Canadian Blood Services
it's in you to give

DONATION & TRANSPLANTATION

Interprovincial Programs Report

2009-**2016**

TERMINOLOGY AND USE OF DATA

A glossary of terms can be found in Appendix 1.

Production of this report has been made possible through a financial contribution from Health Canada, and the Provincial and Territorial governments. The views expressed herein do not necessarily represent the views of the Federal, Provincial or Territorial governments.

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Comments or Questions?

Questions or comments are welcome and can be sent to **transplantregistry@blood.ca.** All suggestions will be considered for inclusion in future reports.

EXECUTIVE SUMMARY

Canadian Blood Services is committed to providing timely and accurate reporting on its organ listing and allocation programs, and has initiated a yearly cycle of reporting beginning with the KPD Program Data Report 2009 – 2013 and the subsequent 2014 and 2015 Donation and Transplantation Interprovincial Programs Reports. Canadian Blood Services is now releasing the 2016 Donation and Transplantation Interprovincial Programs Report. This report serves to celebrate program success and to identify targets for system improvement.

The results contained in this report are intended to provide a comprehensive overview for the Canadian Organ Donation and Transplantation Network (CODTN) in service to transplant candidates and donors participating in the Kidney Paired Donation (KPD) program, the Highly Sensitized Patient (HSP) program and the National Organ Waitlist (NOW) toward the goal of maximizing transplant access for those patients most in need.

The KPD Program, which facilitates living donor transplants by matching compatible donors and recipients, is beginning to see a leveling off of both participation and number of transplants achieved each year. With living donation in Canada being static, participation in KPD has similarly plateaued. Renewed efforts to optimize living donor transplantation will positively impact KPD performance. Additionally new strategies to increase transplant opportunities further for difficult to match patients are underway for 2017-2018 which will positively impact performance.

Although the profile of KPD participants relating to demographic and compatibility factors remains fairly consistent, 2016 showed improvements in the efficiency with which chains of matches are transplanted and an increasing focus on completing chains in which one or more matches is not able to proceed, which is a testament to program facilitators' ongoing efforts to monitor and support completion the work done at transplant centres throughout the life of proposed transplant chains. The importance of strategies that promote new and continued participation from candidate-donor pairs and non-directed anonymous donors cannot be overstated, but results also suggest that improving the efficiency of time from matching to transplant continues to be an important area in which to realize continued program successes.

The HSP program provides access to a national donor pool for those kidney patients with immunologically reduced access to transplant to a significant degree. It has facilitated 293 transplants since its inception in November of 2013; approximately one-third of these transplants occurred in 2016, with transplants occurring at a stable rate over time. With 57% of these transplants being interprovincial donations, interprovincial cooperation continues to be crucial to the continued success of this program. Despite program successes in finding transplant opportunities for patients with moderately high levels of sensitization, the national community continues to explore strategies to address the most extremely difficult-to-match patients, those with less than a 2% chance of matching any given donor. The program has undergone several salient changes in 2016, including prioritization for those patients with the lowest access to transplant among eligible transplant candidates; in addition, limitations purposed at maintaining fair interprovincial balancing were modified to eliminate import thresholds while maintaining export thresholds as a safeguard for transplant activity in net exporting provinces. This is also the first year in which post-transplant outcomes have been available for the program.

Finally, since June of 2012 the NOW for heart, lung, liver, and pancreas, small bowel, and multi-organ patients has represented the only real-time Canadian organ waitlist that operates on a national scale. In addition to heart, lung, and liver results, the presents report also includes results for pancreas candidates and transplants. NOW waiting lists have remained relatively stable into 2016, with 2016 seeing a continuation of the decreases in patient pool for lung and liver transplants relative to previous years. As development of the Canadian Transplant Registry (CTR) progresses in addressing the utility needs of organ communities, it is hoped that the NOW will develop into a unified resource for a comprehensive suite of services, including listing, matching, allocation, offering, and outcome monitoring.

[1] See Canadian Blood Services (2016) *Organ Donation and Transplantation in Canada: System Progress Report, 2006 2015.*

Available online at
profedu.blood.ca/en/organs-and-tissues/living-donation/reports

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1.0 INTRODUCTION

1.1 DATA SOURCES

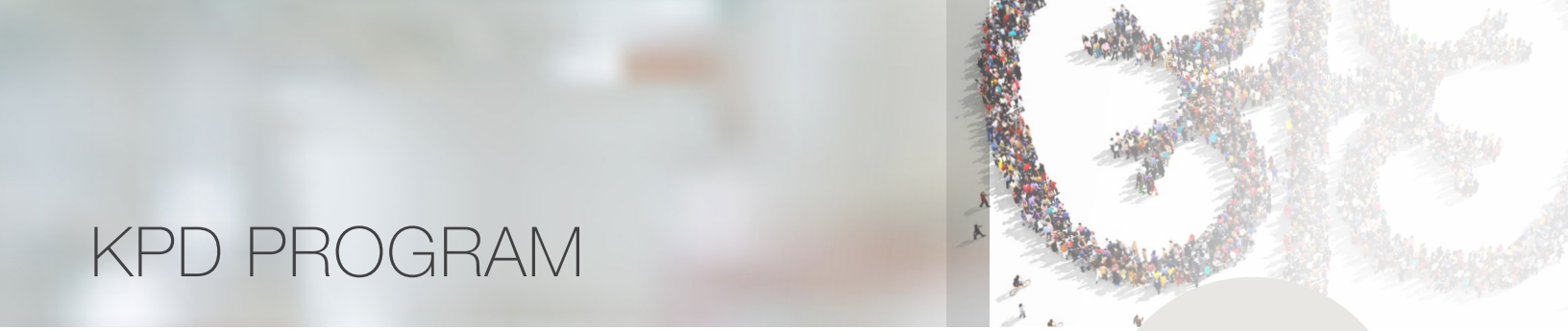
Data for program activities has been extracted from the Canadian Transplant Registry. This is the information technology (IT) system developed and maintained by Canadian Blood Services in which patient data is stored and the matching algorithms are run. Additional data has also been provided directly by the provincial Living Kidney Donation and Transplant Programs. Unless otherwise stated, data is presented for the period of 2009-2016. For programs that were initiated within this period, including the Highly Sensitized Patients (HSP) program (started in November of 2013) and the National Organ Waitlist (NOW) initiated in (June of 2012), results are presented from program start date to the present.

In the case of the Kidney Paired Donation (KPD) program, the results presented are for all Match Cycles initiated up to the end of 2016 (up to and including Match Cycle 26). Transplant outcomes for pairs proposed as part of Match Cycle 26 are included in the results presented, although the actual surgeries took place in early 2017. Unless specified otherwise, transplant results reported by year are based on the year in which each transplanted pair's Match Cycle began rather than the actual transplant date.

1.2 ACKNOWLEDGEMENTS

Canadian Blood Services acknowledges, with gratitude, the commitment of the Kidney Transplant Advisory Committee, the Living Donation Advisory Committee, the National HLA Advisory Committee, the Heart Transplant Advisory Committee, the Liver Transplant Advisory Committee, the Organ Donation and Transplantation Executive Advisory Committee, and those whose advice supports the continued growth and achievements of the KPD, HSP and NOW Programs. The KPD, HSP and NOW programs remain indebted to the administrators, physicians, surgeons, transplant coordinators and allied health professionals of the Organ Donation Organizations and Transplant Programs, for their efforts and collaboration. Their commitment to success and excellence has driven these accomplishments for transplant recipients in Canada.

[2] Transplants from Match Cycle 26 that were placed on indefinite hold due to medical issues have not been included in the results presented in this report. *See KPD Program Summary for details.*



KPD PROGRAM

2.0 KPD PROGRAM

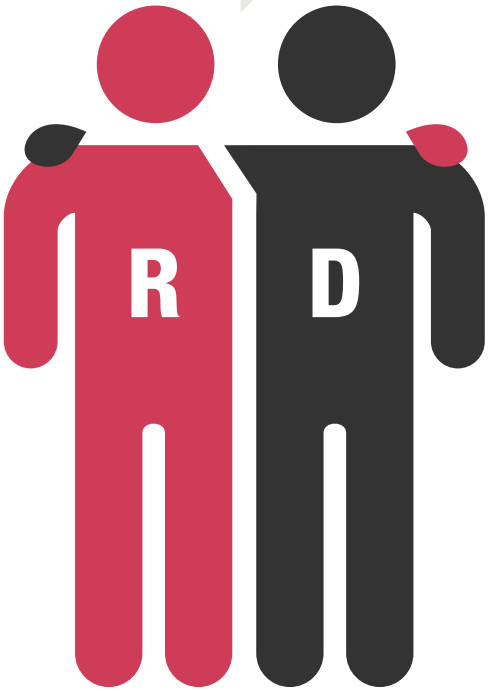
All provinces have been participating in the Kidney Paired Donation (KPD) Program since November 2010. The goal of the KPD program is to identify and facilitate kidney transplant opportunities for end stage renal disease (ESRD) patients who have a willing but incompatible living donor. Matches between candidate and donor records in the Canadian Transplant Registry (CTR) are generated as groups of donor exchanges and each grouping of exchanges is called a chain. Match Cycles are currently run three times a year to identify groups of mutually exclusive chains. Additional reruns and repair runs are done monthly within Match Cycles, or as needed.

2.1 KPD PROGRAM SUMMARY

The first transplants facilitated through the KPD program were performed in June of 2009 as part of the program's second Match Cycle; since the start of the program until the end of 2016, 26 Match Cycles have been run, with the last transplants completed as part of Match Cycle 26 performed in April of 2017. These Match Cycles have collectively resulted in 417 transplants of candidates registered with the program, as well as 88 transplants to patients who were on local kidney waitlists for a total of 505 transplants. On average, 9.4 chains are proposed per Match Cycle, with 5.9 chains proceeding to completed transplants per match cycle.

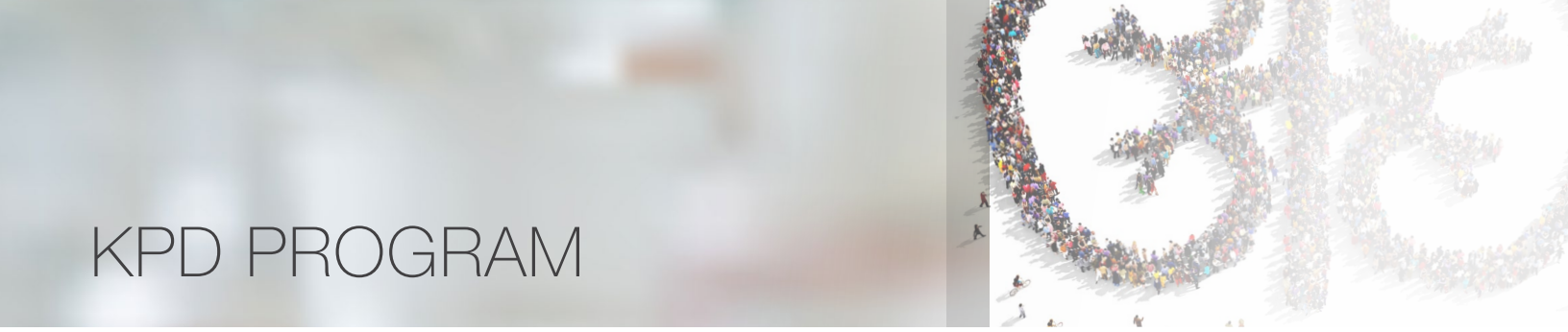
[3] An additional two transplants were identified and included in completed chains as part of Match Cycle 26, but were put on indefinite hold due to medical issues. These transplants are expected to proceed in 2017, and have not been included in the results presented in this report.

505
Transplants
since 2008



Kidney Paired Donation

The KPD Program is led and managed by Canadian Blood Services in collaboration with the provincial Living Donation and Transplant Programs across the county under shared operating guidelines, policies, processes and procedures.



KPD PROGRAM

Table 1.1: KPD Program Activity 2009-2016

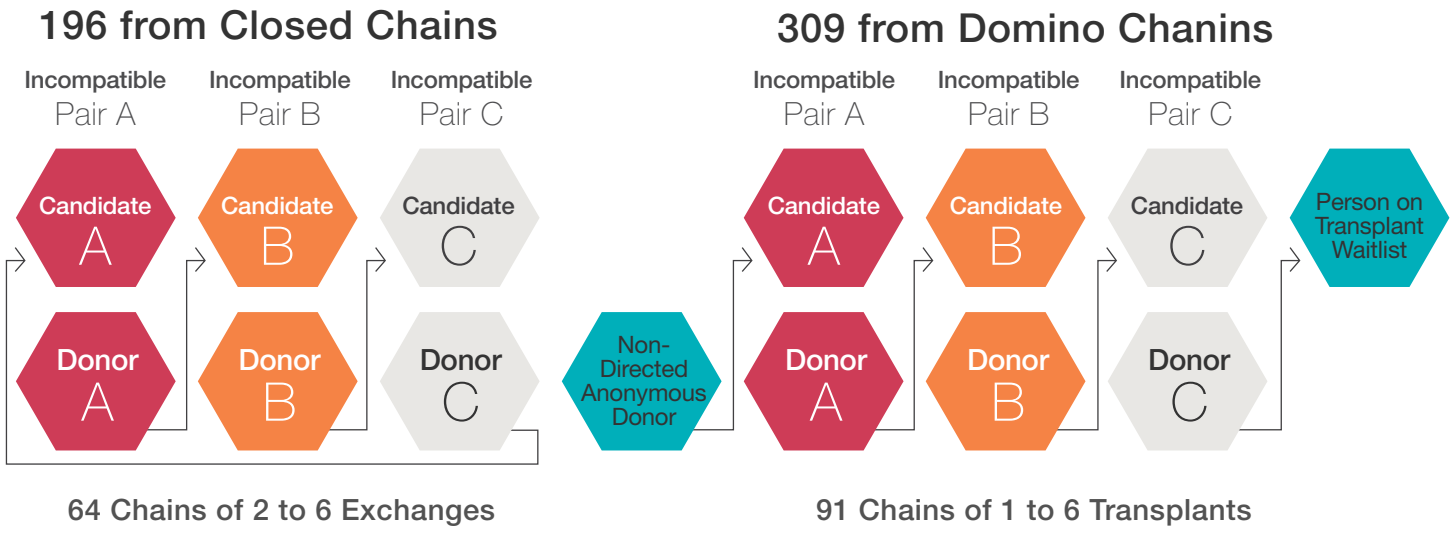
Total Number of Match Cycles	**26**
Pairs Registered	929
Candidates Registered*	848
Non-Directed Anonymous Donors (NDADs) Registered	108
Transplants Completed	**505**
Transplants to KPD Candidates	417
Transplants to Waitlist Candidates	88
Non-Directed Anonymous Donors (NDADs) Donated	90

* A candidate may register with multiple donors; in these cases, each would be registered in the system as a unique pair

There are two general types of donor exchange formats:

The Closed (N-Way) Exchange involves pairs where the donor of the last pair must match the candidate of the first pair. A closed chain can be as small as 2 pairs, which is called a paired exchange. From 2009 to 2016, 196 transplants were completed through 26 paired exchanges and 38 closed chains of exchanges among 3 to 6 pairs.

Figure 1.1: Chain Types & Transplants Completed in KPD Program 2009-2016



The Domino Chain has been the most common format used and has resulted in the most number of transplants. It starts with a non-directed anonymous donor (NDAD) who donates to the candidate of an incompatible pair. The chain ends by having the donor of the last pair donate to a patient on the waitlist of the local transplant program from where the NDAD originated. There have been 309 transplants completed from 2009 to 2016 from 39 domino chains of 1 to 6 transplants each.

KPD PROGRAM

Figure 1.2: Transplants by Chain Type by Year of Match Cycle in which Transplant was Proposed, 2009-2016

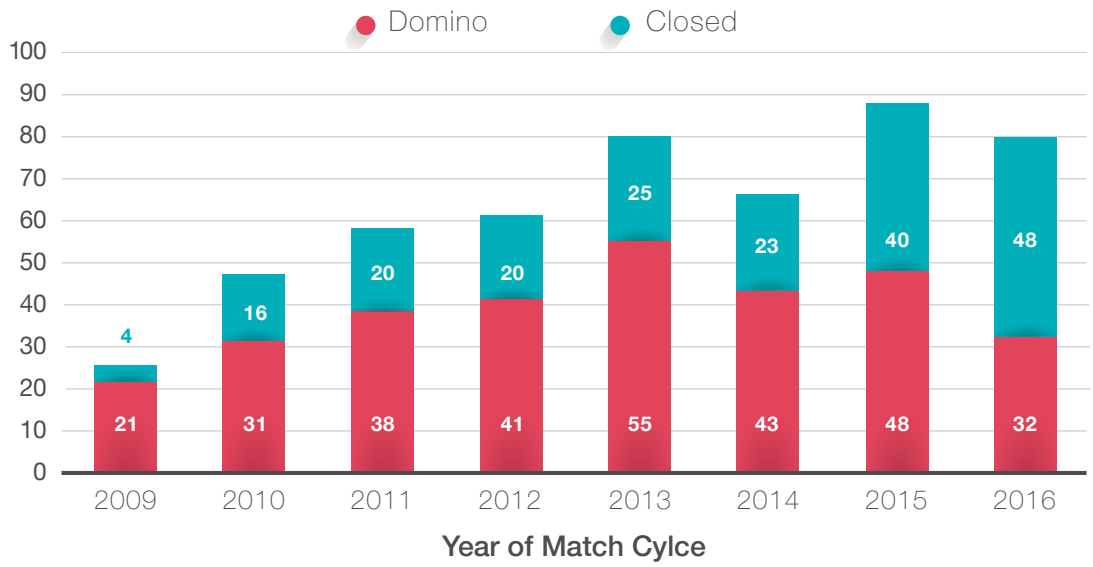
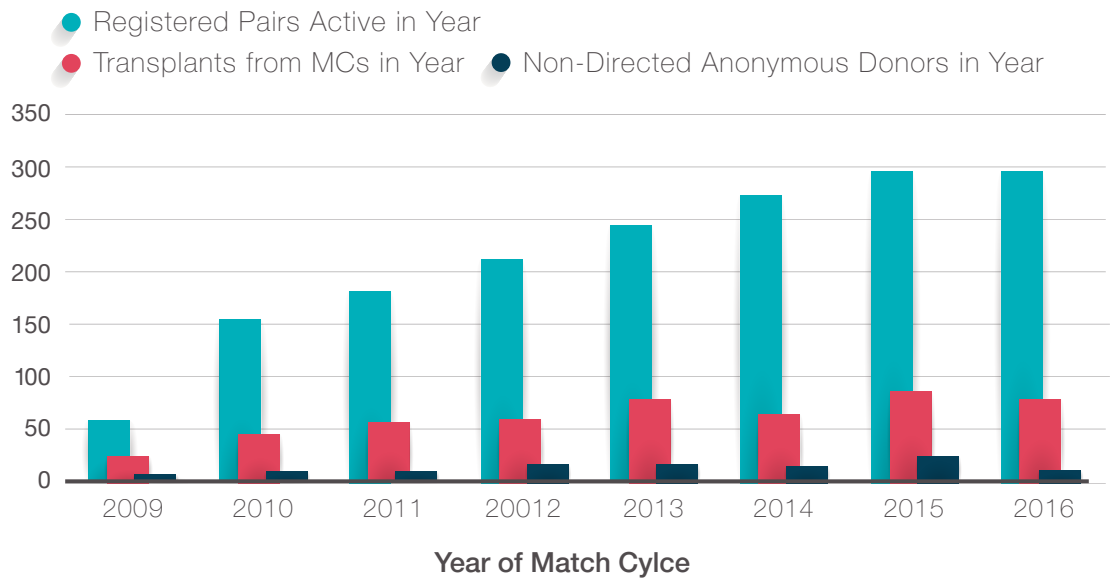


Figure 1.3: Registered Pairs, NDADs and Transplants by Year of Match Cycle, 2009-2016



Counts reflect all pairs/NDADs active for at least one match cycle in year and all transplants completed as a results of match cycles in year.

The program saw a steady increase of registered candidate-donor pairs from 2009 to 2015, mainly because of the carry-over of pairs that could not be matched in a previous year; however, 2016 represents the first year that there have been fewer active pairs than a previous year. A salient factor that contributed to this situation is the decrease in the number of new pairs registering, with 117 pairs registered for the first time in 2016, while 2014 and 2015 averaged 147 new pairs per year.

2.2 Transplant Candidates, Transplant Recipients and Donors

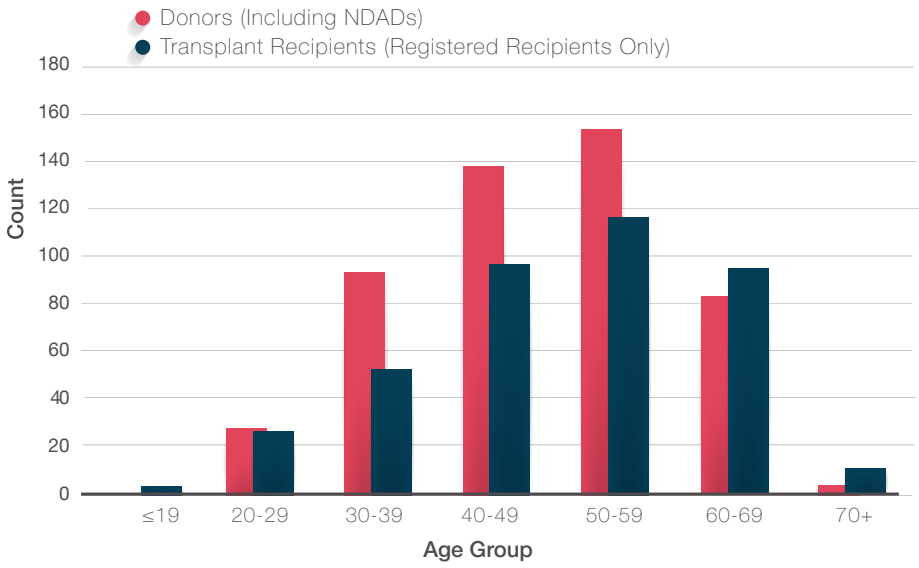
Age & Sex

Transplant candidates registered in the program have ranged in age from 1 to 77; the median age of candidates across Match Cycles remains fairly constant with the mean age of candidates at the time of their first Match Cycle being 48 years of age. Donors enrolling in the program as part of a registered pair have a mean age of 47 at time of first active Match Cycle, while the mean age among NDADs at the time of their first active Match Cycle is 50 years of age.

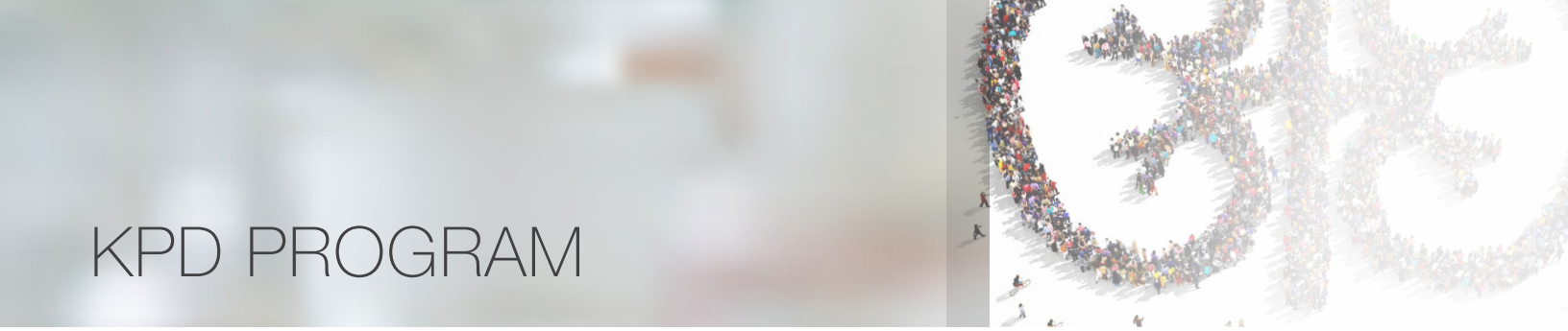
Adults aged 40 to 69 at their first Match Cycle make up 71% of the registered candidate population, and this age group received 62% of the transplants among registered recipients. Similarly, 71% of donors were between 40 and 69 at their first Match Cycle; however, donors in this age group accounted for 75% of donations (excluding NDAD donations). Donors are most commonly between the ages of 50 and 59, with this age group accounting for 30% of donors participating in the program and 31% of program donations. Only 9% of donors registered and 6% of those making a donation have been younger than 30.

There have been 21 candidates who first participated in the program while in the pediatric age range (≤19 years old), 14 (67%) of whom received a transplant while still within this age range, with 10 transplanted in their first active Match Cycle and the remaining 4 transplanted within 2 Match Cycles. Pediatric candidates comprise approximately 3% of registered recipients transplanted through the KPD program.

Figure 1.4: Age of Registered Recipients and Donors, 2009-2016



Over all age ranges, 48% of transplant candidates have been male (52% have been female), which is consistent with the ratio between sexes represented among those who received a transplant. Similarly, donors who donated through the KPD program (including NDADs) have been 59% female and 41% male, which is also consistent with the proportions represented among all potential donors participating in the program (60% and 40% respectively). Of the NDADs who have participated in at least one Match Cycle, 56% were female and 44% were male, with the same proportions represented among NDADs who made a donation.



KPD PROGRAM

Table 1.2: Transplant Recipients by Age and Sex, 2009-2016: Count (Proportion of Recipients by Type), n (%)

	Registered Recipients			Waitlist Recipients			
	Total	Female	Male	Total	Female	Male	Not specified
All Ages	**417** (100)	**216** (100)	**201** (100)	**88** (100)	**25** (100)	**37** (100)	**26** (100)
≤19	14 (3)	4 (2)	10 (5)	6 (7)	2 (8)	2 (5)	2 (8)
20-29	27 (6)	8 (4)	19 (9)	3 (3)	-	2 (5)	1 (4)
30-39	53 (13)	24 (11)	29 (14)	5 (6)	-	3 (8)	2 (8)
40-49	98 (24)	61 (28)	37 (18)	24 (27)	7 (28)	9 (24)	8 (31)
50-59	118 (28)	60 (28)	58 (29)	27 (31)	9 (36)	12 (32)	6 (23)
60-69	96 (23)	56 (26)	40 (20)	16 (18)	5 (20)	9 (24)	2 (8)
70+	11 (3)	3 (1)	8 (4)	3 (3)	2 (8)	-	1 (4)
Unknown	-	-	-	4 (5)	-	-	4 (15)

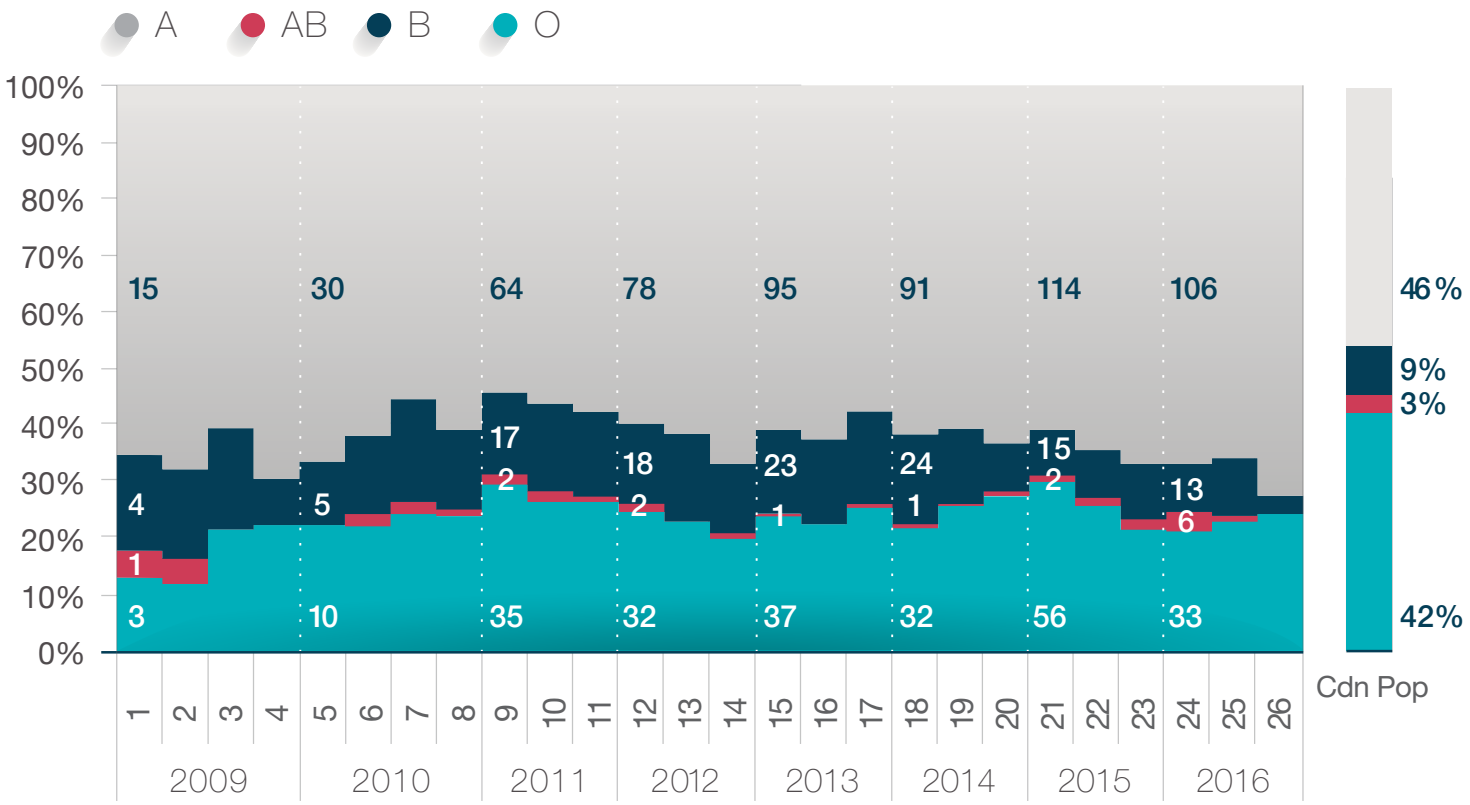
Please see Table A3.3 in Appendix 3 for the equivalent results relating to KPD donors.

Blood Group

ABO blood group is a significant factor in identifying compatible matches between donors and candidates. ABO O candidates are over represented in the registry compared to their representation in the general population, due to their current absolute requirement for an ABO O donor in the program. Despite preferential matching of O donors to O recipients (which is resulting in a majority of O donors transplants being received by O recipients as would be expected), type O candidates continue to accumulate in program because of a combination of restrictive factors (type O and their HLA profile).

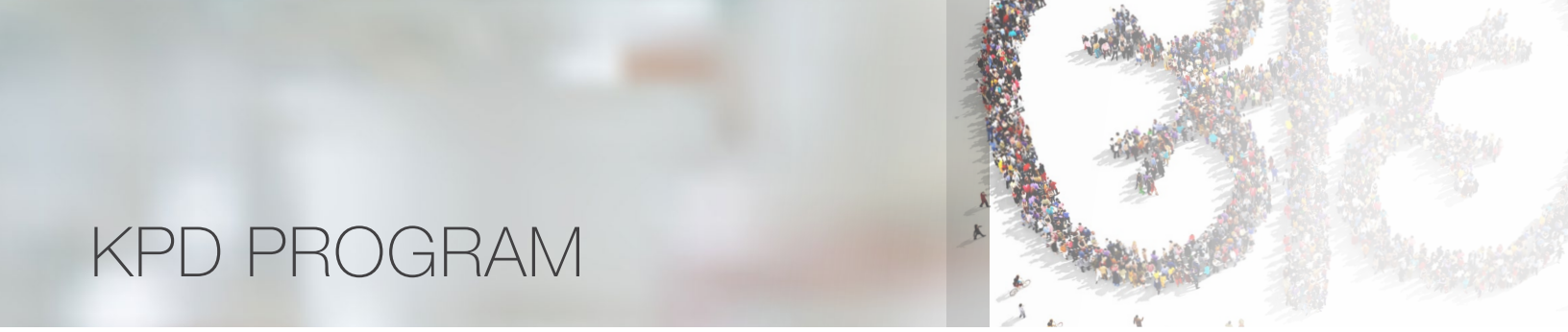
KPD PROGRAM

Figure 1.5: Proportion among Registered Candidates Active in KPD Program at the Time of Each Match Cycle by Blood Group, 2009 to 2016



Blood group O candidates comprise 57% of all registered candidates. Despite preferential blood group O donor to blood group O candidate matching, blood group O candidates still received only 44% of the transplants facilitated through KPD to registered recipients. Only 38% of blood group O candidates received a transplant, compared with 64% of candidates in other blood groups.

34% of donors registered in KPD (including paired donors and NDADs) are in blood group O, and 56% of donors in blood group O made a donation.



KPD PROGRAM

Table 1.3: Transplants to Registered Recipients by Donor and Recipient Blood Groups for Years 2009 to 2016

Recipient Blood Group	Donor Blood Group A		Donor Blood Group AB		Donor Blood Group B		Donor Blood Group O		Total	
A	140	(34%)	-		-		**3**	(1%)	**143**	(34%)
AB	7	(2%)	2	(0.5%)	1	(0.2%)		-	10	(2%)
B	1	(0.2%)	-		70	(17%)	9	(2%)	80	(19%)
O	1	(0.2%)	-		-		183	(44%)	184	(44%)
Total	149	(36%)	2	(0.5%)	71	(17%)	195	(47%)	417	(100%)

Calculated Panel Reactive Antibody (cPRA) Levels

Some candidates are incompatible with their registered donors (and other donors) due to donor specific HLA antibodies (DSA), which can form after sensitization or exposure to foreign HLA antigens from prior transfusions, transplantations or pregnancies. The percentage of the general population to which a candidate has HLA antibodies is estimated as calculated panel reactive antibodies (cPRA). A candidate with a higher cPRA level will be incompatible with more donors. Transplants with HLA DSA present are associated with higher rates of kidney rejection and shortened survival of the transplanted organ.

Candidates with a cPRA of greater than or equal to 97% are the most biologically difficult-to-match population in the Registry. These candidates comprise 29% of all candidates since registry inception, but receive only 10% of transplants facilitated by KPD to registered candidates. Therefore accumulating in the registry over time; more than half of the active candidates in 2016 had cPRA ratings of 97% or higher. Conversely, those with a cPRA of 95-96% were transplanted at rates comparable to their prevalence in the candidate population, making up 3.4% of candidates and 3.8% of registered transplant recipients

Figure 1.6: Proportion among Registered Candidates Active in KPD Program at the Time of Each Match Cycle by cPRA Group, 2009 to 2016

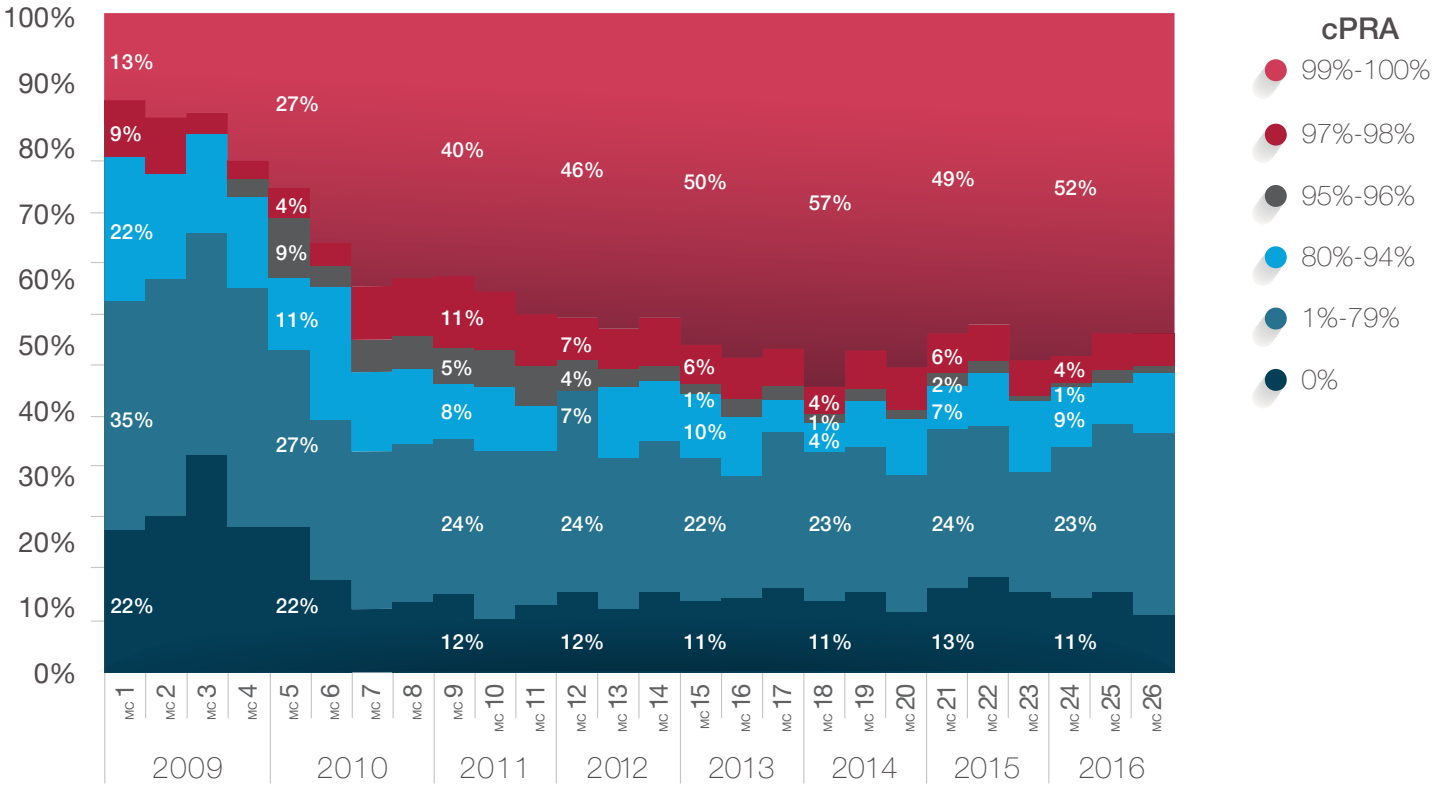


Table 1.4: Percentage of Unexpected Positive Crossmatches/DSA by Year

Category	2010	2011	2012	2013	2014	2015	2016
Number of actual crossmatches performed	71	80	73	95	91	153	137
Number of unexpected actual positive FCXM and/or new DSA	6	5	1	2	5	8*	5
Percent of unexpected positive FCXM and/or new DSA	8%	6%	1%	2%	4%	5%	4%

FCXM: Flow Cytometry Crossmatch

* Note: In one case in which an unexpected positive crossmatch was detected, the chain was primarily declined due to a medical condition unrelated to the crossmatch. An additional chain had two unexpected positive crossmatches identified in the same chain.

HLA antibody testing of transplant candidates is repeated several times per year as antibody formation is a dynamic process; the candidate antibody profile may change over time. In rare cases, a new donor-specific antibody (DSA) can form between the time a Match Cycle is run and the subsequent confirmatory testing. Overall however, once a match has been approved by the HLA laboratory, the percentage of subsequently unexpected positive confirmatory crossmatches or newly discovered DSA remains rare and is not a major contributor to chain breakdown.

2.3 MATCH CYCLE STATISTICS

Chains are scored based on match points attributes representing priorities for access (refer to Appendix 2) and the group of chains with the highest total points, which by definition represents the most optimal transplant combination possible, is proposed to move forward. Incompatible pairs who are not matched in a given Match Cycle and agree to remain in the Registry are carried forward into the next Match Cycle. Pairs may be included in a Match Cycle after the initial set of chains is proposed under certain circumstances; for instance, a pair may be added as a replacement for a proposed pair that could not proceed as part of the process to repair a chain, and in some cases the matching algorithm may be rerun with additional pairs included.

Chain Length and Time to Completion

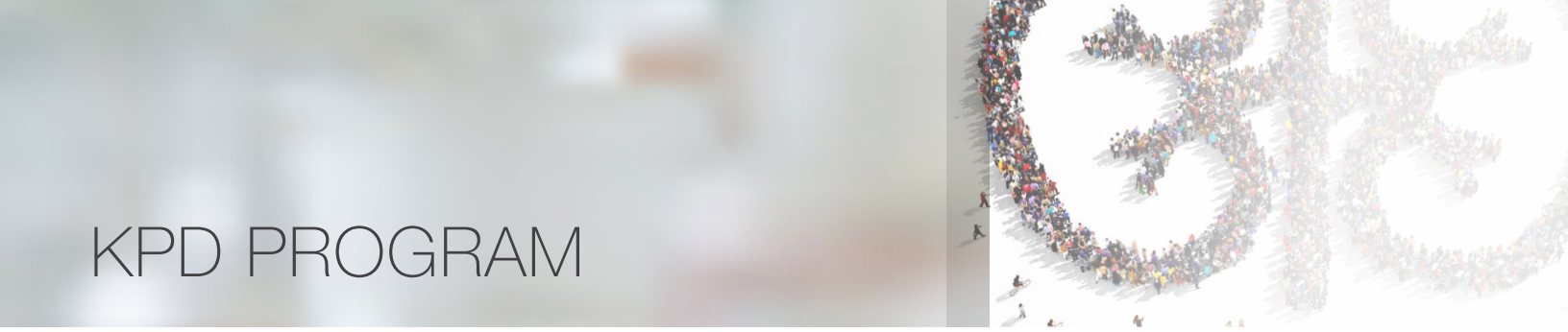
The KPD program's target is to complete a chain of transplants within 120 days from the time of chain proposal. Up to the end of 2016, the median time to completion for all chains was 118 days. For the 3 Match Cycles run in 2016, 70% of completed chains were completed within the target time frame, which represents a substantial improvement over past years in which only 52% of chains were completed within 120 days. The chains completed in 2016 were also longer in general, averaging 3.6 pairs transplanted per chain as opposed to 3.2 pairs on average historically for the program (a 13% increase in average chain length).

Repaired chains tend to require more time to complete compared with chains that proceed as originally proposed, with repaired chains requiring 30 days longer to complete on average. Prior to 2016, approximately one in seven chains (14%) has been repaired; however, 41% of chains completed in 2016 required one or more repairs, representing almost triple the rate for repairs in previous years.

Despite the higher repair rate, chains requiring repairs in 2016 were still completed more quickly on average than repaired chains in previous years, as were chains not requiring repairs. As a result, 2016 Match Cycles evidenced lower chain completion times on average than the average among chains from previous years.

[4] Chain completion time is the time from the date the chain was first proposed to the time the last transplant is completed. The final completed chain may contain some pairs that differ from the initial proposal if the chain was repaired using new pairs to respect the time already invested by the pairs and the donation programs.

Irene Mills, a member of the Haida First Nation, donated one of her kidneys to a complete stranger. Mills was motivated to become an anonymous donor after a family friend was in need of a transplant. She's encouraging others to learn more about living organ donation, as well as becoming blood and stem cell donors.



KPD PROGRAM

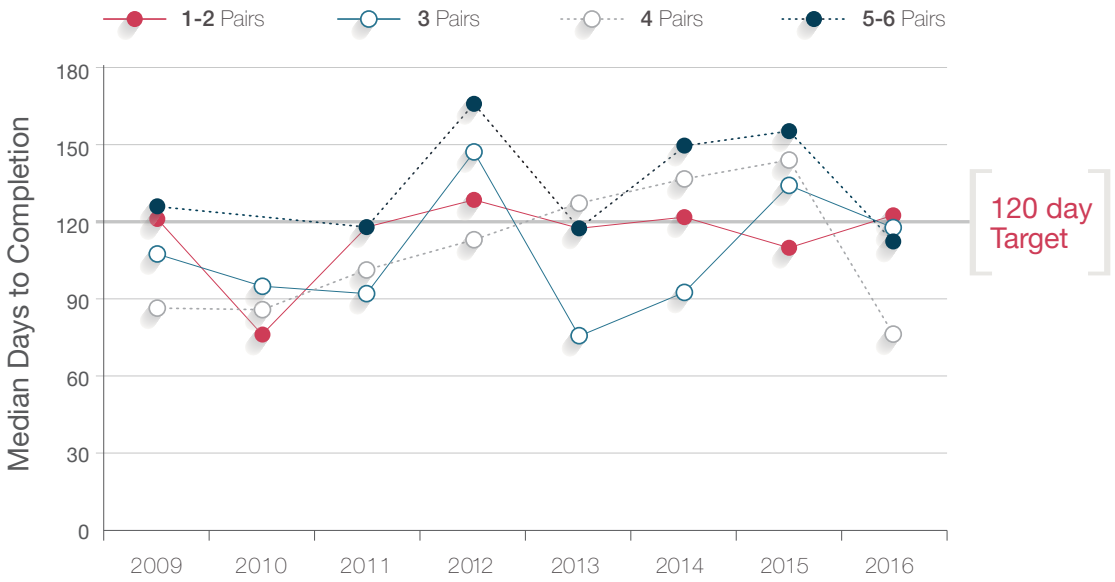
Table 1.5: Chain Length and Median Time to Completion*

Number of Candidates in Chains		2016 Number of Chains Completed	2016 Median Time to Completion in Days (Interquartile Range)	2009 to 2015 Average # of Chains Completed per Year	2009 to 2015 Median Time to Completion in Days (Interquartile Range)
Closed Chains					
2 (Paired Exchange)	6	107	(88-133)	3.0	117	(56-124)
3	2	120	(104-135)	2.0	125	(84-159)
4	2	74	(71-76)	1.0	133	(113-153)
5	2	141	(130-151)	0.9	129	(119-169)
6	2	93	(90-97)	0.1	128	(128-128)
All Closed	**14**	**96**	**(86-133)**	**7.0**	**119**	**(87-145)**
Domino Chains					
1-2	3	133	(101-165)	3.3	125	(85-145)
3	0	-	-	3.3	101	(88-138)
4	1	117	-	3.3	110	(95-139)
5	2	133	(123-144)	1.7	137	(116-166)
6	2	93	(83-104)	0.3	210	(162-259)
All Domino	**8**	**116**	**(102-138)**	**11.9**	**118**	**(93-145)**
All Chains	**22**	**113**	**(86-135)**	**18.9**	**119**	**(92-145)**

In some cases, fewer transplants are actually completed in a given chain than the number of matches that were included in the final version of that chain; these chains are categorized as completed, and are represented in the table above based on the actual number of transplants that were completed as part of the chain.

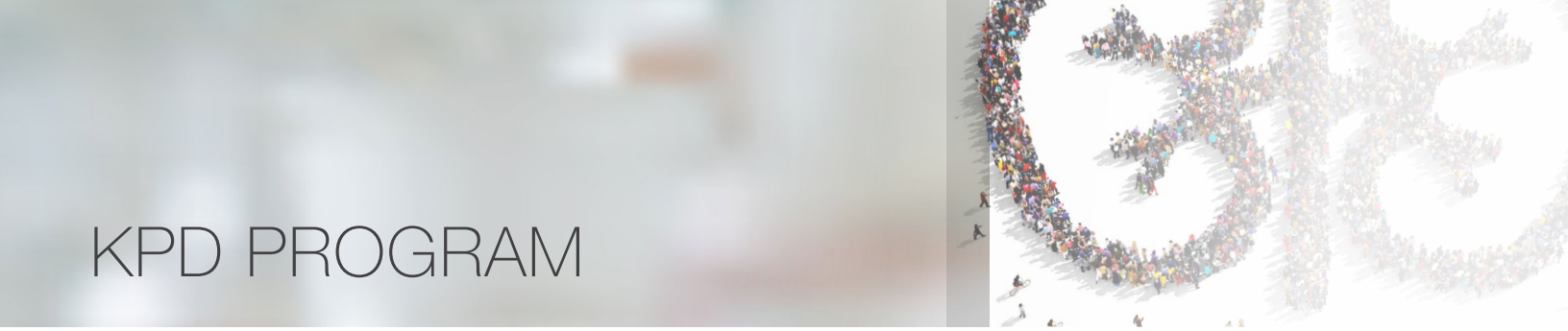
* Time to chain completion refers to the time from the initial chain proposal date to the date of the final transplant that occurred as part of the chain.

Figure 1.7: Median Time from Chain Proposal to Completion by Year and Chain Length



In some cases, fewer transplants are actually completed in a given chain than the number of matches that were included in the final version of that chain; these chains are categorized as completed, and are represented in the figure above based on the actual number of transplants that were completed as part of the chain.

Since 2015, the KPD team has been tracking and encouraging completion of chain tasks by participating transplant centres, and improvements in efficiency can be seen in the results for chain completion in 2016, particularly in chains of 4 or more pairs, which decreased in mean completion time from 131 days from 2009-2015 (11 days over the target) to 108 days in 2016 (12 days under the target). Nevertheless, in light of the year-to-year variation in chain completion times, it would be premature to conclude that this represents a sustainable change in program performance.



KPD PROGRAM

Chain Collapses

A chain is collapsed and does not proceed to transplant if there is one or more matched pair declines before a significant amount of the chain evaluation work is completed. Approximately 44% of chains collapsed because of medical issues of a donor and/or a candidate, making medical issues the leading cause of chain collapses.

Relatively few chains collapsed in 2016 as compared with previous years. HLA collapses accounted for 14% of proposed chains in 2016, which is comparable to the approximately 11% of chains that collapsed due to HLA issues each previous year on average.

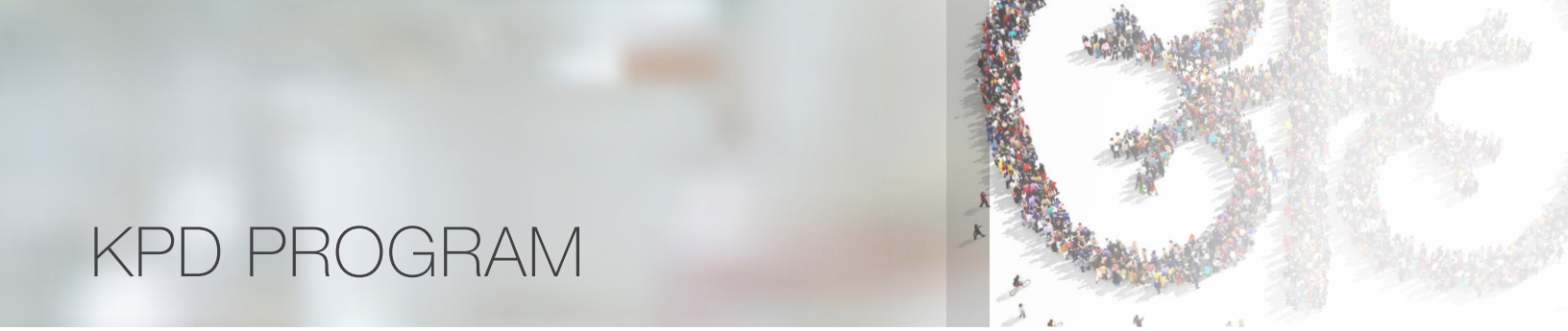
Table 1.6: Reasons for Chain Collapses by Year

		Reason Category				
Year		Medical	Non-Medical	HLA	Surgical/ Anatomical	Total
2009	Count	0	2	0	0	2
	%	0%	100%	0%	0%	100%
2010	Count	2	1	5	0	8
	%	25%	13%	63%	0%	100%
2011	Count	4	2	4	0	10
	%	40%	20%	40%	0%	100%
2012	Count	4	2	1	2	9
	%	44%	22%	11%	22%	100%
2013	Count	9	4	2	2	16
	%	56%	25%	13%	13%	100%
2014	Count	10	5	6	3	24
	%	42%	21%	25%	13%	100%
2015	Count	10	1	3	0	14
	%	71%	7%	21%	0%	100%
2016	Count	1	2	4	0	7
	%	14%	29%	57%	0%	100%
Total	Count	40	19	25	7	90
	%	44%	21%	28%	8%	100%
Avg. 2009-15	Count	5.6	2.4	3.0	1.0	11.9
		47%	20%	25%	8%	100%

Year of match decline is based on year of the Match Cycle in which the match was proposed.
One 2013 chain declined for both medical and non-medical reasons.

In an attempt to reduce the amount of medical declines of donors, the Living Donation Advisory Committee has established the Kidney Paired Donation Protocol for Participating Donors which has been used as of October 2015 by Living Donation Programs to assess all donors wishing to enroll in the Program. For Programs seeking to enroll a donor they feel is clinically acceptable but does not completely meet the assessment Protocol parameters, a process exists to submit a Living Donor Query to the Living Donor Advisory Committee and/or the Kidney Transplant Advisory Committee. The committee(s) will return a decision as to whether or not the donor can still be enrolled and under what restrictions or conditions, if any.

[5] Richardson R, Connelly M, Dipchand C, Garg AX, Ghanekar A, Houde I, Johnston O, Mainra R, McCarrell R, Mueller T, Nickerson P, Pippy C, Storsley L, Tinckam K, Wright L, Yilmaz S, Landsberg D & Protocols Working Group of the Canadian Blood Services' Living Donation Advisory Committee. 2015. Kidney Paired Donation Protocol for Participating Donors 2014. Transplantation. Oct;99(10 Suppl 1):S1-S88.



KPD PROGRAM

Match and Chain completions

Of the 29 chains that were proposed in 2016, 22 (76%) were completed. Approximately one-quarter of the chains proposed in 2016 could not be repaired and so were collapsed. Nine of the 22 completed chains were completed after being repaired by replacement or reconfiguration of one or more pairs. For reference, just over half (52%) of all chains proposed since the program began have been completed without a repair, and an additional 11% were completed after being repaired.

Prior to 2016, 19% of the chains that could not be completed as originally proposed were completed following a repair; however, 56% of chains that could not be completed as originally proposed in 2016 were repaired and completed, for a repair rate that is three times the rate among previous years. The low number of chains collapsed in 2016 (lower than six of the seven prior years of the program's operation) is consistent with 2016 having more repair opportunities than any previous year.

Table 1.7: Match and Chain Completion Rates, 2009-2016

	KPD Matches^					KPD Chains				
Year	Completed n (%)		Cancelled† n (%)		Total Proposed n (%)	Completed* n (%)		Collapsed n (%)		Total Proposed n (%)
2009	25	(69%)	11	(31%)	36	8	(80%)	3	(30%)	10
2010	47	(58%)	34	(42%)	81	17	(68%)	8	(32%)	25
2011	58	(62%)	36	(38%)	94	15	(60%)	10	(40%)	25
2012	61	(66%)	31	(34%)	92	20	(69%)	9	(31%)	29
2013	80	(64%)	45	(36%)	125	23	(59%)	16	(41%)	39
2014	66	(51%)	64	(49%)	130	20	(45%)	24	(55%)	44
2015	88	(58%)	64	(42%)	152	29	(67%)	14	(33%)	43
2016	80	(59%)	56	(41%)	136	22	(76%)	7	(24%)	29
Total	**505**	**(60%)**	**341**	**(40%)**	**846**	**154**	**(63%)**	**91**	**(37%)**	**244**
Average 2009-15	**61**	**(60%)**	**41**	**(40%)**	**101**	**19**	**(61%)**	**12**	**(39%)**	**31**

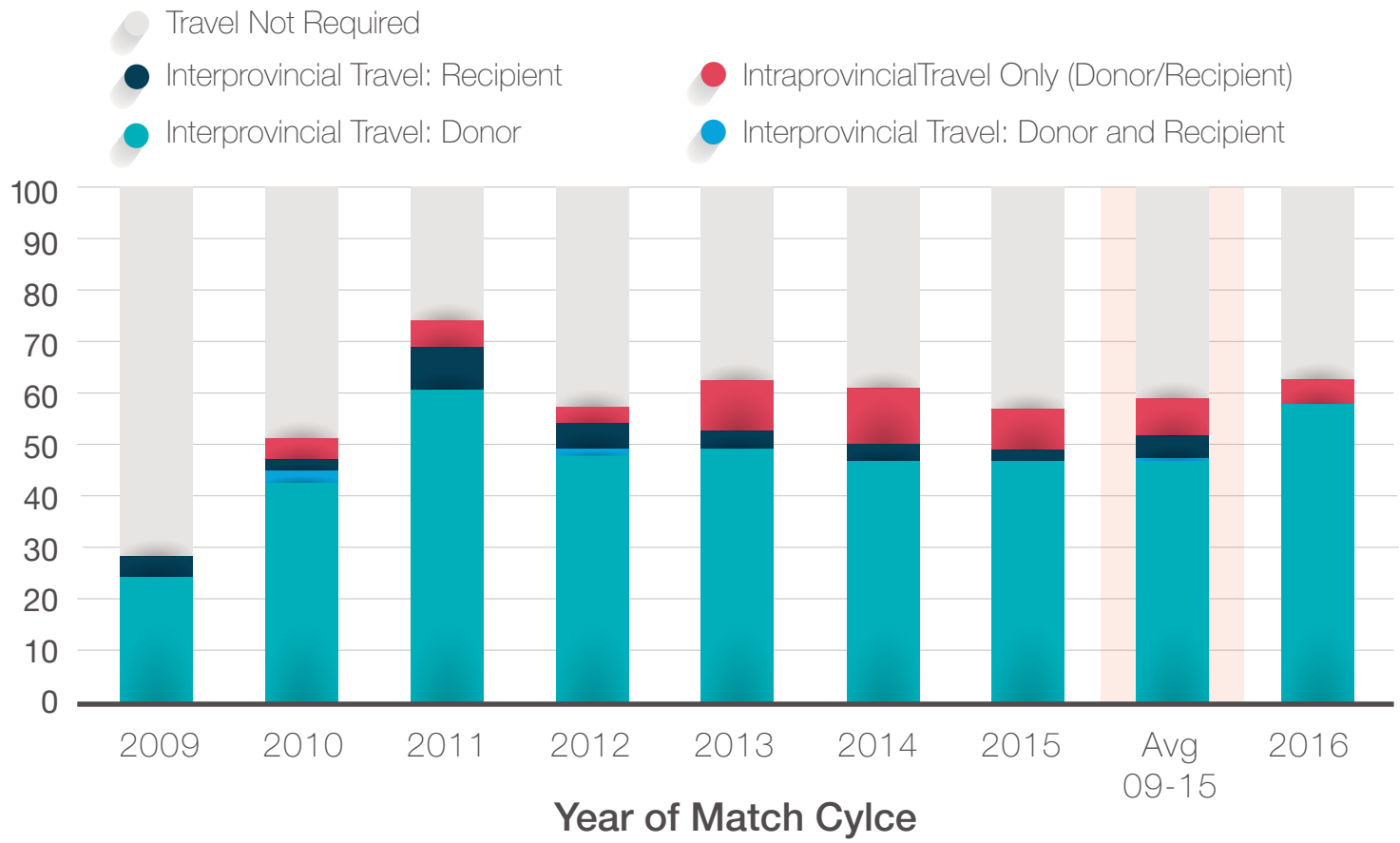
* Chains resulting in fewer transplants than the total proposed as part of the final version of the chain have been included under completed chains. ^Includes matches between a given donor and a waitlist recipient †Number of cancelled matches is based on unique matches that were proposed but did not proceed to transplant. Matches that were proposed multiple times as part of different chains in the same year are counted once for that year. Matches that were cancelled in one chain but later completed as part of a different chain are only counted among successful transplants.

2.4 TRAVEL

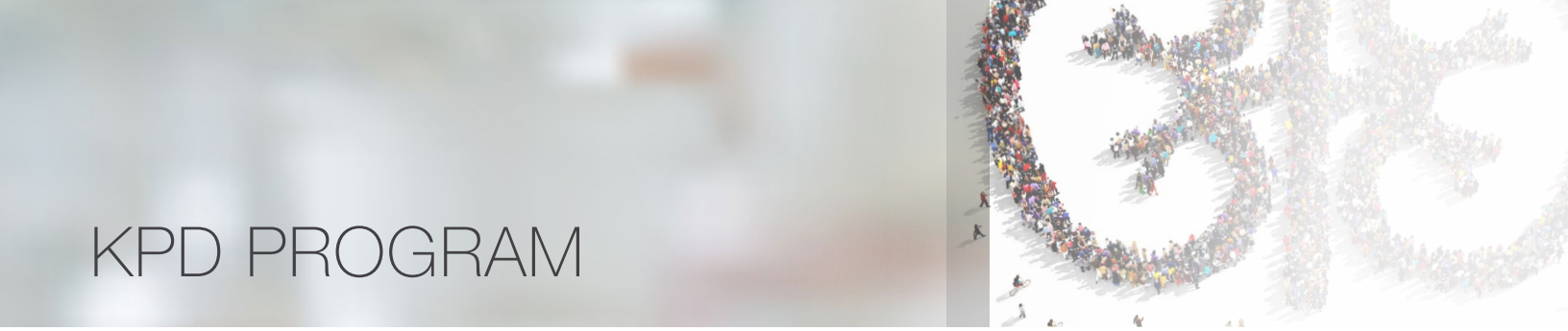
The KPD matching algorithm assigns points to matches between donors and candidates in the same city in an attempt to reduce the number of donors needing to travel. Donor travel continues to be a significant part of facilitating KPD transplants. Work has begun to establish protocols for shipping donor kidneys more regularly in the future. For transplants conducted in Match Cycles initiated prior to 2016, just over half (52%) required inter-provincial travel; however, in 2016 this proportion increased slightly to 58% of transplants requiring the donor to travel interprovincially and no interprovincial recipient travel. Transplants in 2016 also differed from previous years in that none required the recipient to travel interprovincially for transplant.

Historically 7% of KPD transplants required intraprovincial travel for either the donor or the recipient and 41% did not require travel, and 2016 results show 5% of transplants involved intraprovincial travel and 38% did not require either the recipient or the donor to travel.

Figure 1.8: Proportion of KPD Participants Travelling for Transplantation



Travel between Atlantic provinces is not counted as interprovincial or intraprovincial travel because all Atlantic province residents must go to Halifax as their surgical transplant centre.



KPD PROGRAM

2.5 OUTCOMES

Program Performance

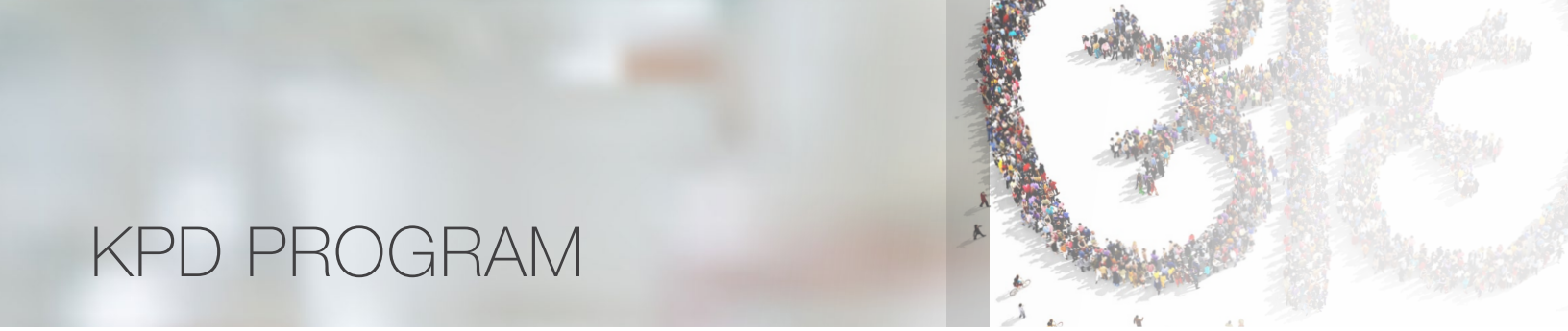
There have been 417 transplants to 415 registered recipients, with an additional 88 waitlist candidates transplanted through the KPD program. Two patients came back into the KPD program after their first transplant failed and received a second transplant.

Just under half (49%) of candidates who registered in KPD Match Cycles to the end of 2016 received a transplant through the program, with 11% of candidates remaining active for the first Match Cycle in 2017, comprising two-thirds of the candidates active in that match cycle (MC27). A total of 343 registered candidates have been inactivated; 79 of these candidates were inactivated in 2016. Reasons for inactivation are not routinely provided to the program but may include transplant from local waitlist or a local living donor, or withdrawal for medical reasons.

Table 1.8: Candidate Activity for KPD Program 2009 – 2016

	2009	2010	2011	2012	2013	2014	2015	2016	All Years
Registered candidates transplanted through KPD program	19	37	49	48	65	54	73	72	**417**
Inactivated candidates by year of most recent Match Cycle	11	26	24	38	48	53	64	79	**343**
Candidates active at end of 2016 by year of first Match Cycle*	1	7	4	10	8	14	18	29	**91**

Transplant recipients stratified by year of match cycle in which they received a transplant.
*Does not include candidates whose first Match Cycle was 27.



KPD PROGRAM

Recipient Outcomes

One month and one year post-surgery minimum outcome data has been collected for both donors and recipients.

For transplant recipients from Match Cycles in 2009-2016 for whom outcome information is available, 99.8% of recipients were alive one month after the date of the transplant, as were 99.5% at one year post-transplant. Please see Appendix 3: Table A3.10 for additional results relating to recipient outcomes.

Table 1.9: One Month Recipient and Graft Outcomes, 2009 – 2016

	Recipients		Waitlist Recipients		Total	
Patient Survival	374	99.7%	84	100%	**458**	**99.8%**
Graft Survival	371	98.9%	84	100%	**455**	**99.1%**
Patients Experiencing Rejection Episodes	26	7.2%	7	9.1%	**33**	**7.4%**

Data available for 459 recipients (rejection information available for 443 recipients).

[6] One-month outcome results are available for 459 (91%) of the 505 recipients transplanted through the KPD program, and one-year outcome results are available for 374 recipients (373 for graft survival).

Table 1.10: One Year Recipient and Graft Outcomes, 2009 – 2016

	Recipients		Waitlist Recipients		Total	
Patient Survival	304	99.3%	67	100%	**371**	**99.5%**
Graft Survival	300	97.7%	67	100%	**367**	**98.1%**
Patients Experiencing Rejection Episodes	45	15.2%	10	14.7%	**55**	**15.0%**

Patient survival data available for 373 recipients and graft survival data available for 374 recipients (rejection information available for 366 recipients). Rejection episode results include rejection episodes occurring within the first month after receiving the transplant.

HIGHLY SENSITIZED PATIENT PROGRAM

3.0 HIGHLY SENSITIZED PATIENT PROGRAM

The Highly Sensitized Patient (HSP) program represents the first completely national deceased donor kidney sharing agreement in Canada, and has begun to correct, along with newer provincial allocation policies, historical imbalances between the number of highly sensitized patients and the proportion of this group receiving transplants.

Under the HSP program national agreement, donor organs from anywhere in the country will be first offered nationally to a suitably matched transplant candidate with a cPRA ≥ 95%. From inception to end of 2016, the program has facilitated 293 kidney transplants as a result of collaboration between Transplant Programs, ODOs, HLA Laboratories, Canadian Blood Services and Provincial Governments in Canada.

3.1 HSP PROGRAM SUMMARY

Policy Changes

Since the establishment of the HSP program, the Kidney Transplant Advisory Committee (KTAC) and the National HLA Advisory Committee (NHLAAC) have been tracking HSP program activity on a monthly basis. In April 2015 as part of an ongoing system performance review the KTAC began evaluating the HSP program policies using data analysis and simulation models provided by Canadian Blood Services.

During the evaluation, KTAC observed that Highly Sensitized Patients (HSPs) with cPRA >98% are transplanted at a proportion significantly lower than their prevalence on the national HSP wait list and comprise a majority of HSPs still waiting for transplant. Conversely HSPs with cPRA 95-98% are transplanted more readily and few remain on the HSP wait list. Therefore, KTAC recommended the prioritization of HSPs with cPRA >98% in the HSP allocation as a tie-breaker in order to improve transplant opportunities for these hardest to match patients.

The second observation made by KTAC during the evaluation related to the interprovincial import and export thresholds designed to ensure import and export balance between provinces. The data analysis and simulation models showed smaller provinces were “on hold for HSP” due to import threshold restrictions for a combined 705 days. In this case, KTAC recommended the removal of all import thresholds but agreed to maintain export thresholds as a safeguard for transplant activity in net exporting provinces.

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Since the establishment of the HSP program, the Kidney Transplant Advisory Committee (KTAC) and the National HLA Advisory Committee (NHLAAC) have been tracking HSP program activity on a monthly basis.

In April 2015, as part of ongoing system performance review, KTAC observed that Highly Sensitized Patients (HSPs) with cPRA >98% are transplanted at a proportion significantly lower than their prevalence on the national HSP wait list, and now comprise the majority of HSPs still waiting for transplant. Conversely HSPs with cPRA 95-98% are transplanted more readily and few remain on the HSP wait list. Therefore, following a review of simulations that model and predict program impact, KTAC recommended the prioritization of HSPs with cPRA >98% in the HSP allocation when required to adjudicate between allocation to multiple recipients, in order to ensure transplant opportunities for these hardest to match patients. See section 3.3 for an analysis of factors used in allocation decisions in cases in which there are multiple matches per donor (outlined in section 8.0 of Appendix 4).

The second observation made by KTAC during the evaluation related to the interprovincial import and export thresholds designed to ensure import and export balance between provinces. The data analysis and simulation models showed smaller provinces were “on hold for HSP” due to import threshold restrictions for a combined 705 days. In this case, KTAC recommended the removal of all import thresholds but agreed to maintain export thresholds as a safeguard for transplant activity in net exporting provinces.

Recommendations from KTAC were endorsed by the Donation and Transplant Administrators Advisory Committee (DTAAC) and the Organ Donation & Transplantation Expert Advisory Committee (ODTEAC) prior to implementation. A summary of HSP Program policy changes are presented in Table 2.1.

[7] Highly-sensitized patients comprise up to 25% of waitlists in Canada, but historically (within local allocation algorithms) received <5% of the transplants through local allocation programs. See Call to Action: A strategic plan to improve organ and tissue donation and transplantation performance for Canadians (2011).

Available at blood.ca/sites/default/files/otdt-indx-final-c2a.pdf

HIGHLY SENSITIZED PATIENT PROGRAM

Table 2.1: Summary of HSP Program Policy Changes, 2009

Policy		CTR 50 001: Recipient Eligibility Criteria	CTR 50 002: Requirements to Offer	CTR 50 003: Matching and Ranking Methodology	CTR 50 004: Inter-provincial Balancing
Status		Version 1.3 effective on 2014-06-06	Version 1.3 effective on 2013-04-01	Version 3.0 effective on 2016-06-20	Version 2.0 effective on 2016-12-01
Policy Change Recommendation		2014-05-23: Remove the minimum age eligibility	No change recommendation	2015-09-23: Include high cPRA as a ranking attribute	2015-08-24: Remove import thresholds and revise export thresholds
Endorsements	KTAC	2014-05-23	NA	2015-09-23	2016-03-30
	DTAAC	2014-06-23	NA	2016-03-23	2016-09-02
	ODTEAC	2014-06-20	NA	2015-11-27	2015-11-27
Provincial Sign-Off		2016-11-01	NA	2016-06-20	2016-12-01
CTR Implementation		No change required in CTR	NA	2016-07-15	2016-12-16

Program Activity

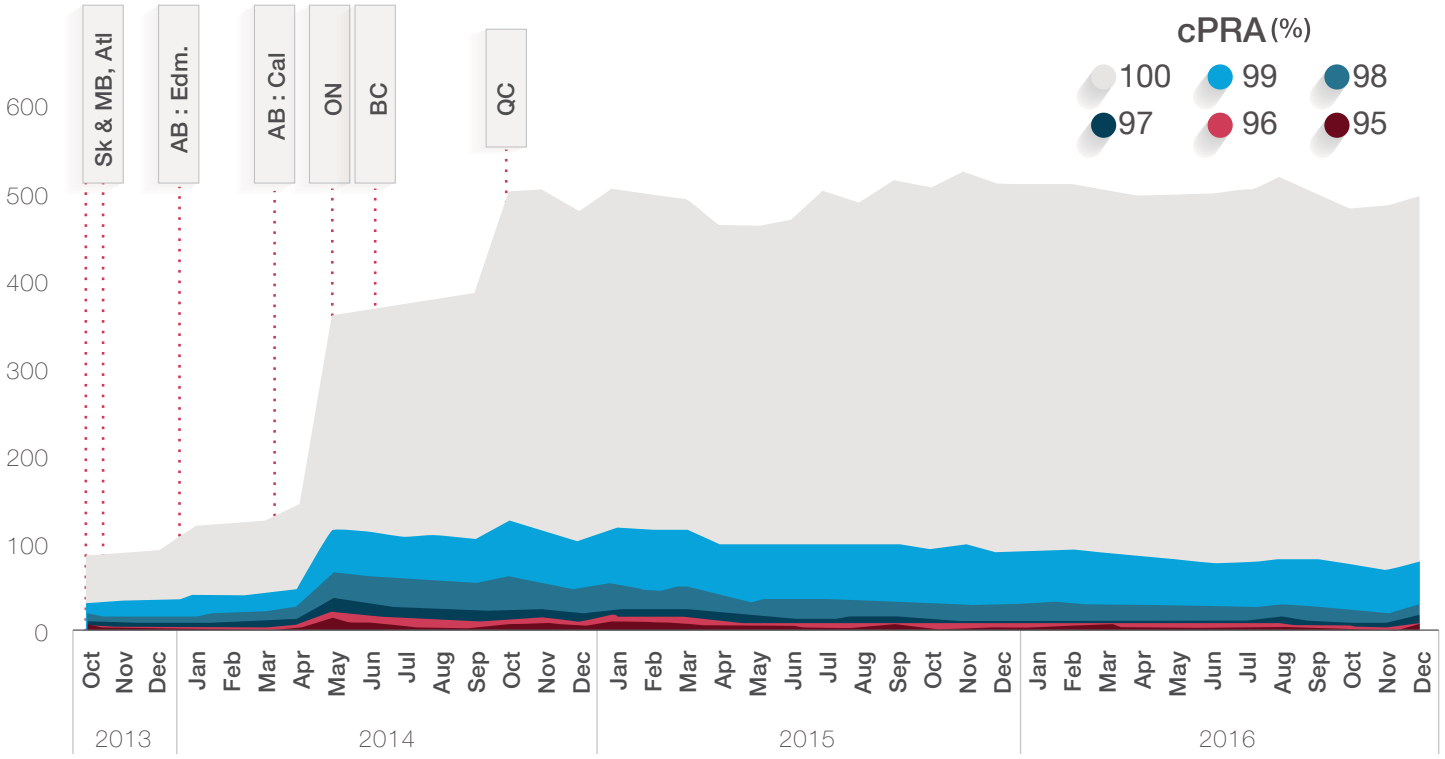
Table 2.2: HSP Candidates and Transplants

Candidates Active on Waitlist (>98%)	465
Candidates Active on Waitlist (≥95 and ≤ 98%)	30
Total Candidates Active on Waitlist	495
Total Transplants	293
Interprovincial	167
Intraprovincial	126
Total Donors with HSP Allocation Run	1,980

HIGHLY SENSITIZED PATIENT PROGRAM

3.2 HSP TRANSPLANT CANDIDATES AND RECIPIENTS

Figure 2.1: HSP Candidate Pool since Inception by cPRA

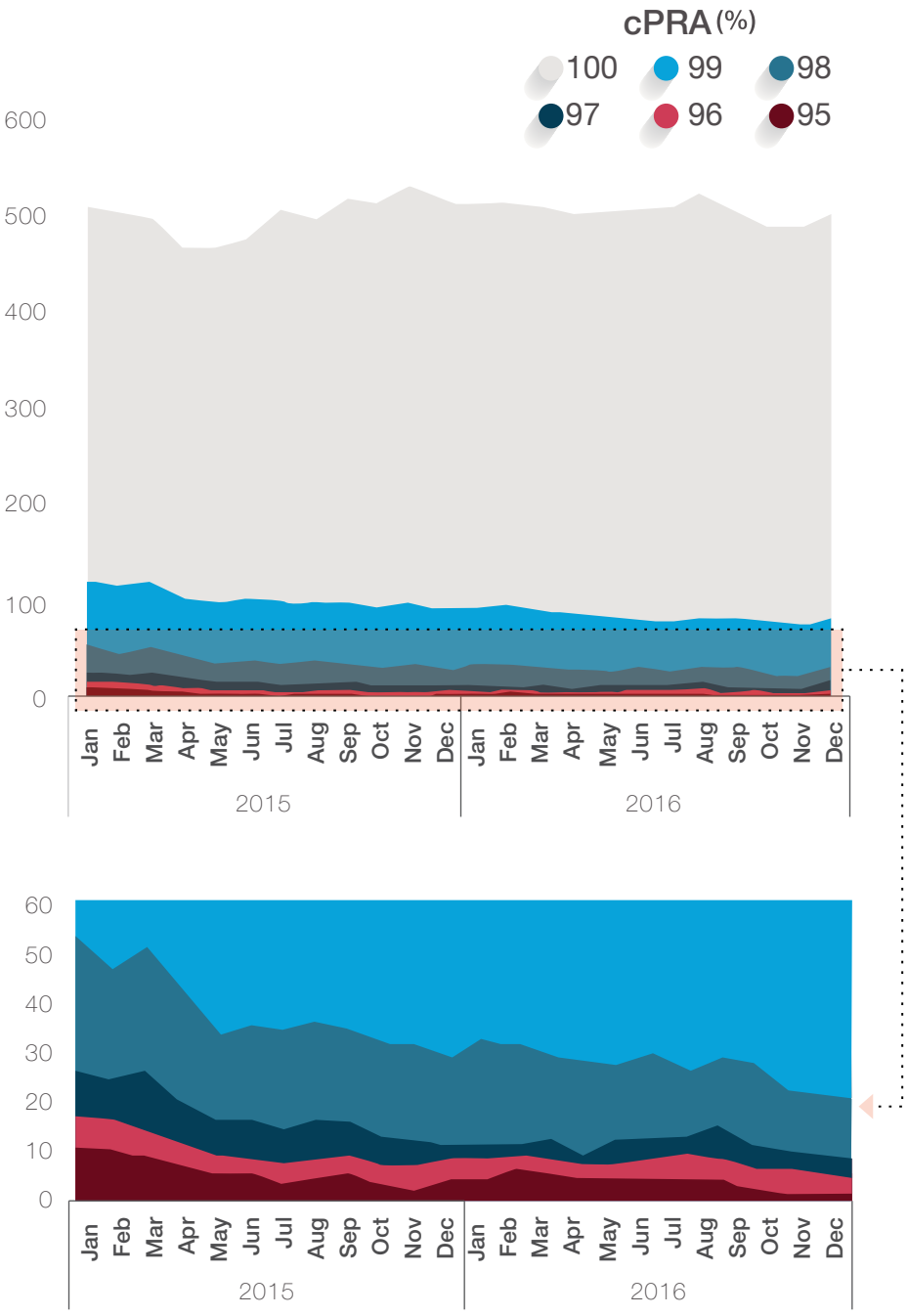


Given the staggered implementation of provinces joining the HSP program, transplant numbers were relatively slow to start. Monthly activity increased dramatically starting in June 2014, as the larger provincial programs joined.

Values shown represent count of active HSP patients at end of month. Dashed Lines indicate program participation start dated by province (SK & MB: October 21, 2013; Atlantic Provinces: November 4, 2013; AB: January 6 [Edmonton] and April 7 [Calgary], 2014; ON: May 27, 2014; BC: June 12, 2014; QC: October 27, 2014). cPRA values as calculated as of 2017 Q1. Please see table A5.4 in Appendix 5 for values.

HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.2: HSP Candidate Pool by cPRA, 2015-2016



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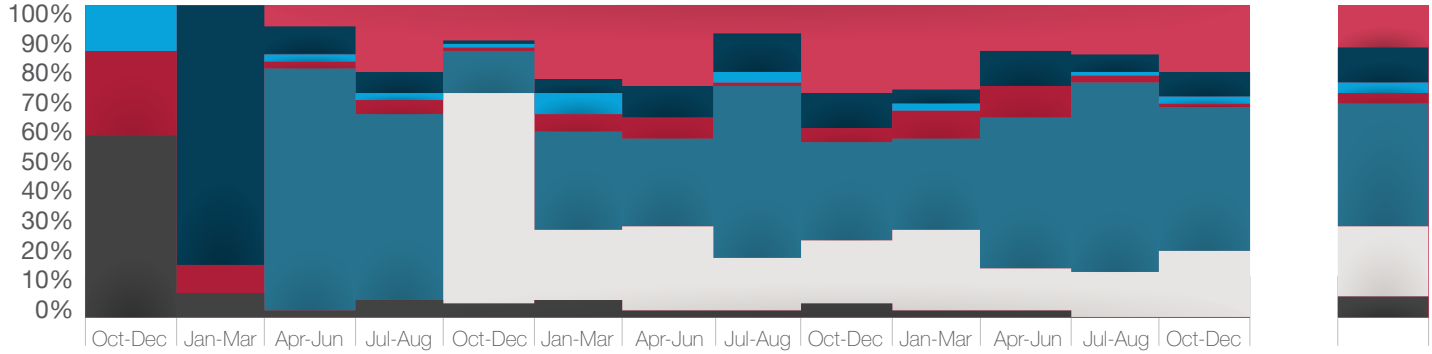
HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.3: New HSP Candidates over Time by PHN/Home Province, with Population by Province

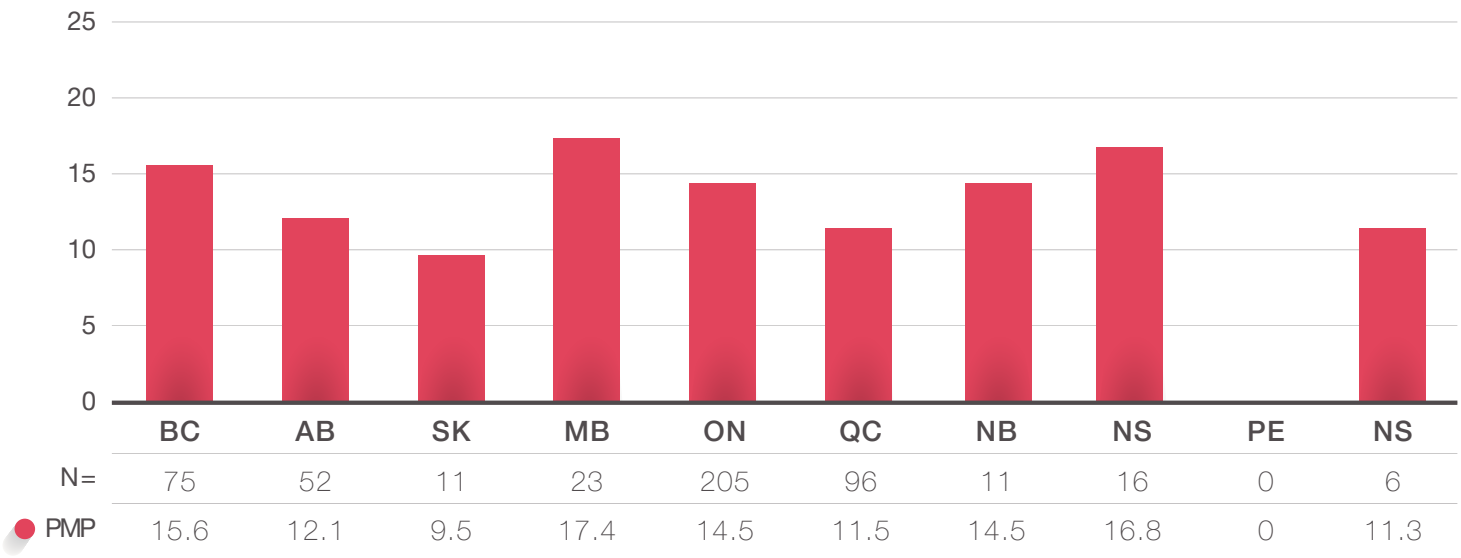


	2013		2014		2015				2016					Prov. Pop.
BC			22	13	20	18	11	6	18	13	6	9	11	13%
AB		41	27	4	2	3	4	5	7	2	4	3	4	12%
SK	17		5	1	2	5		2		1		1	1	3%
MB	30	4	6	3	2	4	3	1	3	4	4	1	1	4%
ON			232	35	25	23	12	35	20	14	19	35	23	39%
QC					120	17	11	11	13	12	5	8	11	23%
ATL	65	4	6	3	8	4	1	1	3	1	1			75

The composition of the HSP candidates on the national waiting list as of December 31st, 2016 is illustrated in Figure 2.4. The number of HSP patients listed by province is generally proportional to the provincial population size, with some variation between provinces.

HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.4: HSP Candidate Participation by PHN/Home Province (pmp)

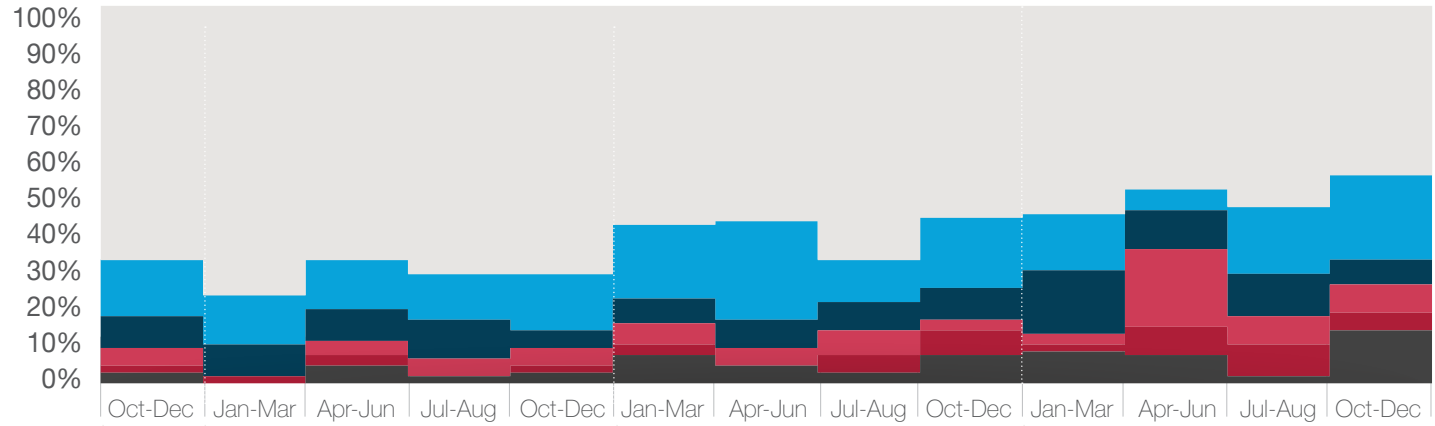


Les valeurs exprimées par million d'habitants (pmh) sont fondées sur les données populationnelles provinciales de 2016 de Statistique Canada. Voir le tableau 051-0005 : Estimations de la population, Canada, provinces et territoires, présenté en ligne à : http://www5.statcan.gc.ca/cansim/a26?lang=fra&id=510005&retrLang=fra.

HIGHLY SENSITIZED PATIENT PROGRAM

La plupart des nouveaux candidats hyperimmunisés ont un PRAc > 98 %.

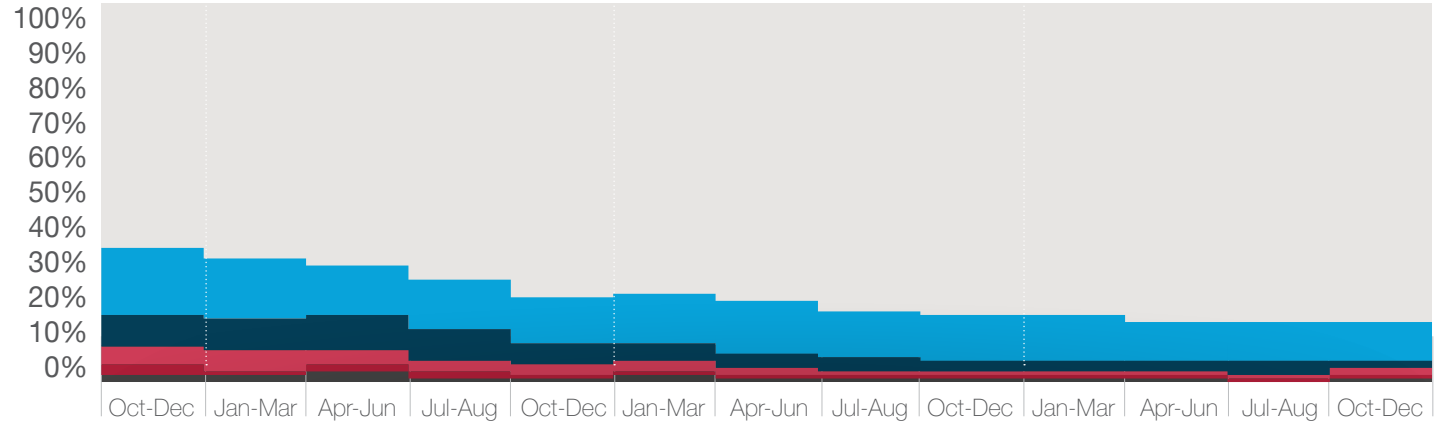
Figure 2.5: New HSP Candidates over Time by cPRA



cPRA	2013	2014				2015				2016			
100%	42	36	195	41	125	41	24	43	36	26	19	30	22
99%	9	6	38	7	27	14	11	7	12	7	2	10	11
98%	5	4	25	6	8	5	3	5	5	8	4	6	3
97%	3	0	12	3	8	4	2	4	2	1	8	4	4
96%	1	1	8	0	4	2	0	3	4	1	2	5	2
95%	2	0	12	1	5	5	2	2	5	4	3	1	7

Results based on cPRA as calculated at the end of FY 2016-2017; candidates whose cPRA was modified to be outside of the eligible range for the HSP program (approximately 1% of total) are not included.

Figure 2.6: Active HSP Transplant Candidates over Time by cPRA



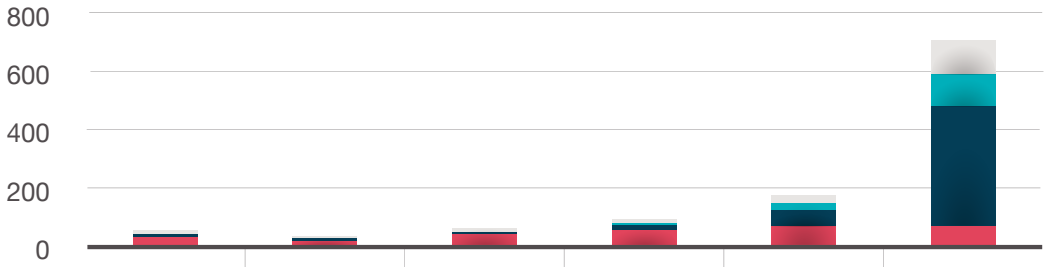
cPRA	2013	2014				2015				2016			
100%	59	89	250	280	371	375	368	414	419	415	419	419	416
99%	17	19	50	49	56	66	65	63	62	59	50	53	49
98%	7	11	32	31	28	25	19	18	18	17	17	16	16
97%	5	6	13	12	10	12	8	7	3	4	4	5	9
96%	2	2	9	7	5	5	3	4	4	3	4	4	3
95%	2	2	9	4	6	9	5	5	4	5	4	2	5

Results based on cPRA as calculated at the end of FY 2016-2017; candidates whose cPRA was modified to be outside of the eligible range for the HSP program (approximately 1% of total) are not included.

HIGHLY SENSITIZED PATIENT PROGRAM

Overall, 26% of eligible patients have been transplanted through the HSP program, with transplant rates among patients with cPRA scores of 95-97% being more than double this overall rate at 63%. Almost two-thirds (63%) of patients eligible for the program have a cPRA of 100%, but patients with this cPRA rating have received only 24% of HSP program transplants. For patients that are biologically difficult to match, a national program contributes towards, but cannot completely solve, the issue of equitable access. Ongoing improvement in total deceased donor cases is critically important in order to improve access for this most difficult to match group.

Figure 2.7: HSP Candidate Participation by cPRA

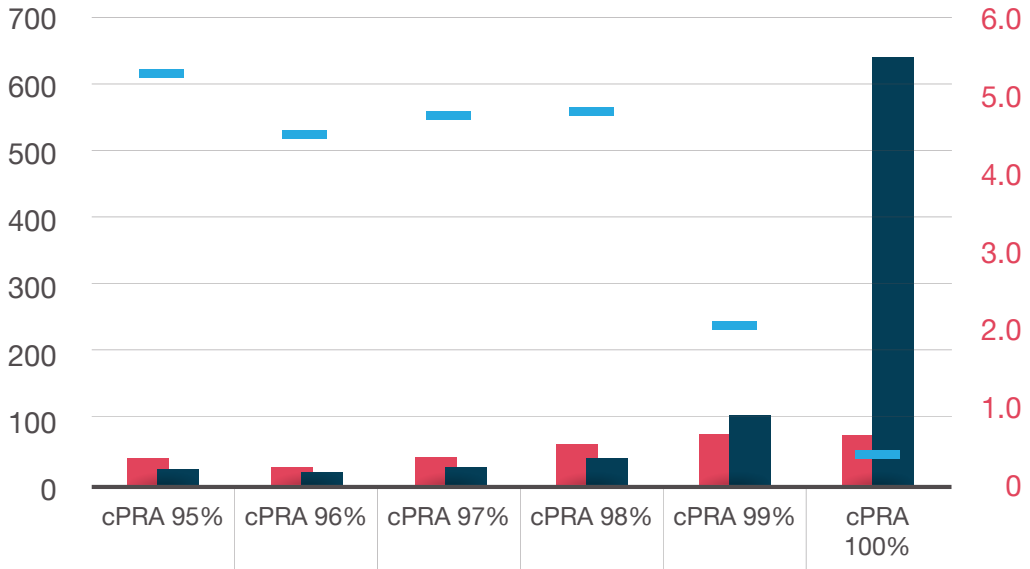


	cPRA 95%	cPRA 96%	cPRA 97%	cPRA 98%	cPRA 99%	cPRA 100%
Off List	11	8	13	15	29	115
HSP Candidates On Hold	3	3	2	6	24	110
HSP Candidates Waiting (Active)	5	3	9	13	49	416
HSP Tansplants	35	22	37	57	70	67

See Canadian Institute for Health Information (2017) "Treatment of End-Stage Organ Failure in Canada, Canadian Organ Replacement Register, 2006 to 2015" Available online at www.cihi.ca/en/corr-annual-statistics-2017

HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.8: HSP Transplants and Candidates



	cPRA 95%	cPRA 96%	cPRA 97%	cPRA 98%	cPRA 99%	cPRA 100%
HSP Transplants	35	22	38	57	71	69
HSP Candidates	19	14	23	34	101	639
Relative Ratio of Transplant Rate for cPRA Group to Overall Transplant Rate (35%)	5.2	4.5	4.7	4.8	2.0	0.3

Results based on cPRA as calculated at year-end 2016. Transplant recipients (1) and candidates (14) whose current cPRA is below 95% are not shown.Relative ratio = (transplant recipients in cPRA category / total candidates in cPRA category) /(total transplants / total recipients)

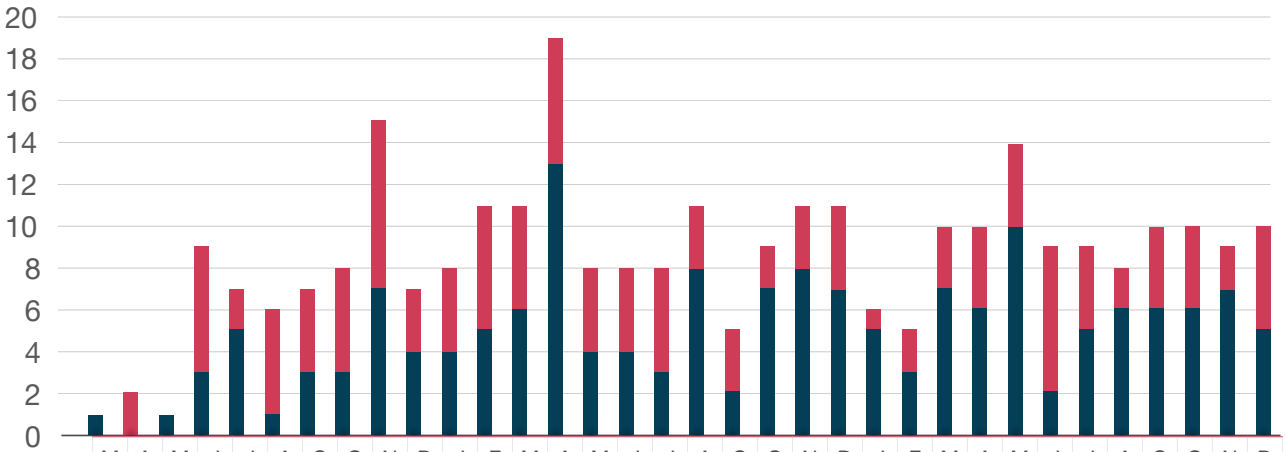
The difficulty of finding a potential match for highly sensitized patients increases as their cPRA value increases. Even within the eligible group of cPRA of 95 or greater, the vast majority of patients remaining listed have a cPRA of 99 or 100%. At 99%, patients have only a 1 in 100 chance that any given ABO compatible donor in Canada would be an acceptable match for them. At 100%, their chances of finding a donor can range from 1 in 200 donors to less than 1 in 10,000. In Canada, in which there have been fewer than 600 deceased donors available per year, national sharing to ensure potential opportunities to find donor organs for these patients are not missed is clearly essential to maximize transplant access.

[8] See Canadian Institute for Health Information (2017) "Treatment of End-Stage Organ Failure in Canada, Canadian Organ Replacement Register, 2006 to 2015", Available online at: www.cihi.ca/en/corr-annual-statistics-2017

HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.9: HSP Transplantation Activity over Time

Total HSP Transplants: 293
Intraprovincial: 126
Interprovincial: 167



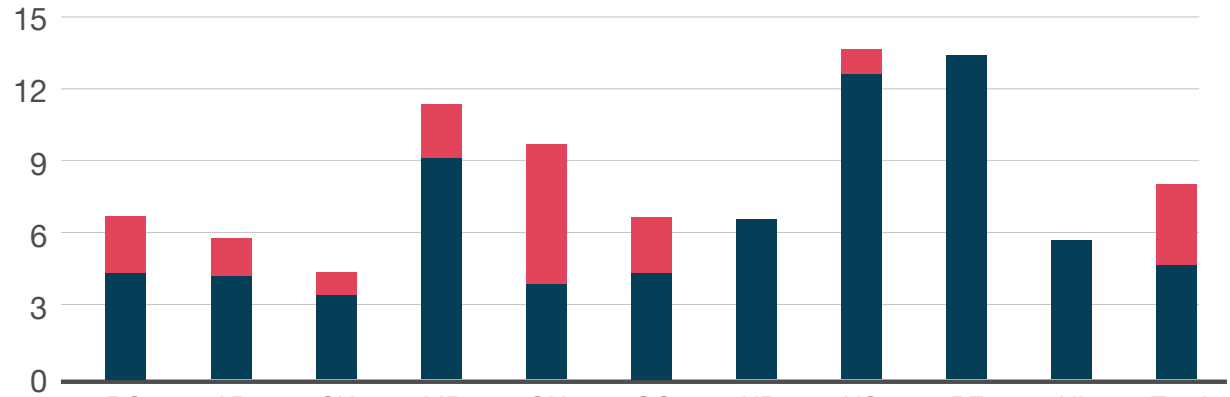
	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	2014										2015												2016											
Total HSP Transplants	1	2	1	9	7	6	7	8	15	7	8	11	11	19	8	8	8	11	5	9	11	11	6	5	10	10	14	9	9	8	10	10	9	10
Intraprovincial	0	2	0	6	2	5	4	5	8	3	4	6	5	6	4	4	5	3	3	2	3	4	1	2	3	4	4	7	4	2	4	4	2	5
Interprovincial	1	0	1	3	5	1	3	3	7	4	4	5	6	13	4	4	3	8	2	7	8	7	5	3	7	6	10	2	5	6	6	6	7	5

HSP Transplants: Number of transplants to highly sensitized kidney patients as a results of the HSP program (Non-Intended recipient transplants are excluded), by recipient's PHN/Home province; Interprovincial: Number of interprovincial transplants to highly sensitized kidney patients as a result of the HSP program, by recipient's PHN/Home province; Intraprovincial: Number of intraprovincial transplants to highly sensitized kidney patients as a result of the HSP program, by recipient's PHN/Home province.

There were 126 intraprovincial transplants and 167 interprovincial transplants providing transplant opportunities for Highly Sensitized Patients that would not be realized without a national collaborative program.

HIGHLY SENSITIZED PATIENT PROGRAM

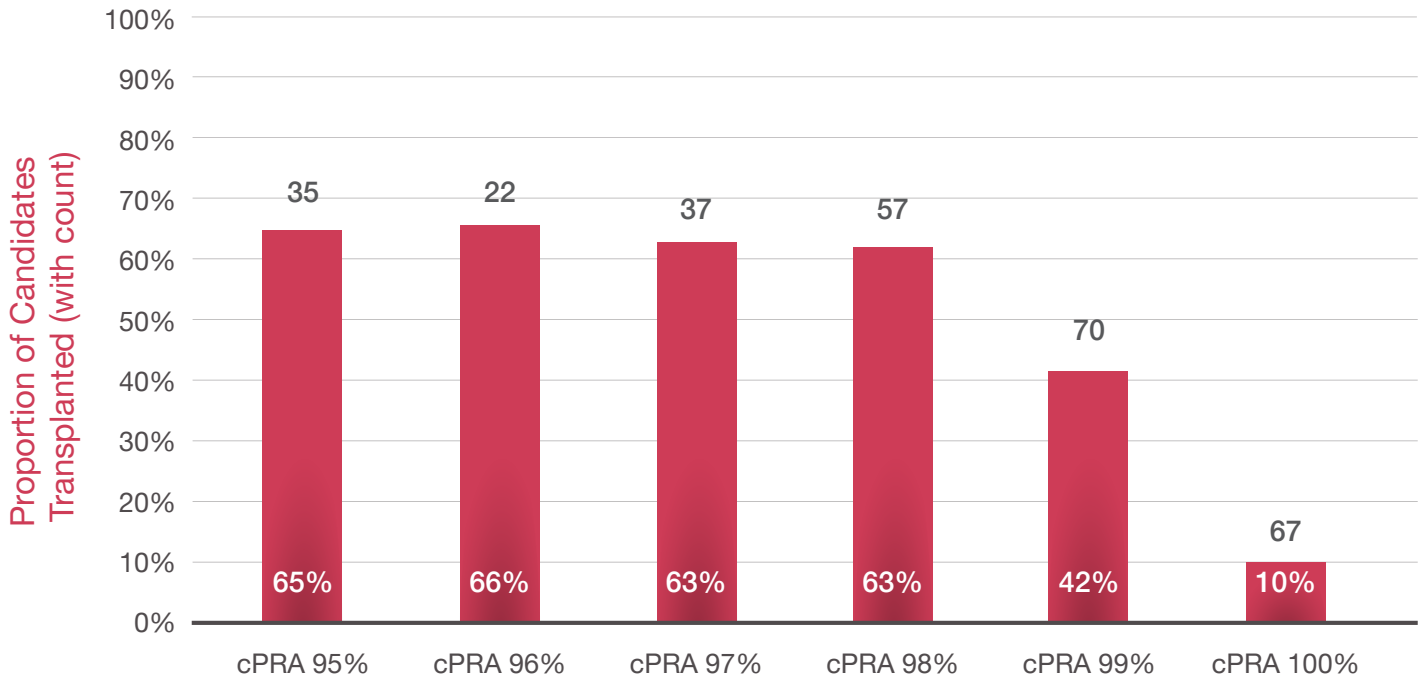
Figure 2.10: HSP Transplantation Activity by PHN/Home Province per Million Population (PMP)



	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
Total HSP Transplants	6.7	5.8	4.3	11.3	9.7	6.7	6.6	13.7	13.4	5.7	8.0
Intraprovincial	2.3	1.6	0.9	2.3	5.9	2.4	N/A	1.1	N/A	N/A	3.5
Interprovincial	4.4	4.2	3.5	9.1	3.8	4.3	6.6	12.6	13.4	5.7	4.6

PMP values based on Statistics Canada 2016 Q4 population estimates by province (CANSIM 051-005 Estimates of population, Canada, provinces and territories). Atlantic recipients are registered in a shared transplant program based in Nova Scotia.

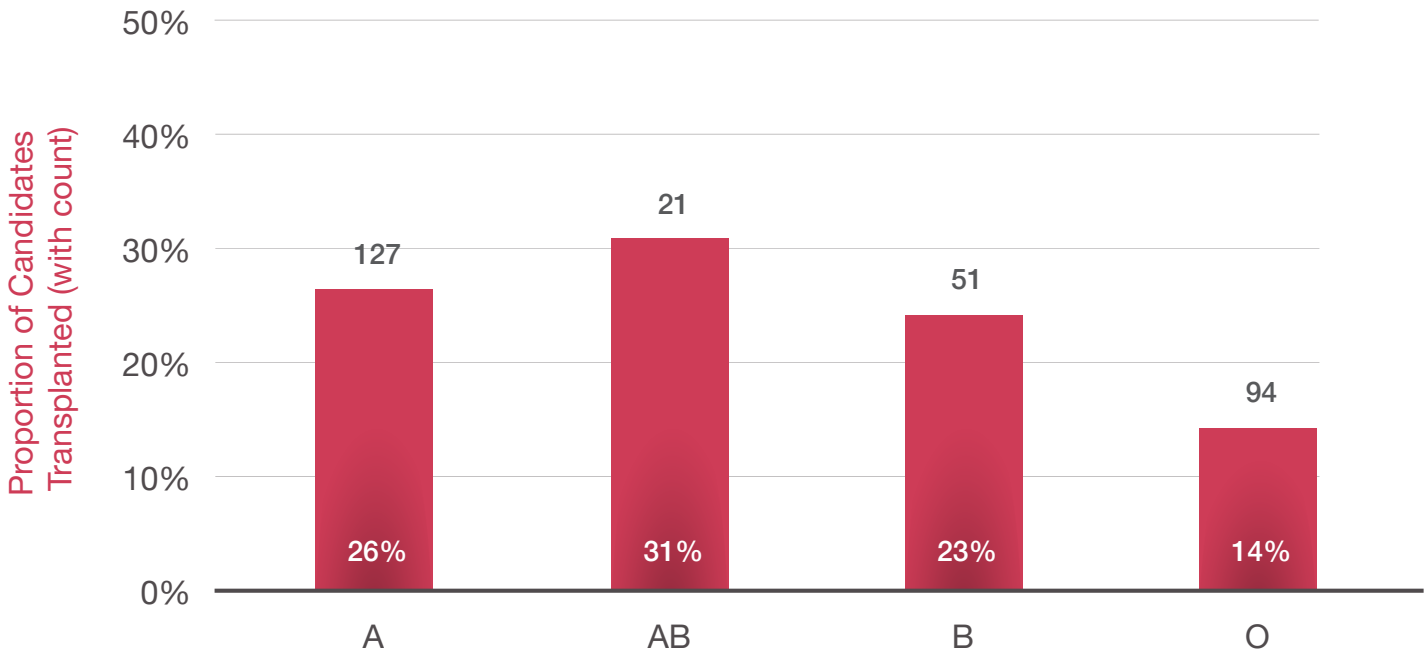
Figure 2.11: Proportion of Total HSP Program Candidates in cPRA Group Transplanted, with Count



Transplant counts do not include patients who were re-listed or whose cPRA changed to be outside HSP-eligible range following transplant

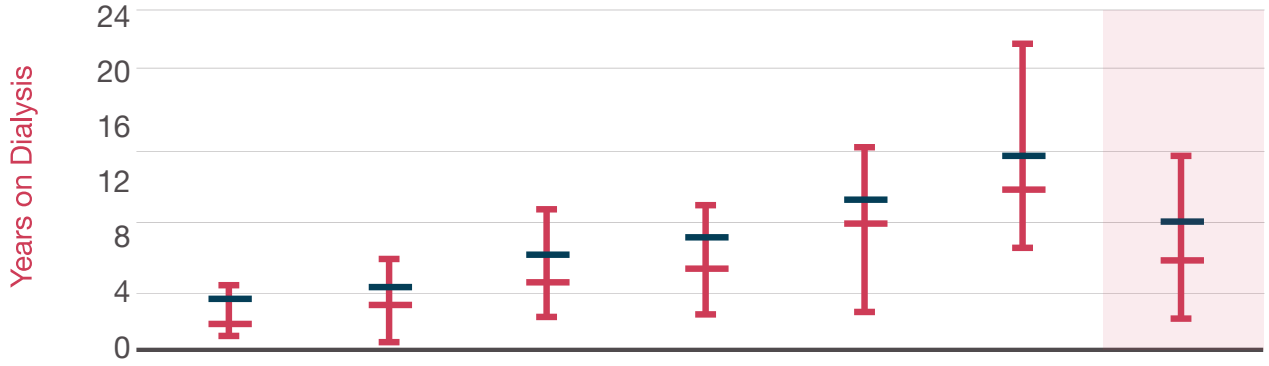
HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.12 Proportion of Total HSP Program Candidates in Blood Group Transplanted, with Count



Time on Dialysis

Figure 2.13: HSP Transplant Recipients' Time on Dialysis (with Interquartile Range)

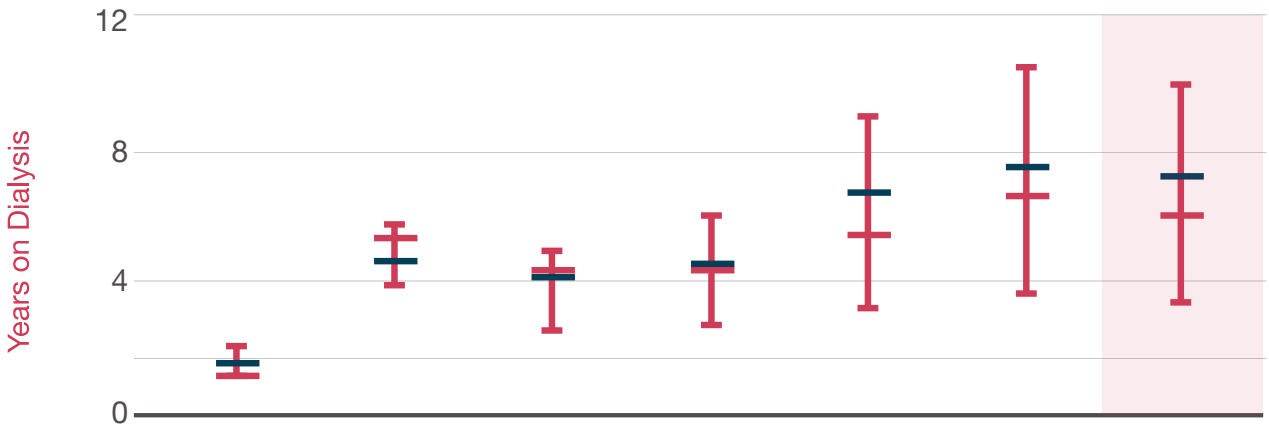


	cPRA (%)	95	96	97	98	99	100	All
	Patients (n)	35	23	38	57	71	69	293
—	Mean	3.5	4.3	6.6	7.9	10.5	13.6	8.9
—	Median (with IQR)	1.7	2.9	4.7	5.6	9.0	11.2	6.3

Time is measured from most recent dialysis start date prior to transplant to recipient's transplant date.

HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.14: Time on Dialysis for Active HSP Candidates as of Year-End 2016 (with Interquartile Range)



	cPRA (%)	95	96	97	98	99	100	All
	Patients (n)	5	3	9	13	49	416	495
—	Mean	1.5	4.6	4.0	4.5	6.7	7.4	7.1
—	Median (with IQR)	1.2	5.3	4.2	4.4	5.4	6.6	6.0

Time is measured from most recent dialysis start date prior to transplant to recipient's transplant date.

3.3 HSP RECIPIENT OUTCOMES

The following is based on the sub-sample of available results for 275 patients who received HSP program transplants between March 2014 and March 2017. These patients account for 86% of the 320 HSP patients who received an HSP program transplant over that time period.

Post-Operative Dialysis

Post-operative dialysis for HSP program transplant recipients was required in 27% of known cases, with 17% requiring more than one post-operative dialysis session. Those who received transplants from DCD (Donation after Cardiac Death) donors required post-operative dialysis more frequently as compared those who received transplants from NDD (Neurologically Determined Death) donors, with 49% of DCD donation recipients requiring one post-operative dialysis session while only 22% of NDD donation recipients required one or more sessions.

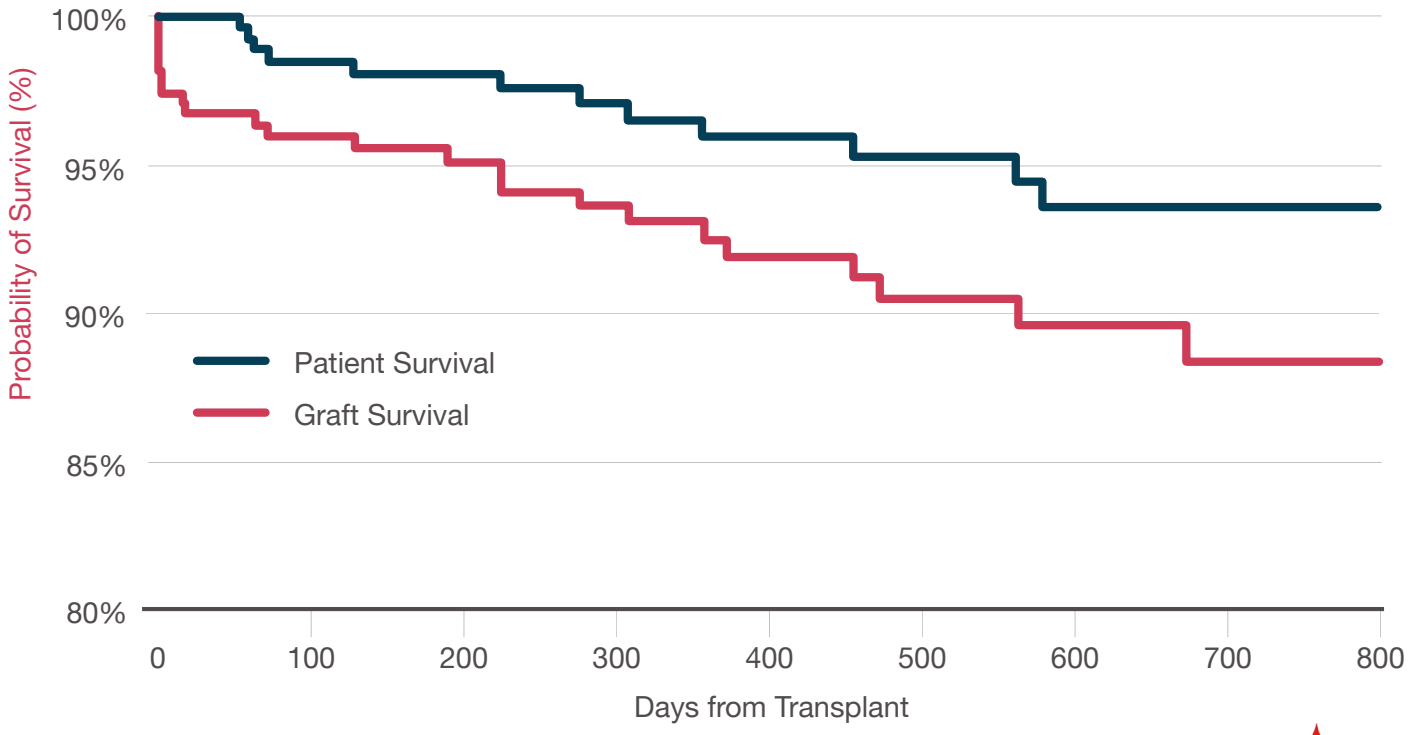
HIGHLY SENSITIZED PATIENT PROGRAM

Table 2.3: Summary of Patient Death and Graft Failure Cases

	Count	Mean Time to Graft Failure	Mean Time to Patient Death	Patients Experiencing Rejection Episodes
Patients Experiencing Graft Failure without Patient Death	11	181 days		4 (36%)
Patients Experiencing Patient Death without Graft Failure	7		266 days	1 (14%)
Patients Experiencing Graft Failure and Patient Death	5	113 days	254 days	2 (40%)
Total Patients Experiencing Graft Failure and/or Death	**23**	**159 days**	**261 days**	**7 (30%)**

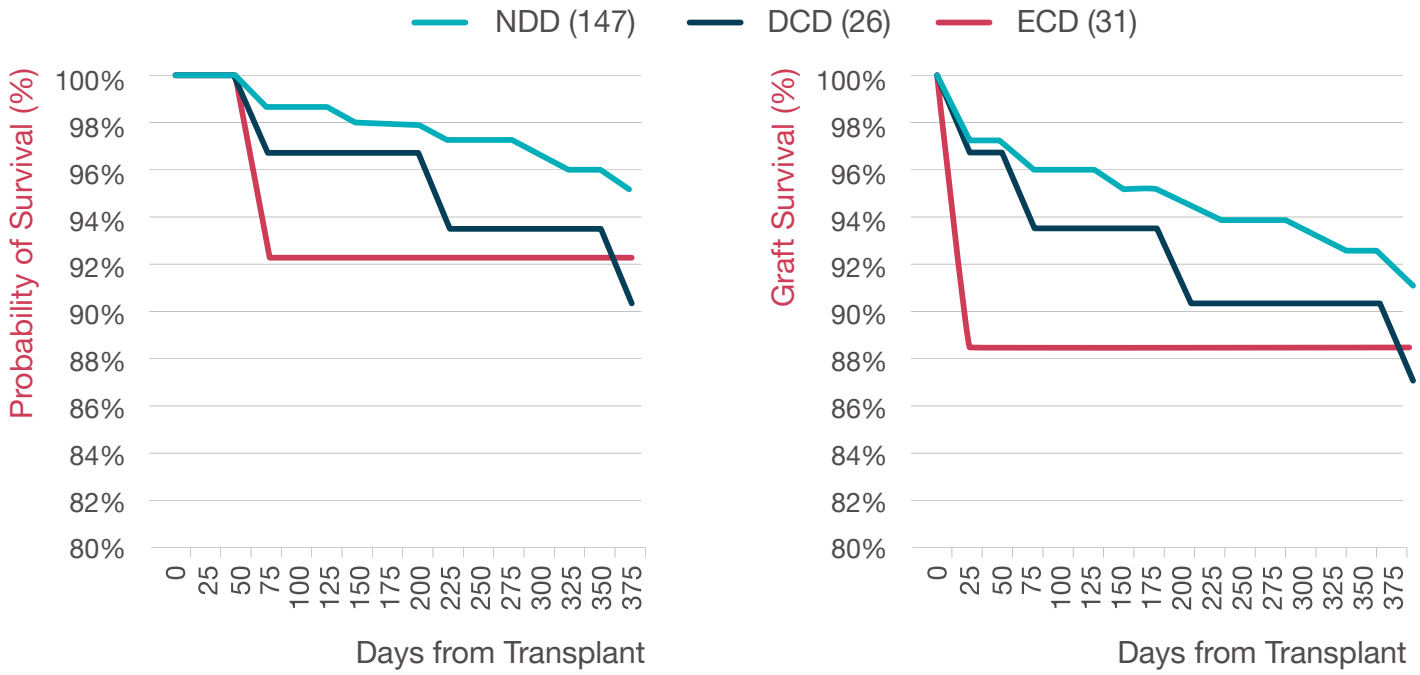
Overall, 91.6% of HSP program transplant recipients (n = 252) for whom transplant results are available remained alive with functional grafts as of data collection. 16 HSP program transplant recipients (5.8%) are known to have experienced graft failure, of whom 5 (1.8%) are deceased, with an additional 7 (2.5%) who died without experiencing graft failure. Among these 23 recipients, 30% experienced one or more rejection episodes, with 32 (12%) of patients overall experiencing rejection episodes. The most common type of rejection was cellular, with 66% experiencing cellular rejection episodes only, 28% experiencing antibody-mediated rejections only, and 6% experiencing both rejection types.

Figure 2.15: Kaplan-Meier Survival Curves for Patient Survival and Graft Survival Probability over Time (N = 275)



HIGHLY SENSITIZED PATIENT PROGRAM

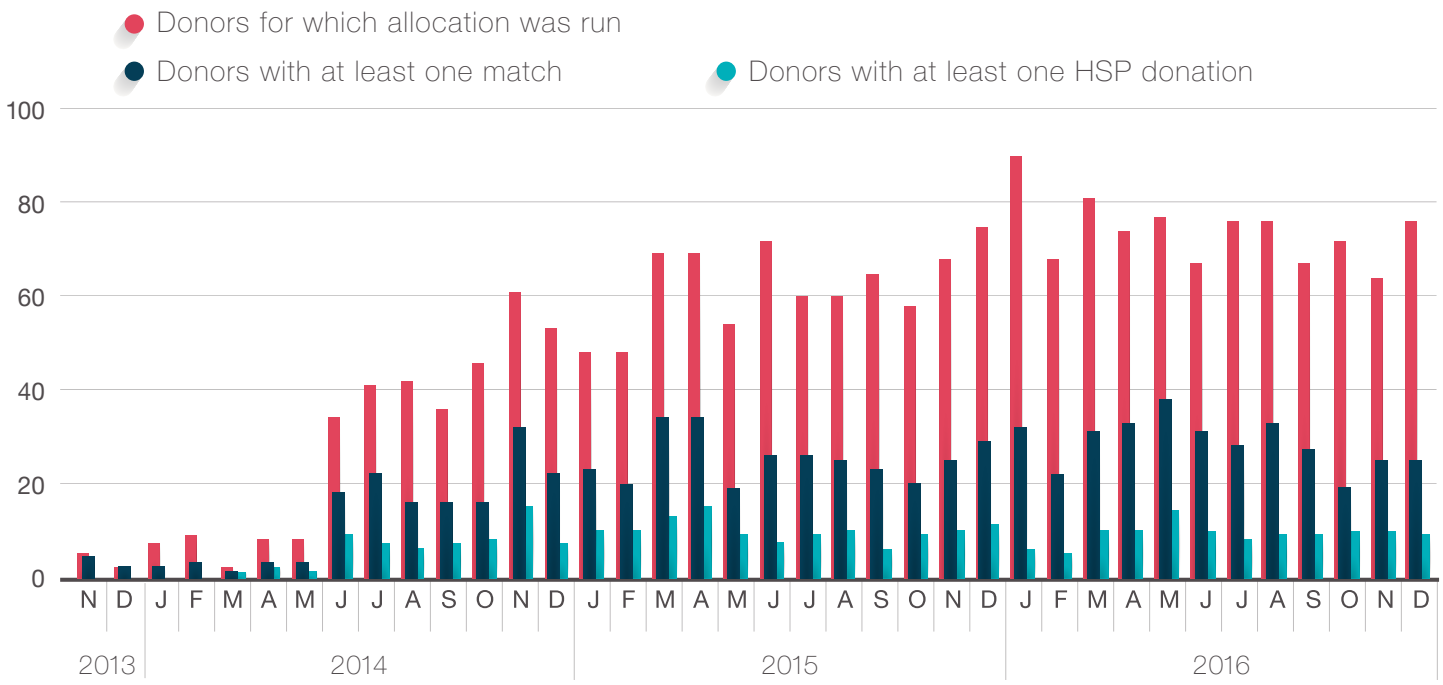
Figure 2.16: Patient and Graft Survival Rates for Recipients with One Year from Transplant to Data Collection by Donor Type (N = 173)



ECD includes donors 60+ years of age only (i.e. excludes donations from younger donors who are ECD due to medical complexities). NDD and DCD survival presented includes ECD donor cases. NDD: Neurologically Determined Death; DCD: Donation after Cardiac Death; ECD: Extended Criteria Donor

3.4 HSP RECIPIENT OUTCOMES

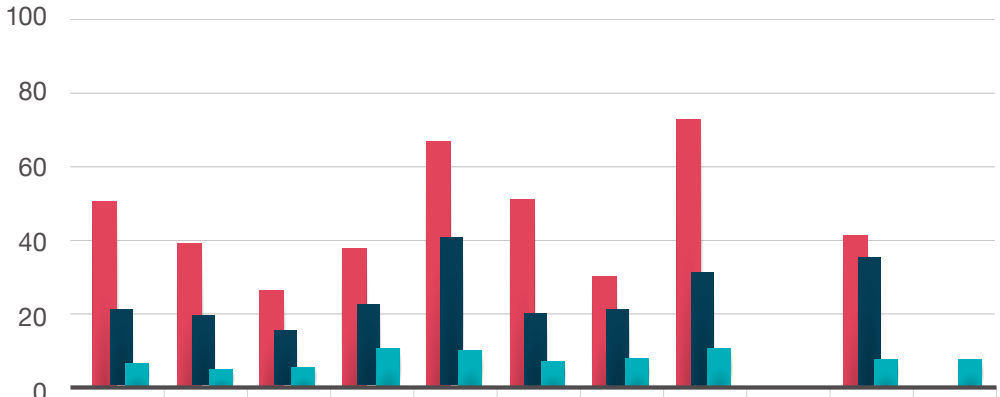
Figure 2.17: Donation Activity over Time



Please see table A5.5 in Appendix 5 for values.
Donors with kidneys consented: Number of donor cases consented for kidney donation and eligible to be included in an HSP allocation run; Donors for which allocation was run: Number of donor cases participating in the HSP program for which allocation was run ; Donors with at least one match: Number of donor cases with one or more HSP matches identified; Donors with at least one offer: Number of donor cases for which one or more offers was made to highly sensitized kidney patients, as a result of the HSP program; Donors with at least one donation: Number of donor cases from which one or more kidneys were donated to highly sensitized kidney patients, as a result of the HSP program. Non-Intended Recipient donations are excluded.

HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.18: Donation Activity by PHN/Home Province per Million Population (PMP)



	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
Donors for which allocation was run	51.1	39.0	26.8	37.8	66.8	51.5	30.3	73.5		41.5	54.4
Donors with at least on match	21.4	19.5	15.6	22.7	41.1	20.0	21.1	31.5		35.8	28.7
Donors with at least one HSP donation	6.4	4.9	5.2	10.6	9.9	7.3	7.9	10.5		7.5	8.0

Donors with kidneys consented: Number of donor cases consented for kidney donation and eligible to be included in an HSP allocation run; Donors for which allocation was run: Number of donor cases participating in the HSP program for which allocation was run ; Donors with at least one match: Number of donor cases with one or more HSP matches identified; Donors with at least one offer: Number of donor cases for which one or more offers was made to highly sensitized kidney patients, as a result of the HSP program; Donors with at least one donation: Number of donor cases from which one or more kidneys were donated to highly sensitized kidney patients, as a result of the HSP program. Non-Intended Recipient donations are excluded.

[9] PMP values based on Statistics Canada 2016 Q4 population estimates by province
(CANSIM 051-005 Estimates of population, Canada, provinces and territories)

Table 2.4: HSP Transplants by Blood Group of Donor and Recipient

		Recipient Blood Group				
		A	AB	B	O	Total
Donor Blood Group	A	70	8	--	--	78
	AB	--	0	--	--	0
	B	--	4	17	--	21
	O	57	9	34	94	194
	Total	127	21	51	94	293

Table 2.5: HSP Transplants by Age of Donor and Recipient

		Recipient Age							
		<19	19-29	30-39	40-49	50-59	60-69	70+	Total
Donor Age	<19	1	3	1	6	3	9	1	24
	19-29	2	6	2	10	13	11	2	46
	30-39	-	3	4	11	8	6	3	35
	40-49	1	7	6	12	16	13	4	59
	50-59	-	2	9	14	17	21	5	68
	60-69	-	1	4	10	17	15	3	50
	70+	-	-	-	2	4	5	-	11
	Total	4	22	26	65	78	80	18	293

3.5 HSP MATCHING AND ALLOCATION

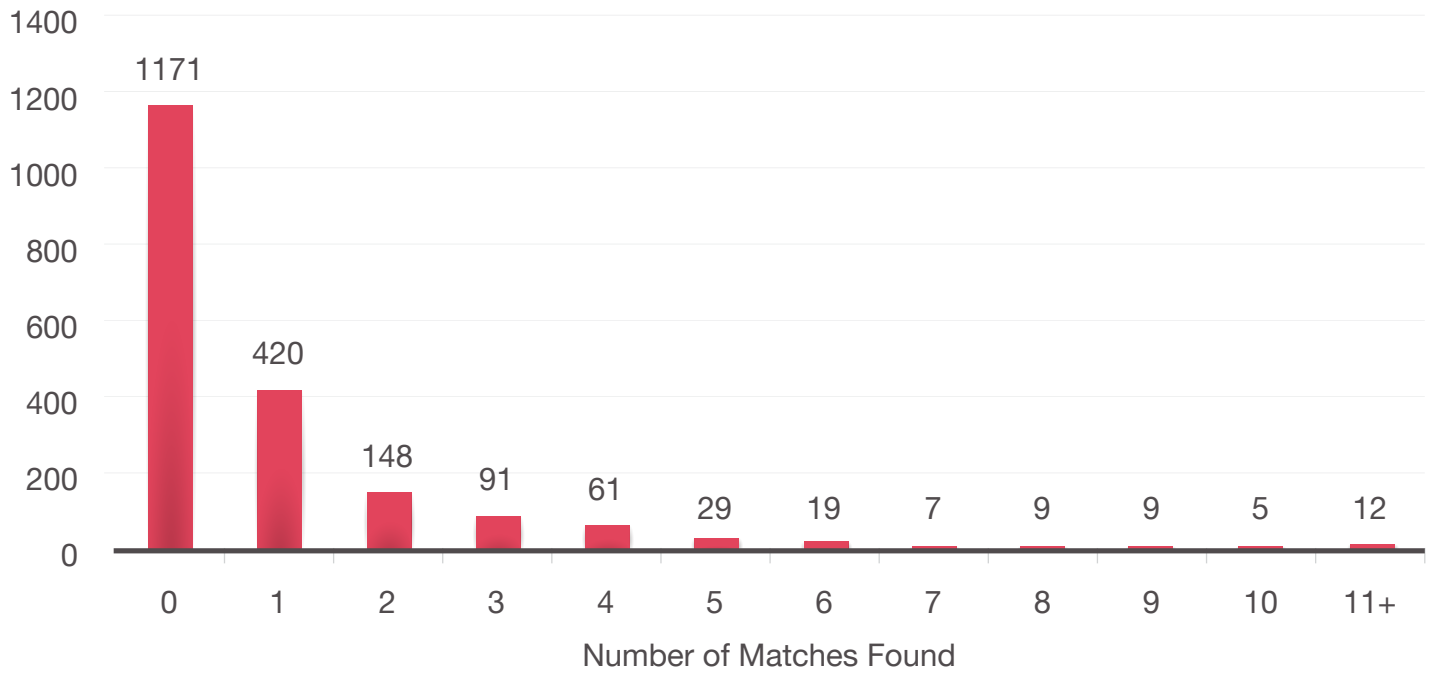
HSP Allocation

There are 4 tiers of matching and ranking that the HSP algorithm performs to develop a final listing of potential HSP recipients who are compatible with an available deceased donor organ (refer to details in Appendix 4).

- **Step One:** Matching for compatible blood group, using the same compatibility rules as any patient requiring a blood transfusion.
- **Step Two:** Then HLA compatibility to avoid donor specific antibodies for patients identified as blood group compatible.
- **Step Three:** Further screening of donor suitability based on individual attributes of the potential recipient/donor or the clinical direction of potential receiving local programs.
- **Step Four:** At this point if more than one potential recipient is identified, the HSP algorithm uses agreed-upon policies to transparently prioritize recipients based on key medically and logistically relevant factors (see figure 2.23).

Figure 2.19 illustrates how many allocations required the use of step 4. Figures 2.20 and 2.21 detail the frequency with which medically and logistically relevant factors were the deciding factor in a ranked allocation.

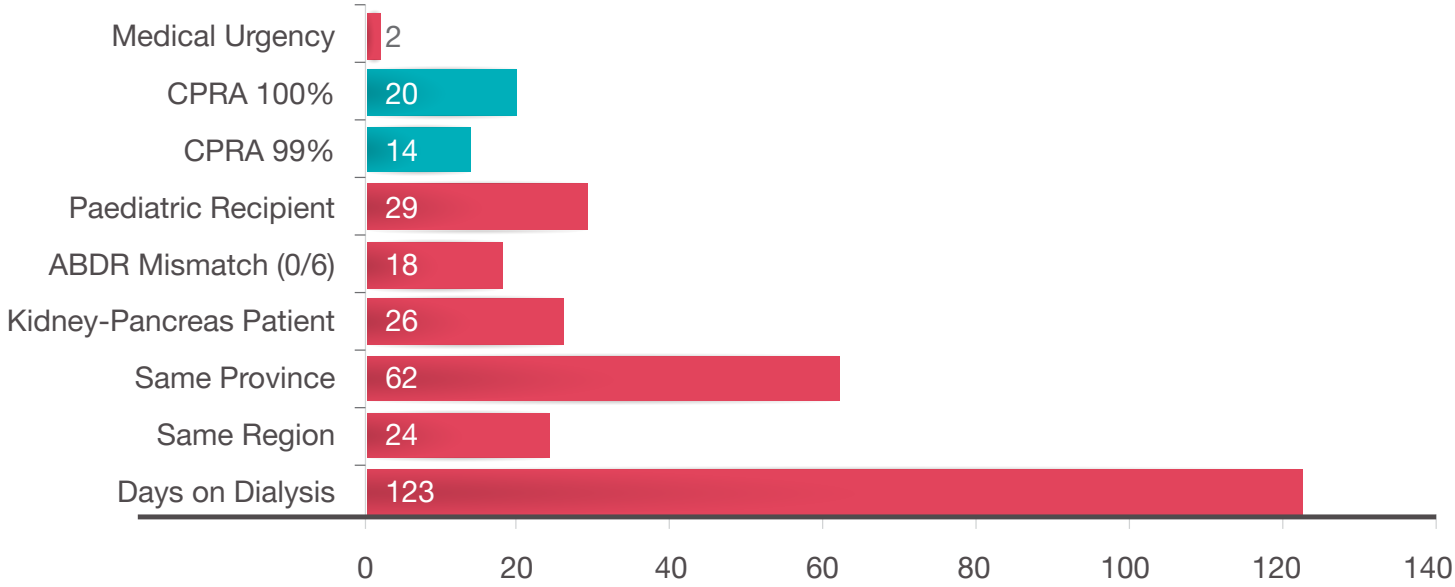
Figure 2.19: HSP Matches Found per Donor for which Allocation was Run



Results for Donors entered into CTR on or before December 31, 2016 (N = 1,980)

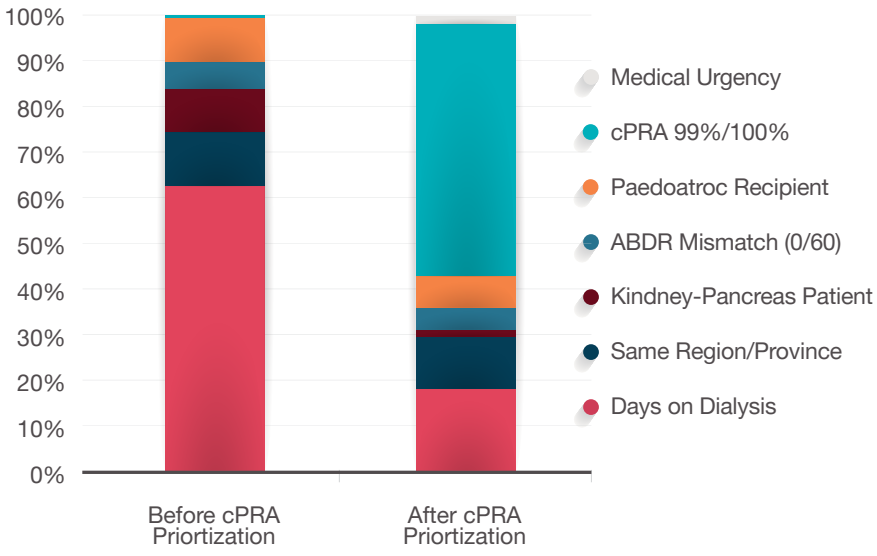
HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.20: Ranking Factor Used to Determine Allocation Decisions in HSP Program: Program Totals



As of July 16, 2016, candidates with the highest cPRA ratings (99% and 100%) have been prioritized in cases in which multiple eligible candidates matched with a given donor (see Section 3.1 for details concerning this policy change). Of the donor cases entered after the implementation of this policy with multiple eligible matches, 57% of allocation decisions in multiple-match cases were made on the basis of the candidates' cPRA ratings.

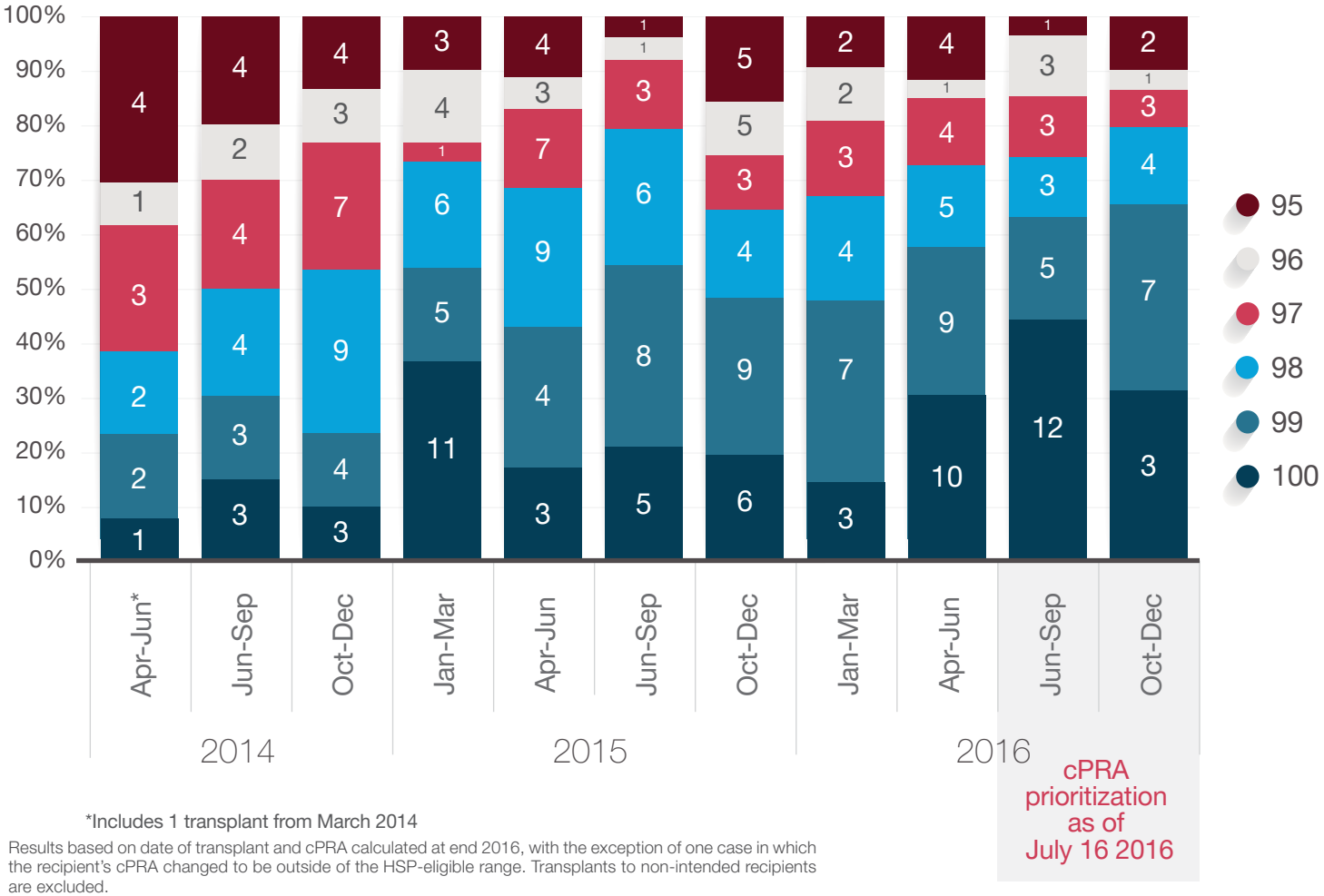
Figure 2.21: Ranking Factor Used to Determine Allocation Decisions in HSP Program: Pre/Post Implementation of Policy Changes Prioritizing High cPRA candidates



As would be expected, since the cPRA-based prioritization criteria were implemented, patients with cPRA ratings of 99%-100% have been transplanted at a higher rate, with 64% of transplants in July to December of 2016 being to recipients with cPRA ratings of 99% or 100% compared with 44% of transplants prior to the new policy implementation.

HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.22: Transplant Recipients by cPRA Over Time by Quarter



*Includes 1 transplant from March 2014

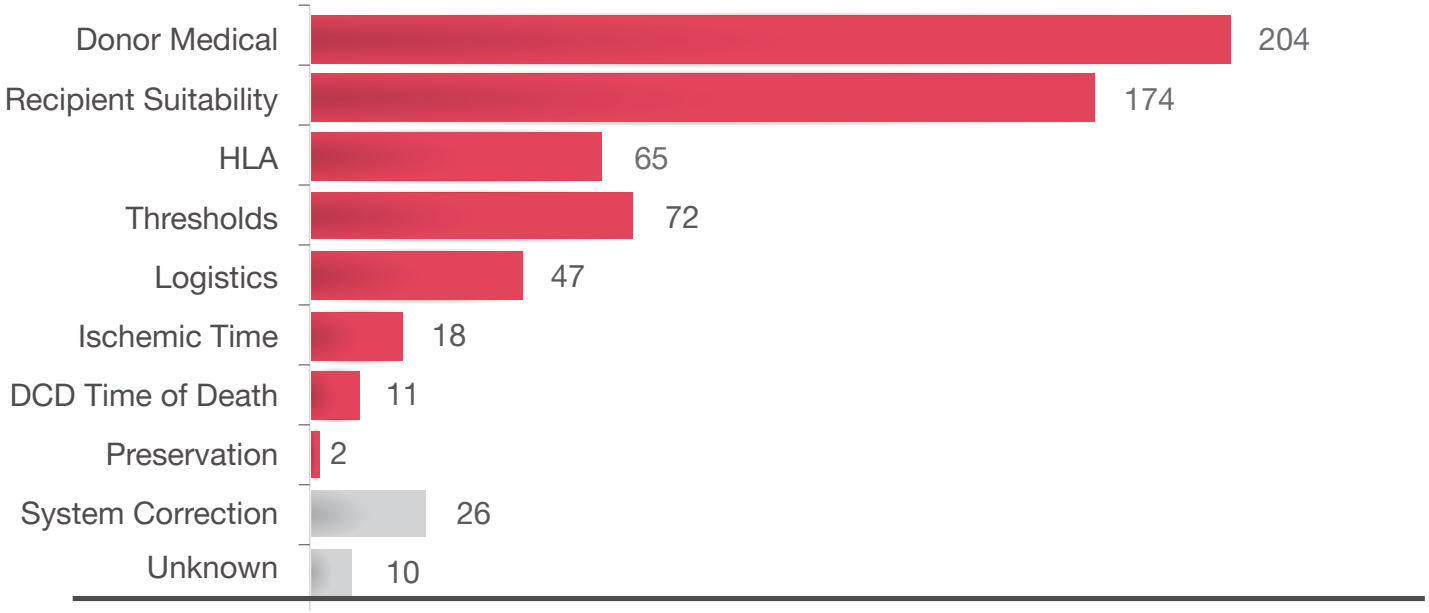
Results based on date of transplant and cPRA calculated at end 2016, with the exception of one case in which the recipient's cPRA changed to be outside of the HSP-eligible range. Transplants to non-intended recipients are excluded.

HIGHLY SENSITIZED PATIENT PROGRAM

Offer Declines

Donor offers may be declined for many different reasons. The most common reasons recorded for decline are donor's or recipient's health at the time of the offer. The information presented in this section relates to offers that were created up to and including December 31, 2016 that were declined, including those that were initially accepted and later had that acceptance cancelled.

Figure 2.23: Reasons offer was declined by transplant team



HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.24: Offers declined by reason and province of declining transplant centre

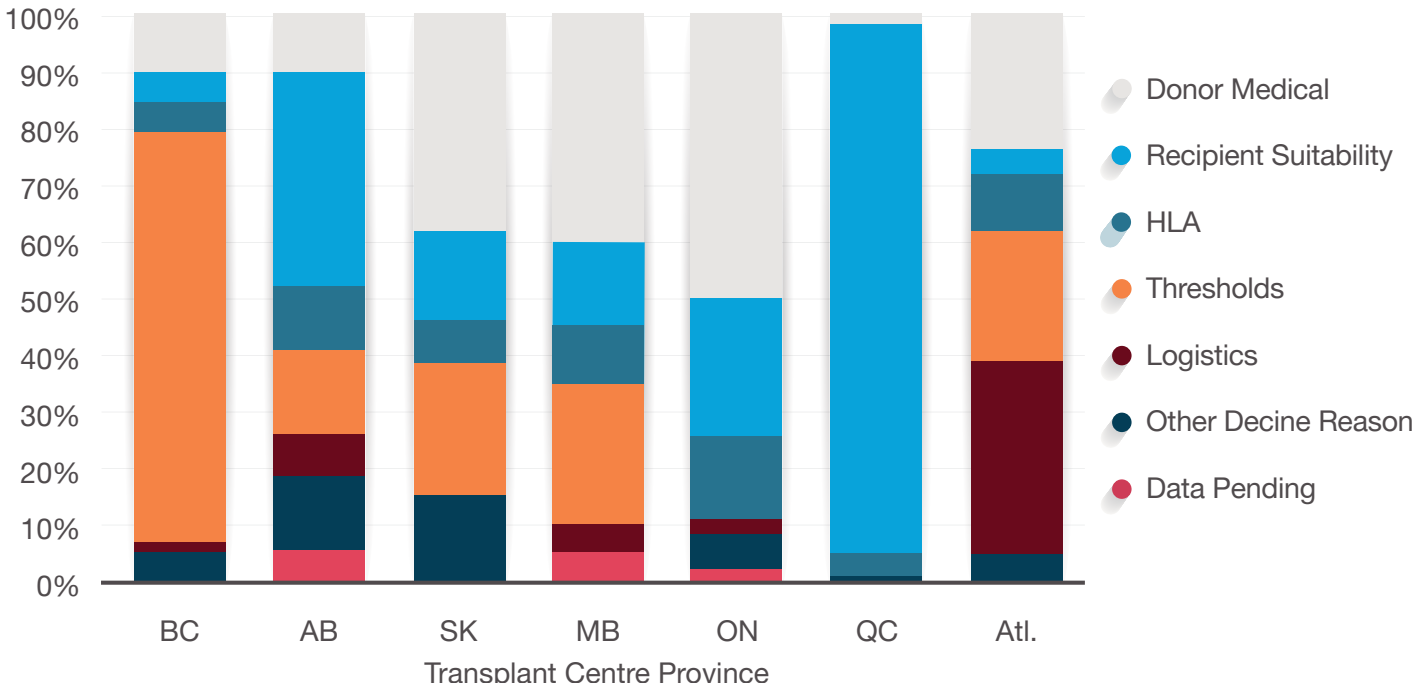
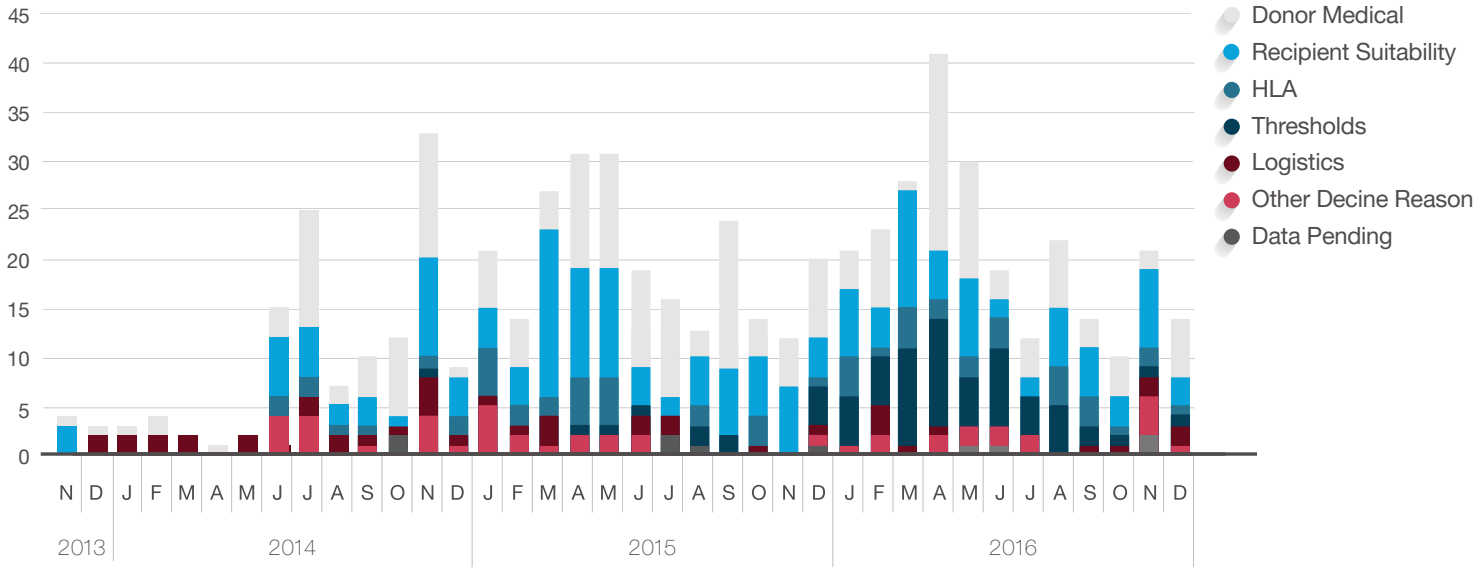


Figure 2.25: Offers declined by transplant team by reason over time



HIGHLY SENSITIZED PATIENT PROGRAM

Table 2.6: Candidates Declining for Donor Medical Issues

	Final Kidney Disposition				
	Transplanted Locally	Not Transplanted	Not Recovered	Data Pending	Total
Donor quality (general)*	62	13	42	1	106
ABO identical donor preferred	1	1			2
Donor age	14	5	22		41
Donor size	9				9
Organ declined on visualization in OR	1		2		3
Organ not as described	7		2		9
Organ test results unavailable	2	1			3
Positive serology			2		2
Total Candidates Declining for Donor Medical Issues	**86**	**20**	**66**	**1**	**138**

Candidates may decline different donors for different donor medical reasons, and may decline multiple donors (regardless of final kidney disposition) for the same reason.

*Includes Abnormal test results, Donor medical history, Donor quality, High medical risk, Donor social history, Unstable donor, Organ test results unacceptable, and Organ anatomical damage or defect.

In 2015, KTAC began tracking the final disposition of the kidney offered to a highly sensitized patient but declined for donor medical reasons. 15% of cases were declined for donor medical reasons and nearly half (7%) of these resulted in a local kidney transplant.

[10] Results reported here reflect decline reasons as entered by provincial organ donation organizations into the Canadian Transplant Registry. Although believed to be accurate, Canadian Blood Services does not systematically validate these results. Only one reason is entered for each declined offer, although more than one reason may contribute to an offer being declined.

HIGHLY SENSITIZED PATIENT PROGRAM

Figure 2.26: Final Disposition of HSP Kidneys Offered

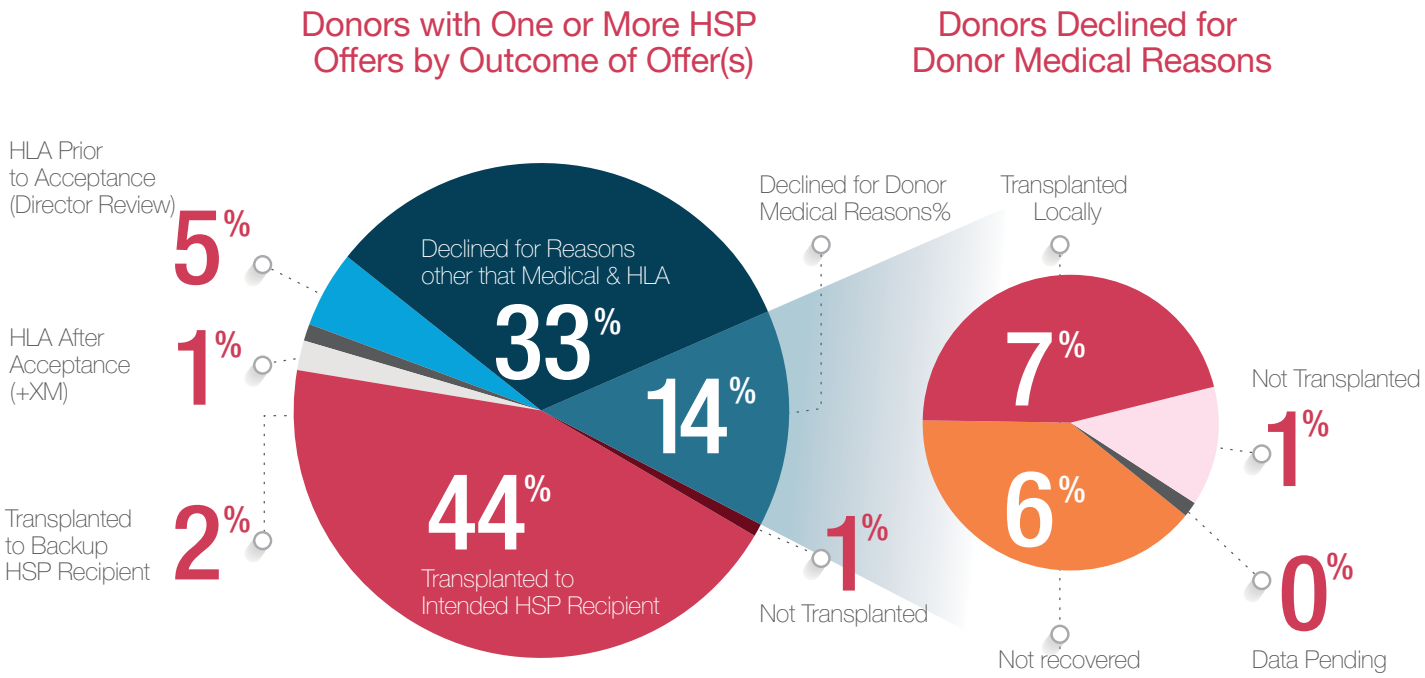


Figure 2.26 presents the final disposition of all donors with at least one kidney offer to a Highly Sensitized Patient

HIGHLY SENSITIZED PATIENT PROGRAM

Table 2.7: Offers Declined by Transplant Team by Reason, cPRA, and Kidney Disposition

		cPRA <99% candidates					cPRA 99%-100% Candidates					
	Decline Reason	Transplanted	Not Transplanted	Not Recovered	Data Pending	Total	Transplanted	Not Transplanted	Not Recovered	Data Pending	Total	All Offers
Donor Medical	Donor quality (general)*	41	6	20		67	33	8	25	1	67	134
	ABO identical donor preferred	1				1		1			1	2
	Donor age	8	1	13		22	6	4	10		20	42
	Donor size	6				6	3				3	9
	Organ declined on visualization in OR	1		1		2			1		1	3
	Organ not as described	6		1		7	1		1		2	9
	Organ test results unavailable		1			1	2				2	3
	Positive serology			1		1			1		1	2
	Total	**63**	**8**	**36**		**107**	**45**	**13**	**38**	**1**	**97**	**204**
Recipient Suitability	Multi-organ placement	4				4	3				3	7
	No suitable recipient	3		2		5	1	1	1		3	8
	Recipient deceased						1				1	1
	Recipient medically unsuitable	25	1	1		27	21	1	1	1	24	51
	Recipient refused	9				9	3				3	12
	Recipient unavailable	5		4		9	3				3	12
	Selected incorrect recipient	21	1	17	3	42	23	4	14		41	83
	Total	**67**	**2**	**24**	**3**	**96**	**55**	**6**	**16**	**1**	**78**	**174**
HLA	AFTER organ acceptance due to positive crossmatch	6				6	3				3	9
	PRIOR to organ acceptance and due to director review	10	1	2		13	23	1	4		28	41
	Data Pending	9		1		10	3		2		5	15
	Total	**25**	**1**	**3**		**29**	**29**	**1**	**6**		**36**	**65**
Other	**Thresholds**	**29**	**2**	**8**		**39**	**23**	**2**	**8**		**33**	**72**
	Logistics	**23**	**1**	**3**		**27**	**14**	**1**	**5**		**20**	**47**
	Prolonged Ischemic Time	**9**		**5**		**14**	**2**		**5**		**7**	**21**
	DCD did not die within acceptable time			**4**		**4**			**7**		**7**	**11**
	Preservation		**1**			**1**		**1**			**1**	**2**
	System Correction	**10**	**2**			**12**	**12**		**2**		**14**	**26**
	Totall	**71**	**6**	**20**		**97**	**51**	**4**	**27**		**82**	**179**
	Data Pending	**2**				**2**	**7**		**1**		**8**	**10**
	Overall Total	**228**	**17**	**83**	**3**	**331**	**187**	**24**	**88**	**2**	**301**	**632**

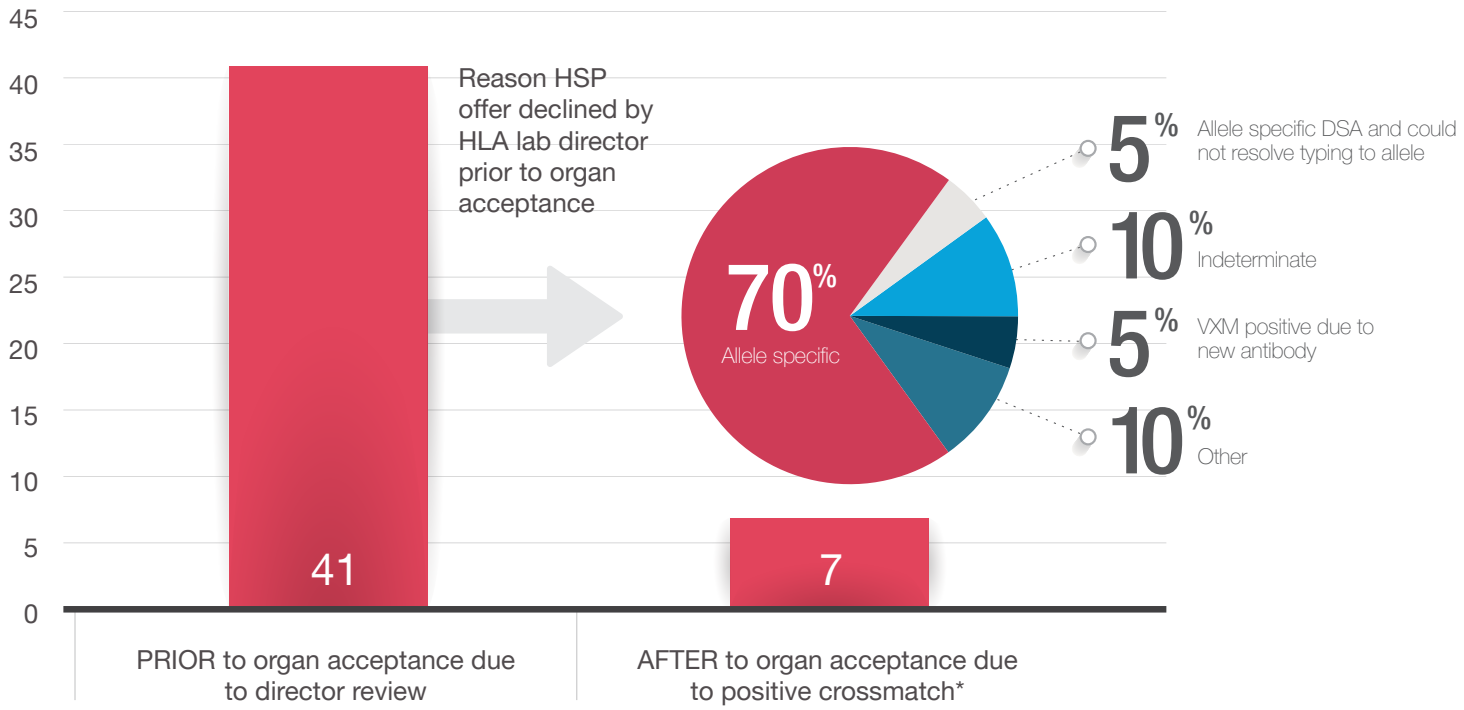
*Includes Abnormal test results, Donor medical history, Donor quality, High medical risk, Donor social history, Unstable donor, Organ test results unacceptable, and Organ anatomical damage or defect.

HIGHLY SENSITIZED PATIENT PROGRAM

HLA Declines and Unexpected Positive Crossmatch

A major achievement for the HSP program is the low number of unexpected positive actual crossmatches. HLA Laboratories review each kidney offer to a Highly Sensitized Patient in order to appropriately adjudicate antibodies that cannot be identified by the automated virtual crossmatch in the CTR. Currently there have only been 7 donor-recipient pairings (9 offers in total) in which there were unexpected positive actual crossmatches out of 661 donors.

Figure 2.27: Reason Offer Declined for Known HLA Decline Cases



*In two cases (Q1 and Q3 of 2016), there were multiple HLA declined offers between the same recipient-donor matches; as such the total number of unique offers declined after organ acceptance due to HLA is 7.

HIGHLY SENSITIZED PATIENT PROGRAM

Table 2.8: Reason Offer Declined Over Time for Known HLA Decline Cases

		2014			2015				2016				
		Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Total
AFTER organ acceptance due to positive crossmatch*		1				2	1		3		2		9
PRIOR to organ acceptance due to director review	Allele specific	1	2		8	10	1	1	2	1	2	1	29
	Allele specific DSA and could not resolve typing to allele							1		1			2
	Indeterminate		1	2				1					4
	VXM positive due to new antibody			1								1	2
	Other		1		1		1			1			4
	Total	1	4	3	9	10	2	3	2	3	2	2	41

*In two cases (Q1 and Q3 of 2016), there were multiple HLA declined offers between the same recipient-donor matches; as such the total number of unique offers declined after organ acceptance due to HLA is 7. Results are based on date of offer.

HIGHLY SENSITIZED PATIENT PROGRAM

HSP Thresholds and General Ledger

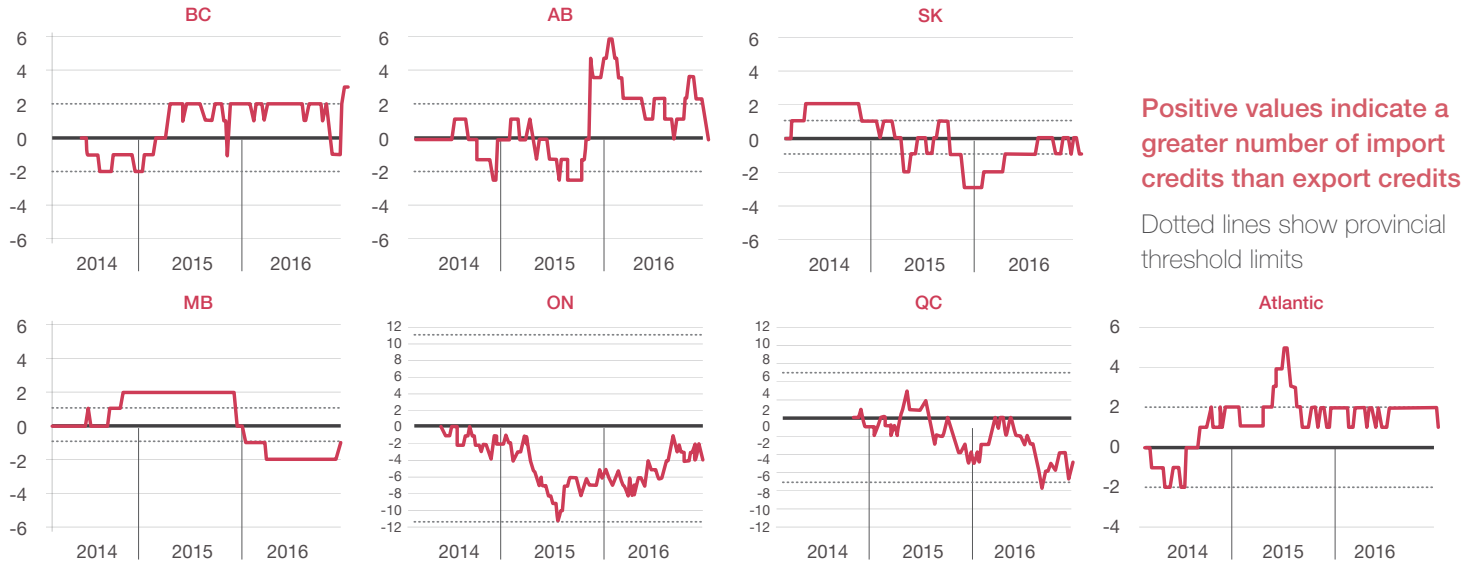
Provincial import/export thresholds, which are based upon 5% of the provincial deceased donation activity in 2010, are used to ensure protection of provincial local transplant activity. When at export threshold, a province is not required to offer a kidney to an HSP recipient in another province (but may choose to). Similarly, when at import threshold, they could not receive offers from out of province through the HSP program. Table 2.9 shows the threshold levels and the import/export activity for each province or region (Atlantic Canada operates as a single importing region, as they share a single waitlist managed by the transplant program in Halifax).

Table 2.9: General Ledger by Province as of December 31, 2016

	BC	AB	SK	MB	ON	QC	ATL
Export Threshold	-3	-2	-1	-1	-12	-7	-2
Net Balance	3	0	-1	-1	-4	-5	1
Imports	24	20	4	12	57	39	18
Exports	21	20	5	13	61	44	17
In Province	11	8	1	3	85	20	5

The graphs in Figure 2.28 further illustrate this activity from March of 2014 to December of 2016.

Figure 2.28: Net Balance Over Time by Province, (March 1, 2014 – December 31, 2016)



Positive values indicate a greater number of import credits than export credits

Dotted lines show provincial threshold limits

Although the thresholds were purposed at protecting provinces from importing or exporting organs above a certain value, they do not prevent making or receiving offers through the CTR. Several provinces have exceeded their import/export thresholds, often based on discussion between offering/receiving programs in the context of patient need. Programs may offer organs when a rare opportunity exists for certain very difficult to match patients. KTAC reviewed data and models on import and export thresholds during their 2015 annual meeting. KTAC recommended the removal of import thresholds and revisions to export thresholds based on data models and analysis provided by Canadian Blood Services. The implementation of KTAC's recommendation took place in December 2016, following committee endorsements and provincial policy sign-off.

NATIONAL ORGAN WAITLIST (NOW)

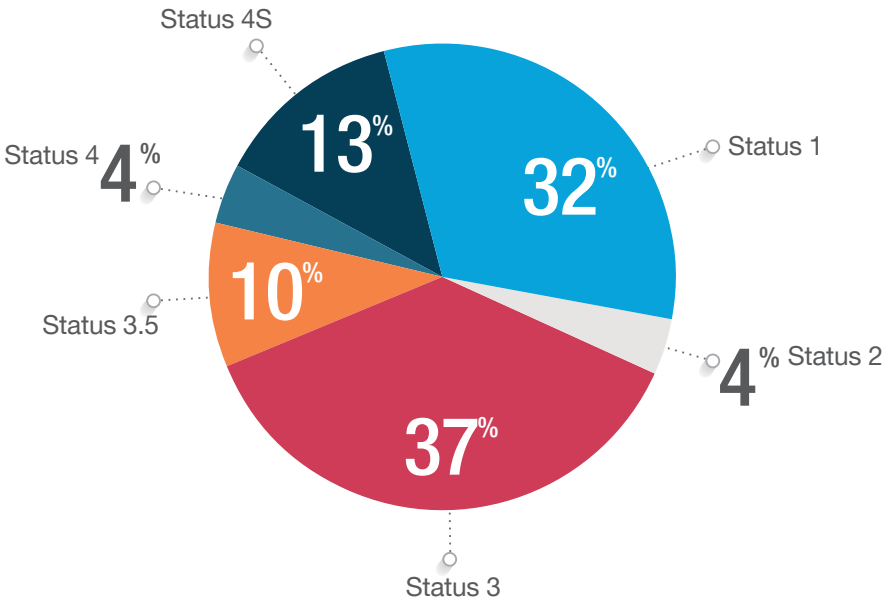
4.0 NATIONAL ORGAN WAITLIST (NOW)

The National Organ Waitlist (NOW) is a real-time, on-line national waitlist for heart, lung, liver, pancreas, small bowel and multi-organ transplants. It replaced the paper-based London Health Sciences waitlist issued weekly. As of December 31, 2016, a total of 6749 heart, lung, and liver transplant patients have been listed on the NOW since its initiation in June of 2012, 703 of whom were active on that date.

The detailed results for heart, lung, and liver candidates are provided below based on Canadian Transplant Registry (CTR) records. These data are provided by transplant coordinators, transplant program data clerks or provincial ODO programs using data feeds. All results are as of December 31, 2016. Definitions of the various candidate statuses are provided in Appendix 6. Transplant results are based on a patient's status being changed to off list due to transplant.

4.1 HEART

Figure 3.1: Active Heart Candidate Participation by Status



16%

High status (4+4S) heart candidates waiting

[11] This includes 1,301 Heart patients, 3,705 Liver patients, and 1,804 Lung patients, with some patients waiting for multiple organs.

NATIONAL ORGAN WAITLIST (NOW)

Figure 3.2: Active Heart Candidates by PHN/Home Province and Status

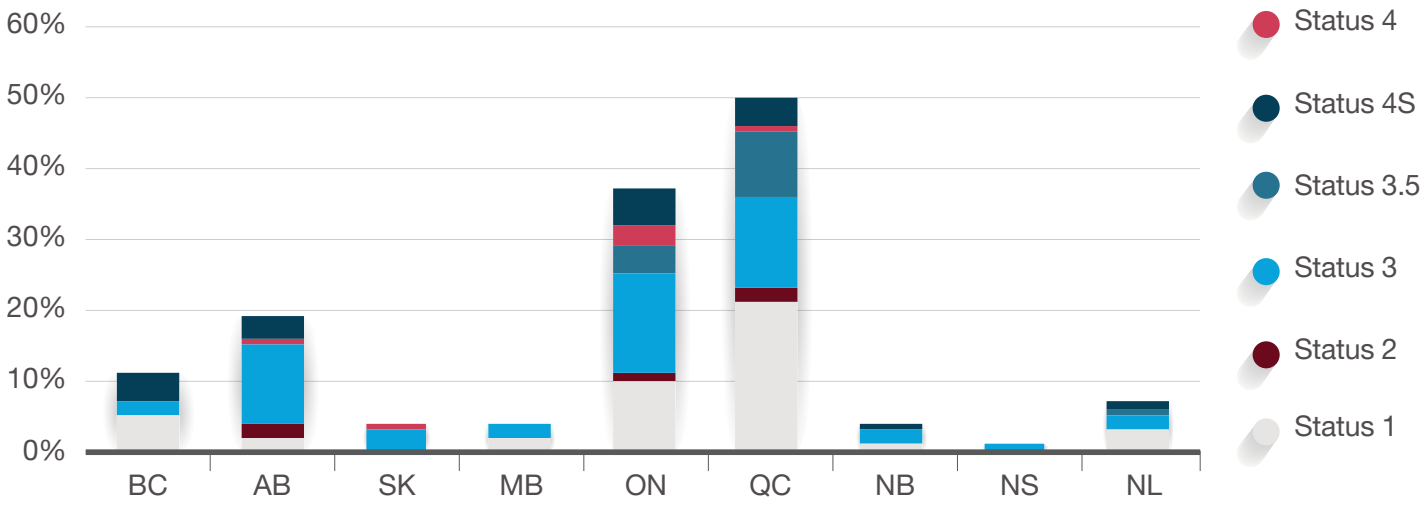
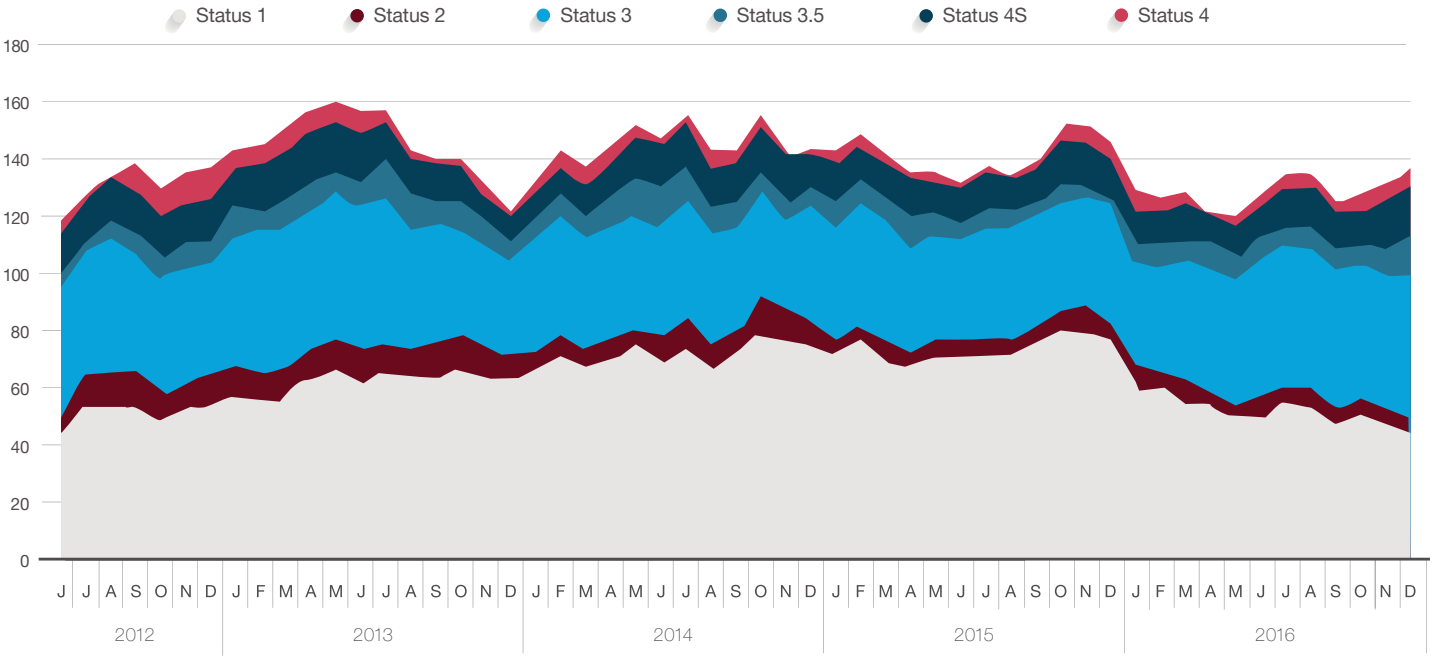


Figure 3.3: Active Heart Candidates Listed by Status Over Time



NATIONAL ORGAN WAITLIST (NOW)

Figure 3.4: Total Heart Transplants by Transplant Centre and Status, 2012-2016

One status 1 transplant recipient registered at St. Joseph's Hospital (ON) not shown. Ottawa Heart Institute counts nclude one status 4 patient and one status 1 patient registered at the Ottawa General Hospital (ON).

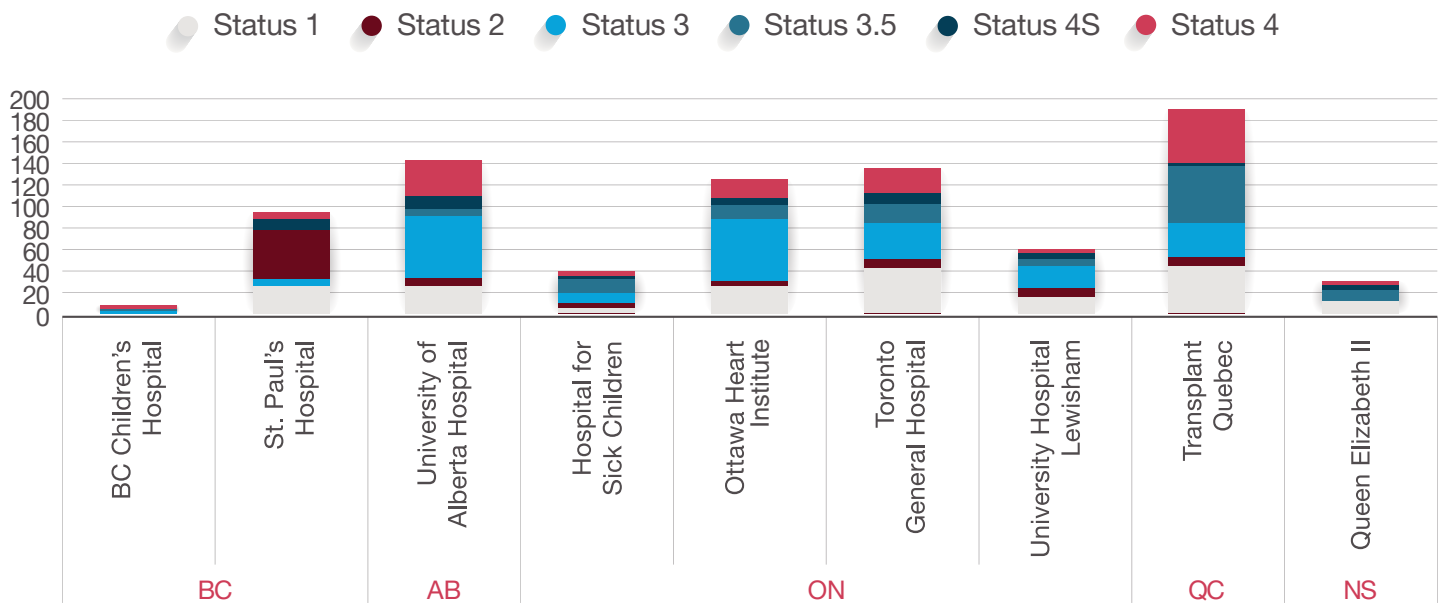
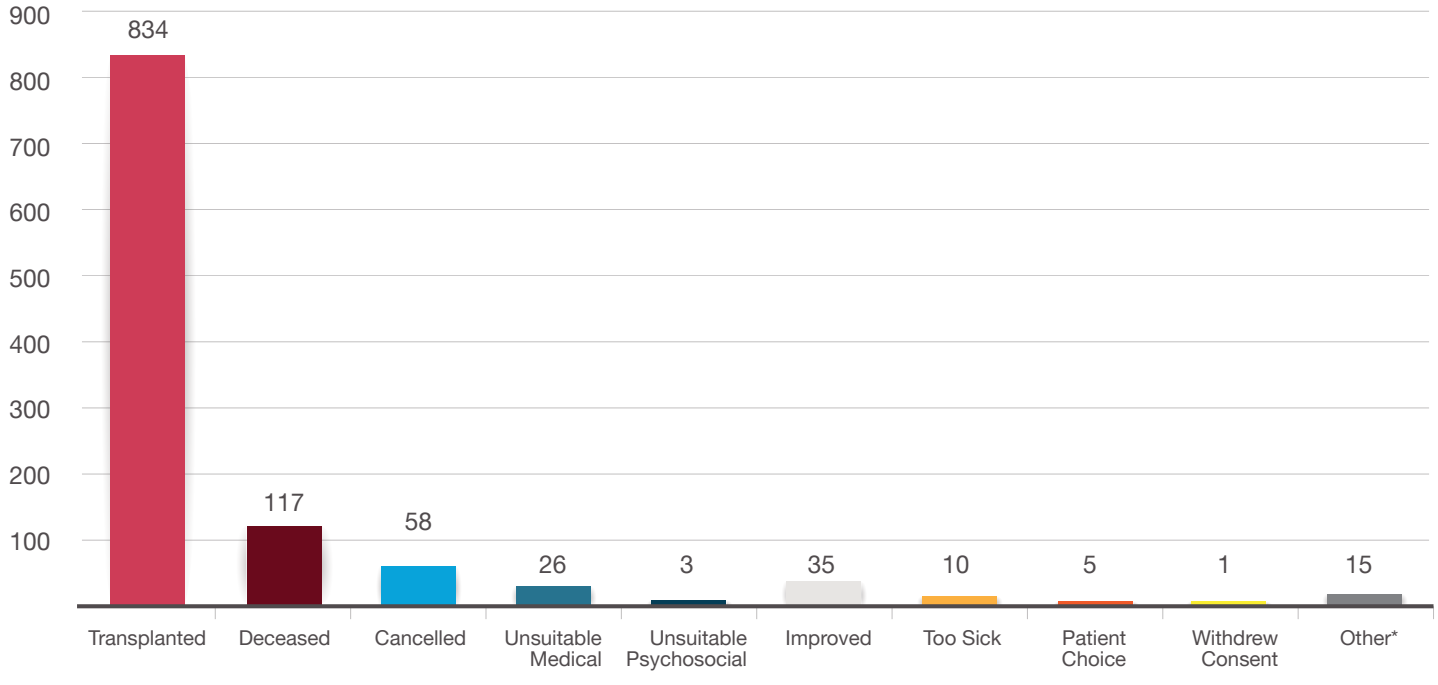


Figure 3.5: Total Heart Candidates Off-listed from Canadian Transplant Registry by Reason, 2012-2016

Include one status 4 patient and one status 1 patient registered at the Ottawa General Hospital (ON).



*"Other": Duplicate (3), Created in Error (1), and Other (11)

4.2 LUNG

Figure 3.6: Active Lung Candidate Participation by Status

Note: there were no active Status 1T lung candidates as of year-end 2016

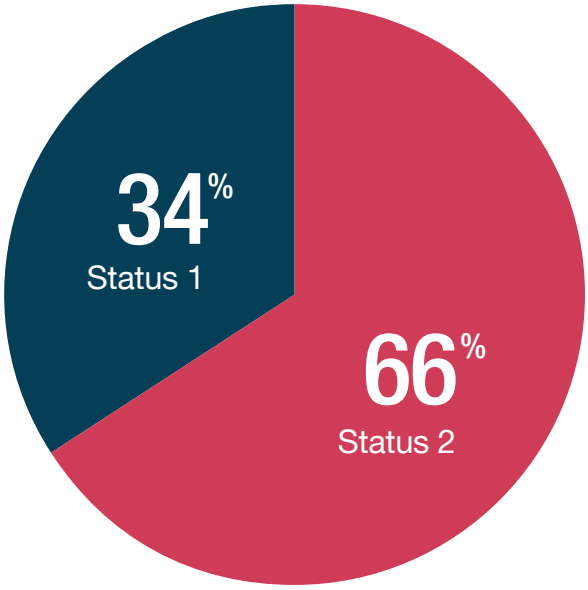
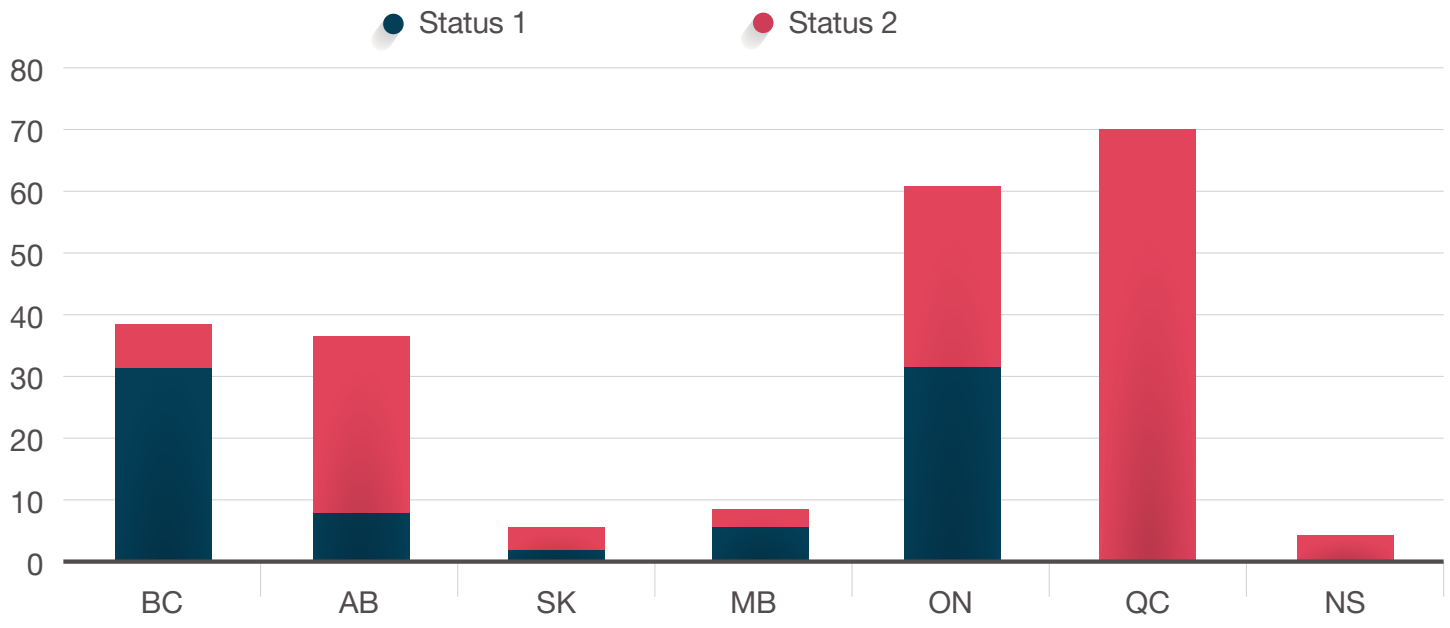


Figure 3.7: Active Lung Candidates by PHN/Home Province and Status



NATIONAL ORGAN WAITLIST (NOW)

Figure 3.8: Active Lung Candidates Listed by Status Over Time

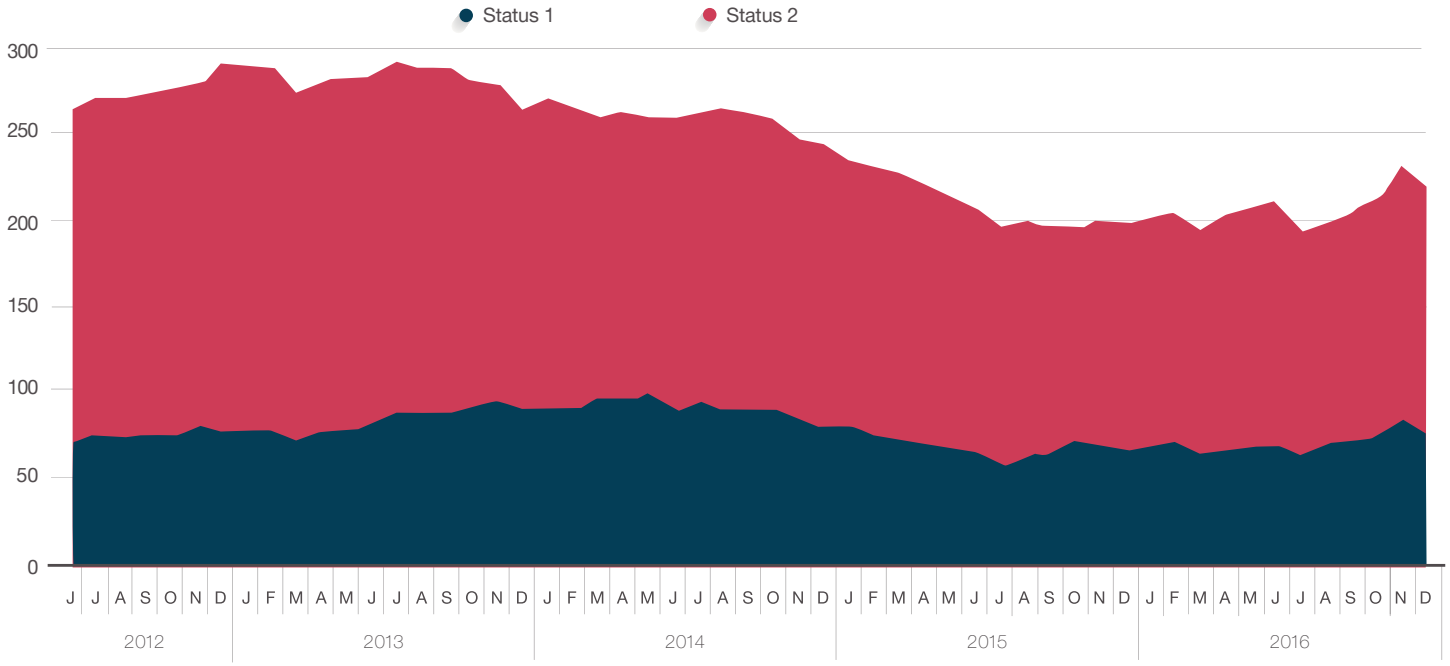
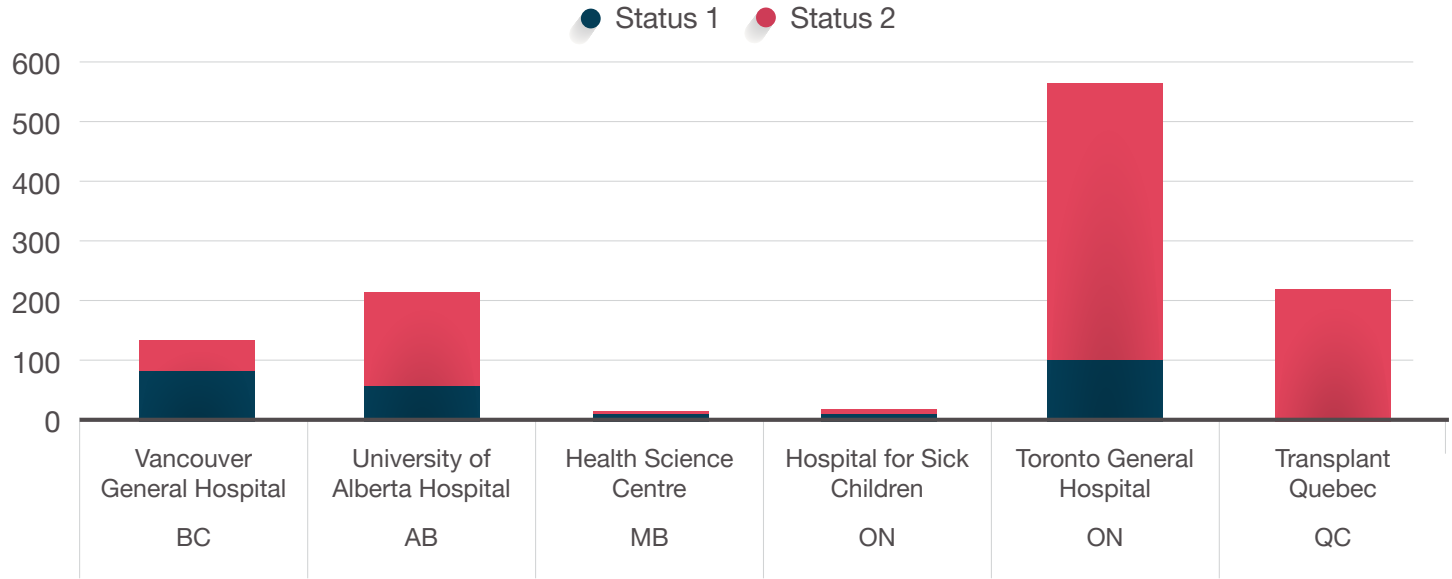


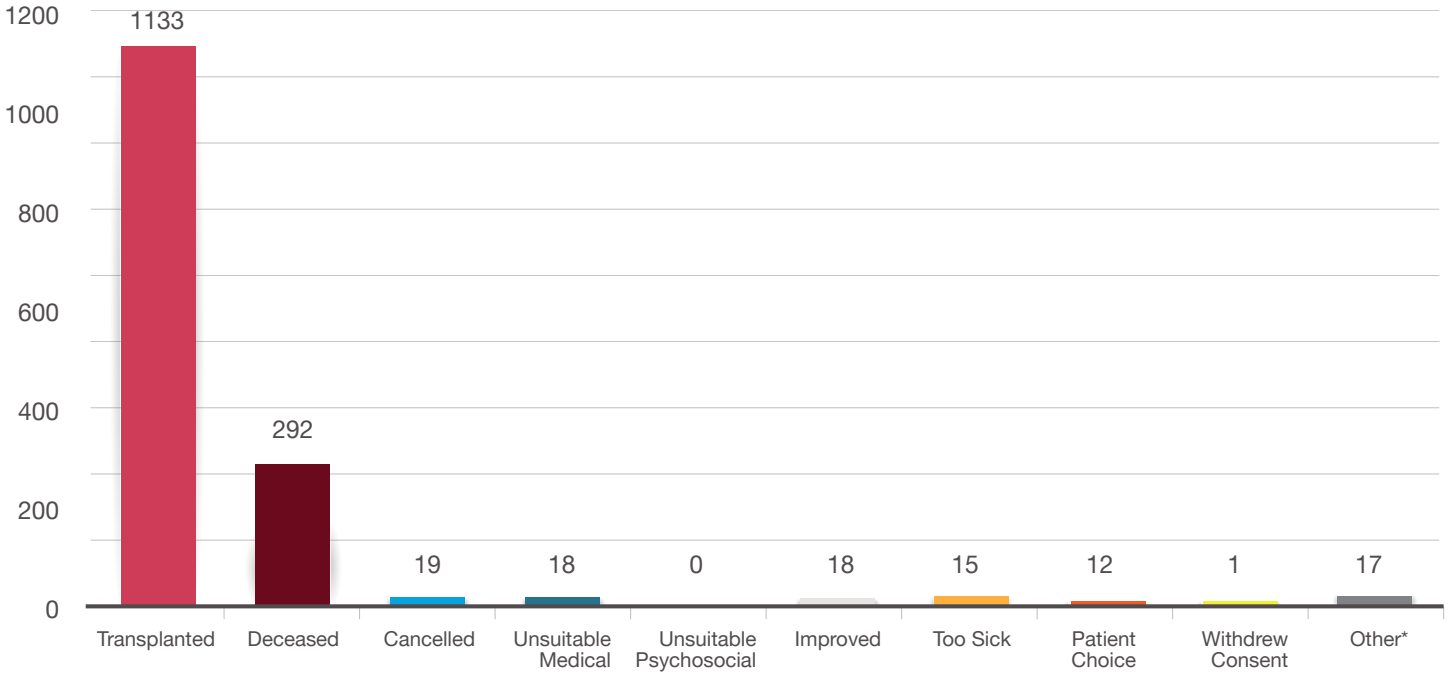
Figure 3.9: Total Lung Transplants by Transplant Centre and Status, 2012-2016



Not shown: One status 2 transplant recipient registered at St. Joseph's Hospital (ON), three status 2 transplant recipients registered at University Hospital Lewisham (ON), and one status 1 transplant recipient registered at the Ottawa General Hospital (ON).

NATIONAL ORGAN WAITLIST (NOW)

Figure 3.10: Total Lung Candidates Off-listed from Canadian Transplant Registry by Reason, 2012-2016



*"Other": Duplicate (2) and Other (15)

4.3 LIVER

Figure 3.11: Active Liver Candidates by PHN/Home Province

Note: There were no active Status 3F, 4, or 4F patients as of year-end 2016.

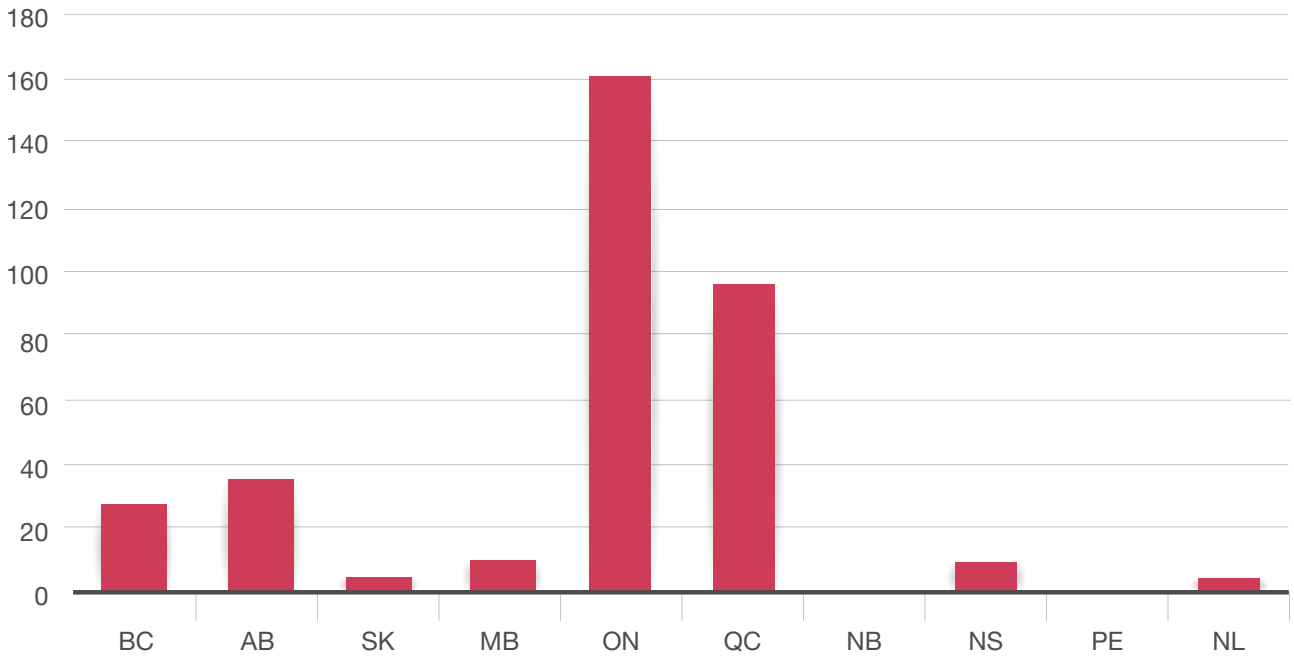
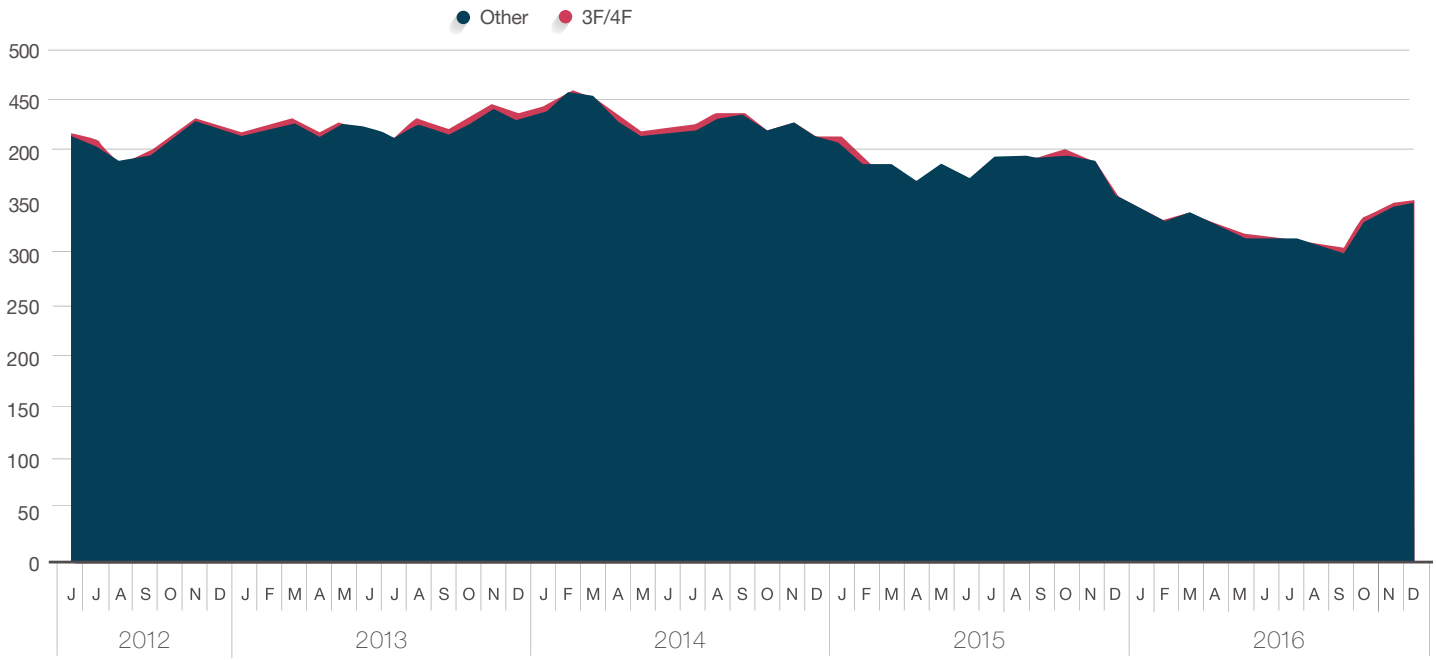
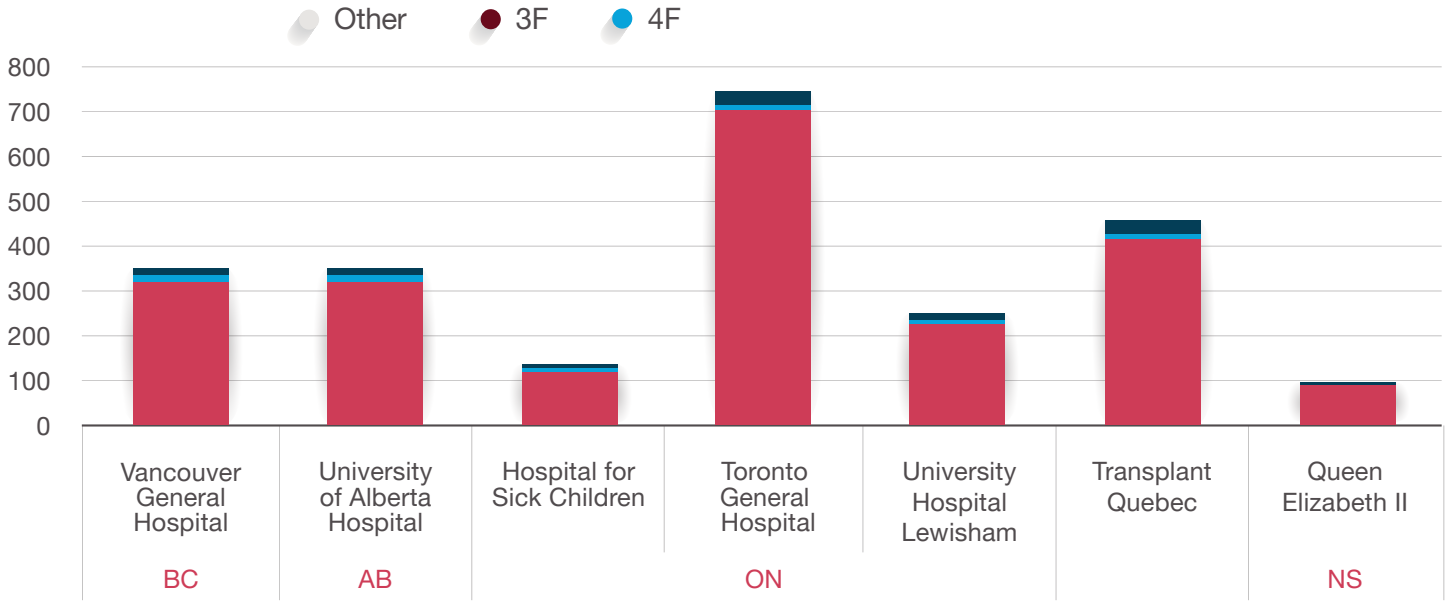


Figure 3.12: Active Liver Candidates by Status Over Time



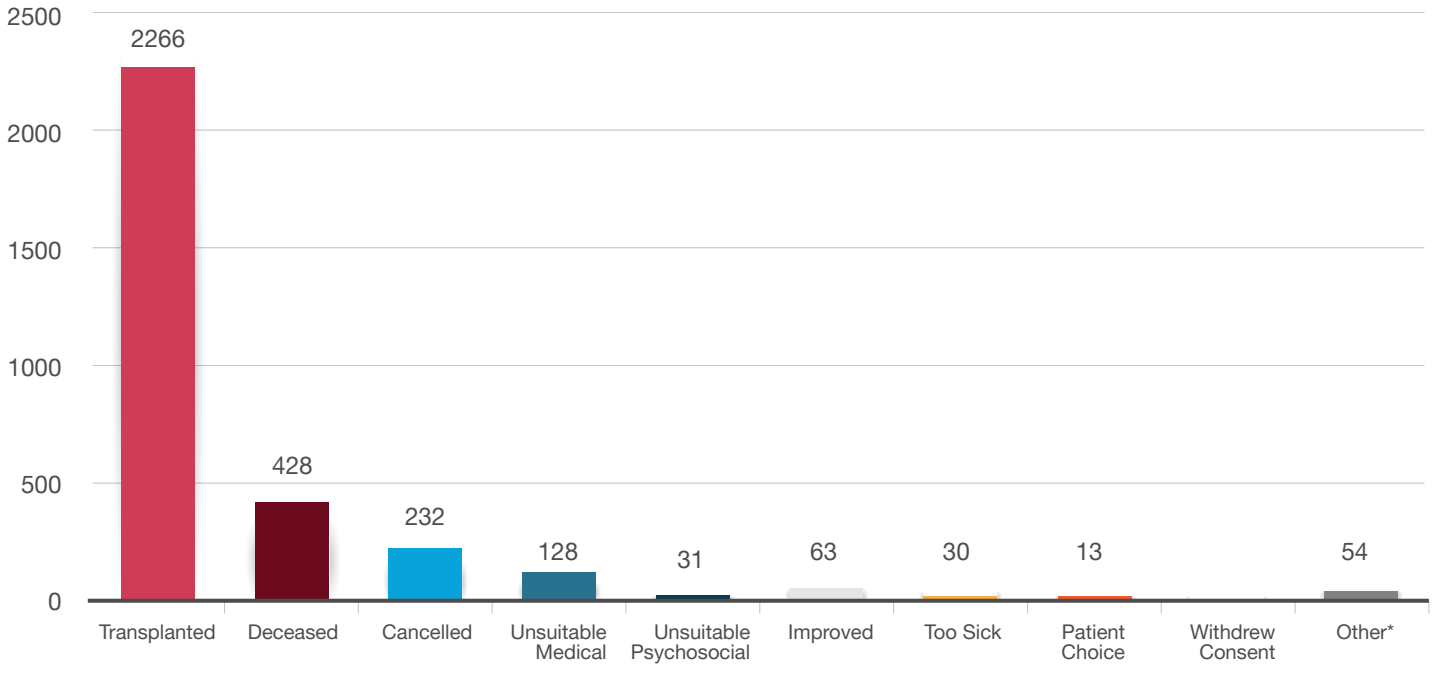
NATIONAL ORGAN WAITLIST (NOW)

Figure 3.13: Total Liver Transplants by Transplant Centre, 2012-2016



Status is based on recipient's most recent status recorded in the Canadian Transplant Registry (CTR).
Not shown: Seven non-urgent transplant recipients from the Ottawa General hospital (ON) and an additional three transplant recipients [one from a Quebec transplant centre and the remaining two from Toronto General Hospital (ON)] whose statuses prior to transplant could not be determined from CTR records.

Figure 3.14: Total Liver Candidates Off-listed from Canadian Transplant Registry by Reason, 2012-2016



*"Other": Duplicate (11), Created in Error (2), and Other (41)

4.4 PANCREAS

Figure 3.15: Active Pancreas Candidates by PHN/Home Province

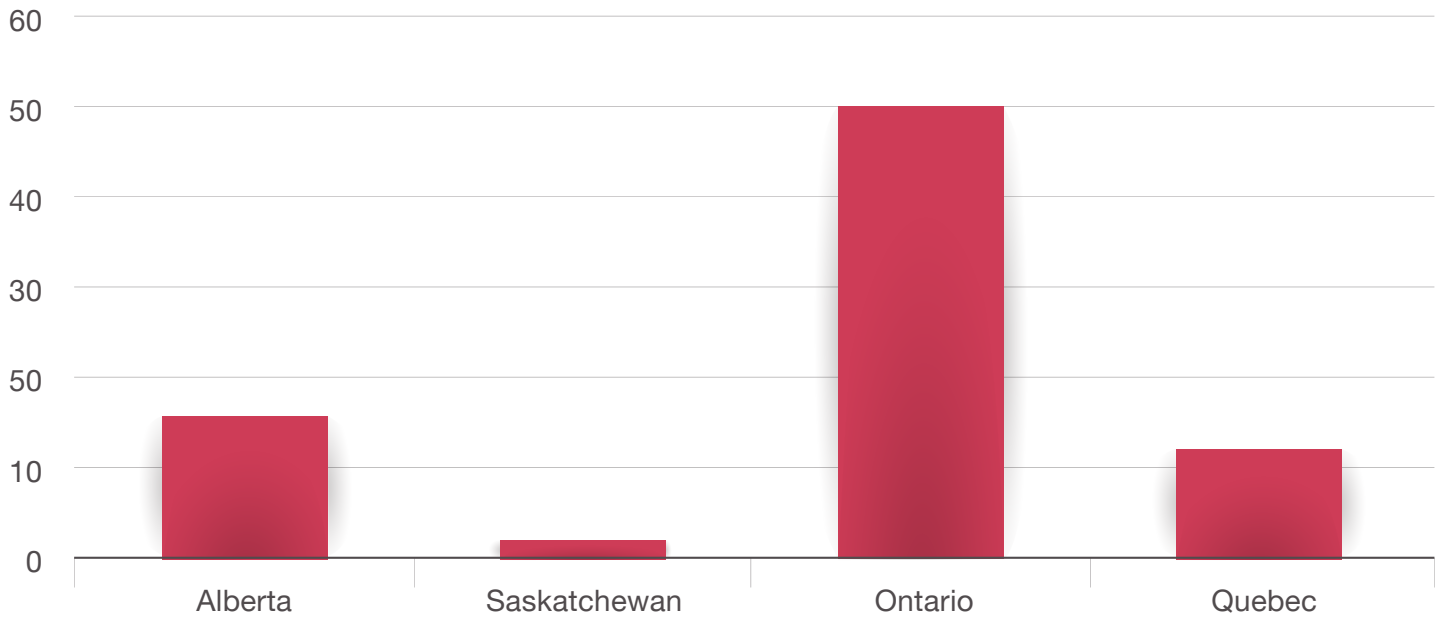
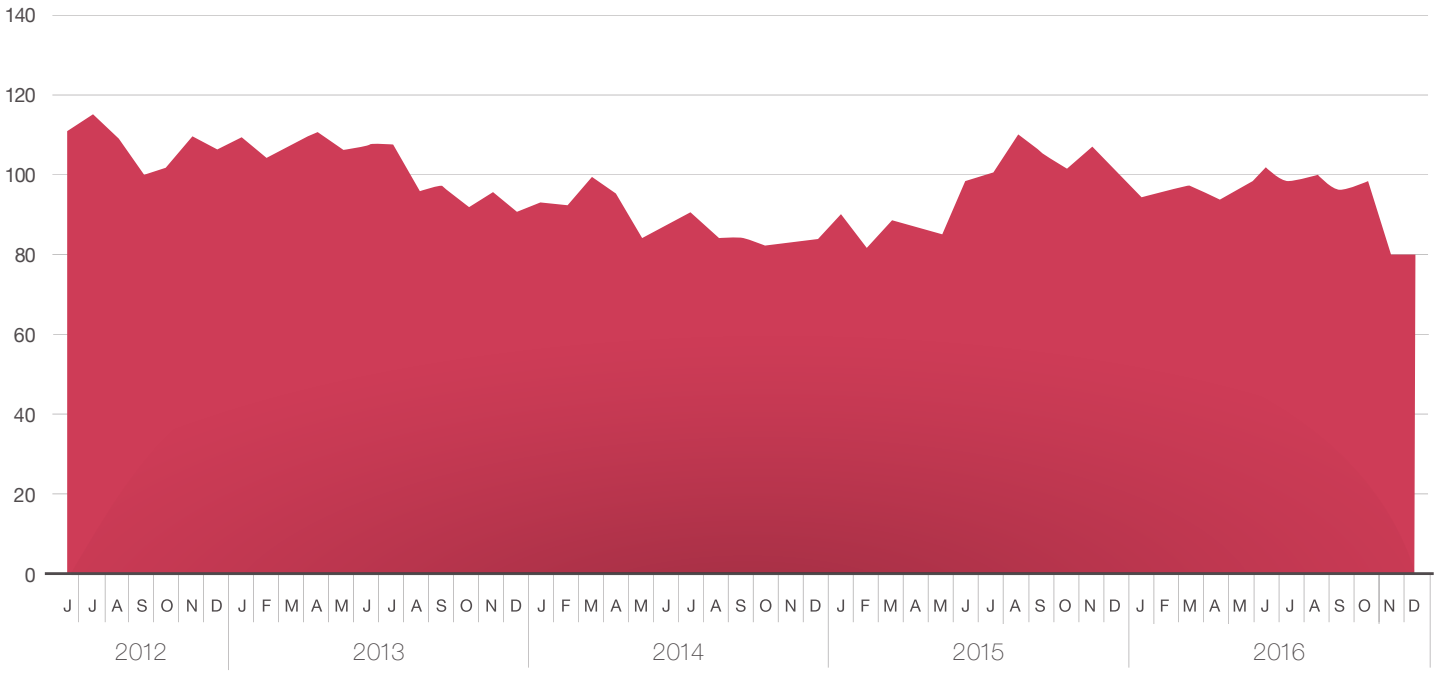


Figure 3.16: Active Pancreas Candidates Over Time



NATIONAL ORGAN WAITLIST (NOW)

Figure 3.17: Total Patients Receiving Pancreas Transplants by Transplant Centre, 2012-2016

Not shown: One transplant recipient from the Toronto Hospital for Sick Children.
Unique patient counts only (i.e. multiple transplants to the same recipient counted once)

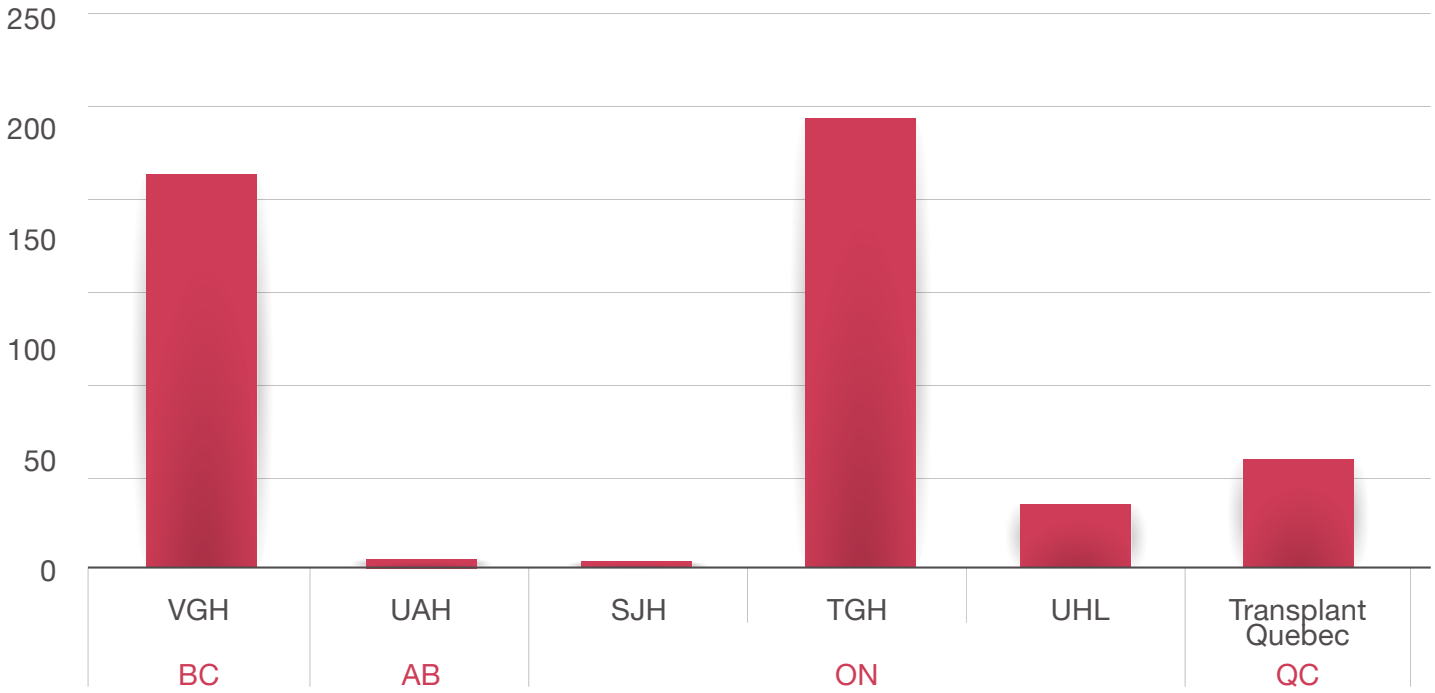
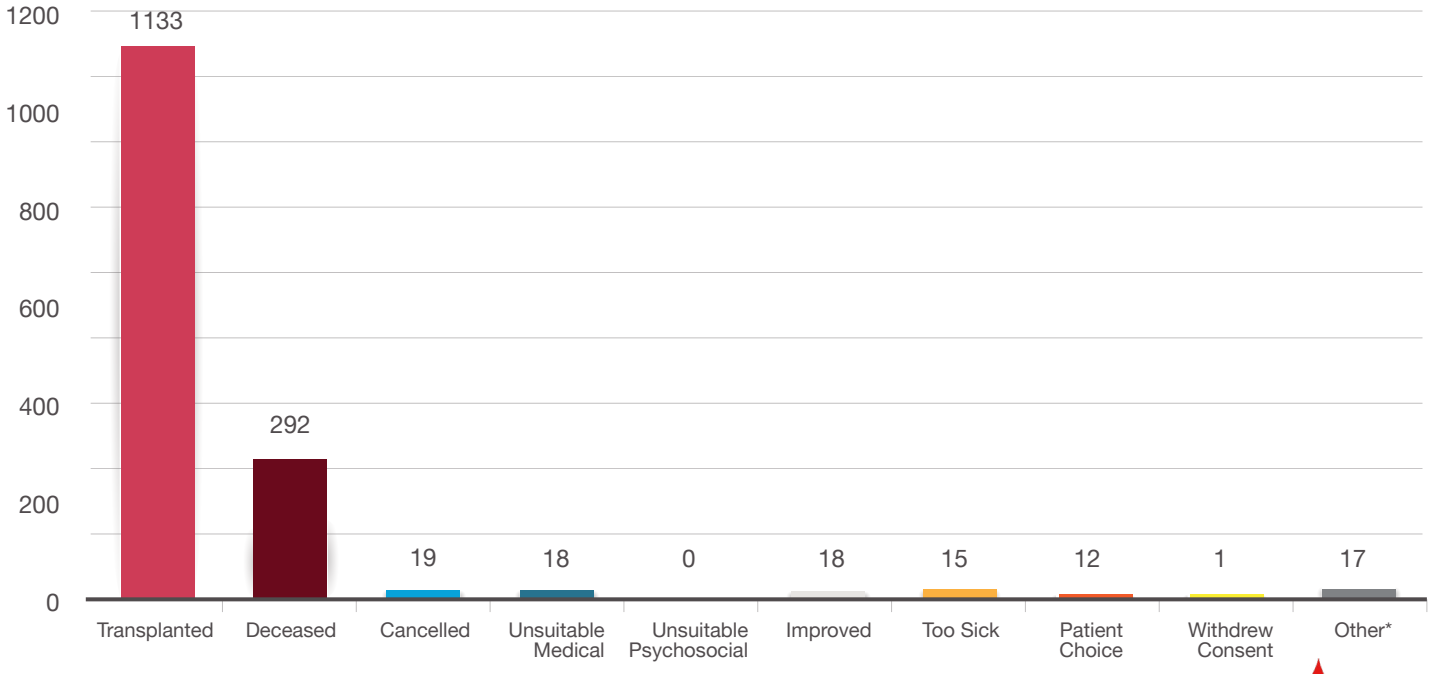
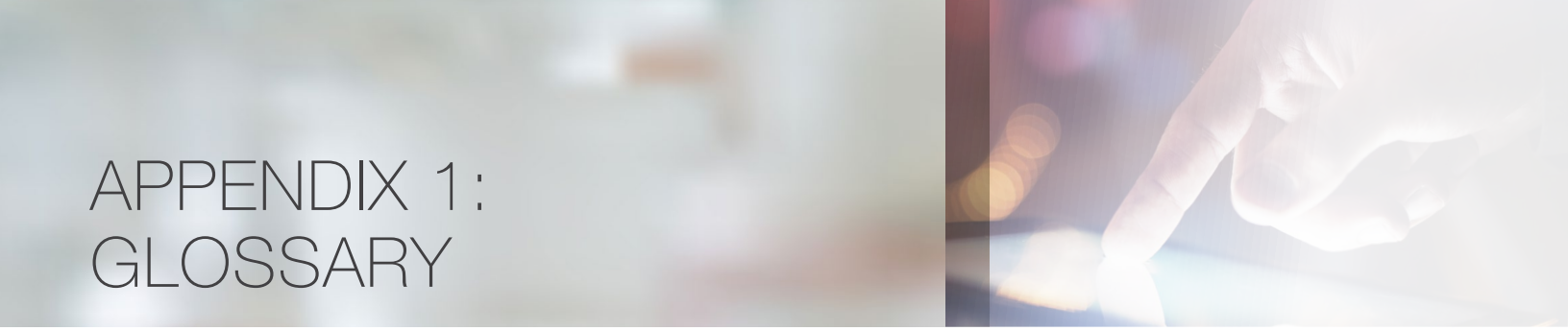


Figure 3.18: Total Pancreas Candidates Off-listed from Canadian Transplant Registry by Reason, 2012-2016

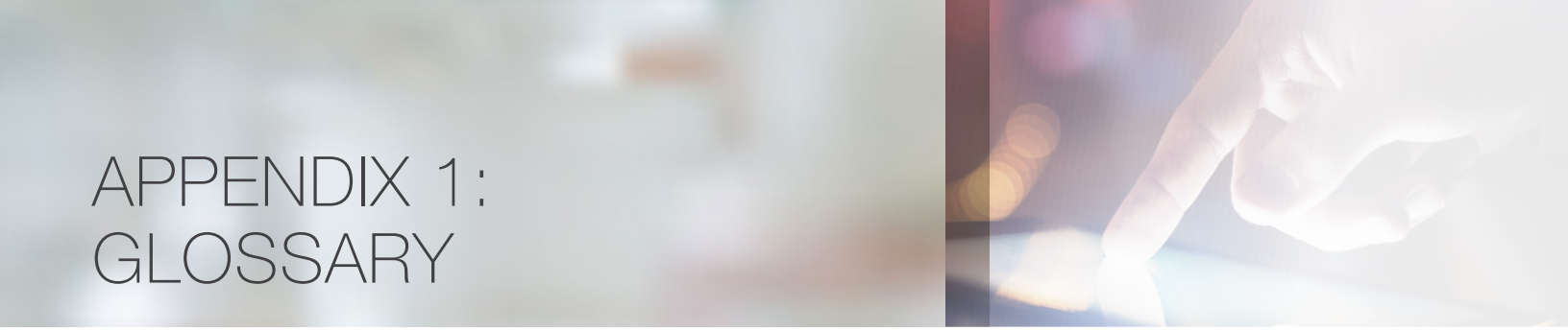




APPENDIX 1: GLOSSARY

5.0 APPENDIX 1: GLOSSARY

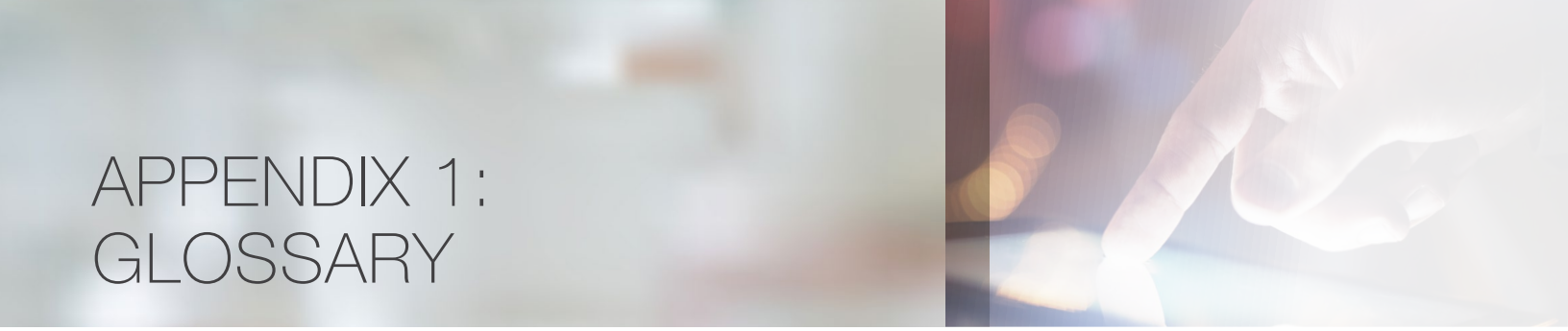
Term	Definition
ABO (or Blood Group)	A term used interchangeably with "blood group." For example, ABO-O refers to blood group O whereas ABO-B refers to blood group B.
Active	Any donor or candidate record that is ready for matching in the registry.
Algorithm (or Matching Algorithm)	An automated computer program which is used to determine potentially compatible candidate-donor pairs within the KPD program and groups of mutually exclusive chains of matched pairs.
Antibody	A protein molecule produced by the immune system in response to a foreign body (known as an antigen).
Antigen (ABDR Antigen or HLA Antigen)	An HLA protein on a cell surface (such as those on a donor kidney) which can cause the recipient immune system to react and injure or reject the organ. These help determine Donor/Recipient compatibility.
Blood Group	See ABO.
Calculated Panel Reactive Antibody (cPRA)	A population-based estimate of the percentage of donors that will be incompatible with a given candidate due to the presence of antibodies.
Canadian Transplant Registry (CTR)	A web-based database for inter-provincial listing of donors and potential recipients and for allocating the donor organs to the recipients. It is operated by Canadian Blood Services and supports the KPD program, the Highly Sensitized Patient (HSP) program for high-cPRA kidney transplant candidates and the National Organ Waitlist (NOW) for non-renal transplant candidates.
Candidate (or Transplant Candidate)	A patient who needs a solid organ transplant and who is registered in the Canadian Transplant Registry (CTR).
Candidate-Donor Pair (or Registered Pair)	A kidney transplant candidate and donor who are registered together in the KPD program, with the goal of finding a suitable match for the transplant candidate through a donor exchange.
Chain	A group of candidate-donor pairs, with or without an NDAD, in which all the candidates are able to get a kidney transplant from a donor in the group and all the donors are able to donate to someone in the group. Chains may be closed (involving only registered pairs) or domino (involving an NDAD and a waitlist recipient).
Chain Completion	The completion of all transplants proposed as part of a given chain.
Closed Chain (or N-way Exchange)	A chain in which the donor of the last pair must match the candidate of the first pair.
Collapsed Chain	A chain that cannot proceed because one or more proposed transplants cannot proceed.
Compatible Match	A transplant candidate and donor whose ABO and HLA types are compatible for transplantation.
Crossmatch	A test performed in an HLA laboratory to determine the HLA compatibility between a candidate and a potential donor.
Domino Chain	A chain of donor exchanges that begins with an NDAD and ends with the last donor in the chain donating to a patient on the deceased donor waitlist, waiting for a kidney transplant.
Donor	A person, either living or deceased, who provides cells, tissues, or organs for transplantation.
Donor-Specific Antibodies (DSA)	Recipient HLA antibody or antibodies against a given donor's antigens.
End Stage Renal Disease (ESRD)	The final stage of chronic kidney disease in which the kidneys are no longer able to function at a level required for day-to-day life. The treatment for ESRD is dialysis or transplant.
Enrolment Date	The date on which a candidate-donor pair is first activated in the CTR as part of the KPD program, and is included in the matching process.



APPENDIX 1: GLOSSARY

APPENDIX 1: GLOSSARY continued

Term	Definition
Graft	A transplanted organ, tissue, or cells. In the case of KPD and HSP, a transplanted kidney.
Interquartile Range (IQR)	A statistical measure of dispersion (variability) based on dividing a data set into quartiles.
Incompatible Pair	A transplant candidate and a donor whose blood types and/or HLA tissue types are not compatible for transplant. A kidney transplant from the donor would be rejected by the candidate's antibodies.
Human Leucocyte Antigen (HLA)	The antigens on the donor's cell surface that may cause the recipient's immune system to react and reject a transplanted organ. See also antigen, above. HLA antigens are named in groups, or loci, and identified as: A, B, Cw, DR, DRw, DQA, DQ, DPA, and DP.
HLA Crossmatch	A test performed in an HLA laboratory to determine the HLA compatibility between a candidate and a potential donor.
Kidney Paired Donation (KPD) Program	A program operated and managed by Canadian Blood Services in collaboration with the provincial Living Kidney Donation and Transplantation programs. The KPD program matches candidate-donor pairs and NDADs into chains of donor exchanges and works with their Living Kidney Donation and Transplant programs to facilitate the completion of all the donations and transplants in the chain.
KTAC	Kidney Transplant Advisory Committee
Matching Algorithm	See Algorithm.
Match Cycle (MC)	A period of time beginning on the date the matching algorithm is run to identify a group of mutually exclusive chains from a set group of donor-candidate pairs and NDADs, and ending on the date the last transplant in the last chain is completed. Match Cycles can overlap one another in time.
Match Run	The running of the KPD matching algorithm to identify chains of proposed exchanges. Each Match Cycle will have a main run and may have additional runs (re-runs) using the same group of pairs and NDADs, if required.
N-way Exchange	See Closed Chain.
Non-Directed Anonymous Donor (NDAD)	A donor who wishes to donate a kidney to anyone in need and is registered in the KPD program without a paired registered candidate. NDADs allow for domino chains to be proposed.
Paired Exchange (PE)	A KPD donor exchange between two registered pairs wherein each recipient receives a kidney from the donor in the other pair. This is equivalent to a 2-way exchange or a closed chain involving only two pairs.
Proposed Pair/Match	A potentially compatible donor and candidate who are matched for transplant by the matching algorithm.
Rejection	An immunological response to the transplanted organ in which the recipient's immune system (antibodies) attempts to destroy the graft, resulting in decreased function. A rejection episode does not necessarily result in graft loss.
Registered Pair	See Candidate-Donor Pair.
Repaired Chain	When a matched donor-candidate pair in a chain can no longer proceed to transplant, the KPD Program attempts to repair the chain to allow the rest of the matches to continue to transplantation. Repairs are generally done by substituting in one or more pairs for the pair that cannot proceed or by shortening the domino chain to allow at least some of the transplants to proceed.
Terminal Donor	The last donor in a domino chain whose kidney is transplanted to a recipient from a provincial or local waitlist. The terminal donor surgery is not necessarily the last surgery to occur, as chains may not be done in chronological order.



APPENDIX 1: GLOSSARY

APPENDIX 1: GLOSSARY continued

Term	Definition
Virtual Crossmatch (VXM)	A comparison between candidate antibodies and donor antigens. A positive VXM means that the candidate has antibody(ies) to the donor's antigen(s) and could result in injury or rejection of the transplanted organ. A negative VXM means that the candidate's antigens match the donor's antigens with a corresponding lower risk of organ injury and rejection.
Waitlist	A list of patients who are qualified and registered by a transplant program and who are waiting to receive an organ transplant.

APPENDIX 2: MATCHING ALGORITHM FOR KPD

6.0 APPENDIX 2: MATCHING ALGORITHM FOR KPD

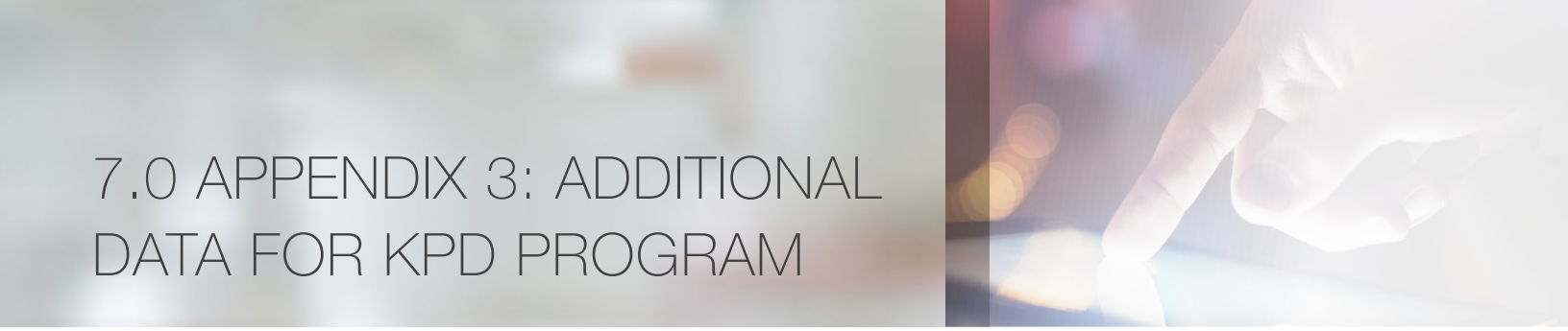
Table A2.1: Matching Points

Match points are assigned to matches between donor and candidate records with the following characteristics:

Attribute	Points
Compatible Donor-Candidate match (using ABO, HLA, filters)	100
Highly Sensitized (cPRA > 95%)	125
ABO Match: O to O	75
Pediatric Candidate (≤19 years of age)	75
Candidate is a Prior Living Donor	75
ABDR 0/6 Mismatch	75
Dialysis Wait Time (starting at initiation of dialysis)	Days/30
Geography: Same City	25
Donor/Candidate Age difference of ≤30 years	5
ABO Match: A to A, B to B, AB to AB	5
EBV Negative to Negative Match	5

Guiding Principles for Kidney Paired Donation Program

1. Maximize Transplants – primary goal should be to find the greatest number of high quality matches between living donors and candidates.
2. Maximize Logistics – to the extent possible, the need for donors or recipients to travel should be minimized.
3. Equity for High Need Patient Groups – any candidates who are disadvantaged due to medical or demographic factors should receive additional priority (e.g., highly sensitized, blood group O, pediatrics, lengthy time on dialysis, etc.).
4. Priority for Higher Quality Matches – transplants that are zero mismatch HLA-A, B, DR or other clinical criteria considered to be "more ideal" should receive special priority.
5. Evidence-Based Decision Making – all principles adopted and algorithm decisions made should be based on the most current and best quality peer–reviewed evidence available.



7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

7.1 KPD PROGRAM SUMMARY

Table A3.1: KPD Program Activity Over Time, 2009 - 2016

Year	Month (MC)	Registered Pairs in MC	NDADs in MC	New Pairs in MC	Transplants in MC	Proposed Chains	Completed Chains	Completed Chains % of Chains Completed *	Registered Candidates only: Proposed Matches Transplanted	Registered Candidates only: Unique Proposed Matches	Registered Candidates only: % of Proposed Matches Transplanted	Transplants from MCs in Year	Transplants by Surgery Date
2009	Jan (1)	21	0	21	0	N/A	N/A	N/A	N/A	26	73%	25	17
	Feb (2)	25	2	5	4	2	1	50%	3				
	May (3)	33	2	14	13	4	4	100%	11				
	Oct (4)	36	4	19	8	4	3	75%	5				
2010	Feb (5)	45	4	19	14	5	5	100%	10	67	55%	47	48
	May (6)	63	2	29	6	5	2	40%	5				
	Aug (7)	83	5	34	24	13	9	69%	19				
	Nov (8)	100	0	45	3	2	1	50%	3				
2011	Mar (9)	118	2	33	23	8	6	75%	21	82	60%	58	44
	Jun (10)	110	3	27	14	9	4	44%	12				
	Oct (11)	125	7	34	21	8	5	63%	16				
2012	Feb (12)	129	2	36	11	7	4	57%	10	75	64%	61	50
	Jun (13)	141	3	44	17	6	5	83%	15				
	Oct (14)	145	11	31	33	16	11	69%	23				
2013	Feb (15)	155	9	50	16	10	4	40%	12	109	60%	80	85
	May (16)	143	4	23	33	12	9	75%	29				
	Oct (17)	154	8	55	31	17	10	59%	24				
2014	Feb (18)	147	8	42	22	11	7	64%	17	121	45%	66	77
	Jun (19)	170	4	54	28	15	8	53%	24				
	Oct (20)	179	6	51	16	18	5	28%	13				
2015	Feb (21)	181	4	49	29	11	7	64%	27	131	55%	88	70
	Jun (22)	189	8	57	35	20	13	65%	27				
	Oct (23)	173	12	40	24	12	9	75%	19				
2016	Feb (24)	158	7	28	26	10	8	80%	22	123	59%	80	83
	Jun (25)	150	2	44	21	8	4	50%	19				
	Oct (26)	157	3	45	33	11	10	91%	31				
Total		**848**	**108**	**929**	**505**	**244**	**154**	**63%**	**417**	**721**	**59%**	**505**	**474**

*Chains in which one or more proposed transplants was completed.

7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

Table A3.2: KPD Program Activity by Province and Year (Registered Recipients Only)

		Province of Candidate/Recipient (by Personal Health Number)										
		BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Can.
Results to End of 2016	Transplants	133	45	10	18	154	35	6	8	1	7	417
	Transplants PMP	44.9	23.1	19.0	32.4	22.8	11.0	19.8	24.2	13.4	24.5	23.2
	Candidates	216	100	22	43	322	92	15	23	2	13	848
	Candidates PMP	45.3	23.4	19.2	32.8	23.1	11.1	19.8	24.3	13.5	24.5	23.5
	% Transplanted	62%	45%	45%	42%	48%	38%	40%	35%	50%	54%	49%
Active Candidates PMP	2016	11.6	5.3	3.5	9.8	6.7	4.5	5.3	6.3	0	5.7	6.6
	2015	10.1	7.5	7.9	13.8	7.5	4.2	6.6	6.3	6.8	9.4	7.3
	2014	11.0	7.4	10.6	9.3	6.2	3.8	9.3	7.4	6.8	11.3	6.9
	2013	12.3	8.3	8.1	11.0	4.4	3.8	7.9	9.5	6.9	9.5	6.4
	2012	11.5	5.8	6.4	10.3	3.7	4.3	6.6	4.2	0	13.3	5.6
Transplants PMP	2016	4.2	1.6	0	1.5	2.3	1.0	1.3	1.1	0	0	2.0
	2015	2.9	2.3	1.8	3.8	2.4	0.7	1.3	1.1	0	1.9	2.0
	2014	4.0	1.0	0.9	0.8	1.7	0.6	1.3	0	0	0	1.5
	2013	4.9	3.4	0.9	0.8	1.4	0.4	1.3	2.1	0	1.9	1.8
	2012	4.1	1.3	0.9	4.0	0.8	0.6	1.3	0	0	1.9	1.4

These data represent registered recipients only and do not include waitlist recipients. Candidate totals represent the "per million population" (PMP) counts of registered candidates active in each year (i.e., an active candidate in 2012 that was still active in 2013 would be counted in both years). Transplant totals are based on year of the Match Cycle in which the match was proposed. Provincial populations used to derive PMP values based on year-end estimates from Statistics Canada Table 051-0005: Estimates of population, available online at http://www5.statcan.gc.ca/cansim/a26?lang=en&id=510005. Yukon, Northwest Territories, and Nunavut populations are included in British Columbia, Alberta, and Ontario, respectively.

7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

7.2 KPD CANDIDATES, RECIPIENTS AND DONORS

Age & Sex

Table A3.3: KPD Program Participants by Age, Sex, and Type, 2009-2016

			Age Group															
			≤19		20-29		30-39		40-49		50-59		60-69		70+		All Ages	
			#	(%)	#	(%)	#	(%)	#	(%)	#	(%)	#	(%)	#	(%)	#	(%)
Patients Registered with KPD Program: Age at First Match Cycle	Donors in Registered Pairs	Male	1	(0%)	40	(4%)	69	(7%)	85	(9%)	116	(13%)	56	(6%)	2	(0%)	369	(40%)
		Female	-	-	45	(5%)	116	(13%)	167	(18%)	162	(17%)	65	(7%)	4	(0%)	559	(60%)
		All	1	(0%)	85	(9%)	185	(20%)	252	(27%)	278	(30%)	121	(13%)	6	(1%)	928	(100%)
	NDADs	Male	-	-	1	(1%)	8	(7%)	12	(11%)	10	(9%)	14	(13%)	3	(3%)	48	(44%)
		Female	-	-	3	(3%)	11	(10%)	13	(12%)	26	(24%)	8	(7%)		(0%)	61	(56%)
		All	-	-	4	(4%)	19	(17%)	25	(23%)	36	(33%)	22	(20%)	3	(3%)	109	(100%)
	All Donors[1]	Male	1	(0%)	41	(4%)	77	(7%)	97	(9%)	125	(12%)	70	(7%)	5	(0%)	416	(40%)
		Female	-	-	48	(5%)	126	(12%)	180	(17%)	188	(18%)	73	(7%)	4	(0%)	619	(60%)
		All	1	(0%)	89	(9%)	203	(20%)	277	(27%)	313	(30%)	143	(14%)	9	(1%)	1035	(100%)
	Candidates	Male	14	(2%)	41	(5%)	61	(7%)	82	(10%)	111	(13%)	86	(10%)	14	(2%)	409	(48%)
		Female	7	(1%)	32	(4%)	69	(8%)	112	(13%)	118	(14%)	97	(11%)	4	(0%)	439	(52%)
		All	21	(2%)	73	(9%)	130	(15%)	194	(23%)	229	(27%)	183	(22%)	18	(2%)	848	(100%)
Patients involved in transplants: Age at Time of Transplant/Donation	Donors in Registered Pairs	Male	-	-	12	(3%)	30	(7%)	45	(11%)	51	(12%)	31	(7%)	-	-	169	(41%)
		Female	-	-	13	(3%)	51	(12%)	73	(18%)	72	(17%)	36	(9%)	1	(0%)	246	(59%)
		All	-	-	25	(6%)	81	(20%)	118	(28%)	123	(30%)	67	(16%)	1	(0%)	415	(100%)
	NDADs	Male	-	-	-	-	5	(6%)	11	(12%)	10	(11%)	11	(12%)	3	(3%)	40	(44%)
		Female	-	-	3	(3%)	8	(9%)	11	(12%)	22	(24%)	6	(7%)		(0%)	50	(56%)
		All	-	-	3	(3%)	13	(14%)	22	(24%)	32	(36%)	17	(19%)	3	(3%)	90	(100%)
	All Donors	Male	-	-	12	(2%)	35	(7%)	56	(11%)	61	(12%)	42	(8%)	3	(1%)	209	(41%)
		Female	-	-	16	(3%)	59	(12%)	84	(17%)	94	(19%)	42	(8%)	1	(0%)	296	(59%)
		All	-	-	28	(6%)	94	(19%)	140	(28%)	155	(31%)	84	(17%)	4	(1%)	505	(100%)
	Registered Transplant Recipients2	Male	10	(2%)	19	(5%)	29	(7%)	37	(9%)	58	(14%)	40	(10%)	8	(2%)	201	(48%)
		Female	4	(1%)	8	(2%)	24	(6%)	61	(15%)	60	(14%)	56	(13%)	3	(1%)	216	(52%)
		All	14	(3%)	27	(6%)	53	(13%)	98	(24%)	118	(28%)	96	(23%)	11	(3%)	417	(100%)
	Waitlist Transplant Recipients	Male	2	(2%)	2	(2%)	3	(3%)	9	(10%)	12	(14%)	9	(10%)		(0%)	37	(42%)
		Female	2	(2%)	-	-	-	-	7	(8%)	9	(10%)	5	(6%)	2	(2%)	25	(28%)
		Unknown[3]	2	(2%)	1	(1%)	2	(2%)	8	(9%)	6	(7%)	2	(2%)	1	(1%)	26	(30%)
		All	6	(7%)	3	(3%)	5	(6%)	24	(27%)	27	(31%)	16	(18%)	3	(3%)	88	(100%)
	All Transplant Recipients2	Male	12	(2%)	21	(4%)	32	(6%)	46	(9%)	70	(14%)	49	(10%)	8	(2%)	238	(47%)
		Female	6	(1%)	8	(2%)	24	(5%)	68	(13%)	69	(14%)	61	(12%)	5	(1%)	241	(48%)
		Unknown[3]	2	(0%)	1	(0%)	2	(0%)	8	(2%)	6	(1%)	2	(0%)	1	(0%)	26	(5%)
			20	(4%)	30	(6%)	58	(11%)	122	(24%)	145	(29%)	112	(22%)	14	(3%)	505	(100%)

Percentage values refer to total in category of participant for each age/sex combination.

[1]Two donors registered as both an NDAD and in a match pair; they have been counted in each category but have not been double-counted in the total

[2]Transplants to the same individual are counted separately based on recipient's age at each transplant

[3]Age and sex are unknown for an additional 4 waitlist recipients; these recipients are included in the totals presented.

7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

Blood Group

Table A3.4: KPD Program Participants by Blood Group, 2009-2016

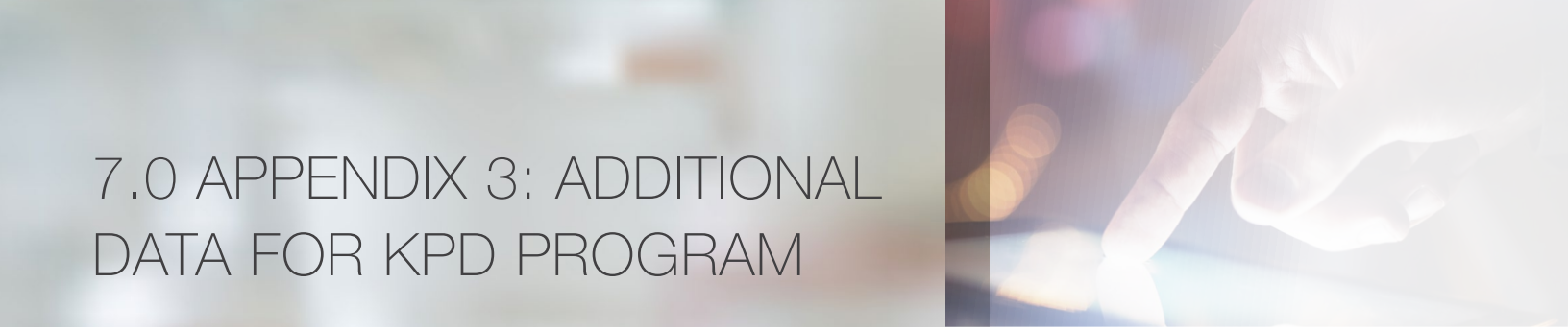
Year	Month (MC)	Blood Group[1] A n	A (%)	AB n	AB (%)	B n	B (%)	O n	O (%)	Total (100%) n
2009	Jan (1)	3	(13%)	1	(4%)	4	(17%)	15	(65%)	23
	Feb (2)	3	(12%)	1	(4%)	4	(16%)	17	(68%)	25
	May (3)	7	(21%)		(0%)	6	(18%)	20	(61%)	33
	Oct (4)	6	(18%)		(0%)	3	(9%)	25	(74%)	34
2010	Feb (5)	9	(20%)		(0%)	5	(11%)	30	(68%)	44
	May (6)	11	(18%)	1	(2%)	9	(15%)	39	(65%)	60
	Aug (7)	17	(22%)	2	(3%)	13	(17%)	45	(58%)	77
	Nov (8)	22	(23%)	1	(1%)	13	(14%)	60	(63%)	96
2011	Mar (9)	34	(30%)	2	(2%)	15	(13%)	63	(55%)	114
	Jun (10)	28	(26%)	2	(2%)	14	(13%)	62	(58%)	106
	Oct (11)	31	(26%)	1	(1%)	14	(12%)	72	(61%)	118
2012	Feb (12)	31	(26%)	2	(2%)	13	(11%)	75	(62%)	121
	Jun (13)	31	(23%)		(0%)	18	(13%)	85	(63%)	134
	Oct (14)	27	(20%)	1	(1%)	12	(9%)	93	(70%)	133
2013	Feb (15)	35	(24%)	1	(1%)	17	(12%)	91	(63%)	144
	May (16)	32	(24%)		(0%)	14	(10%)	90	(66%)	136
	Oct (17)	37	(26%)	1	(1%)	18	(13%)	86	(61%)	142
2014	Feb (18)	30	(22%)	1	(1%)	18	(13%)	85	(63%)	134
	Jun (19)	42	(27%)	1	(1%)	17	(11%)	97	(62%)	157
	Oct (20)	45	(27%)	1	(1%)	13	(8%)	105	(64%)	164
2015	Feb (21)	48	(29%)	2	(1%)	14	(8%)	103	(62%)	167
	Jun (22)	39	(23%)	3	(2%)	16	(9%)	112	(66%)	170
	Oct (23)	31	(20%)	3	(2%)	16	(10%)	106	(68%)	156
2016	Feb (24)	28	(20%)	5	(4%)	12	(9%)	96	(68%)	141
	Jun (25)	29	(21%)	2	(1%)	14	(10%)	93	(67%)	138
	Oct (26)	33	(23%)	5	(3%)	16	(11%)	92	(63%)	146
Total		223	(26%)	16	(2%)	124	(15%)	485	(57%)	848
Donor Blood Group for Transplants to Registered Recipients2	A	140	(94%)	7	(5%)	1	(1%)	1	(1%)	149
	AB			2	(100%)					2
	B			1	(1%)	70	(99%)			71
	O	3	(2%)	-	-	9	(5%)	183	(94%)	195
Transplants to Registered Recipients[2]		143	(34%)	10	(2%)	80	(19%)	184	(44%)	417
Waitlist Transplants (known)[3]		46	(52%)	21	(24%)	15	(17%)	2	(2%)	88
Donor Position in Domino Chain[4]	Terminal	50	(57%)	22	(25%)	13	(15%)	3	(3%)	88
	Non-Terminal	76	(34%)	-	-	44	(20%)	101	(46%)	221
% of ABO group Transplanted		64%		63%		65%		38%		49%
Canadian Population		42%		3%		9%		46%		100%
Days from First MC Start Date to Transplant for Registered Recipients	Median	147		123		161		224		164
	IQR	114-217		84-154		108-221		135-456		121-334

[1] Results are categorized based on the blood group of the candidate for all measures except in relation to "Donor Position in Domino Chain"; for this measure, results are categorized based on the blood group of the donor.

[2] Two type O recipients each received two KPD transplants, for a total of 417 KPD transplants.

[3] Blood group is unknown for 4 waitlist KPD transplant recipients.

[4] In cases in which a chain was only partially completed, donor position is based on original order in chain.



7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

HLA Antibody Levels

Table A3.5: KPD Transplant Recipients by Months on Dialysis, cPRA, Year, and Type, 2009-2016

MC Year	Type	Months on Dialysis	cPRA												Total (100%)
			0%		1%-79%		80%-94%		95%-96%		97%-98%		99%-100%		Unknown		
			n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	
2009-2015	Registered Recipients	0	19	(19%)	55	(54%)	12	(12%)	4	(4%)	5	(5%)	7	(7%)	-	-	102
		1 to 12	13	(23%)	29	(52%)	9	(16%)	2	(4%)	1	(2%)	2	(4%)	-	-	56
		13 to 24	11	(17%)	32	(50%)	15	(23%)	3	(5%)	2	(3%)	1	(2%)	-	-	64
		25 to 36	11	(26%)	14	(33%)	12	(28%)	-	-	3	(7%)	3	(7%)	-	-	43
		37+	18	(23%)	31	(39%)	12	(15%)	6	(8%)	3	(4%)	10	(13%)	-	-	80
		Total	72	(21%)	161	(47%)	60	(17%)	15	(4%)	14	(4%)	23	(7%)	-	-	345
	Waitlist Recipients	0	2	(67%)	1	(33%)	-	-	-	-	-	-	-	-	-	-	3
		1 to 12	1	(25%)	3	(75%)	-	-	-	-	-	-	-	-	-	-	4
		13 to 24	10	(71%)	3	(21%)	-	-	-	-	-	-	1	(7%)	-	-	14
		25 to 36	5	(71%)	1	(14%)	-	-	-	-	-	-	1	(14%)	-	-	7
		37+	26	(58%)	14	(31%)	2	(4%)	1	(2%)	1	(2%)	1	(2%)	-	-	45
		Unknown	1	(14%)	2	(29%)	-	-	-	-	-	-	-	-	4	(57%)	7
		Total	45	(56%)	24	(30%)	2	(3%)	1	(1%)	1	(1%)	3	(4%)	4	(5%)	80
2016	Registered Recipients	0	5	(21%)	13	(54%)	5	(21%)	-	-	1	(4%)	-	-	-	-	24
		1 to 12	7	(37%)	6	(32%)	4	(21%)	1	(5%)	1	(5%)	-	-	-	-	19
		13 to 24	2	(14%)	8	(57%)	3	(21%)	-	-	1	(7%)	-	-	-	-	14
		25 to 36	-	-	8	(89%)	-	-	-	-	-	-	1	(11%)	-	-	9
		37+	1	(17%)	3	(50%)	1	(17%)	-	-	-	-	1	(17%)	-	-	6
		Total	15	(21%)	38	(53%)	13	(18%)	1	(1%)	3	(4%)	2	(3%)	-	-	72
	Waitlist Recipients	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		1 to 12	1	(50%)	1	(50%)	-	-	-	-	-	-	-	-	-	-	2
		13 to 24	-	-	1	(100%)	-	-	-	-	-	-	-	-	-	-	1
		25 to 36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		37+	1	(50%)	1	(50%)	-	-	-	-	-	-	-	-	-	-	2
		Unknown	1	(33%)	1	(33%)	-	-	-	-	-	-	-	-	1	(33%)	3
		Total	3	(38%)	4	(50%)	-	-	-	-	-	-	-	-	1	(13%)	8
All Years	Registered Recipients	0	24	(19%)	68	(54%)	17	(13%)	4	(3%)	6	(5%)	7	(6%)	-	-	126
		1 to 12	20	(27%)	35	(47%)	13	(17%)	3	(4%)	2	(3%)	2	(3%)	-	-	75
		13 to 24	13	(17%)	40	(51%)	18	(23%)	3	(4%)	3	(4%)	1	(1%)	-	-	78
		25 to 36	11	(21%)	22	(42%)	12	(23%)	-	-	3	(6%)	4	(8%)	-	-	52
		37+	19	(22%)	34	(40%)	13	(15%)	6	(7%)	3	(3%)	11	(13%)	-	-	86
		Total	87	(21%)	199	(48%)	73	(18%)	16	(4%)	17	(4%)	25	(6%)	-	-	417
	Waitlist Recipients	0	2	(67%)	1	(33%)	-	-	-	-	-	-	-	-	-	-	3
		1 to 12	2	(33%)	4	(67%)	-	-	-	-	-	-	-	-	-	-	6
		13 to 24	10	(67%)	4	(27%)	-	-	-	-	-	-	1	(7%)	-	-	15
		25 to 36	5	(71%)	1	(14%)	-	-	-	-	-	-	1	(14%)	-	-	7
		37+	26	(62%)	12	(29%)	1	(2%)	1	(2%)	1	(2%)	1	(2%)	-	-	42
		Unknown	3	(20%)	6	(40%)	1	(7%)	-	-	-	-	-	-	5	(33%)	15
		Total	48	(55%)	28	(32%)	2	(2%)	1	(1%)	1	(1%)	3	(3%)	5	(6%)	88
Total			**135**	**(27%)**	**227**	**(45%)**	**75**	**(15%)**	**17**	**(3%)**	**18**	**(4%)**	**28**	**(6%)**	**5**	**(1%)**	**505**

7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

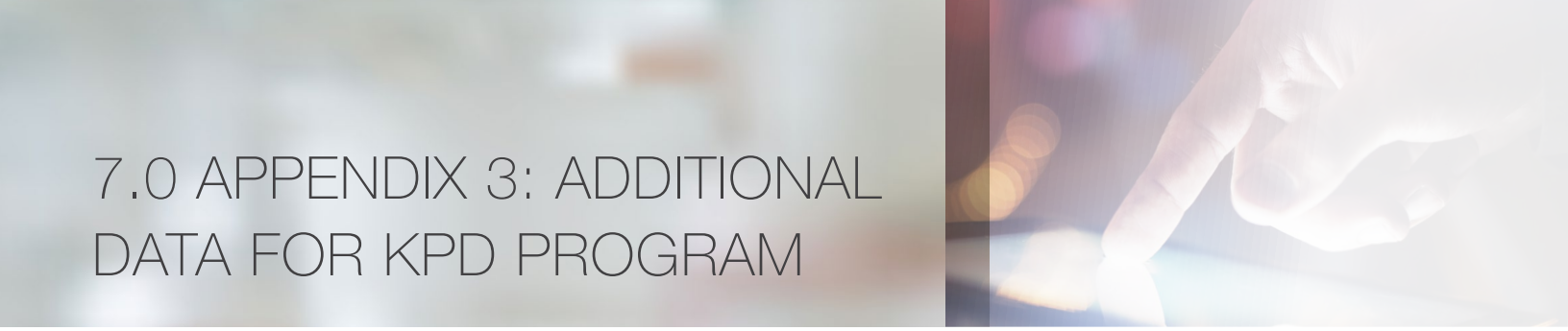
Table A3.6a: KPD Registered Pairs and New Candidates by cPRA and Match Cycle, 2009-2016

Year	cPRA	0%		1%-79%		80%-94%		95%-96%		97%-98%		99%-100%		Total (100%)
	MC	n	%	n	%	n	%	n	%	n	%	n	%	
2009	1	5	(22%)	8	(35%)	5	(22%)	-	-	2	(9%)	3	(13%)	23
	2	6	(24%)	9	(36%)	4	(16%)	-	-	2	(8%)	4	(16%)	25
	3	11	(33%)	11	(33%)	5	(15%)	-	-	1	(3%)	5	(15%)	33
	4	8	(22%)	13	(36%)	5	(14%)	1	(3%)	1	(3%)	8	(22%)	36
2010	5	10	(22%)	12	(27%)	5	(11%)	4	(9%)	2	(4%)	12	(27%)	45
	6	9	(14%)	15	(24%)	13	(21%)	2	(3%)	2	(3%)	22	(35%)	63
	7	8	(10%)	20	(24%)	10	(12%)	4	(5%)	7	(8%)	34	(41%)	83
	8	11	(11%)	24	(24%)	11	(11%)	5	(5%)	9	(9%)	40	(40%)	100
2011	9	14	(12%)	28	(24%)	10	(8%)	6	(5%)	13	(11%)	47	(40%)	118
	10	9	(8%)	28	(25%)	11	(10%)	6	(5%)	10	(9%)	46	(42%)	110
	11	13	(10%)	29	(23%)	9	(7%)	7	(6%)	10	(8%)	57	(46%)	125
2012	12	16	(12%)	31	(24%)	9	(7%)	5	(4%)	9	(7%)	60	(46%)	130
	13	14	(10%)	32	(23%)	15	(11%)	4	(3%)	9	(6%)	67	(48%)	141
	14	18	(12%)	33	(23%)	13	(9%)	4	(3%)	10	(7%)	67	(46%)	145
2013	15	17	(11%)	34	(22%)	15	(10%)	2	(1%)	10	(6%)	78	(50%)	156
	16	17	(11%)	27	(18%)	14	(9%)	4	(3%)	9	(6%)	77	(52%)	148
	17	20	(13%)	36	(23%)	8	(5%)	3	(2%)	9	(6%)	78	(51%)	154
2014	18	16	(11%)	34	(23%)	6	(4%)	2	(1%)	6	(4%)	84	(57%)	148
	19	21	(12%)	38	(22%)	12	(7%)	3	(2%)	10	(6%)	88	(51%)	172
	20	17	(9%)	38	(21%)	17	(9%)	2	(1%)	12	(6%)	99	(54%)	185
2015	21	24	(13%)	45	(24%)	13	(7%)	3	(2%)	11	(6%)	91	(49%)	187
	22	28	(15%)	44	(23%)	16	(8%)	3	(2%)	10	(5%)	91	(47%)	192
	23	22	(13%)	31	(18%)	19	(11%)	1	(1%)	9	(5%)	91	(53%)	173
2016	24	18	(11%)	37	(23%)	14	(9%)	1	(1%)	6	(4%)	82	(52%)	158
	25	19	(13%)	38	(25%)	9	(6%)	3	(2%)	8	(5%)	73	(49%)	150
	26	14	(9%)	43	(27%)	15	(10%)	1	(1%)	8	(5%)	76	(48%)	157
Registered Pairs		**158**	**(17%)**	**333**	**(36%)**	**108**	**(12%)**	**31**	**(3%)**	**60**	**(6%)**	**239**	**(26%)**	**929**

7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

Table A3.6b: KPD Registered Pairs and New Candidates by cPRA and Match Cycle, 2009-2016

Year	cPRA	0%		1%-79%		80%-94%		95%-96%		97%-98%		99%-100%		Total (100%)
	MC	n	%	n	%	n	%	n	%	n	%	n	%	
2009	1	5	(22%)	8	(35%)	5	(22%)	-	-	2	(9%)	3	(13%)	23
	2	1	(33%)	1	(33%)	-	-	-	-	-	-	1	(33%)	3
	3	6	(43%)	5	(36%)	2	(14%)	-	-	-	-	1	(7%)	14
	4	3	(18%)	9	(53%)	-	-	1	(6%)	-	-	4	(24%)	17
2010	5	3	(16%)	4	(21%)	2	(11%)	3	(16%)	1	(5%)	6	(32%)	19
	6	1	(4%)	9	(35%)	7	(27%)	-	-	-	-	9	(35%)	26
	7	4	(13%)	7	(23%)	1	(3%)	2	(6%)	5	(16%)	12	(39%)	31
	8	8	(18%)	13	(29%)	6	(13%)	2	(4%)	4	(9%)	12	(27%)	45
2011	9	6	(19%)	9	(28%)	1	(3%)	1	(3%)	5	(16%)	10	(31%)	32
	10	1	(4%)	8	(30%)	7	(26%)	3	(11%)	2	(7%)	6	(22%)	27
	11	5	(16%)	9	(29%)	1	(3%)	3	(10%)	3	(10%)	10	(32%)	31
2012	12	6	(19%)	13	(41%)	4	(13%)	1	(3%)	2	(6%)	6	(19%)	32
	13	5	(13%)	11	(28%)	5	(13%)	1	(3%)	3	(8%)	14	(36%)	39
	14	8	(28%)	12	(41%)	3	(10%)	-	-	2	(7%)	4	(14%)	29
2013	15	6	(13%)	18	(38%)	7	(15%)	1	(2%)	4	(9%)	11	(23%)	47
	16	6	(32%)	5	(26%)	1	(5%)	2	(11%)	-	-	5	(26%)	19
	17	12	(23%)	21	(40%)	3	(6%)	-	-	3	(6%)	13	(25%)	52
2014	18	6	(17%)	14	(39%)	2	(6%)	-	-	1	(3%)	13	(36%)	36
	19	10	(21%)	21	(44%)	6	(13%)	1	(2%)	4	(8%)	6	(13%)	48
	20	4	(9%)	19	(41%)	9	(20%)	1	(2%)	3	(7%)	10	(22%)	46
2015	21	11	(27%)	17	(41%)	3	(7%)	2	(5%)	2	(5%)	6	(15%)	41
	22	14	(27%)	21	(41%)	5	(10%)	1	(2%)	2	(4%)	8	(16%)	51
	23	4	(12%)	11	(33%)	6	(18%)	1	(3%)	2	(6%)	9	(27%)	33
2016	24	6	(24%)	13	(52%)	4	(16%)	-	-	-	-	2	(8%)	25
	25	8	(20%)	20	(50%)	2	(5%)	3	(8%)	3	(8%)	4	(10%)	40
	26	5	(12%)	20	(48%)	7	(17%)	-	-	1	(2%)	9	(21%)	42
All Candidates		154	(18%)	318	(38%)	99	(12%)	29	(3%)	54	(6%)	194	(23%)	848



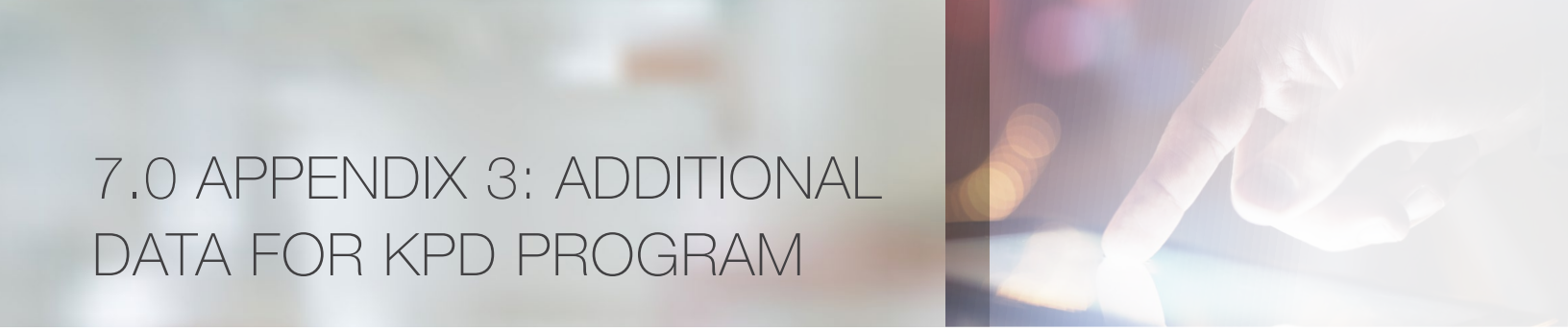
7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

7.3 MATCH CYCLE STATISTICS

Donor Outcomes

Table A3.7: Donors by Level of Participation and Number of Match Cycles in which Donor Participated, 2009-2016

Number of Match Cycles in which Donor was Active	Donors who were Active at the end of Match Cycle 26 (count)		Donors who were Inactive at the end of Match Cycle 26 (count)		
	Never Included in Any Proposed Chain	Never Included in Any Proposed Chain	Never Included in Any Proposed Chain	Included in a Proposed Chain One or More Times	
				No Donation in KPD	Donated in KPD
1	46	-	75	47	315
2	14	-	48	22	99
3	16	1	43	8	27
4	2	-	46	8	19
5	10	-	22	4	19
6	9	4	25	6	6
7	1	-	16	4	14
8	10	2	17	2	3
9	4	1	2	4	1
10	3	-	4	2	1
11	5	-	5	2	-
12	2	-	7	-	-
13	1	-	3	1	-
14	1	-	3	-	-
15 or more	11	2	4	1	1



7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

Chain Length and Time to Completion

Table A3.8: Days from Enrolment and Date of Proposal to Date of Surgery for NDADs versus Registered Donors, 2009-2016

Donor Type	Time Interval	Mean	Median	Interquartile Range	Total Range
Non-Directed Anonymous Donors	Final Chain Proposal to Transplant[b]	115	111	91-140	18-229
	Enrolment to Transplant[a]	166	132	989-173	41-684
Donors in Registered Pairs	Final Chain Proposal to Transplant[b]	120	118	92-145	29-307
	Enrolment to Transplant[a]	261	164	120-327	47-1980
All Donors	Final Chain Proposal to Transplant[b]	119	117	92-145	18-307
	Enrolment to Transplant[a]	244	157	113-278	41-1980
	Enrolment to End of Match Cycle 26[c]	614	249	0-980	0-2934

Time is measured (a) from the start date of the donor's first active Match Cycle to their donation date; (b) from the proposal date of the chain in which the donation is made to the donation date; and (c) from the start date of the donor's first active Match Cycle to the start of Match Cycle 27 for donors who remain active.

7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

Travel

Table A3.9a: Counts of All Travelers in Transplanted Matched Pairs by Province, 2009-2016

Province of Transplant Centre			Province of Surgical Centre							All Donors Travelling	Donor/ Recipient Out: Interprovincial
			BC	AB	SK	MB	ON	QC	Atl.		
Donors Travelling Interprovincially or Intraprovincially*	BC	All	-	10	1	2	31	9	3	56	56
		Paired	-	8	1	2	27	9	3	50	50
		NDAD	-	2	-	-	4	-	-	6	6
	AB	All	10	3	2	5	13	4	3	40	37
		Paired	8	3	1	5	11	4	3	35	32
		NDAD	2	-	1	-	2	-	-	5	5
	SK	All	2	2	-	2	6	1	1	14	14
		Paired	-	2	-	2	4	1	-	9	9
		NDAD	2	-	-	-	2	-	1	5	5
	MB	All	5	1	1	-	7	1	2	17	17
		Paired	4	1	1	-	4	1	1	12	12
		NDAD	1	-	-	-	3	-	1	5	5
	ON	All	33	18	2	5	22	16	5	101	79
		Paired	30	15	2	4	18	14	4	87	69
		NDAD	3	3	-	1	4	2	1	14	10
	QC	All	9	5	1	1	14	2	2	34	32
		Paired	7	5	-	1	12	1	2	28	27
		NDAD	2	-	1	-	2	1	-	6	5
	Atl.	All	2	3	-	1	8	-	-	14	14
		Paired	2	2	-	1	7	-	-	12	12
		NDAD	-	1	-	-	1	-	-	2	2
	All Donors Travelling	All	61	42	7	16	101	33	16	276	
		Paired	51	36	5	15	83	30	13	233	
		NDAD	10	6	2	1	18	3	3	43	
	Donor In: Interprovincial	All Donors	61	39	7	16	79	31	16		249
		Paired	51	33	5	15	65	29	13		211
			10	6	2	1	14	2	3		38

7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

Table A3.9a: Counts of All Travelers in Transplanted Matched Pairs by Province, 2009-2016

Province of Transplant Centre			Province of Surgical Centre							All Donors Travelling	Donor/ Recipient Out: Interprovincial
			BC	AB	SK	MB	ON	QC	Atl.		
Recipients Travelling Interprovincially or IntraProvincially*	BC	All	-	-	-	-	2	-	1	3	3
		Paired	-	-	-	-	2	-	1	3	3
	AB	All	1	-	-	1	-	-	-	2	2
		Paired	1	-	-	1	-	-	-	2	2
	SK	All	1	-	-	1	4	1	-	7	7
		Paired	1	-	-	-	4	-	-	5	5
		WL	-	-	-	1	-	1	-	2	2
	MB	All	-	-	-	-	2	1	-	3	3
		Paired	-	-	-	-	2	1	-	3	3
	ON	All	1	1	-	-	3	-	1	6	3
		Paired	1	1	-	-	2	-	1	5	3
		WL	-	-	-	-	1	-	-	1	0
	QC	All	-	-	-	-	-	5	-	5	0
		Paired	-	-	-	-	-	4	-	4	0
		WL	-	-	-	-	-	1	-	1	0
	Atl.	All	-	-	-	-	1	-	-	1	1
		Paired	-	-	-	-	1	-	-	1	1
	All Recipients Travelling	All	3	1	0	2	12	7	2	27	
		Paired	3	1	0	1	11	5	2	23	
		WL	0	0	0	1	1	2	0	4	
	Recipient In: Interprovincial	All	3	1	0	2	9	2	2		19
		Paired	3	1	0	1	9	1	2		17
		WL	0	0	0	1	0	1	0		2

*Intraprovincial travel is shown where transplant centre and surgical centre are in the same province (highlighted).

7.0 APPENDIX 3: ADDITIONAL DATA FOR KPD PROGRAM

Outcomes

Table A3.10: Outcome Results for KPD Recipients Reaching One Month and One Year Post-Transplant

			Patient Survival	Known Cases (Patient Survival)	Graft survival	Known Cases (Patient Survival)	Patients experiencing rejection episodes*	Known Cases (Rejection)	Serum Creatinine (sCr) Level†					
									< 100	100-149	150-174	175-199	>199	Known cases
Transplant	Registered Recipients	#	374	375	371	375	26	359	156	160	31	9	12	356
		%	99.7%		98.9%		7.2%		44%	45%	9%	3%	3%	100%
	WL Recipients	#	84	84	84	84	7	84	24	44	9	5	2	82
		%	100%		100%		9.1%		29%	54%	11%	6%	2%	100%
	All Recipients	#	458	459	455	459	33	443	180	204	40	14	14	438
		%	99.8%		99.1%		7.4%		41%	47%	9%	3%	3%	100%
Transplant	Registered Recipients	#	304	306	300	307	45	297	136	129	20	7	9	292
		%	99.3%		97.7%		15.2%		47%	44%	7%	2%	3%	100%
	WL Recipients	#	67	67	67	67	10	68	16	40	7	2	2	65
		%	100%		100%		14.7%		25%	62%	11%	3%	3%	100%
	All Recipients	#	371	373	367	374	55	366	152	169	27	9	11	357
		%	99.5%		98.1%		15.0%		43%	47%	8%	3%	3%	100%

"Known cases" refers to the number of transplants for which outcome data is available.

†At the one-month point, recorded creatinine levels ranged from 18 to 683, with a mean of 115 µmol/L and a median of 109 µmol/L. At the one-year point, recorded creatinine levels ranged from 22 (pediatric) to 580, with a mean of 113 µmol/L and a median of 108 µmol/L.

*Results include borderline rejections. Deceased patients are excluded from total known cases at the one-year point. One-year rejection episode results include rejection episodes occurring within the first month after receiving the transplant.

8.0 APPENDIX 4: HSP MATCHING ALGORITHM

There are 4 tiers of matching and ranking that the HSP algorithm performs to develop a final listing of potential HSP recipients who are compatible with an available deceased donor organ.

Step One: Matching is first done on blood group, using the same compatibility rules as any patient requiring a blood transfusion.

Step Two: The second step checks HLA compatibility for patients identified as blood group compatible. Recipient's "unacceptable HLA antigens" are compared to a donor's HLA antigens to identify recipients that are unlikely to have a positive crossmatch to the donor ("virtual crossmatch"). In this step, potential donor-recipient matches are excluded when the donor has HLA antigens that have been listed in the recipient's record as being incompatible.

Step Three: Further screening of donors based on individual attributes of the patient or the clinical direction of a local program occurs at this step. This involves filters based on donor age, donor infectious disease status, and whether or not the proposed donor was declared dead using donation after cardio-circulatory death (DCD).

Step Four: At this point, it is quite common for a donor to have only one or sometimes no matches. However, for cases with two or more potential candidates that are blood group, HLA, and patient-filter matches, the HSP algorithm uses agreed upon policies to rank order the remaining matches based on key medically and logistically relevant factors. See Section 3.1 for a summary of recent policy changes impacting these criteria.

Table A4.3: Step Three: Patient and Transplant Program-Specific Filters

Matching/Ranking Attribute	Rank
Medical urgency (requires prior approval of KTAC sub-committee)	1
Recipient cPRA is 100%	2
Recipient cPRA is 99%	3
Paediatric recipient (≤19 years of age)	4
Recipient is a prior living donor	5
HLA match: The HLA trying for the donor and recipient indicates a zero out of six (0/6) mismatch for ABDR antigens	6
Kidney-pancreas patients	7
The donor and recipients are in the same province	8
The donor and recipient are in the same region: • West region: BC,AB,SK, MB • East region: ON, QC,ATL	9
Time on Dialysis (number of days starting at the most recent initiation of dialysis)	10

Table A4.1: Step One: Blood group Matching

Blood Group (ABO) Compatibility	
If donor blood group is:	Then recipient blood group can be:
O	O,A,B,AB
A	A, AB
B	B, AB
AB	AB

Table A4.2: Step Three: Patient and Transplant Program-Specific Filters

Filter Attribute
Accept a donor to specified maximum age (<45, <55, <65, no restrictions)
Accept a donor above a specified minimum age (>10, <11, >12, >13, >14, >15, >16, >17, >18, no restriction)
Accept a donor who has tested positive for Hepatitis B core antibody
Accept a donor who has tested positive for Hepatitis C
Accept a DCD (donation after cardio-circulatory death) donor

All four of the tiers are examined annually by clinical experts advising Canadian Blood Services on the operations and policies of the HSP program. As policy changes are proposed and endorsed by the national community (including physicians, donation professionals, laboratory professionals, and administrators), these matching and ranking rules used by the Canadian Transplant Registry are updated accordingly.

9.0 APPENDIX 5: ADDITIONAL DATA FOR HSP PROGRAM

Table A5.1: Transplanted Recipients by cPRA, Age, and Sex

		Male							Female							All Recipients
	cPRA (%)	95	96	97	98	99	100	All	95	96	97	98	99	100	All	
Age Group	<19		1					1	2				1		3	4
	19-29	1		1	3		6	11		1	3	5		2	11	22
	30-39		3	1	3	5	5	17	1			2	1	5	9	26
	40-49	3	1	1	7	9	8	29	4	5	7	3	11	6	36	65
	50-59	5	2	2	4	8	8	30	4	2	13	7	13	10	49	79
	60-69	3	4	4	6	4	7	28	7	3	3	16	16	7	52	80
	70+	2			1	1	2	6	3	1	3		2	3	12	18
	All Ages	14	11	9	24	27	36	121	21	12	29	33	44	33	172	293
	% of cPRA	40%	48%	24%	42%	38%	52%	41%	60%	52%	76%	58%	62%	48%	59%	

Table A5.2: Transplanted Recipients by cPRA, Age, and Sex

		DCD					NDD					
	Blood Group	A	AB	B	O	DCD	A	AB	B	O	NDD	All
Age Group	<19	7		5	7	19	42	4	11	39	96	115
	19-29	17	3	6	19	45	69	10	23	96	198	243
	30-39	21	4	2	28	55	50	8	26	65	149	204
	40-49	41	3	16	48	108	82	11	18	91	202	310
	50-59	91	11	17	88	207	126	13	46	130	315	522
	60-69	51	1	16	75	143	106	13	27	119	265	408
	70+	10		5	7	22	64	6	16	53	139	161
	All Ages	238	22	67	272	599	539	65	167	593	1364	1963
	Mean age	50	45	49	51	50	48	47	47	47	47	48

Note: The results presented here include donors registered in CTR for whom an HSP allocation was run. The type of donor was unknown in 17 cases out of the 1980 total donors for whom an allocation was run; these cases are excluded from the table to the left.

Table A5.3: HSP Candidate Participation by Blood Group

Patient Status	Blood Group				Total
	A	AB	B	O	
Active	143	20	64(2)	264(2)	491(4)
Transplanted	127	21	49(2)	92(2)	289(4)
Offlist	58	5	28	100	191
On Hold	47	9	20	75	148
Total	**375**	**55**	**163**	**530**	**1123**

9.0 APPENDIX 5: ADDITIONAL DATA FOR HSP PROGRAM

Table A5.4: Active HSP Candidates over Time: Counts at Month End by cPRA

		cPRA					
		95%	96%	97%	98%	99%	100%
2013	Oct	4	2	6	7	13	54
	Nov	2	2	5	7	16	56
	Dec	2	2	5	7	17	59
2014	Jan	1	2	6	7	22	81
	Feb	1	3	6	11	21	80
	Mar	2	2	6	11	19	84
	Apr	3	4	6	15	18	97
	May	13	9	14	31	48	245
	Jun	9	9	13	32	50	250
	Jul	6	10	11	32	48	263
	Aug	2	10	13	34	50	266
	Sep	4	7	12	31	49	280
	Oct	5	8	13	35	64	374
	Nov	8	7	10	28	62	386
	Dec	6	5	10	28	56	371
2015	Jan	10	7	9	27	66	386
	Feb	10	6	8	22	67	387
	Mar	9	5	12	25	66	375
	Apr	7	4	9	22	60	359
	May	5	4	7	17	63	364
	Jun	5	3	8	19	65	368
	Jul	3	4	7	20	65	401
	Aug	4	4	8	19	61	392
	Sep	5	4	7	18	63	414
	Oct	3	4	6	19	60	413
	Nov	2	5	5	19	65	427
	Dec	4	4	3	18	62	419

		cPRA					
		95%	96%	97%	98%	99%	100%
2016	Jan	4	4	3	21	60	414
	Feb	6	3	2	20	62	415
	Mar	5	3	4	17	59	415
	Apr	4	3	2	19	58	408
	May	4	3	5	15	55	414
	Jun	4	4	4	17	50	419
	Jul	4	5	3	14	49	426
	Aug	4	4	7	14	51	436
	Sep	2	4	5	16	53	419
	Oct	1	5	4	12	53	407
	Nov	1	3	4	12	52	412
	Dec	5	3	9	13	49	416

9.0 APPENDIX 5: ADDITIONAL DATA FOR HSP PROGRAM

Table A5.4: Active HSP Candidates over Time: Counts at Month End by cPRA

		Donors ws consentedith kidney	Donors for whom allocation was run	Donors with at least one match	Donors with at least one offer	Donors with at least one HSP donation
2013	Nov	6	5	5	4	
	Dec	2	2	2	2	
2014	Jan	9	7	4	2	
	Feb	11	9	5	3	
	Mar	3	2	2	1	1
	Apr	9	8	4	3	2
	May	10	8	5	2	1
	Jun	40	34	24	17	9
	Jul	47	41	28	20	7
	Aug	48	42	22	13	6
	Sep	42	36	22	14	7
	Oct	51	46	21	11	8
	Nov	83	61	54	29	15
	Dec	69	53	38	15	7
2015	Jan	54	48	29	17	10
	Feb	52	48	24	17	10
	Mar	74	69	39	30	13
	Apr	67	62	39	30	15
	May	59	54	24	17	9
	Jun	78	72	32	23	7
	Jul	66	60	32	19	9
	Aug	65	59	31	18	10
	Sep	71	65	29	15	6
	Oct	65	58	27	19	9
	Nov	73	68	30	22	10
	Dec	81	75	35	27	11
2016	Jan	99	90	41	23	6
	Feb	73	68	27	21	5
	Mar	88	81	38	22	10
	Apr	83	74	42	27	10
	May	82	77	43	32	14
	Jun	78	67	42	25	10
	Jul	88	76	40	21	8
	Aug	86	76	43	25	9
	Sep	75	67	35	22	9
	Oct	79	72	26	16	10
	Nov	69	64	30	19	10
	Dec	85	76	34	18	9
Total		2220	1980	808	661	292

10.0 APPENDIX 6: ADDITIONAL INFORMATION FOR NOW SUMMARY

Status Criteria: Heart
Adult Cardiac Transplantation (Canadian Cardiac Transplant Network 2012)

Status 4

1) Mechanically ventilated patient on high-dose single or multiple inotropes ± mechanical support (eg. Intra-aortic balloon pump, extra-corporeal membrane oxygenation (ECMO), abiomed BVS5000, or biomedicus), excluding long-term ventricular assist devices (VAD).
2) Patient with VAD malfunction or complication, such as thromboembolism, systemic device-related infection, mechanical failure, or life-threatening arrhythmia.
3) Patient should be recertified every 7 days as a Status 4 by a qualified physician, if still medically appropriate.

Status 4S

1) High PRA (>80%)

Status 3.5

1) High-dose or multiple inotropes in hospital, and patients not candidates for VAD therapy or no VAD available.
2) Acute refractory ventricular arrhythmias.

Status 3

1) VAD not meeting Status 4 criteria.
2) Patients on inotropes in hospital, not meeting above criteria.
3) Heart/Lung recipient candidates.
4) Cyanotic congenital heart disease with resting saturation <65%.
5) Congenital heart disease – arterial-shunt-dependent.
6) Adult-sized complex congenital heart disease with increasing dys-rhythmic or systemic ventricular decline.

Status 2

1) In-hospital patient, or patient on outpatient inotropic therapy not meeting the above criteria.
2) Adult with cyanotic CHD: resting 02 saturation 65–75% or prolonged desaturation to less than 60% with modest activity (i.e., walking).
3) Adult with Fontan palliation with protein-losing enteropathy.
4) Patients listed for multiple organ transplantation (other than heart-lung).

Status 1. All other out-of-hospital patients.

Status Criteria: Liver

2008 Listing and Allocation Practices for Liver Transplantation in Canada
(Canadian Council for Donation and Transplantation Working Document)

Status 4F

Patient in an ICU and intubated due to FHF (includes primary graft non-function).

Status 3F

Patient in an ICU or equivalent care facility due to FHF, but not requiring intubation, and fulfills the King's College criteria for high mortality without transplantation.

Status Criteria: Lung

A Review of Listing and Allocation Criteria for Lung Transplantation – 2008
(Canadian Council for Donation and Transplantation Working Document)

Status 0 - accepted for transplant; not actively listed
Status 1 - actively listed and clinically stable
Status 2 - actively listed and clinically deteriorating