

# NHS BLOOD AND TRANSPLANT

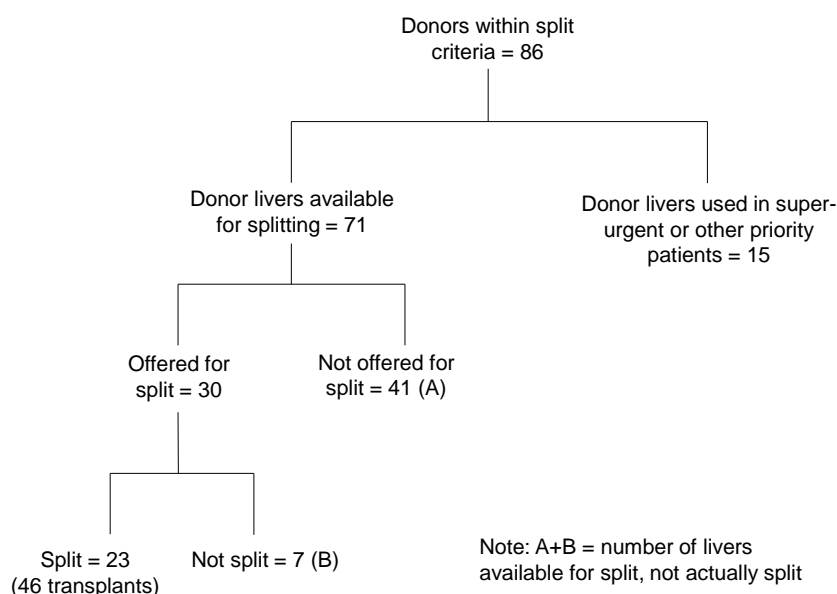
## LIVER ADVISORY GROUP

### LIVER SPLITTING ACTIVITY REPORT

#### SUMMARY

- 1 Donors after brain death (DBD) aged < 40 years, weighing > 50kg and known to have spent < five days in an intensive care unit meet the criteria for liver splitting. If a donated liver is split it can be used to transplant two patients; typically one adult and one paediatric patient. This paper reports on transplant activity of livers from DBD donors who donated their liver in a recent time period and who met the criteria for liver splitting.
- 2 **Figure 1** shows a summary of the liver splitting activity in the 6-month period 1 October 2016 to 31 March 2017.

**Figure 1** Liver splitting activity from donors who met the criteria for liver splitting, 1 October 2016 - 31 March 2017



- 3 The percentage of livers split of those available for splitting increased from only 16 (16%) in 2014/15 to 18 (20%) in 2015/16, and finally to 44 (35%) in 2016/17, with the highest number of reported split livers.
- 4 In 2016/17 there were an additional 6 donors outside of the donor splitting criteria that led to 12 split liver transplants.

#### ACTION

- 5 In 2015/16, 20% of available livers were split which has increased to 35% in 2016/17, representing the highest rate over the last 10 years. Members are asked to consider what action should be taken to optimise use and outcomes of split liver transplantation.

## NHS BLOOD AND TRANSPLANT

### LIVER ADVISORY GROUP

#### LIVER SPLITTING ACTIVITY REPORT

##### INTRODUCTION

- 1 If a liver from a deceased donor is split it can be used to transplant two patients; typically an adult patient receives the right liver lobe and a paediatric patient receives the left lobe or the left lateral segment. This paper reports on the outcome of livers from donors after brain death (DBD) who donated their liver between 1 October 2016 and 31 March 2017 and who met the criteria for liver splitting. The paper also reports briefly on activity over the last 10 years.
- 2 Liver transplant unadjusted survival outcomes are analysed for patients who received a DBD donor split liver transplant between 1 April 2006 and 30 September 2016. Comparisons are made between livers retained by the splitting centre and those imported as a split from another centre.

##### LIVER SPLITTING ACTIVITY

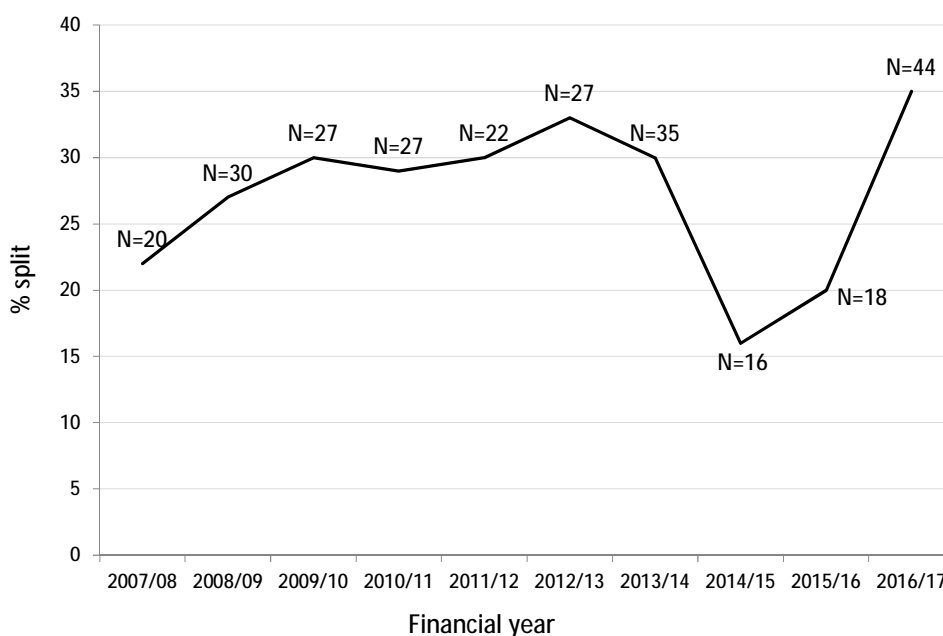
###### Data and methods

- 3 Donors meeting the criteria for liver splitting are under 40 years of age, weighing more than 50kg and known to have spent less than five days in an intensive care unit (ICU). Time in ICU is calculated as the time between start of ventilation and time of second test for brainstem death.
- 4 Data were obtained from the UK Transplant Registry (UKTR) on the 86 UK DBD donors whose liver was donated in the 6 months between 1 October 2016 and 31 March 2017 and who met the criteria for liver splitting. These livers were transplanted in the UK or the Republic of Ireland. Comparable data were also obtained on the 69 UK DBD liver donors in the previous 6 months (1 April 2016 - 30 September 2016), who met the criteria for liver splitting.
- 5 Donated livers were classed as split livers when they were used to transplant two patients and as reduced livers when cut down and used for one patient. Consequently reduced livers were not classed as split livers.
- 6 Livers were classed as offered for splitting if there was a record in the UKTR stating that part of the liver had been offered to a centre (offers that were withdrawn were discounted), as recorded by the ODT Duty Office.
- 7 Account is taken of the requirement in place from 6 October 2014 stating that all within-criteria livers offered to Hepatoblastoma patients must be considered for splitting.

## Results

- 8 The status of donors meeting criteria for liver splitting and transplanted is shown in **Table 1** for October 2016 to March 2017, with April 2016 to September 2016 figures for comparison. For the latest 6 months, 71 (83%) of the 86 DBD donors meeting the splitting criteria were available for splitting. Of these 71 livers, 30 (42%) were offered for splitting. Of the 30 livers offered for splitting, 23 (77%) were actually split. The percentage of livers split out of those available for splitting is summarised in **Figure 1**.
- 9 These 86 livers resulted in 112 transplants, of which 29 (26%) were performed in paediatric patients.
- 10 The percentage of livers split out of those available for splitting ( $N_s / N_A$ ) are plotted in **Figure 2** over the last 10 financial years. This shows a slight rise in the percentage split, followed by a fall in 2014/15. The percentage split is much higher in the most recent financial year.

Figure 2 Percentage of livers split out of those available for splitting, 1 April 2007 – 31 March 2017



**Table 1 Donors meeting criteria for liver splitting, by donor allocation zone, 1 October 2016 to 31 March 2017 (1 April 2016 to 30 September 2016)**

Donor allocation zone	Total meeting liver splitting criteria and transplanted		Super-urgent liver or intestinal/hepatoblastoma recipients		Elective intestinal/multi-organ recipients		Available for splitting		Offered for splitting				Split		Whole		Reduced			
	N		N <sub>P1</sub>		N <sub>P2</sub>		N <sub>A</sub>		N <sub>o</sub>		% of available		N <sub>s</sub>		% of offered		N <sub>w</sub>		N <sub>r</sub>	
Birmingham	14	(18)	2	(5)	1	(1)	11	(12)	4	(7)	36	(58)	4	(3)	100	(43)	0	(2)	0	(2)
Cambridge	9	(4)	0	(1)	1	(0)	8	(3)	6	(2)	75	(67)	6	(2)	100	(100)	0	(0)	0	(0)
Edinburgh	12	(12)	0	(0)	0	(1)	12	(11)	5	(6)	42	(55)	3	(3)	60	(50)	2	(3)	0	(0)
King's College	12	(16)	3	(4)	1	(0)	8	(12)	1	(7)	13	(58)	1	(7)	100	(100)	0	(0)	0	(0)
Leeds	20	(8)	3	(0)	1	(0)	16	(8)	6	(5)	38	(63)	3	(3)	50	(60)	3	(2)	0	(0)
Newcastle	8	(3)	1	(0)	0	(0)	7	(3)	2	(2)	29	(67)	1	(1)	50	(50)	1	(0)	0	(0)
Royal Free	11	(8)	2	(2)	0	(0)	9	(6)	6	(3)	67	(50)	5	(2)	83	(67)	1	(1)	0	(0)
<b>TOTAL</b>	<b>86</b>	<b>(69)</b>	<b>11<sup>1</sup></b>	<b>(12<sup>2</sup>)</b>	<b>4<sup>3</sup></b>	<b>(2)</b>	<b>71</b>	<b>(55)</b>	<b>30</b>	<b>(32)</b>	<b>42</b>	<b>(58)</b>	<b>23</b>	<b>(21)</b>	<b>77</b>	<b>(66)</b>	<b>7</b>	<b>(9)</b>	<b>0</b>	<b>(2)</b>

<sup>1</sup> One of these livers were split and used to transplant one super-urgent/ hepatoblastoma recipient and one elective liver only recipient

<sup>2</sup> Six of these livers were split and used to transplant one super-urgent/ hepatoblastoma recipient and one elective liver only recipient

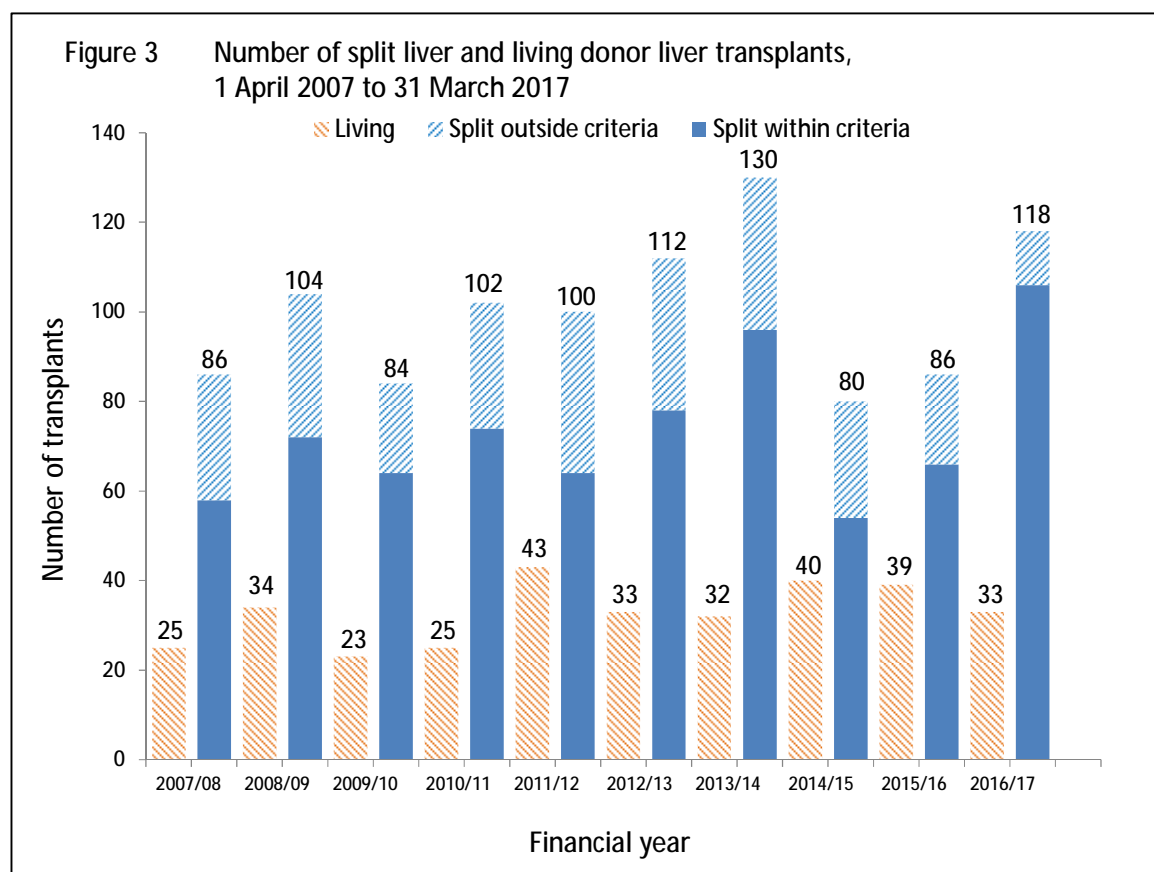
<sup>3</sup> Two of these livers were split and used to transplant one multi-organ recipient and one elective liver only recipient

Note: Due to small numbers the percentages presented must be viewed with caution  
Livers were not necessarily transplanted by the centre that resides in the donor allocation zone  
 $N = N_{P1} + N_{P2} + N_A$ ;  $N_o = N_s + N_w + N_r$

- 11 The percentage of livers split of those available for splitting for the period April 2012 to March 2017 is given in **Table 2**, by donor allocation zone. The number of livers split that were outside splitting criteria is also provided.

Allocation zone	Available for split within criteria N	Split within criteria		Split outside criteria N
		N	%	
Birmingham	102	27	26	20
Cambridge	50	14	28	3
Edinburgh	80	19	24	5
King's College	103	36	25	19
Leeds	89	22	25	10
Newcastle	38	9	24	3
Royal Free	55	14	25	3
<b>TOTAL</b>	<b>517</b>	<b>141</b>	<b>27</b>	<b>63</b>

- 12 A comparison of the number of split liver and living donor liver transplants over the last decade is shown in **Figure 3**. This shows fewer split liver transplants in 2014/15 and 2015/16, with an increase in the last financial year. The number of split liver transplants includes those from donors in **Table 1** and also those where the donor did not meet splitting criteria whose livers were split for transplant. In 2016/17, there were 6 donors outside of the donor splitting criteria. These are only included in **Figure 3** in the report, and summarised in **Table 3**.



**Table 3 Characteristics of liver donors who were outside of splitting criteria but whose livers went on to be split, 1 April 2007 to 31 March 2017**

Year	Aged 40 or more		Weighing 50kg or less		Spent 5 days or more in ICU		Total
	N	%	N	%	N	%	
2007/08	11	79	1	7	2	14	<b>14</b>
2008/09	7	44	7	44	3 <sup>2</sup>	19	<b>16</b>
2009/10	7	70	0	0	3 <sup>1</sup>	30	<b>10</b>
2010/11	9	64	2	14	4 <sup>1</sup>	29	<b>14</b>
2011/12	10	56	5	28	5	28	<b>18</b>
2012/13	12	71	4	24	2	12	<b>17</b>
2013/14	11	65	5	29	3	18	<b>17</b>
2014/15	6	46	4	31	3	23	<b>13</b>
2015/16	8	80	2	20	1	10	<b>10</b>
2016/17	3	50	2	33	1	17	<b>6</b>

Note: Numbers and % may not add up to total in each row as some donors are outside of more than one criteria

<sup>1</sup> includes one donor with unknown ICU length of stay

<sup>2</sup> includes two donors with unknown ICU length of stay

### Reasons for not offering for split transplantation

- 13 **Table 4** details the reasons given by the transplanting centre or noted by the ODT Duty Office for the 41 livers not being offered for splitting (85% of the 48 livers available for splitting that were not split). The donor AST level, reported on the Core Donor Data Form, is presented in the table but is not well reported.

**Table 4** Reasons given for why 41 livers from donors meeting the liver splitting criteria, between 1 October 2016 to 31 March 2017, were not offered for splitting

Donor	Donor allocation zone	Transplanting centre	Reason for liver not being offered for splitting	AST (iu/l)
<b>Donor reasons</b>				
1	Birmingham	Birmingham	Paediatric donor deemed too small for splitting	25
2	Birmingham	Birmingham	Not suitable due to the anatomy	
3	Birmingham	Birmingham	Placed after fast tracking due to damage	20
4	Birmingham	Birmingham	Liver quality (not able to split)	
5	Edinburgh	Edinburgh	Size of donor, poor LFT's and down time	108
6	Edinburgh	Leeds	Liver was not split due to fat on it	12
7	King's College	King's College	Anatomy, left lateral seg too small with 2 hepatic arteries	
8	King's College	King's College	30% fatty 2kg in weight	
9	King's College	King's College	Function - lactate levels 5.5 ph 7.1	223
10	King's College	King's College	Raised ALT	
11	King's College	King's College	Big liver 2kg mildly fatty round edges on the right lobe	
12	King's College	King's College	Length ITU Stay	30
13	Leeds	Birmingham	Function (LFT's)	251
14	Leeds	Edinburgh	Not suitable due to length of ITU stay	
15	Leeds	Edinburgh	Liver was profusely fatty	
16	Leeds	Leeds	Abnormal LFTs	104
17	Leeds	Leeds	Not suitable due to function	
18	Leeds	Leeds	Abnormal LFTs	
19	Leeds	Leeds	Size and blood group	
20	Leeds	Leeds	Not suitable - fatty liver	
21	Leeds	Leeds	Donor size	
22	Leeds	Leeds	Function	
23	Newcastle	Edinburgh	Llft's not normal	
24	Newcastle	Edinburgh	Organ damaged	
25	Newcastle	Edinburgh	Trauma	
26	Royal Free	Royal Free	Abnormal LFTs	
27	Royal Free	Royal Free	Length of stay in ITU	
<b>Recipient reasons</b>				
28	Birmingham	Birmingham	Super urgent recipient required whole liver	
29	Birmingham	Birmingham	Recipient required whole liver due to size	
30	Birmingham	Birmingham	Liver not split due to recipient size	
31	Edinburgh	Newcastle	Top band recipient required whole liver	37
32	Newcastle	Newcastle	Recipient required whole liver as was a re-do.	32
33	Royal Free	Royal Free	Recipient required whole liver due to size	24
<b>Other reasons</b>				
34	Edinburgh	Birmingham	Liver declined by all other centres	360
35	Edinburgh	Cambridge	RPoC is not able to offer a reason as to why liver was not split	35
36	Edinburgh	King's College	Liver declined by all other centres	187
37	Edinburgh	Leeds	Duty Office trainee misinformed SNOD	34
38	Newcastle	King's College	Liver declined by all other centres	
39	Cambridge	Cambridge	Split offered not placed	
40	Cambridge	Cambridge	Split offered not placed	
41	King's College	Cambridge	Split offered not placed	

### Reasons why livers offered for split transplant were not split

- 14 Seven livers were offered for splitting but were not split. The reasons given for not splitting are detailed in **Table 5**.

<b>Table 5 Reasons given for why seven livers from donors meeting the split liver criteria, between 1 October 2016 to 31 March 2017, that were offered for splitting but were not split</b>				
<b>Donor</b>	<b>Donor allocation zone</b>	<b>Transplanting centre</b>	<b>Details of why liver was not split</b>	<b>AST (iu/l)</b>
<b>Donor reasons</b>				
1	Leeds	Edinburgh	LLS declined by paed centres due to size	
2	Leeds	Leeds	Mild to moderately fatty	
<b>Recipient reasons</b>				
3	Newcastle	Cambridge	LLS declined by paed centres - size/history/no suitable recipients	
4	Royal Free	Royal Free	Left lobe declined by paed centres - no suitable recipients	177
5	Leeds	Leeds	LLS declined by paed centres as no suitable recipients and liver fatty	
<b>Other reasons</b>				
6	Edinburgh	Edinburgh	Split offered not placed	20
7	Edinburgh	Edinburgh	Due to liver improperly packaged (in 1 inch of ice)	

- 15 There were two liver transplant recipients with hepatoblastoma transplanted from a DBD donor between 1 October 2016 and 31 March 2017. Details of this transplant are in **Table 6**.

<b>Table 6 Details of hepatoblastoma patients transplanted between 1 October 2016 and 31 March 2017</b>					
<b>Donor</b>	<b>Transplanting centre</b>	<b>Transplant type</b>	<b>Donor age (years)</b>	<b>Recipient age (years)</b>	<b>Reason for not splitting</b>
1	Birmingham	Reduced	18	5	Right lobe damaged on retrieval
2	Leeds	Split	19	1	

Note: On 6 October 2014 it became a requirement to split livers, within criteria for splitting, offered to hepatoblastoma patients



**SUMMARY**

- 16 There were 86 livers donated from donors who met the criteria for liver splitting between 1 October 2016 to 31 March 2017 (20% increase in the previous six months). Of these, 71 (83%) were available for splitting for elective recipients, having not been used in super-urgent, hepatoblastoma, intestinal or multi-organ recipients. Of these 71 livers, 30 (42%) were offered for splitting. Of the 30 livers offered for splitting, 23 (77%) were actually split (2 more than the previous six months).
- 17 The percentage of livers split of those available for splitting increased by from only 16 (16%) in 2014/15 to 18 (20%) in 2015/16, and finally to 44 (35%) in 2016/17, with the highest number of reported split livers.
- 18 In over a third of the cases where the liver was available for splitting but was not offered for splitting, abnormal or raised liver function tests were cited as the reason for not considering splitting. As well as that there were no suitable recipients available. Seven livers were offered for splitting but instead used whole or reduced. Common reasons for not splitting these livers were the split was not placed or a lack of suitable paediatric patients for the left lateral segment.

**ACTION**

- 19 In 2015/16, 20% of available livers were split which has increased to 35% in 2016/17, representing the highest rate over the last 10 years. Members are asked to consider what action should be taken to optimise use and outcomes of split liver transplantation.

**Cathy Hopkinson**  
**Statistics and Clinical Studies**

**April 2017**