

A thick blue wavy line that spans across the top of the slide, starting from the left edge and ending at the right edge, with a slight dip in the middle.

Paired Donor Kidney Transplantation in the UK

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Overview

- Introduction –NHSBT, Organ Donation and Transplantation
- Kidney transplantation
- Paired donation
- Matching algorithm
- Activity
- Further developments
- Future challenges

Introduction



NHSBT – Organ Donation and Transplantation

- NHS Blood and Transplant (NHSBT) is a Special Health Authority, dedicated to saving and improving lives through the wide range of services we provide to the National Health Service
- We match, allocate, audit and analyse organ donations across the whole of the UK
- Each year our donors give around two million donations of blood and 3,500 organs – saving and transforming countless lives



Kidney Transplantation



Why do people need a kidney transplant?

- Chronic kidney disease affects 1 in 10¹ in the population (less common in young adults)
- For those patients where the disease progresses to kidney failure, dialysis or a transplant may be needed
- Around 7000² people start dialysis in the UK each year
- Transplantation is often seen as the best form of treatment for a patient with kidney failure

¹ Source: National Kidney Federation

² Source: UK Renal Registry

Kidney Transplantation

- There are currently over 5000 patients in need of a kidney transplant in the UK
- Around 3000 patients join the waiting list for a kidney each year
- Average waiting time for a transplant is over 3 years for a deceased donor kidney
- Currently expect over 2000 deceased donor kidney transplants each year

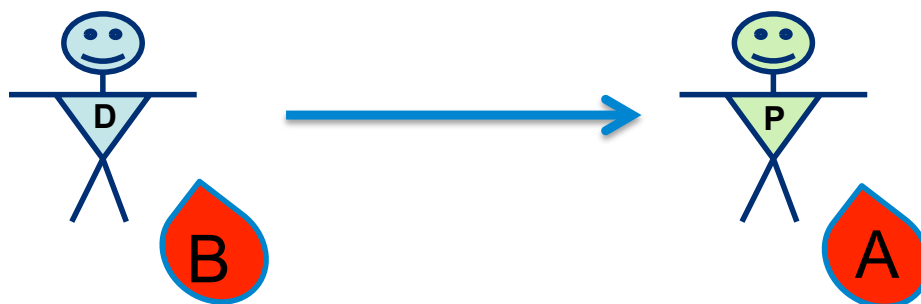


Living Donor Kidney Transplantation

- If a patient has a living kidney donor (relative, partner or friend) then this eliminates waiting time on the list
- Around 1000 living donor kidney transplants in the UK every year
- However, due to the patient being medically incompatible with the donor a transplant may not be able to go ahead

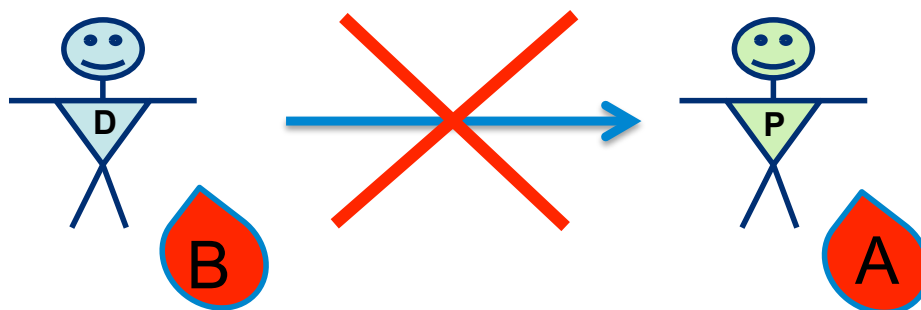
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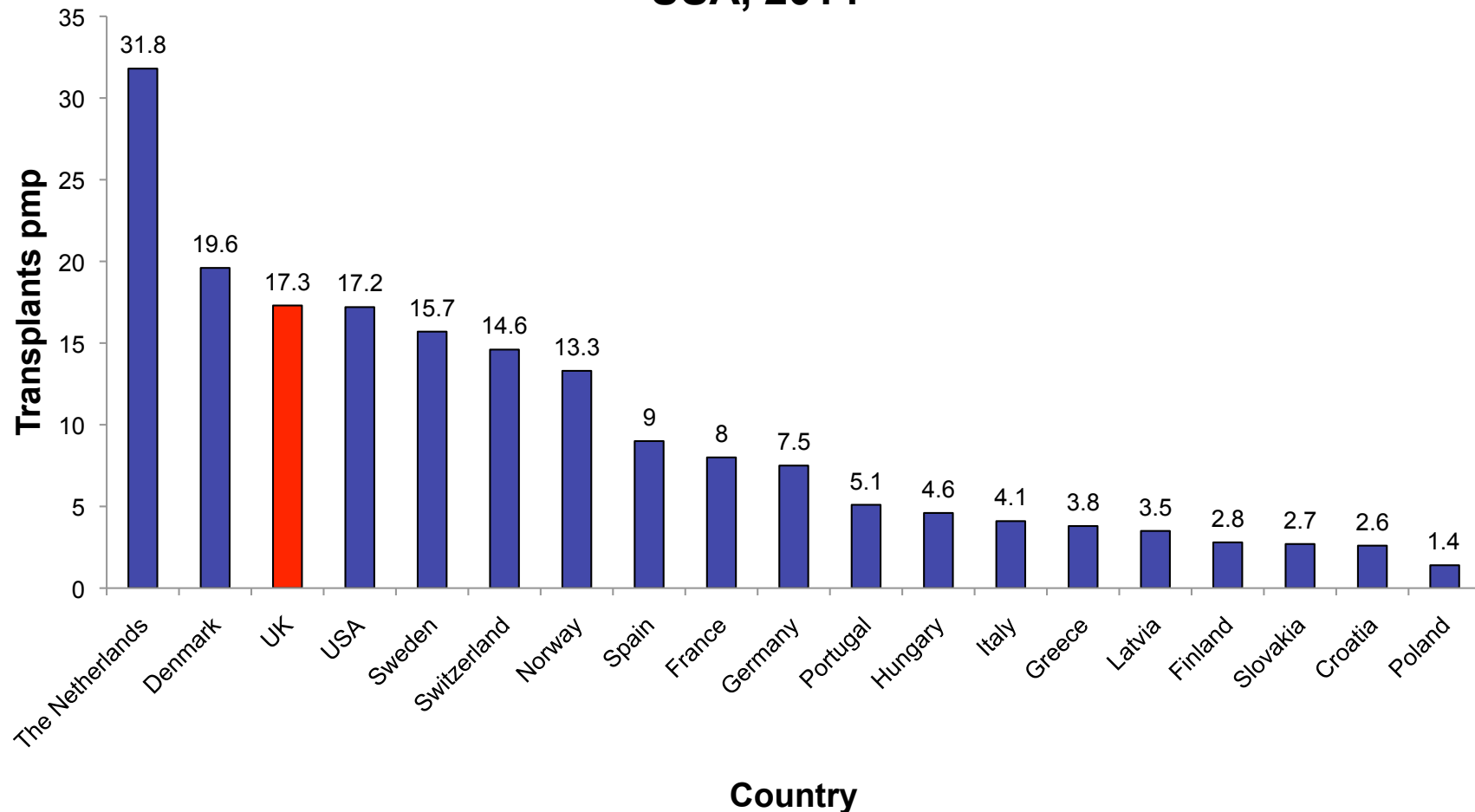
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Living Donor Kidney Transplant Rates

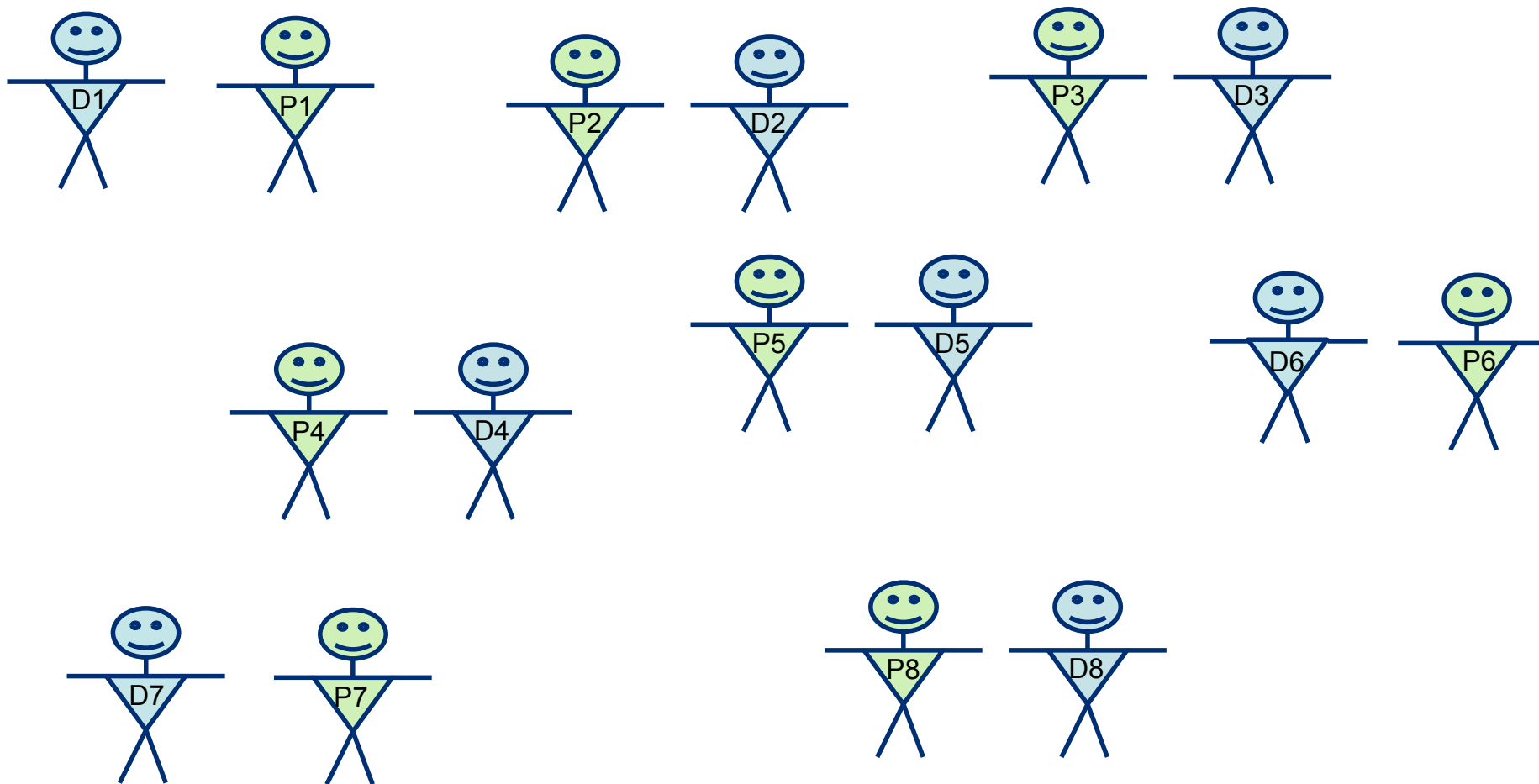
Living donor kidney transplant rates for Europe and the USA, 2014



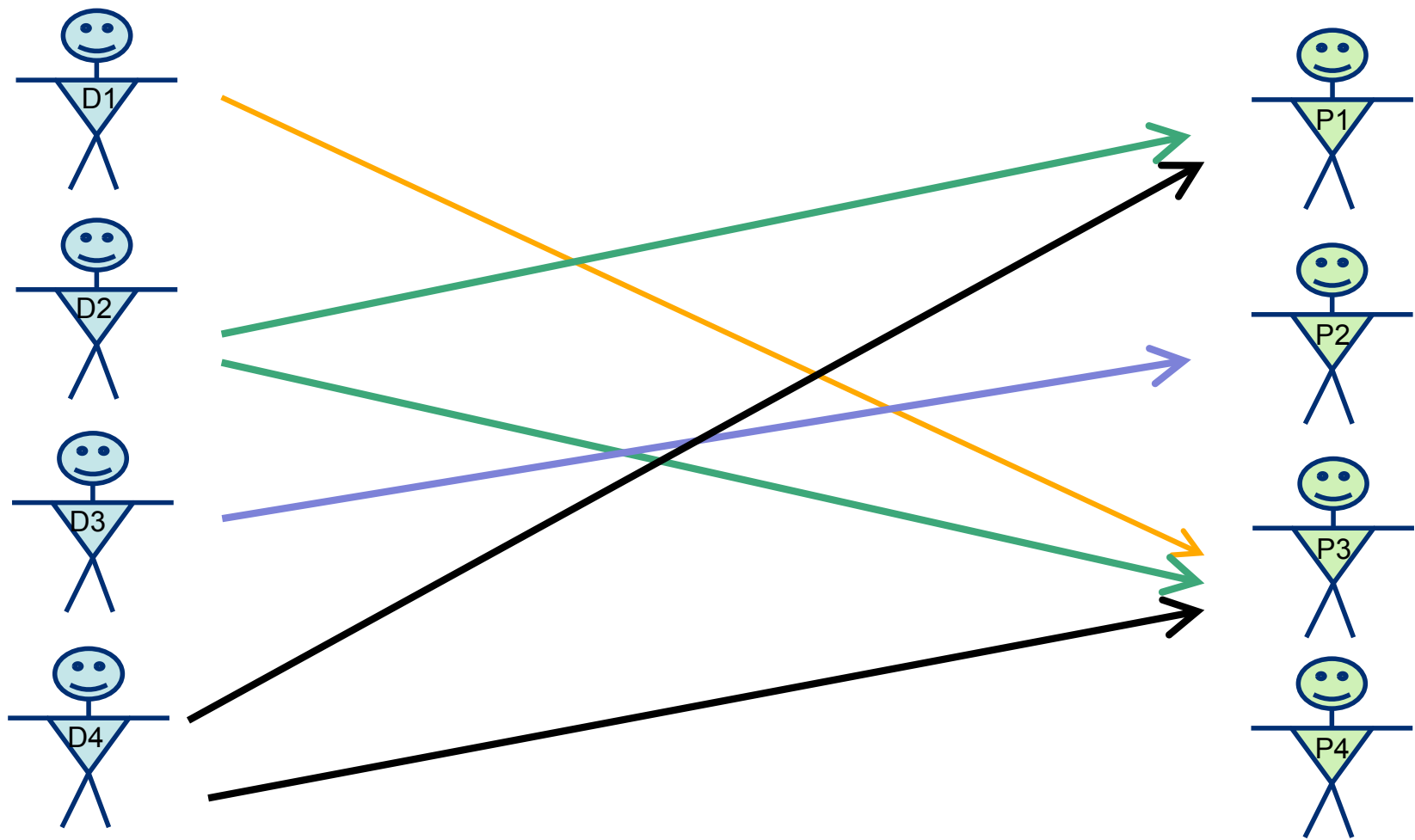
Paired Donation



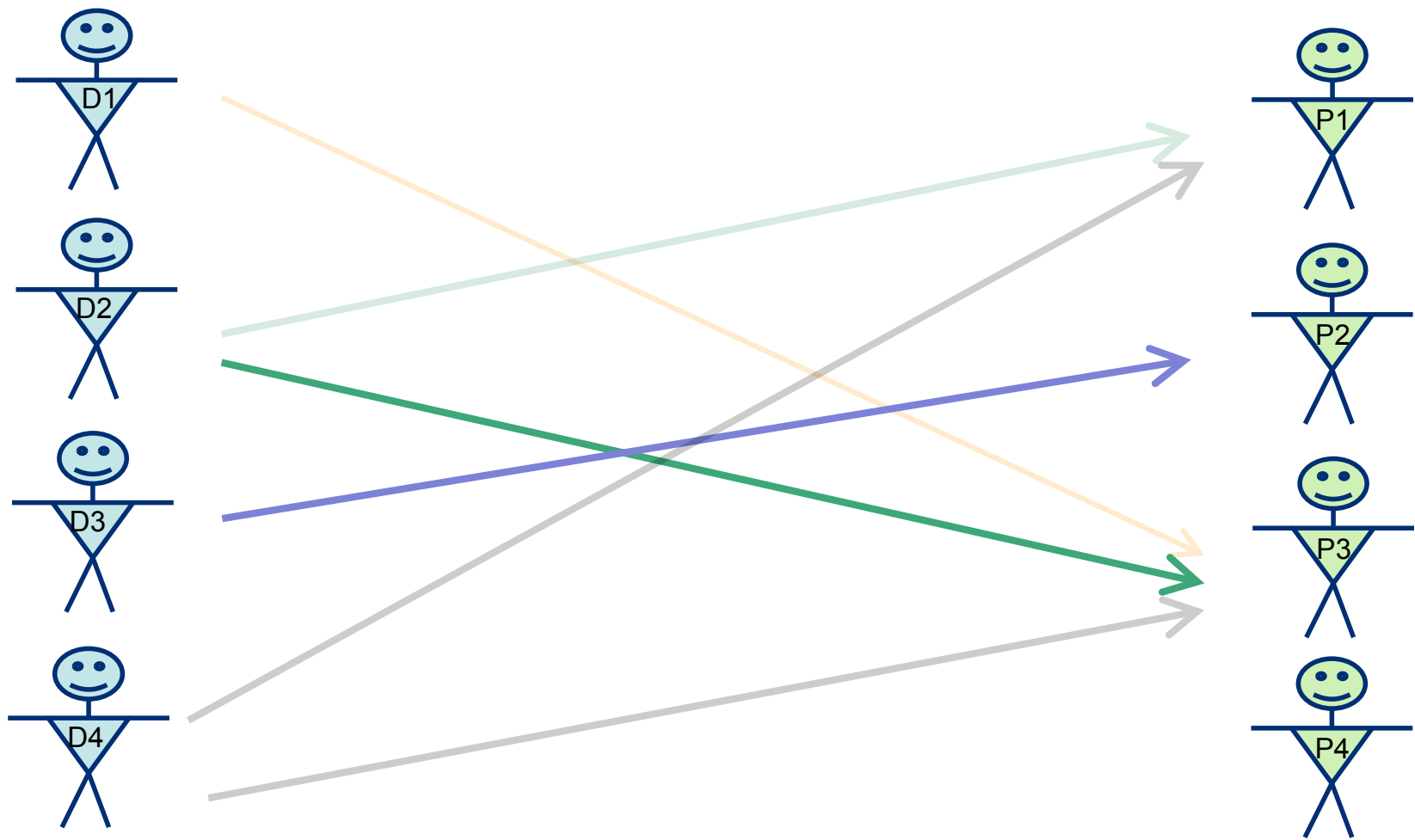
Pairs registered for Matching Run



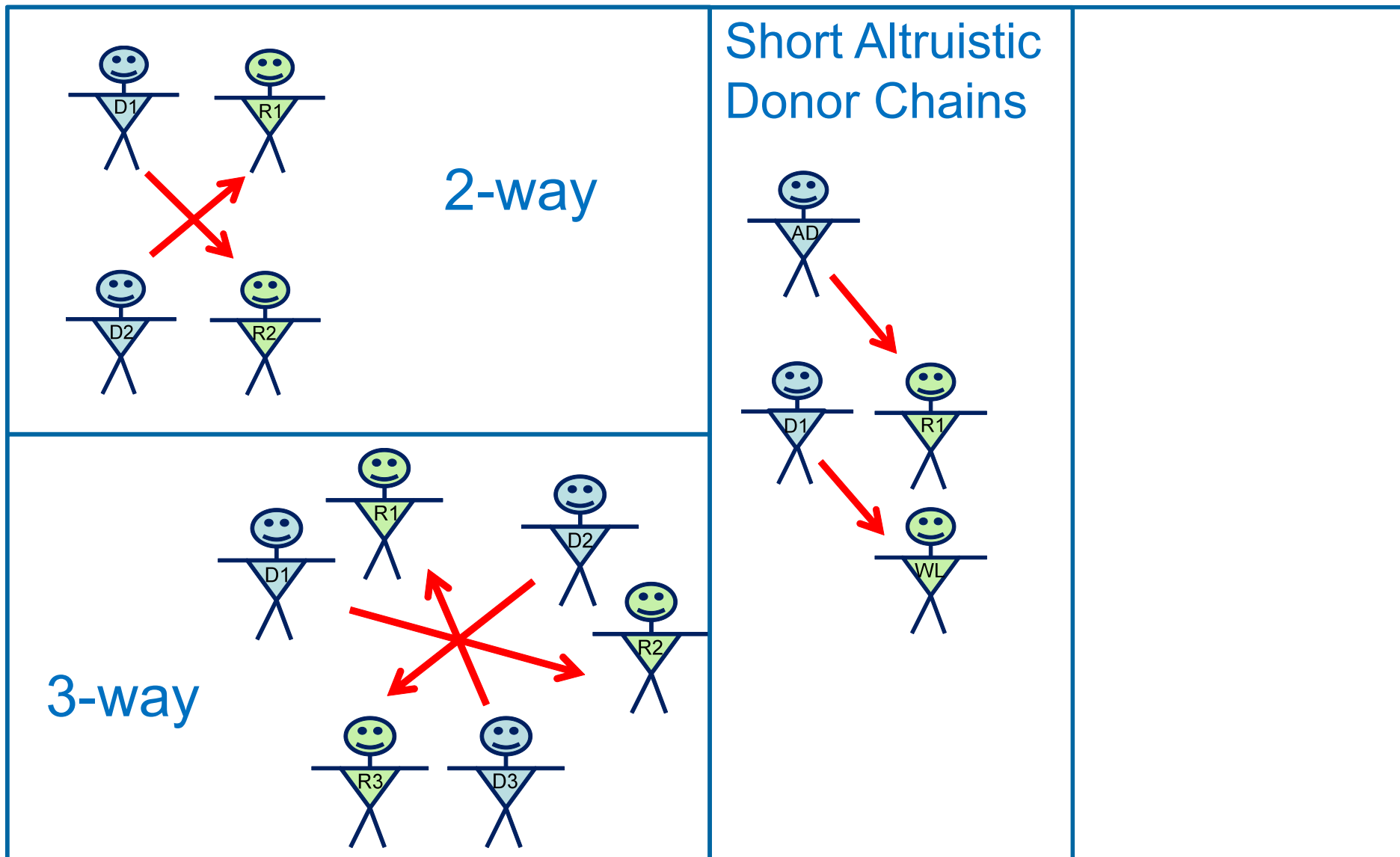
Patients Matched



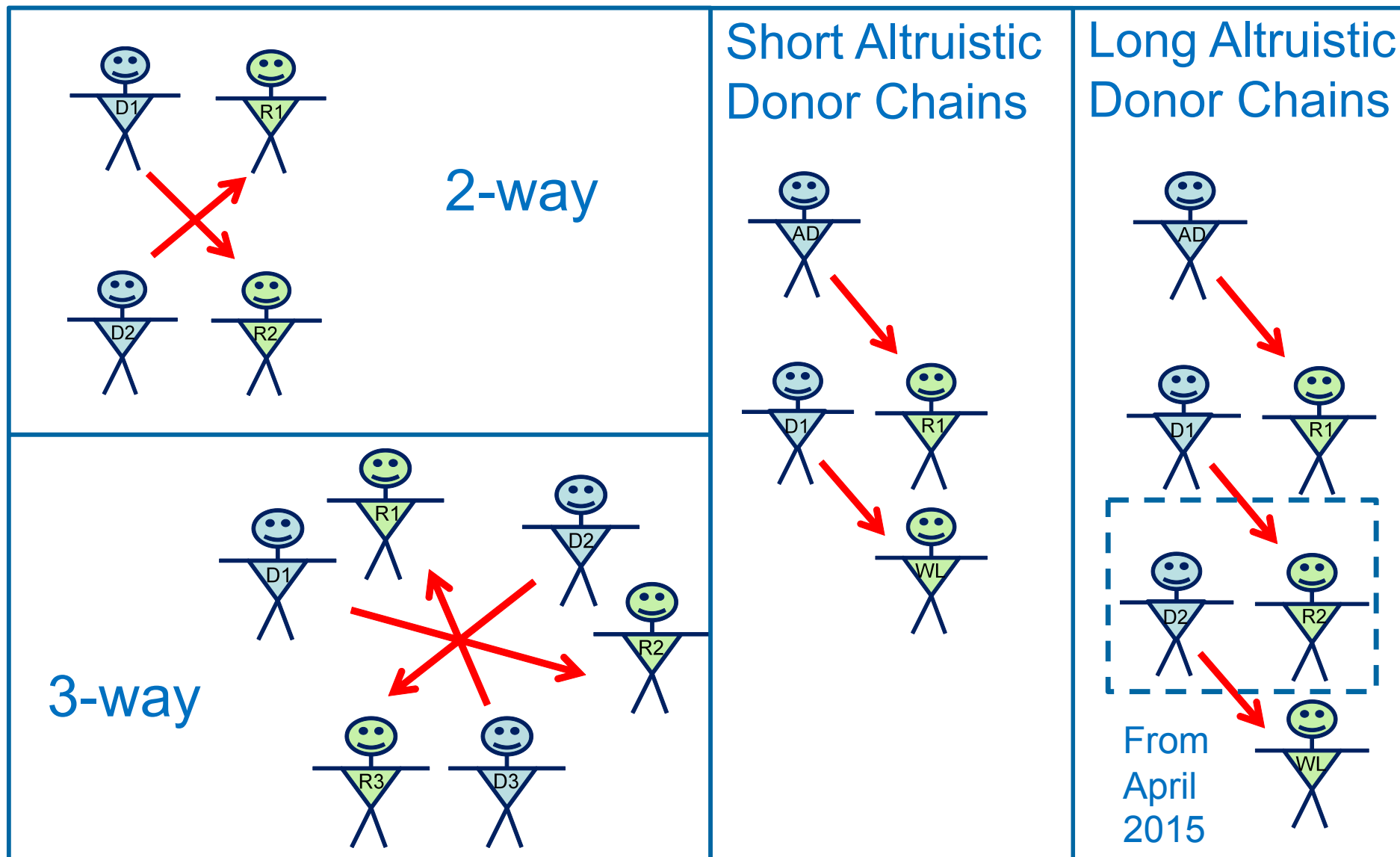
Patients Matched



Transplants Identified



Transplants Identified

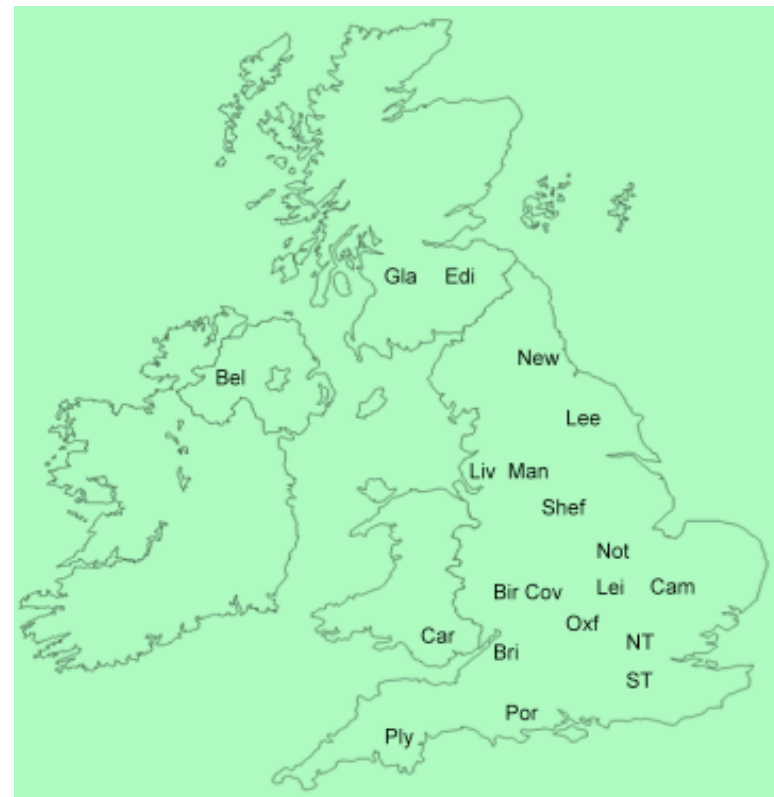


Paired Donation

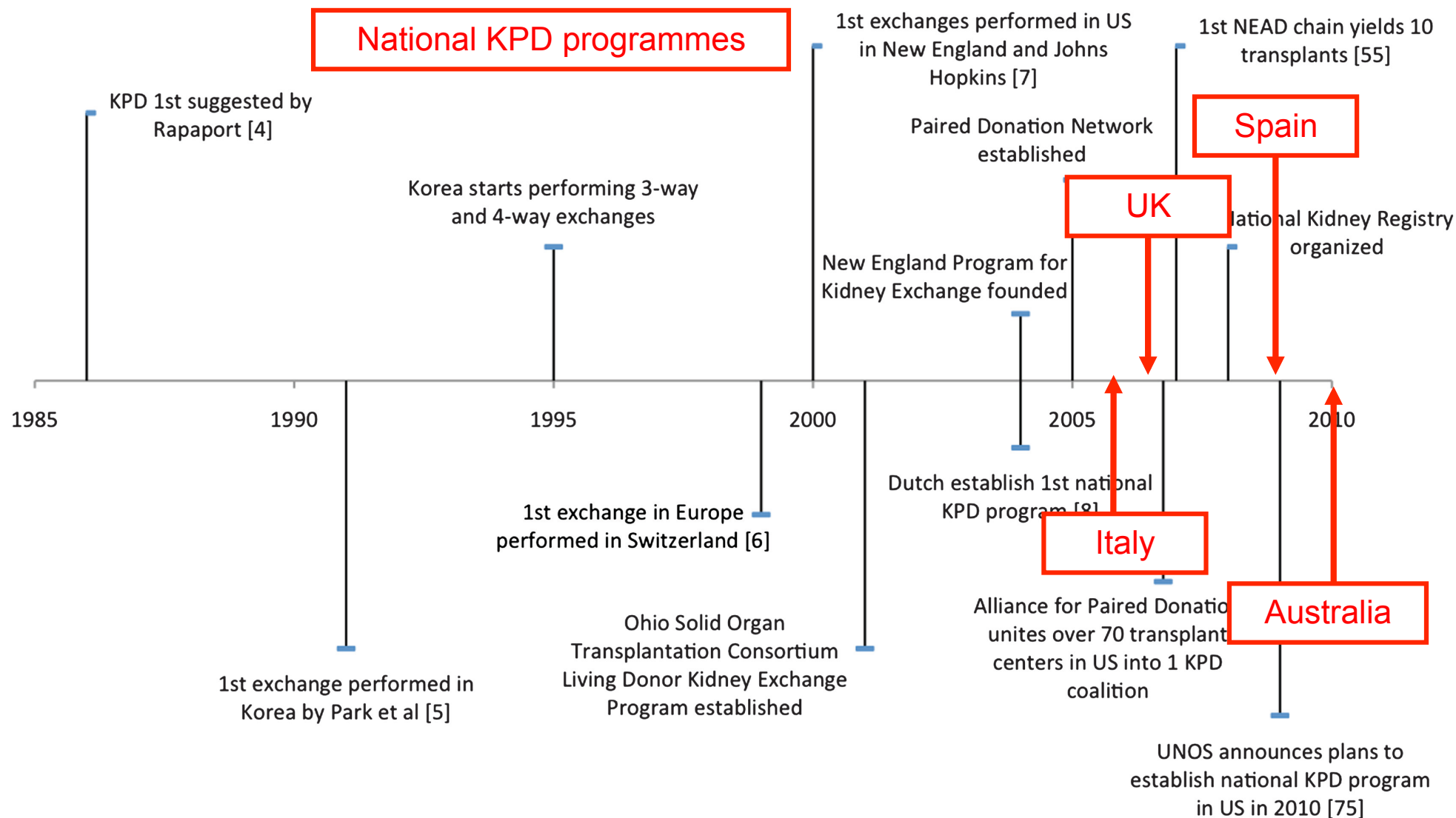
- Prior to 1 September 2006, transplants could only take place between those with a genetic or emotional connection
- Human Tissue Act 2004 and Human Tissue (Scotland) Act 2006:
 - legal framework created to allow transplants between strangers
- New possibilities for live-donor transplants:
 - *Paired kidney donation*: a patient with a willing but incompatible donor can swap their donor with that of another similar patient
 - *Altruistic* (non-directed) donors

UK National Paired Donation Scheme

- Started in April 2007
- 'Matching runs' take place every 3 months
- Includes all 24 UK kidney transplant centres



History of Paired Kidney Donation Programmes

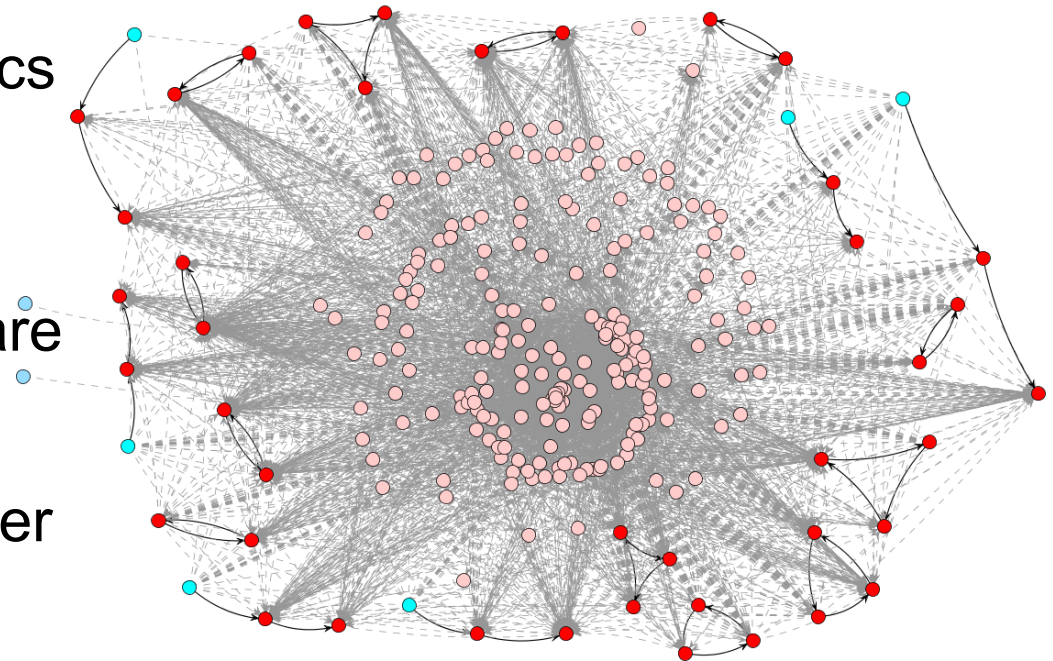


Matching Algorithm



Identifying Optimal Combination of Transplants

- Over 200 pairs every 'matching run'
- This results in 2000-5000 arcs (donor-recipient matches)
- Arcs are weighted to give preference to patients who are more difficult to match
- Need to maximise the number of transplants according to criteria developed with transplant community



Acknowledgement: Tommy Muggleton

Identifying Optimal Combination of Transplants

- 1 Maximise 2-way exchanges (inc embedded in 3-way)
- 2 Maximise number of transplants
- 3 Minimise 3-way exchanges
- 4 Maximise 3-ways with embedded 2-ways
- 5 Maximise 'score' of set of transplants

Score based on

- Previous matching runs of patient (50 points per unsuccessful run)
- Sensitisation of patient (0-50 points for 0-100% sensitised)
- HLA mismatch of identified transplant (0–15 points for levels 4 to 1)
- Donor-donor age difference (3 points if ≤ 20 years)

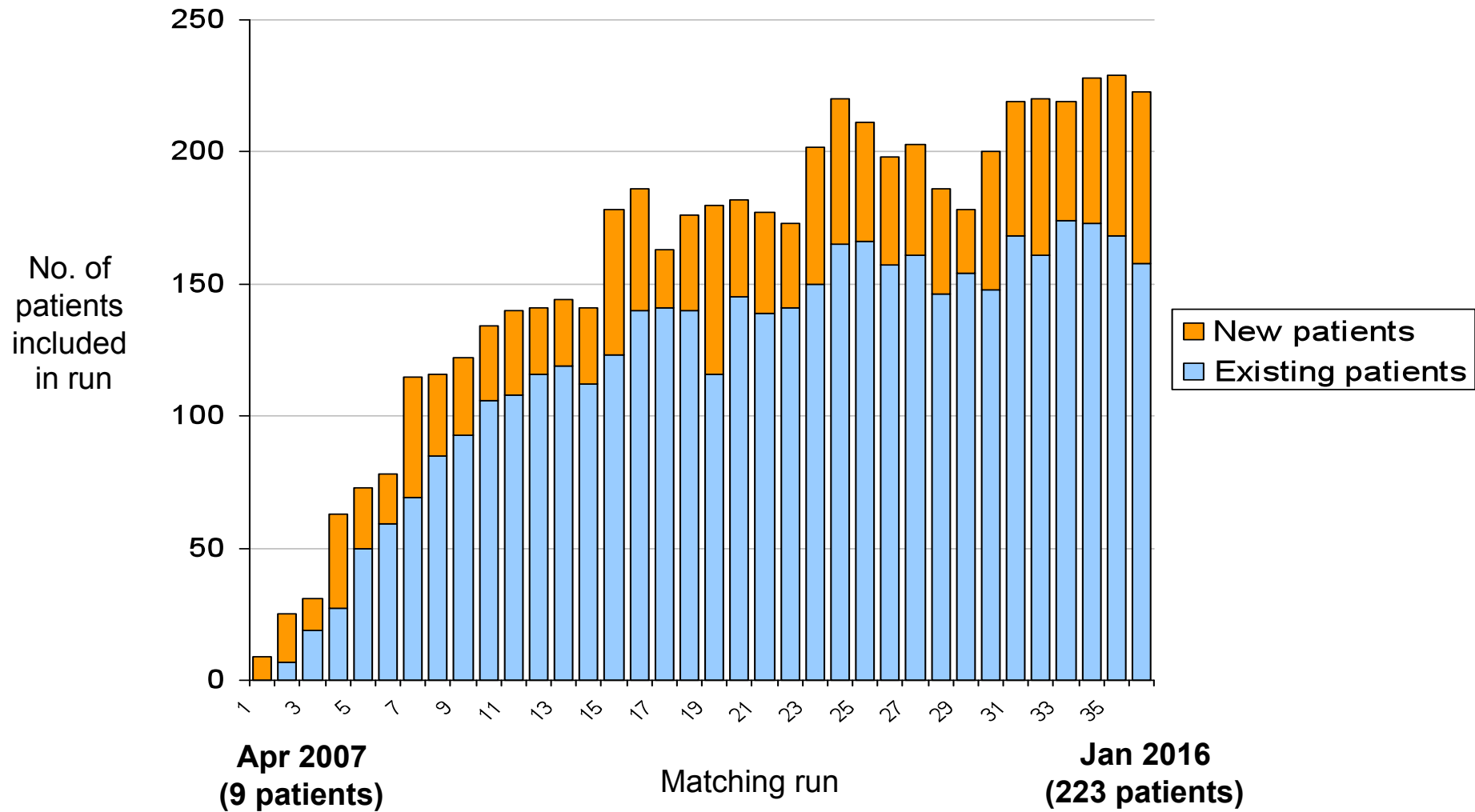
Integer Programming Model

- Builds on the so-called *cycle formulation*
 - first formulated by Roth, Sönmez and Ünver, 2007
 - investigated computationally by Abraham, Blum and Sandholm, 2007
 - Running time of under 2 seconds for all data sets to date

Paired Donation Activity



Number of Patients in Quarterly Matching Runs

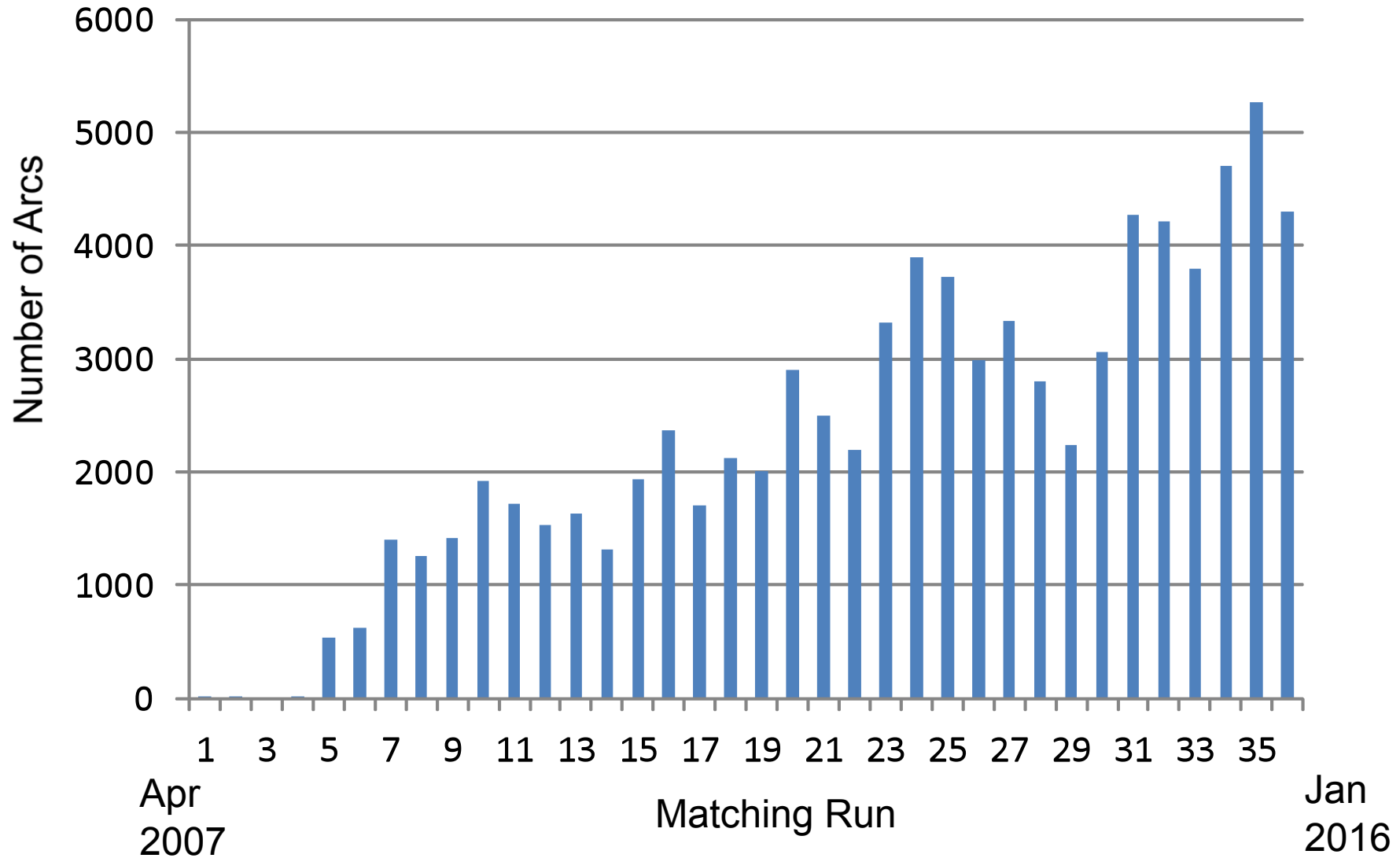


Summary of Registered Patients

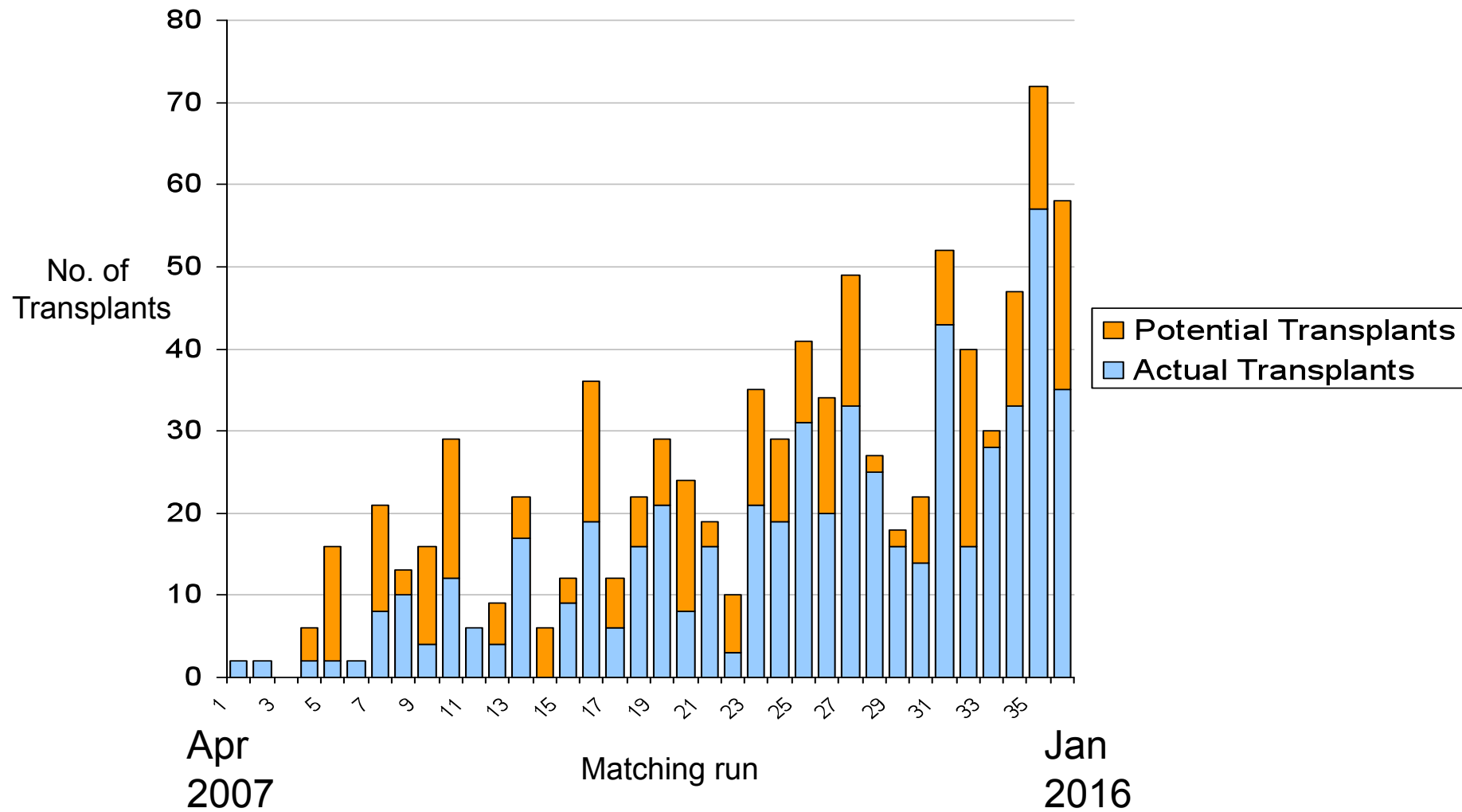
Total of 1438 patients (1586 pairs) enrolled

- 44% spouse/partner pairs, 56% female patients
- Mean age at first matching run 46 years (range 2-78 yrs)
- 35% ABO incompatible, 47% HLA incompatible, 15% ABOi + HLAi, 3% compatible
- 44% patients with high level of antibodies

Number of Arcs in Quarterly Matching Runs

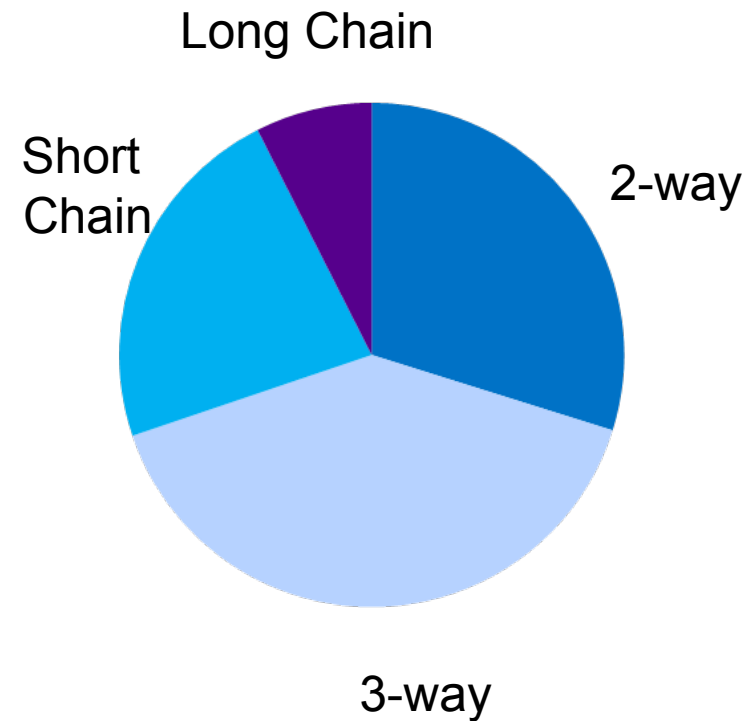


Potential and Actual Transplants



Overall Activity

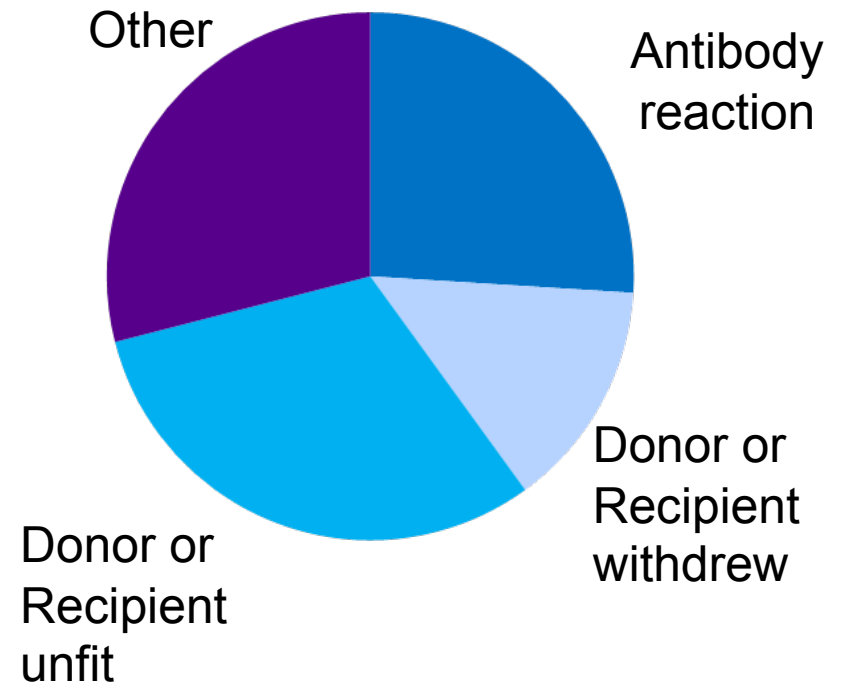
	Total
Patients registered	1438
Transplant Identified	899
Transplants	563 (39% of patients)



Overall Activity

	Total
Patients registered	1438
Transplant Identified	899
Transplants	563 (39% of patients)

Jan 2012-Jan 2016
(146 transplants not proceeding,
38% of identified)

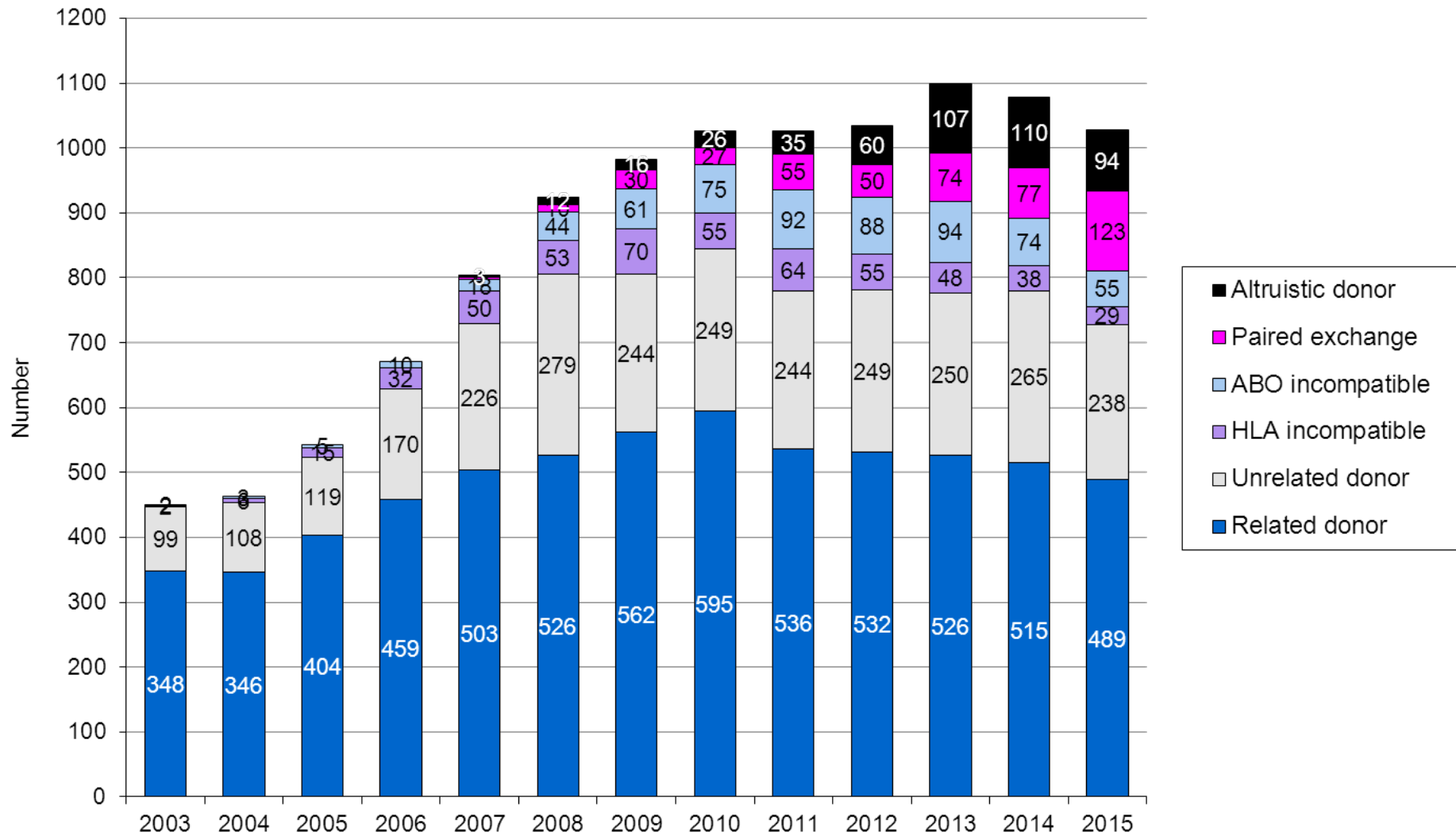


Summary of Transplanted Patients

Total of 563 patients transplanted

- Median of 2 runs to get a match
- 28% patients with high level of antibodies
- 562 adult, 1 paediatric

UK Living Donor Kidney Transplants



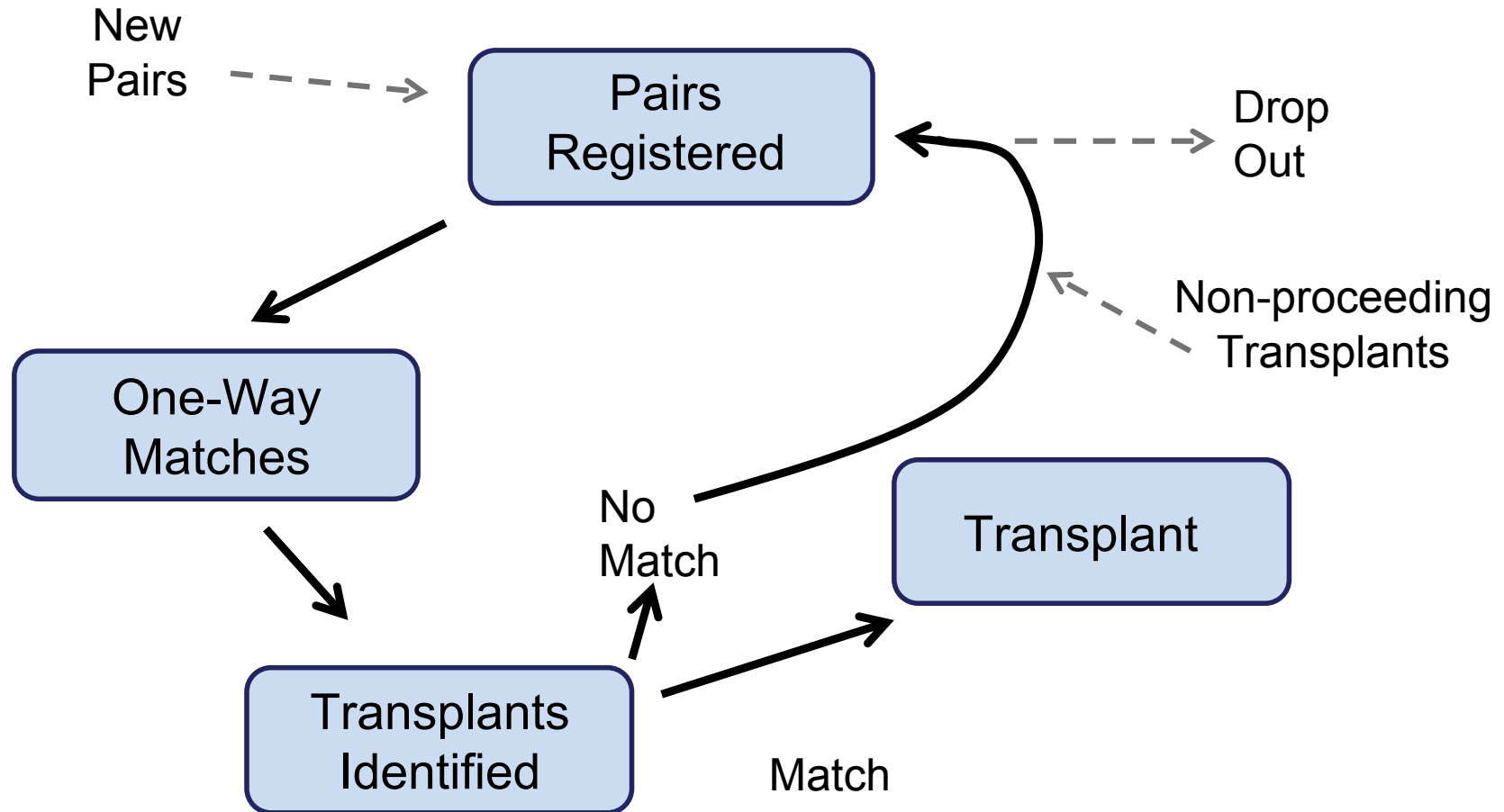
Further Developments



Further Developments

- Simulation work utilising the matching algorithm has also helped shape the scheme
 - Used to develop a tool to help patients understand their chance of transplant
 - Different policies within the scheme have been simulated to inform changes

Simulations

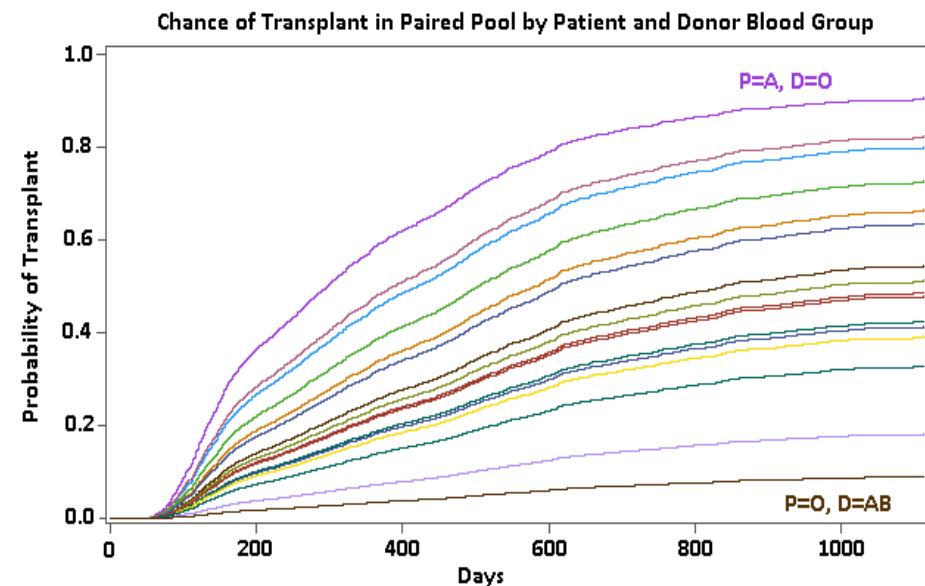


Helping Patients Understand Their Chance of Transplant

- The nature of the paired donation scheme, means that chances of transplant depend on patient and donor characteristics
- Previous to this work, there was limited information available to patients regarding how long they can expect to wait for a transplant
- The availability of the matching algorithm allowed us to use resampled data and simulate 3 years in the scheme to estimate chance of transplant, based on patient and donor characteristics

Helping Patients Understand Their Chance of Transplant

- Data from the simulations includes patients that enter the scheme for a few matching runs and then drop out without transplant
- Censored data – Cox proportional hazards models
- Factors included in the model that are relevant in waiting time
 - Recipient Blood Group
 - Donor Blood Group
 - Level of patient antibodies



Helping Patients Understand Their Chance of Transplant

Incompatible Pairs Living Donor Kidney Application

Variable	Select
Recipient Blood Group	A
Calculated Reaction Frequency	85-94
Donor Blood Group	O
ABOi TX with willing Donor†	Select
HLAi TX with willing Donor†	Select
Recipient Age	Select

Reset

Estimated Chance of Transplant

	Deceased Donor	NLDKSS	ABOi	HLAi
6 Months	<10%	41-50%	-	-
1 Year	11-20%	71-80%	-	-
3 Years	41-50%	>90%	-	-

Transplant Survival Rates

	Deceased Donor	NLDKSS	ABOi	HLAi
6 Months	-	-	-	-
1 Year	-	-	-	-
3 Years	-	-	-	-

Disclaimer: The information is provided for guidance only

†Low titre/Low DSA means acceptable for incompatible transplant. High titre/High DSA means unacceptable for incompatible transplant.

Note: NLDKSS chance of transplant is based on paired donation including short altruistic donor chains.

Chances of transplant through the NLDKSS could be increased by considering an antibody incompatible transplant within the scheme

For a more accurate estimate of waiting time for a deceased donor transplant based on more variables, please visit

http://www.odt.nhs.uk/doc/chance_of_transplant.xls

Available at: <http://www.odt.nhs.uk/transplantation/guidance-policies/tools/>

Informing Changes to the Scheme

- The availability of the matching algorithm also allows us to investigate the effect of making changes to the scheme using simulations:
 - The addition of long altruistic donor chains
 - Non-simultaneous long donor chains
 - Changing the frequency of matching runs
 - Matching altruistic donors as soon as they register

Informing Changes to the Scheme

- Results have shown the benefit of the introduction of long altruistic donor chains. This led to them being introduced in April 2015
- No conclusive evidence under current system that there is a strong benefit of increasing the frequency of matching runs

Policy	Transplants over 5 years
Current scheme policy	+/- 0%
Matching runs every 2 months	+0.7%
Matching Altruistic donors every week	-1.5%

Future Challenges



Future Challenges

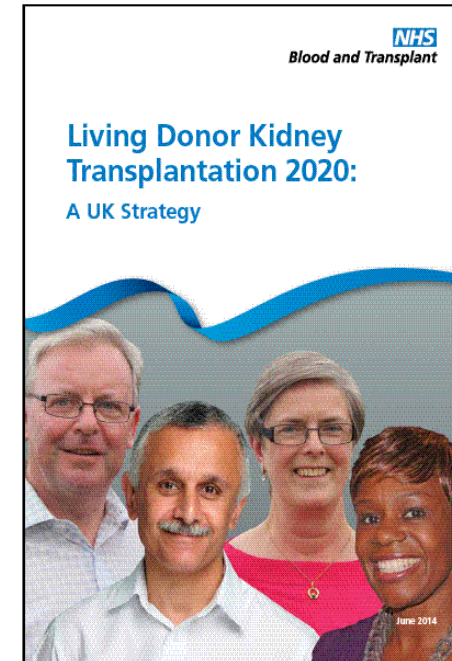
- Addressing the rate of non-proceeding transplants
- Keeping up with expectations of the clinical community
- Centres wanting local flexibility
- Large increase in the number of pairs in the scheme

Summary

- The UK paired donation scheme helps difficult to match patients with a willing live donor to get a transplant
- Matching algorithm is vital to optimise transplants and maximise patient benefit
- The availability of the matching algorithm allows us to investigate the effect of making changes to the scheme, and to give more information to patients

Acknowledgements

- University of Glasgow
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- NHSBT
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“To match world class performance in living donor kidney transplantation”

www.nhsbt.nhs.uk
www.odt.nhs.uk

