant	Short-term (including ECMO) Long-term (including total artificial hearts) None
Recipient IABP at transplant	Yes No
Primary disease group	Cardiomyopathy Coronary heart disease Congenital heart disease Other
Recipient eGFR group at transplant	44 ml/min or below 45-59 ml/min 60-89 ml/min 90 or above
Recipient diabetes at registration	Yes No
Recipient hypertension at registration	Yes No
Recipient blood group	O A B AB
Total preservation time (hours)	(modelled as continuous variable)
OCS used on heart	Yes No
Interaction between ischaemia time and OCS	

## 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.

### Boxplots

The length of the box in this plot represents the [inter-quartile range](#). The line inside the box indicates the [median](#) value. The vertical lines issuing from the box are called the whiskers and indicate the range of values that are outside of the inter-quartile range but are close enough not to be considered outliers. The circles that are outside the box indicate the outliers (any points that are a distance of more than  $1.5 \times \text{IQR}$  from the box).

### 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)**

Donation after brainstem death means donation which takes place following the diagnosis of death using neurological criteria.

**Donor after circulatory death (DCD)**

Donation after circulatory death means donation which takes place following the diagnosis of death using circulatory criteria.

**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. The Kaplan-Meier method can be used for any time to event analysis, including time to transplant. If not enough events have occurred or if there are not enough patients in the cohort, an estimate of the [median](#) may not be possible.

**Long-term device**

Long-term devices are implantable and intended to support the patient for years. Patients can be discharged from hospital with a long-term device.

**Mechanical Circulatory Support**

An umbrella term for devices used to assist the heart, including long-term devices such as implantable [VADs](#) for left, right and biventricular support and total artificial hearts, and short-term devices such as CentriMag, percutaneous [VADs](#) and extracorporeal membrane oxygenation (ECMO).

**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.

**VAD**

Ventricular Assist Device. A mechanical pump used to increase the amount of blood that flows through the body, relieving the symptoms of advanced heart failure.

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