

NHS BLOOD AND TRANSPLANT
PANCREAS ADVISORY GROUP AND ISLET STEERING GROUP
DCD WORKING GROUP - NPOS SIMULATIONS

1. Background

The lack of equity of access to DCD pancreas transplants across transplant centres was highlighted by the PAG DCD working group. The current National Pancreas Offering Scheme (NPOS) prioritises patients in Tiers B and C according to a points-based system. One of the factors used to calculate the total points score is the travel time between the donor hospital and the transplant centre or isolation laboratory. For a donor after circulatory death (DCD) a greater number of points are assigned to patients at the three closest transplant centres and to islet patients if an isolation laboratory is within 150 minutes of the donor hospital. This is particularly important for DCD organs as it avoids unnecessarily long cold ischemia times, so a large number of points are given to this factor.

However, the current scheme results in most DCD pancreases being offered to the closest centre first, even if the second or third closest centres may be of a similar distance from the donor hospital. This paper presents the outcomes of simulations in which the travel time points for DCD organs were amended.

The outcomes of the simulations were compared in terms of transplant activity across the first three years. The transplant activity, end of year waiting lists and median waiting time to transplant at the end of year 3 are also provided in the Appendix. It is important to note that small numbers can cause large variability in median waiting time to transplant.

2. Summary of simulations

The simulations were developed using SAS software. Standard pools of real pancreas donors and listed patients, from a recent period, were used in each of the simulations to model the effects of various travel time points for DCD organs.

Simulation 1 (S1): Current allocation scheme

For DCD donors, whole pancreas patients at the transplant centre closest to the donor hospital receive 10,000 travel time points, and patients at the second and third closest centres receive 5,000 points. Islet patients receive 10,000 travel time points if one of the on-call isolation centres is within 150 minutes of the donor hospital.

Simulation 2 (S2)

As S1, but for DCD donors, whole pancreas patients at the two transplant centres closest to the donor hospital receive 10,000 travel points and patients at the third closest centre receive 5,000 points.

Simulation 3 (S3)

As S1, but for DCD donors, whole pancreas patients at the three transplant centres closest to the donor hospital receive 10,000 travel points.

Simulation 4 (S4)

As S1, but for DCD donors, whole pancreas patients at the three transplant centres closest to the donor hospital receive 365 travel points. Islet patients receive 365 travel time points if one of the on-call isolation centres is within 150 minutes of the donor hospital. This simulation reflects the travel time points awarded for DBD organs.

3. Results

Table 1 presents the total number of DCD transplants performed through the NPOS after three years of simulations. These data have been presented with a breakdown by the location of the transplant centre compared to the donor hospital. The only difference between the simulations is the number of travel time points, and as seen in the Appendix, these changes made little difference to the other factors. It is important to compare the simulations adjusting the points (Sim 2, 3 and 4) with each other or with the simulated current scheme (Sim 1) and not to make comparisons with actual transplant activity.

Compared to S1 (the current scheme), all simulations perform the same number of DCD transplants in the first three years. Increasing the number of travel points for the second closest (S2) or both second and third closest centres (S3) resulted in more transplants being performed at these centres. The proportion of DCD transplants at the 2nd and 3rd centres in S2 and S3 increased to 31% and 50% respectively, compared to only 7% in the current scheme.

Simulating a change in the scheme so that travel points for DCD and DBD organs were similar, resulted in a greater change to the outcomes. 18% of DCD transplants were performed at the non-local centre in S4, compared to 4% in S1. This would result in a greater number of DCD organs traveling further, in turn increasing cold ischemia times.

The simulation outcome data at year 3 for transplant activity, end of year transplant list and median waiting time to transplant are shown in **Appendix I**. This shows that there was little difference in the proportion of transplants performed in different subgroups. For example, in year 3, there were a similar proportion of each transplant type performed, regardless of the simulated change in the scheme. There were also similar median waiting times and a similar distribution of transplants across transplant centres for all the simulations.

Table 1 The simulated effects of altering the travel time points awarded for DCD organs in the NPOS, DCD transplants across first three years

	DCD transplant activity (3 years)							
	Sim 1		Sim 2		Sim 3		Sim 4	
	N	(%)	N	(%)	N	(%)	N	(%)
Local centre								
Closest	112	(76)	86	(59)	56	(38)	44	(30)
2nd or 3rd closest	11	(7)	45	(31)	74	(50)	70	(48)
Within isolation lab range	18	(12)	10	(7)	11	(7)	7	(5)
Non-local centre	6	(4)	6	(4)	6	(4)	26	(18)
Total	147		147		147		147	

4. Summary

For this paper, we simulated increasing the number of DCD travel time points awarded to recipients at centres that are at the second or third closest centre to the donor hospital. This resulted in an increase in the proportion of transplants being performed at centres that were not the closest centre to the donor hospital. Reassuringly, this did not seem to reduce the proportion of transplants being performed in any subgroup of patients. Although this change may not result in shorter median waiting times or change the distribution of transplants by centre, it may result in better equity of access to DCD organs.

5. Recommendation

It is recommended that simulation 2 or 3 is suggested to PAG members as a change to the NPOS. This could result in more DCD transplants being performed at 2nd or 3rd centre closest to the donor and still weights the factor heavily so that the organ doesn't travel to a non-local centre, which would extend the cold ischaemic time.

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Appendix I

Table A1						TRANSPLANT ACTIVITY							
						Year 3 of simulation							
						Sim 1		Sim 2		Sim 3		Sim 4	
						(N = 180)		(N = 180)		(N = 180)		(N = 180)	
						N	(%)	N	(%)	N	(%)	N	(%)
Local centre – DCD													
Closest						35	(70)	29	(58)	19	(38)	14	(28)
2nd or 3rd closest						5	(10)	14	(28)	25	(50)	21	(42)
Within isolation lab range						9	(18)	6	(12)	5	(10)	4	(8)
Non-local centre						1	(2)	1	(2)	1	(2)	11	(22)
Local centre – DBD													
Closest						103	(79)	97	(75)	104	(80)	104	(80)
Non-local centre						27	(21)	33	(25)	26	(20)	26	(20)
Transplant type													
SPK						144	(80)	144	(80)	144	(80)	142	(79)
PTA						10	(6)	10	(6)	11	(6)	11	(6)
SIK						12	(7)	12	(7)	13	(7)	14	(8)
Islet (routine)						4	(2)	4	(2)	4	(2)	4	(2)
Islet (priority)						10	(6)	10	(6)	8	(4)	9	(5)
Waiting time													
0 – <6 months						19	(11)	17	(9)	14	(8)	15	(8)
6 months – <1 year						22	(12)	23	(13)	22	(12)	18	(10)
1 year – <2 years						68	(38)	69	(38)	70	(39)	73	(41)
2 years – <3 years						67	(37)	68	(38)	71	(39)	72	(40)
3 years +						4	(2)	3	(2)	3	(2)	2	(1)
Median waiting time [days] (IQ Range)						580	(494)	593	(489)	552	(488)	555	(459)
Blood group													
O						69	(38)	69	(38)	69	(38)	69	(38)
A						79	(44)	80	(44)	78	(43)	78	(43)
B						18	(10)	18	(10)	18	(10)	18	(10)
AB						14	(8)	13	(7)	15	(8)	15	(8)
Blood group by waiting time – <2 years													
O						11	(10)	10	(9)	8	(8)	8	(8)
A						78	(72)	79	(72)	77	(73)	77	(73)
B						6	(6)	7	(6)	6	(6)	6	(6)
AB						14	(13)	13	(12)	15	(14)	15	(14)
Blood group by waiting time – ≥2 years													
O						58	(82)	59	(83)	61	(82)	61	(82)
A						1	(1)	1	(1)	1	(1)	1	(1)
B						12	(17)	11	(15)	12	(16)	12	(16)
AB						0	-	0	-	0	-	0	-
Sensitisation (%)													
0 – 29						138	(77)	137	(76)	138	(77)	136	(76)
30 – 74						27	(15)	26	(14)	27	(15)	27	(15)
75 – 89						7	(4)	6	(3)	7	(4)	8	(4)
90 – 94						2	(1)	4	(2)	2	(1)	3	(2)
95 – 99						5	(3)	6	(3)	5	(3)	5	(3)
100						1	(1)	1	(1)	1	(1)	1	(1)
Dialysis at registration													
No						107	(59)	97	(54)	94	(52)	96	(53)
Yes						73	(41)	83	(46)	86	(48)	84	(47)
Recipient sex													
Male						95	(53)	91	(51)	91	(51)	91	(51)
Female						85	(47)	89	(49)	89	(49)	89	(49)
Recipient age (years)													
18 – 29						12	(7)	11	(6)	14	(8)	13	(7)
30 – 39						64	(36)	64	(36)	72	(40)	68	(38)
40 – 49						46	(26)	45	(25)	43	(24)	46	(26)
50 – 59						49	(27)	51	(28)	45	(25)	46	(26)
60 +						9	(5)	9	(5)	6	(3)	7	(4)
Mean age (SD)						43	(10)	43	(10)	42	(10)	42	(10)
Ethnicity													

Table A1						TRANSPLANT ACTIVITY					
						Year 3 of simulation					
		Sim 1		Sim 2		Sim 3		Sim 4			
		(N = 180)		(N = 180)		(N = 180)		(N = 180)			
		N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
White		156	(87)	156	(87)	157	(87)	157	(87)	157	(87)
Non-white		22	(12)	20	(11)	20	(11)	21	(12)	21	(12)
Unknown		2	(1)	4	(2)	3	(2)	2	(1)	2	(1)
Transplant centre - Whole											
Cambridge		22	(14)	26	(17)	26	(17)	25	(16)	25	(16)
Cardiff		10	(6)	10	(6)	11	(7)	10	(7)	10	(7)
Edinburgh		8	(5)	9	(6)	8	(5)	7	(5)	7	(5)
Guys		23	(15)	20	(13)	20	(13)	21	(14)	21	(14)
Manchester		44	(29)	45	(29)	44	(28)	43	(28)	43	(28)
Newcastle		7	(5)	6	(4)	9	(6)	8	(5)	8	(5)
Oxford		34	(22)	31	(20)	31	(20)	33	(22)	33	(22)
WLRTC		6	(4)	7	(5)	6	(4)	6	(4)	6	(4)
Transplant centre - Islet											
Edinburgh		5	(19)	7	(27)	8	(32)	7	(26)	7	(26)
King's College		0	-	0	-	0	-	0	-	0	-
Manchester		5	(19)	6	(23)	6	(24)	8	(30)	8	(30)
Newcastle		7	(27)	8	(31)	5	(20)	5	(19)	5	(19)
Oxford		9	(35)	5	(19)	6	(24)	7	(26)	7	(26)
Donor type											
DBD		130	(72)	130	(72)	130	(72)	130	(72)	130	(72)
DCD		50	(28)	50	(28)	50	(28)	50	(28)	50	(28)
D-R blood match											
Identical		167	(93)	168	(93)	166	(92)	166	(92)	166	(92)
Compatible		13	(7)	12	(7)	14	(8)	14	(8)	14	(8)
Total mismatches											
0 – 1		2	(1)	2	(1)	2	(1)	4	(2)	4	(2)
2 – 4		167	(93)	169	(94)	170	(94)	168	(93)	168	(93)
5 – 6		11	(6)	9	(5)	8	(4)	8	(4)	8	(4)
Absolute (donor – recipient) age difference											
0 – 19 years		132	(73)	136	(76)	145	(81)	142	(79)	142	(79)
20 years +		48	(27)	44	(24)	35	(19)	38	(21)	38	(21)
Mean age difference (SD)		15	(10)	14	(10)	13	(10)	13	(10)	13	(10)
Recipient A B or DR homozygous											
No		116	(64)	118	(66)	117	(65)	115	(64)	115	(64)
Yes		64	(36)	62	(34)	63	(35)	65	(36)	65	(36)
Recipient DR homozygous											
No		145	(81)	145	(81)	145	(81)	145	(81)	145	(81)
Yes		35	(19)	35	(19)	35	(19)	35	(19)	35	(19)
Donor A B or DR homozygous											
No		122	(68)	122	(68)	122	(68)	122	(68)	122	(68)
Yes		58	(32)	58	(32)	58	(32)	58	(32)	58	(32)
Donor DR homozygous											
No		158	(88)	158	(88)	158	(88)	158	(88)	158	(88)
Yes		22	(12)	22	(12)	22	(12)	22	(12)	22	(12)
Matchability points score											
1		38	(21)	39	(22)	38	(21)	37	(21)	37	(21)
2		31	(17)	27	(15)	27	(15)	30	(17)	30	(17)
3		18	(10)	17	(9)	20	(11)	18	(10)	18	(10)
4		18	(10)	20	(11)	21	(12)	20	(11)	20	(11)
5		20	(11)	18	(10)	20	(11)	16	(9)	16	(9)
6		16	(9)	19	(11)	18	(10)	18	(10)	18	(10)
7		12	(7)	13	(7)	10	(6)	12	(7)	12	(7)
8		13	(7)	14	(8)	12	(7)	13	(7)	13	(7)
9		12	(7)	11	(6)	12	(7)	14	(8)	14	(8)
10		2	(1)	2	(1)	2	(1)	2	(1)	2	(1)

Table A2		YEAR END WAITING LIST Year 3 of simulation							
		Sim 1 (N = 306)		Sim 2 (N = 307)		Sim 3 (N = 308)		Sim 4 (N = 307)	
		N	(%)	N	(%)	N	(%)	N	(%)
Transplant required									
SPK		250	(82)	251	(82)	253	(82)	253	(82)
PTA		30	(10)	29	(9)	27	(9)	27	(9)
SIK		14	(5)	13	(4)	13	(4)	15	(5)
Islet (routine)		7	(2)	8	(3)	8	(3)	7	(2)
Islet (priority)		5	(2)	6	(2)	7	(2)	5	(2)
Waiting time									
0 – <6 months		83	(27)	87	(28)	85	(28)	84	(27)
6 months – <1 year		76	(25)	73	(24)	79	(26)	79	(26)
1 year – <2 years		103	(34)	104	(34)	101	(33)	104	(34)
2 years – <3 years		44	(14)	43	(14)	43	(14)	40	(13)
3 years +		0	(0)	0	(0)	0	(0)	0	(0)
Median waiting time [days] (IQ Range)		352	(429)	351	(435)	345	(421)	347	(389)
Blood group									
O		131	(43)	130	(42)	134	(44)	128	(42)
A		93	(30)	93	(30)	94	(31)	102	(33)
B		67	(22)	70	(23)	69	(22)	65	(21)
AB		15	(5)	14	(5)	11	(4)	12	(4)
Blood group by waiting time – <2 years									
O		96	(37)	96	(36)	101	(38)	98	(37)
A		93	(35)	93	(35)	94	(35)	102	(38)
B		58	(22)	61	(23)	59	(22)	55	(21)
AB		15	(6)	14	(5)	11	(4)	12	(4)
Blood group by waiting time – ≥2 years									
O		35	(80)	34	(79)	33	(77)	30	(75)
A		0	(0)	0	(0)	0	(0)	0	(0)
B		9	(20)	9	(21)	10	(23)	10	(25)
AB		0	-	0	-	0	-	0	-
Sensitisation (%)									
0 – 29		243	(79)	244	(79)	245	(80)	250	(81)
30 – 74		47	(15)	48	(16)	48	(16)	44	(14)
75 – 89		10	(3)	9	(3)	9	(3)	7	(2)
90 – 94		1	(0)	1	(0)	1	(0)	1	(0)
95 – 99		4	(1)	4	(1)	4	(1)	4	(1)
100		1	(0)	1	(0)	1	(0)	1	(0)
Dialysis at registration									
No		179	(58)	186	(61)	184	(60)	186	(61)
Yes		127	(42)	121	(39)	124	(40)	121	(39)
Recipient sex									
Male		165	(54)	163	(53)	168	(55)	174	(57)
Female		141	(46)	144	(47)	140	(45)	133	(43)
Recipient age (years)									
18 – 29		19	(6)	19	(6)	18	(6)	17	(6)
30 – 39		125	(41)	128	(42)	126	(41)	129	(42)
40 – 49		75	(25)	75	(24)	74	(24)	73	(24)
50 – 59		79	(26)	76	(25)	81	(26)	79	(26)
60 +		8	(3)	9	(3)	9	(3)	9	(3)
Mean age (SD)		42	(10)	42	(10)	42	(10)	42	(9)
Ethnicity									
White		263	(86)	263	(86)	265	(86)	262	(85)
Non-white		38	(12)	40	(13)	39	(13)	40	(13)
Unknown		5	(2)	4	(1)	4	(1)	5	(2)
Transplant centre - Whole									
Cambridge		62	(22)	61	(22)	60	(21)	55	(20)
Cardiff		20	(7)	20	(7)	19	(7)	19	(7)
Edinburgh		12	(4)	9	(3)	14	(5)	16	(6)
Guys		31	(11)	34	(12)	34	(12)	34	(12)
Manchester		55	(20)	58	(21)	57	(20)	58	(21)
Newcastle		11	(4)	9	(3)	12	(4)	11	(4)
Oxford		69	(25)	71	(25)	66	(24)	69	(25)

Table A2								
YEAR END WAITING LIST								
Year 3 of simulation								
	Sim 1		Sim 2		Sim 3		Sim 4	
	(N = 306)		(N = 307)		(N = 308)		(N = 307)	
	N	(%)	N	(%)	N	(%)	N	(%)
WLRTC	20	(7)	18	(6)	18	(6)	18	(6)
Transplant centre - Islet								
Edinburgh	15	(58)	12	(44)	12	(43)	11	(41)
King's College	0	-	0	-	0	-	0	-
Manchester	5	(19)	6	(22)	7	(25)	7	(26)
Newcastle	3	(12)	4	(15)	4	(14)	3	(11)
Oxford	3	(12)	5	(19)	5	(18)	6	(22)
Recipient A B or DR homozygous								
No	181	(59)	181	(59)	181	(59)	186	(61)
Yes	125	(41)	126	(41)	127	(41)	121	(39)
Recipient DR homozygous								
No	244	(80)	247	(80)	244	(79)	245	(80)
Yes	62	(20)	60	(20)	64	(21)	62	(20)
Matchability points score								
1	74	(24)	71	(23)	72	(23)	74	(24)
2	39	(13)	42	(14)	40	(13)	40	(13)
3	46	(15)	45	(15)	44	(14)	42	(14)
4	36	(12)	35	(11)	35	(11)	36	(12)
5	24	(8)	25	(8)	24	(8)	28	(9)
6	22	(7)	20	(7)	23	(7)	22	(7)
7	22	(7)	23	(7)	24	(8)	23	(7)
8	22	(7)	22	(7)	21	(7)	20	(7)
9	20	(7)	23	(7)	24	(8)	21	(7)
10	1	(0)	1	(0)	1	(0)	1	(0)

Table A3 MEDIAN WAITING TIME TO TRANSPLANT								
Year 3 of simulation								
	Sim 1 (N = 180)		Sim 2 (N = 180)		Sim 3 (N = 180)		Sim 4 (N = 180)	
	Median	(IQR)	Median	(IQR)	Median	(IQR)	Median	(IQR)
Transplant type								
SPK	592	(412)	598	(408)	567	(439)	565	(433)
PTA	564	(456)	553	(515)	545	(604)	581	(495)
SIK	473	(868)	835	(728)	514	(844)	639	(844)
Islet (routine)	1045	(638)	1067	(606)	1067	(606)	1032	(625)
Islet (priority)	207	(31)	207	(34)	204	(77)	188	(103)
Blood group								
O	926	(106)	913	(98)	917	(97)	916	(94)
A	485	(286)	472	(267)	453	(216)	457	(191)
B	791	(113)	772	(105)	765	(78)	765	(78)
AB	508	(107)	498	(67)	440	(83)	458	(79)
Blood group by waiting time – <2 years								
O	211	(28)	207	(33)	219	(35)	202	(26)
A	485	(274)	462	(266)	451	(216)	456	(186)
B	656	(103)	688	(106)	651	(123)	651	(123)
AB	508	(107)	498	(67)	440	(83)	458	(79)
Blood group by waiting time – ≥2 years								
O	939	(78)	925	(91)	933	(82)	926	(79)
A	2137	(0)	2137	(0)	2137	(0)	2137	(0)
B	810	(36)	806	(50)	800	(61)	800	(61)
AB	0	-	0	-	0	-	0	-
Sensitisation (%)								
0 – 29	615	(431)	620	(404)	574	(465)	646	(431)
30 – 74	496	(330)	497	(418)	477	(418)	458	(255)
75 – 89	177	(880)	298	(713)	177	(798)	117	(535)
90 – 94	54	(40)	125	(206)	45	(21)	55	(161)
95 – 99	596	(815)	642	(815)	636	(815)	112	(602)
100	2137	(0)	2137	(0)	2137	(0)	2137	(0)
Dialysis at registration								
No	580	(576)	599	(497)	570	(480)	576	(462)
Yes	559	(419)	560	(489)	522	(518)	524	(478)
Recipient sex								
Male	587	(480)	605	(442)	545	(461)	572	(450)
Female	575	(503)	586	(540)	558	(530)	546	(528)
Recipient age (years)								
18 – 29	551	(364)	498	(446)	455	(361)	472	(291)
30 – 39	656	(433)	709	(400)	570	(499)	622	(462)
40 – 49	535	(569)	587	(396)	558	(515)	540	(507)
50 – 59	589	(490)	580	(559)	566	(445)	584	(454)
60 +	229	(505)	250	(503)	585	(593)	434	(603)
Ethnicity								
White	588	(509)	598	(495)	565	(498)	572	(464)
Non-white	508	(334)	502	(378)	476	(417)	490	(330)
Unknown	830	(132)	657	(389)	764	(432)	765	(2)
Transplant centre - Whole								
Cambridge	549	(246)	610	(322)	529	(273)	527	(399)
Cardiff	771	(454)	946	(481)	856	(424)	909	(372)
Edinburgh	920	(833)	865	(800)	894	(386)	890	(361)
Guys	542	(429)	565	(334)	550	(398)	532	(361)
Manchester	637	(426)	599	(480)	627	(519)	666	(459)
Newcastle	860	(353)	873	(109)	849	(416)	692	(435)
Oxford	580	(494)	579	(387)	514	(468)	484	(445)
WLRTC	695	(326)	830	(597)	798	(340)	798	(339)
Transplant centre - Islet								
Edinburgh	231	(772)	233	(840)	234	(429)	233	(891)
King's College	0	-	0	-	0	-	0	-
Manchester	1029	(845)	1010	(520)	1010	(893)	795	(868)
Newcastle	211	(896)	224	(471)	240	(894)	205	(869)
Oxford	234	(432)	678	(591)	479	(833)	343	(781)
Recipient A B or DR homozygous								
No	574	(506)	593	(492)	542	(468)	552	(443)

Table A3		MEDIAN WAITING TIME TO TRANSPLANT							
		Year 3 of simulation							
		Sim 1		Sim 2		Sim 3		Sim 4	
		(N = 180)		(N = 180)		(N = 180)		(N = 180)	
		Median	(IQR)	Median	(IQR)	Median	(IQR)	Median	(IQR)
Yes		590	(453)	593	(465)	572	(527)	557	(477)
Recipient DR homozygous									
No		575	(496)	603	(486)	566	(492)	575	(455)
Yes		587	(452)	571	(628)	521	(564)	538	(475)
Matchability points score									
1		697	(416)	666	(392)	644	(479)	666	(402)
2		530	(589)	708	(487)	735	(468)	633	(421)
3		615	(390)	620	(361)	553	(461)	546	(422)
4		515	(506)	501	(535)	477	(493)	465	(505)
5		532	(405)	516	(363)	462	(339)	553	(374)
6		570	(340)	580	(428)	519	(488)	503	(429)
7		597	(438)	607	(313)	692	(369)	589	(396)
8		849	(125)	822	(299)	855	(138)	849	(188)
9		246	(467)	240	(541)	339	(448)	438	(524)
10		1075	(2124)	1075	(2124)	1075	(2124)	1075	(2124)