TSANZ
The Transplantation Society of Australia and New Zealand

Kidney Allocation Algorithm Revision

Stakeholder Consultation

4 September 2023

General Nephrology Consultation - ANZSN

AGENDA

1. Status quo – current algorithm and outcomes of the current system
2. Why do we need a revision?
3. Scope and timeline of the revision
4. Your feedback on the current system
5. Discussion on the following topics:
    - Prognosis matching
    - Paediatric recipients
    - Kidney-pancreas transplantation
    - Pre-emptive listing
    - Equity issues
6. Monitoring: how do we ensure that the system is delivering equitable outcomes?

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Status Quo

Updates to the Kidney Allocation System were implemented in May 2021 (KAv2). The main changes were:

1. Level 1 national priority for very highly-sensitised patients (mPRA$\geq$95)
2. The introduction of an expected post-transplant survival (EPTS) threshold in the national allocation formula to permit the allocation of well-matched kidneys to waitlisted patients with the longest expected survival (EPTS $\leq$25)
3. Introduction of prognosis-matching into the state level algorithm (higher points where the EPTS-KDPI difference is $\leq$50)

Match level	Description	Criteria		Base score
1	Very Highly sensitised ABO Compatible	**1a**	mPRA ≥99.7	99 700 000
		1b	mPRA ≥99	99 000 000
		1c	mPRA ≥98	98 000 000
		1d	mPRA ≥97	97 000 000
		1e	mPRA ≥96	96 000 000
		1f	mPRA ≥95	95 000 000
National Urgent	ABO Compatible	Recipient National urgency >0		90 000 000
2	EPTS restriction HLA matching Prioritises Low EPTS recipients Matched at HLA DRB1 ABO Matched KDPI max value is applied from this level down	**2a**	0 mismatches HLA-A or HLA-B and EPTS ≤25	89 000 000
		2b	1 mismatch HLA-A or HLA-B and EPTS ≤25	88 000 000
		2c	2 mismatch HLA -A or HLA-B and EPTS ≤25	87 000 000
		2d	0 mismatches HLA -A or HLA-B and EPTS ≤60	86 000 000
3	HLA matching Highly Sensitised	**3a**	0 mismatch at HLA A or HLA B or HLA DRB1 and mPRA >80	79 000 000
		3b	1 mismatch at HLA A or HLA B or HLA DRB1 and mPRA >80	78 000 000
		3c	2 mismatches at HLA A or HLA B or HLA DRB1 and mPRA >80	77 000 000
	HLA Matching Centre credit difference	**3d**	Matched at HLA DRB1 1 mismatch HLA A or HLA B And mPRA ≤80 And Centre credit difference ≤-3	76 000 000
		3e	Matched at HLA DRB1 2 mismatch HLA A or HLA B And mPRA ≤80 Centre credit difference ≤-6	75 000 000
		3f	mPRA >80 Centre credit difference ≤-9	74 000 000
		3g	Centre credit difference <-20	73 000 000

Status Quo

National Allocation formula

Other parameters	**Bonus points**
Paediatric	250,000
Donor centre = patient centre	50
Recipient centre credit	1000 + recipient centre credit
Recipient and donor are HLA DRB1 homozygote	500,000 (except level 3g)
Waiting time (on dialysis)	Number of months x 1

Status Quo

State Allocation formula

State Allocation

- Allocation initially matched with restriction applied (EPTS-KDPI <=50) then unrestricted matching is applied
- KPDI max at clinician's discretion.

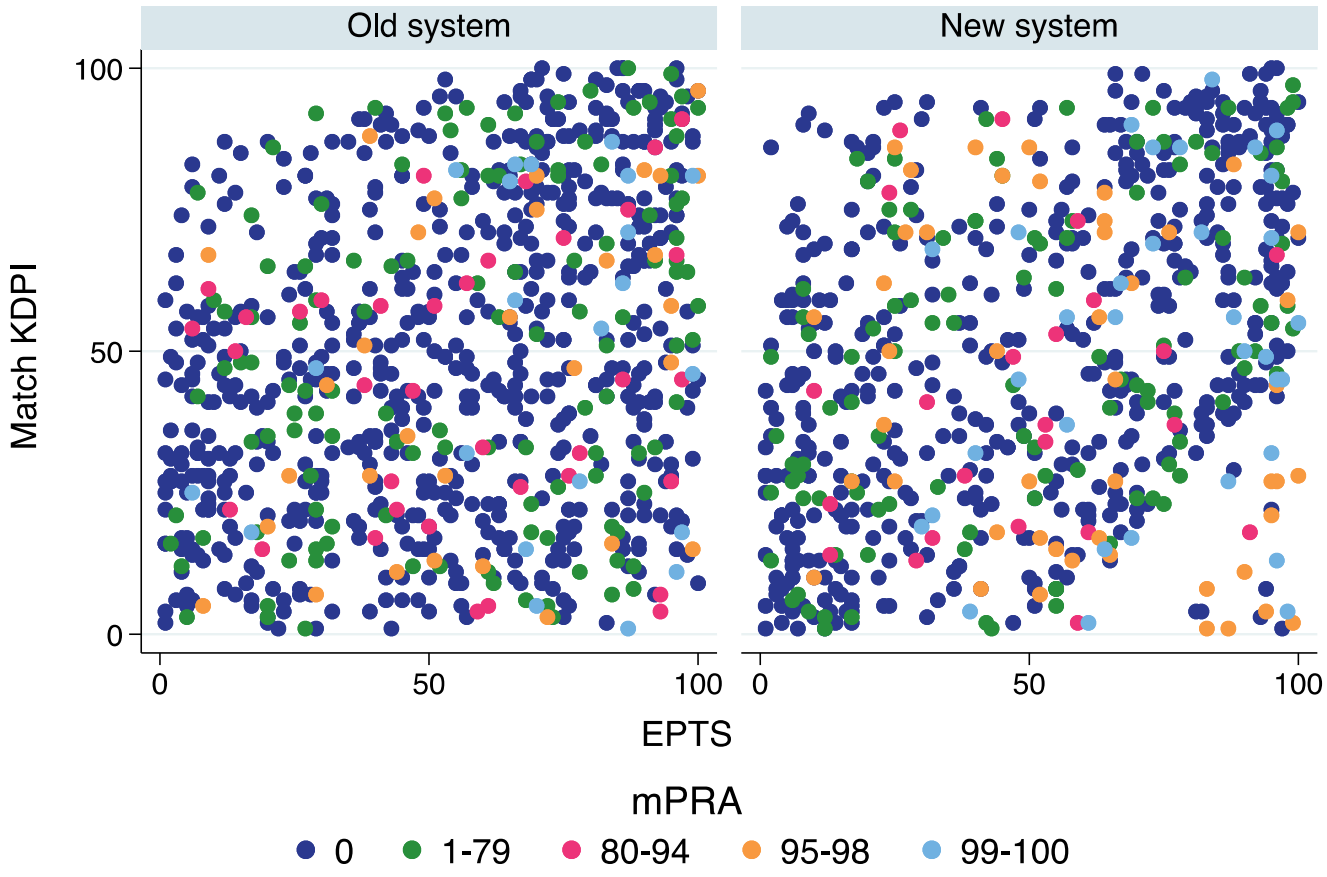
Level	Description	Details	Base Score
State Urgent	State Urgency Index >0	Urgency index added to base score	60 000 000

Level	Description	Details	Restricted base score	Unrestricted base score
State HLA	HLA mismatches A/B/DRB1	**1a** 0 0 0	49 000 000	39 000 000
		1b 1 0 0 or 0 1 0	48 000 000	38 000 000
		1c 1 1 0	47 000 000	37 000 000
		1d 0 0 1	46 000 000	36 000 000
		1e 2 0 0 or 0 2 0	45 000 000	35 000 000
		1f 1 0 1 or 0 1 1	44 000 000	34 000 000
		1g 2 1 0 or 1 2 0	43 000 000	33 000 000
State Waiting	Months on dialysis	Number of months x 1	40 000 000	30 000 000

Other parameters	**Bonus points**
Paediatric	100,000
Recipient and donor are HLA DRB1 homozygote	500,000 (HLA matching algorithm only)

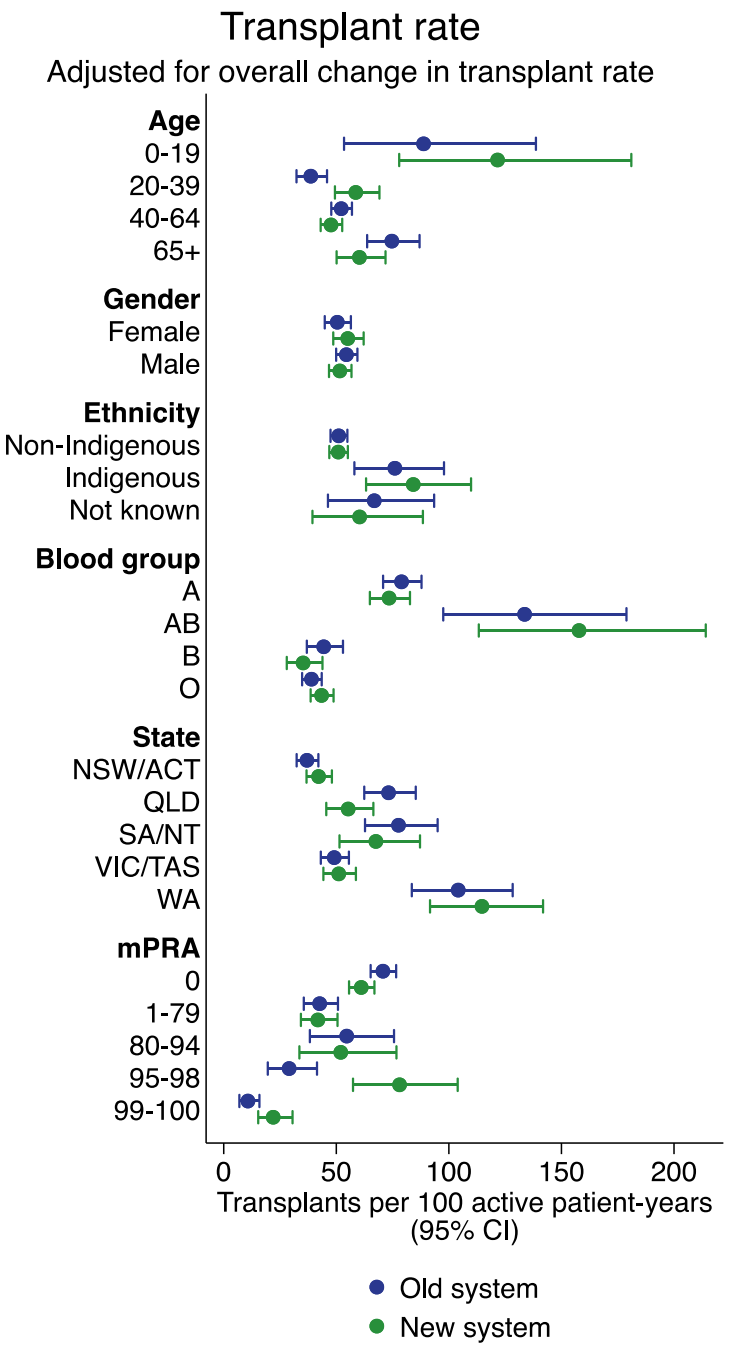
Outcomes of the current KAv2

Status Quo



KAv2

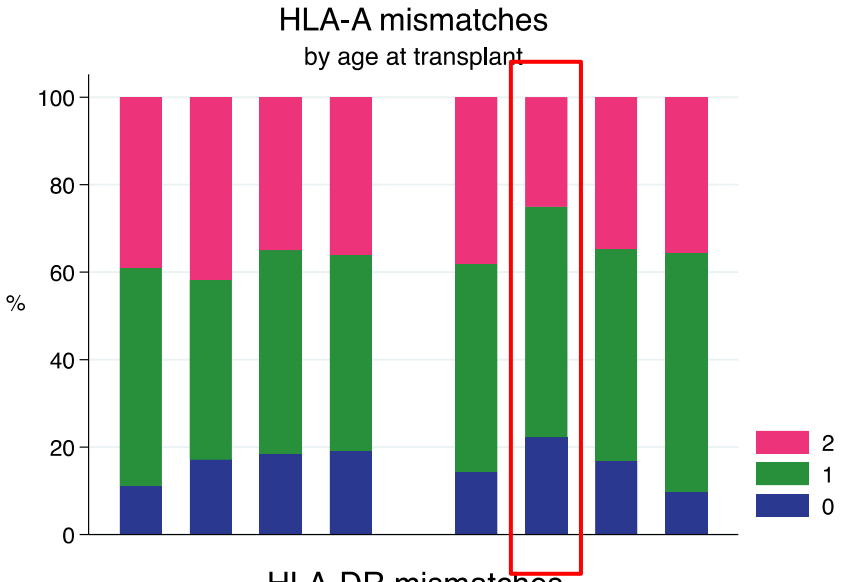
- Better prognosis matching
- Reduction in high quality kidneys going to recipients with a poor prognosis
- Room for further improvement in the avoidance of low KDPI to high EPTS recipients, even for highly sensitised persons

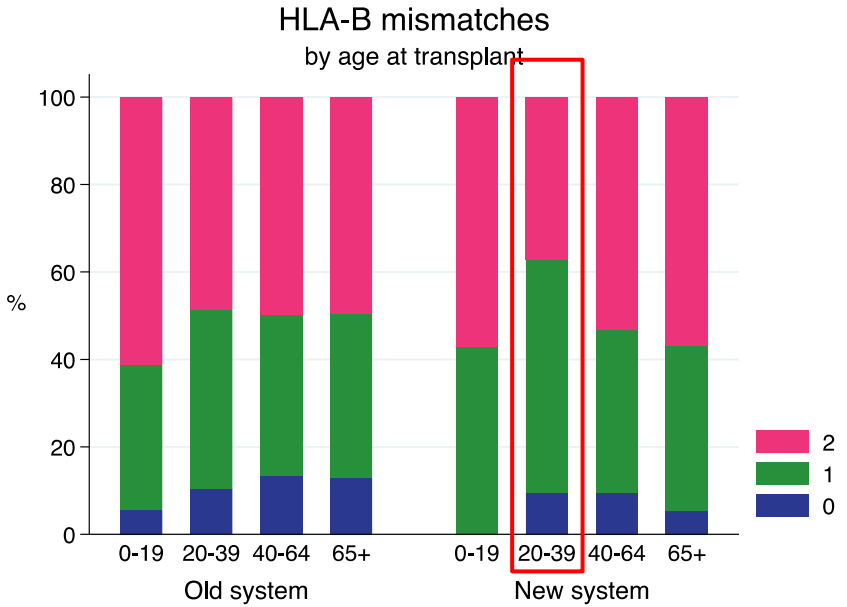


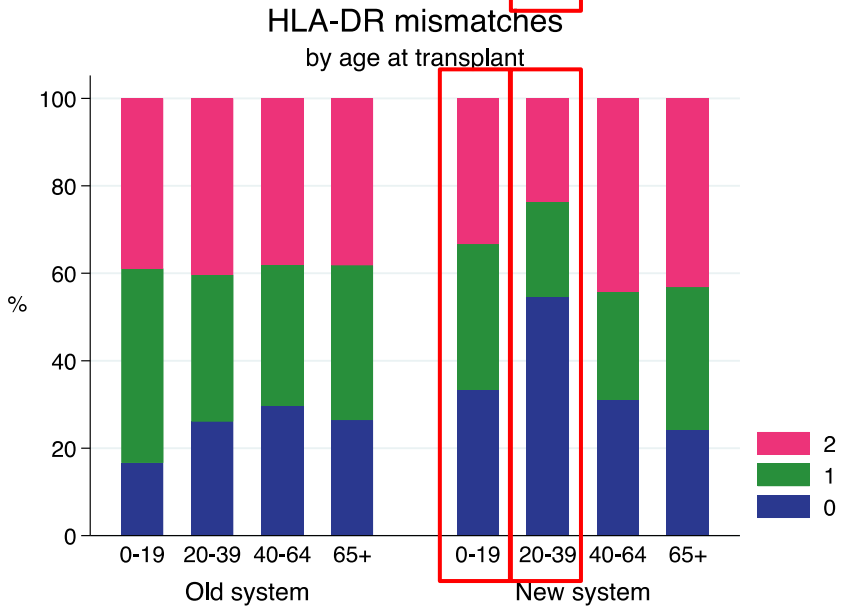
KAv2

- Increased transplant rate for paediatric recipients
- Decreased transplant rate for 65+ group
- Increased disparities by blood group (lowest transplant rate for B blood-group)
- Variation between states
- Highest transplant rate for the mPRA 95-98 group, possible over-compensation

Outcomes of the current KAv2







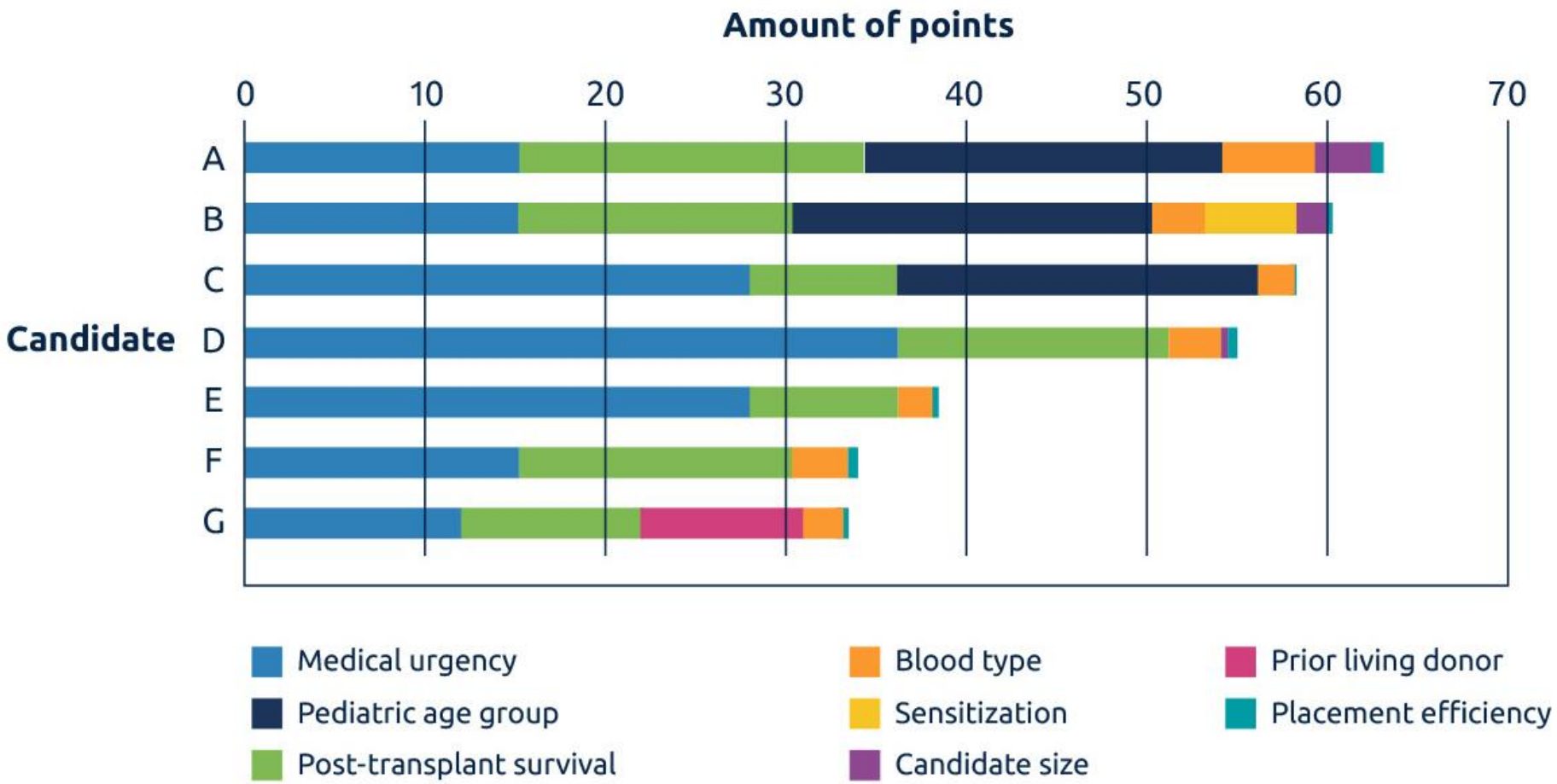
KAv2

- Improved HLA-matching for patients <40 years
- Still ~30% of patients <20 years with 2 HLA-DR mismatches
- More HLA A/B-mismatches for patients 65+

Why do we need a revision?

- Need to improve specific aspects of the current system
- The current algorithm is based on tiers and hard cut-offs, which can be unfairly arbitrary and don’t take account of the full range of relevant patient characteristics and the continuum of risk associated with some factors.
- A system based on continuous points has the potential to produce fairer outcomes as well as increased utility from transplantation.

EXAMPLE


Amount of points
0
10
20
30
40
50
60
70
Candidate
A
B
C
D
E
F
G
Medical urgency
Pediatric age group
Post-transplant survival
Blood type
Sensitization
Candidate size
Prior living donor
Placement efficiency

Scope of the revision

In scope

- All factors in the kidney allocation algorithm
- Interstate shipping and centre balancing rules
- Pre-emptive transplant rules (relevant to prioritisation by waiting time)
- Combined organ transplantation and SPK

Out of scope

- Transplant eligibility criteria/waitlisting rules
- Eplet matching

A Working Group under RTAC has been formed, and a workplan for the development, testing and implementation of the revised algorithm is due to TSANZ in December 2023

Time horizon for implementation of ~2 years.

Your feedback on the existing system

Issues with the current algorithm

1. Need to improve the extent of prognosis matching
2. Priority access to low KDPI kidneys for SPK patients
3. No priority access to paediatric donor kidneys for paediatric patients
4. Need to improve the proportion of young patients with good HLA-matching
5. Abrupt loss of paediatric bonus points at 18 years, disadvantaging adolescents
6. Pre-emptive listing
7. Recipient centre credits/state balancing system has some unintended consequences
8. The challenge of adapting to a changing donor pool

Your feedback on the existing system

Inequities produced by the current algorithm

1. People from regional/remote areas, far from a transplant centre or living in areas with few donors are currently at a disadvantage
2. Longer waiting times for ethnic minorities and people with rare HLA/HLA-combinations
3. First Nations patients disadvantaged in their access to the waiting list
4. Inequities for young adults due to paediatric bonus hard cut-off at age 18

Issue: Prognosis matching

Prognosis matching

- A goal of allocation should be to maximise the longevity of the highest quality kidneys by preferentially allocating them to recipients expected to benefit the most
- The majority of allocation decisions should incorporate a degree of prognosis matching
- Current state level algorithm prioritises EPTS-KDPI <50. If we wanted to meaningfully increase life years saved from transplantation compared to the status quo, we would need to be much more restrictive (e.g. a difference of 20-30)
- Accepting a high KDPI kidney should come with some acceptable trade-off, such as reduced waiting time.

Prognosis matching

In a points-based system, we can incorporate continuous points for EPTS-KDPI difference, or use a stratified approach that gives maximum points for like-for-like.

The US system under development models EPTS-KDPI difference as:

$$(0.5 + 2 * (EPTS/100 – 0.5) * (KDPI/100 – 0.5)$$

Example stratified approach:

	KDPI quintile 1	**KDPI quintile 2**	**KDPI quintile 3**	**KDPI quintile 4**	**KDPI quintile 5**
EPTS quintile 1	20 points	10 points	0	0	0
EPTS quintile 2	10	20	10	5	0
EPTS quintile 3	5	10	20	10	5
EPTS quintile 4	0	5	10	20	10
EPTS quintile 5	0	0	5	10	20

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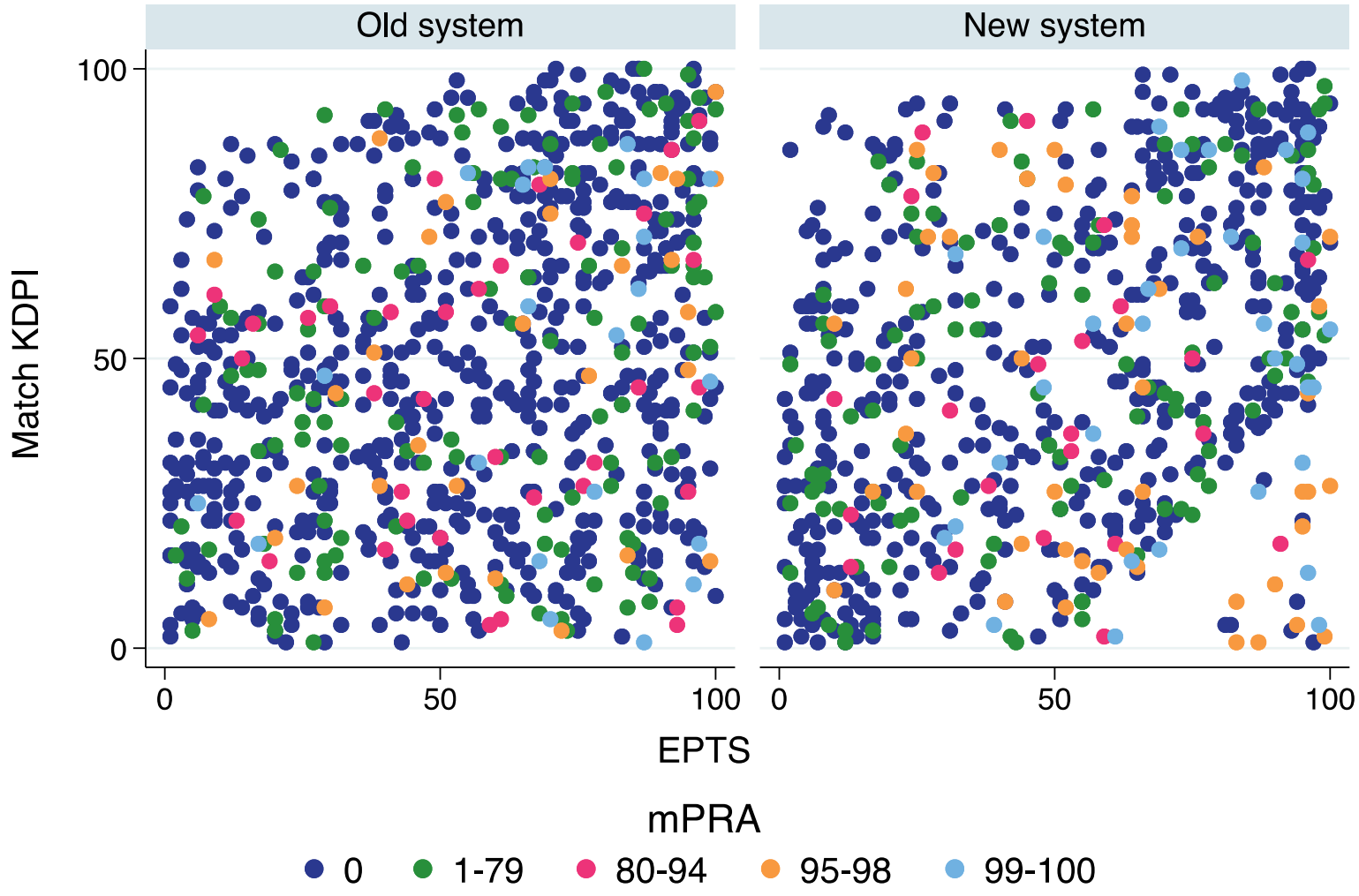
Question

What proportion of low KDPI (<25) kidneys should be allocated to low EPTS (<25) recipients?

Outcomes of the current KAv2



Issue: Paediatric Recipients

Paediatric patients

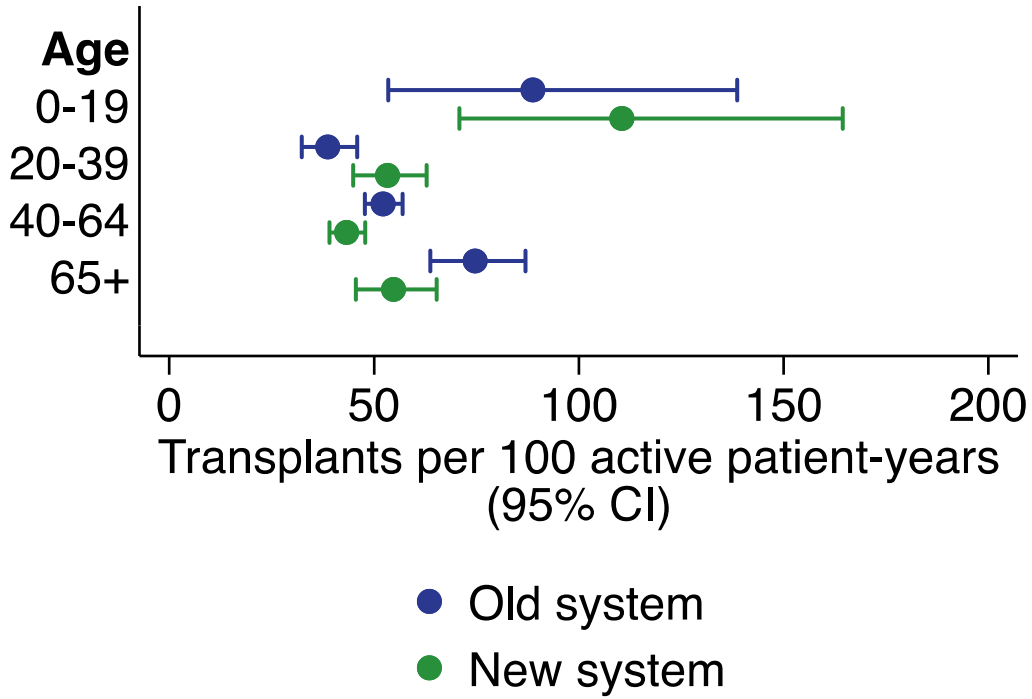
Status Quo

The current Australian Kidney Allocation Algorithm gives a paediatric (<18 years) bonus of:

- 250,000 points at the national allocation level, and
- 100,000 points at the state level (for EPTS-KDRI <50 offers only).

In addition, national allocation gives a higher base score to good HLA matches in patients with an EPTS of ≤25. Low EPTS patients have priority in allocation of kidneys with up to 2 HLA-A/B mismatches, ahead of sensitised patients with mPRA of <95.

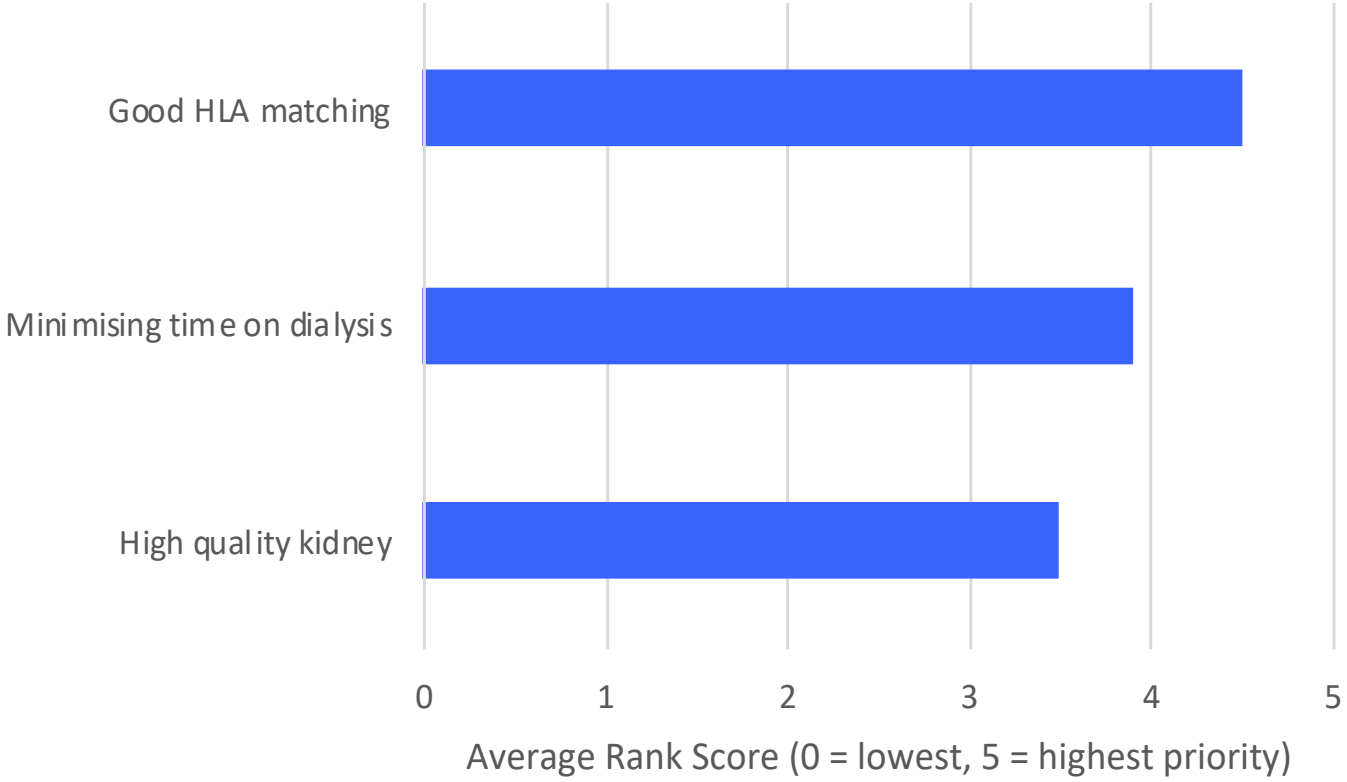
Under the current kidney allocation algorithm, paediatric patients (<20 years) get transplanted at around twice the rate of all other age groups.



Paediatric patients

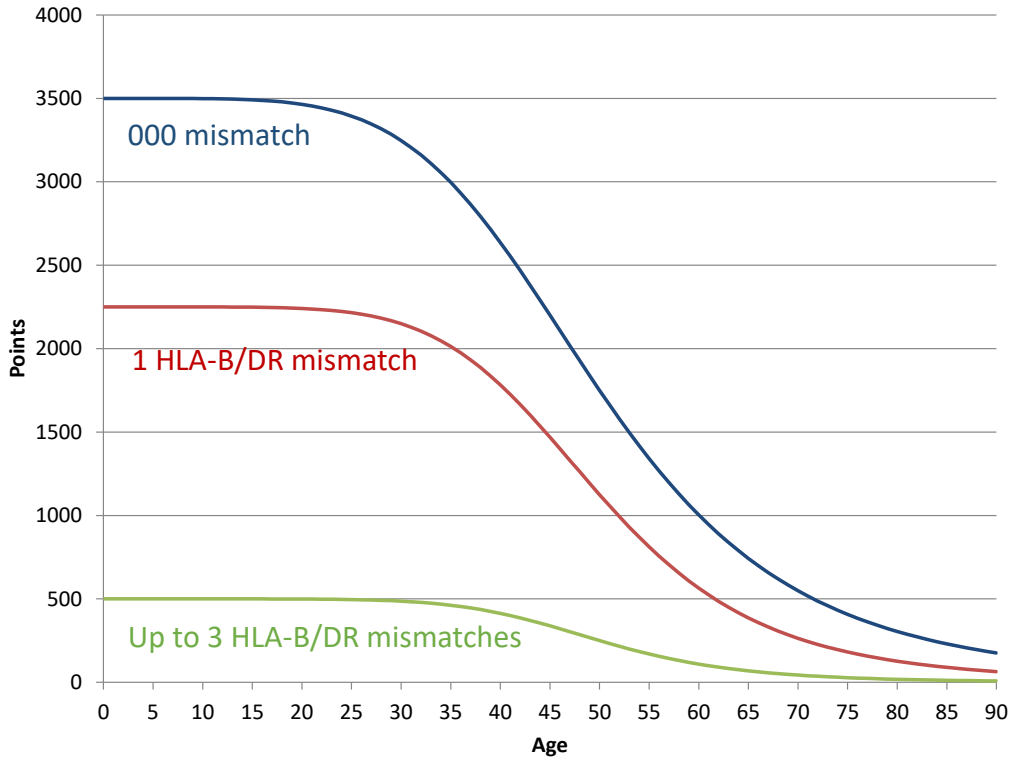
Allocation objectives with respect to paediatric patients

1	Good HLA matching for paediatric recipients to reduce the risk of de novo DSA, AbMR and sensitization for future transplantation
2	Minimise time on dialysis for paediatric patients
3	Increase the average longevity of grafts for younger recipients (allocate low KDPI kidneys to low EPTS recipients)



Issue – improve HLA-matching for paediatric recipients

- International systems emphasise good matching for younger recipients by combining points for HLA-match with points for age
- UK give ~3x more points for good HLA matching in paediatric patients; US and Eurotransplant give ~2x more
- Do the youngest paediatric patients need more priority than the older ones?

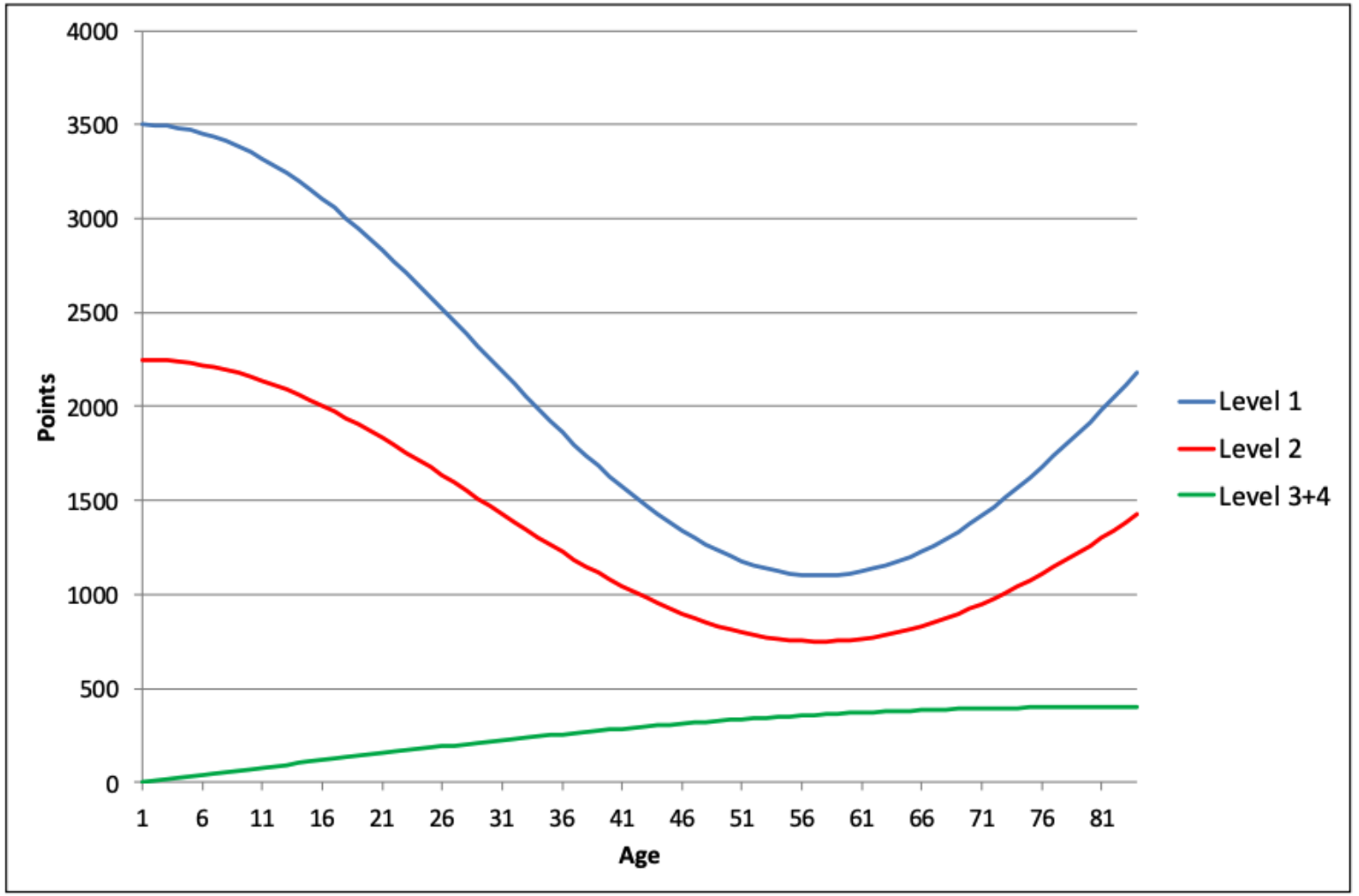


Issue – improve HLA-matching for paediatric recipients

HLA match and age combined
- UK System

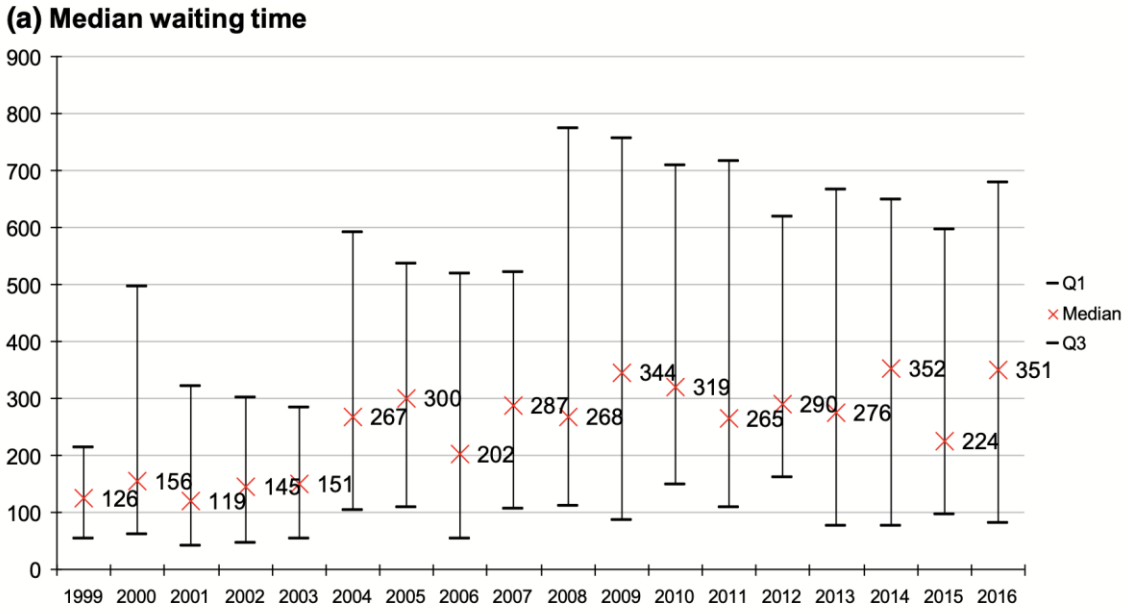
Points are defined as:
Level 1 = 1200*COS(age/18)+2300
Level 2 = 750*COS(age/18)+1500
Level 3+4 = 400*SIN(age/50)

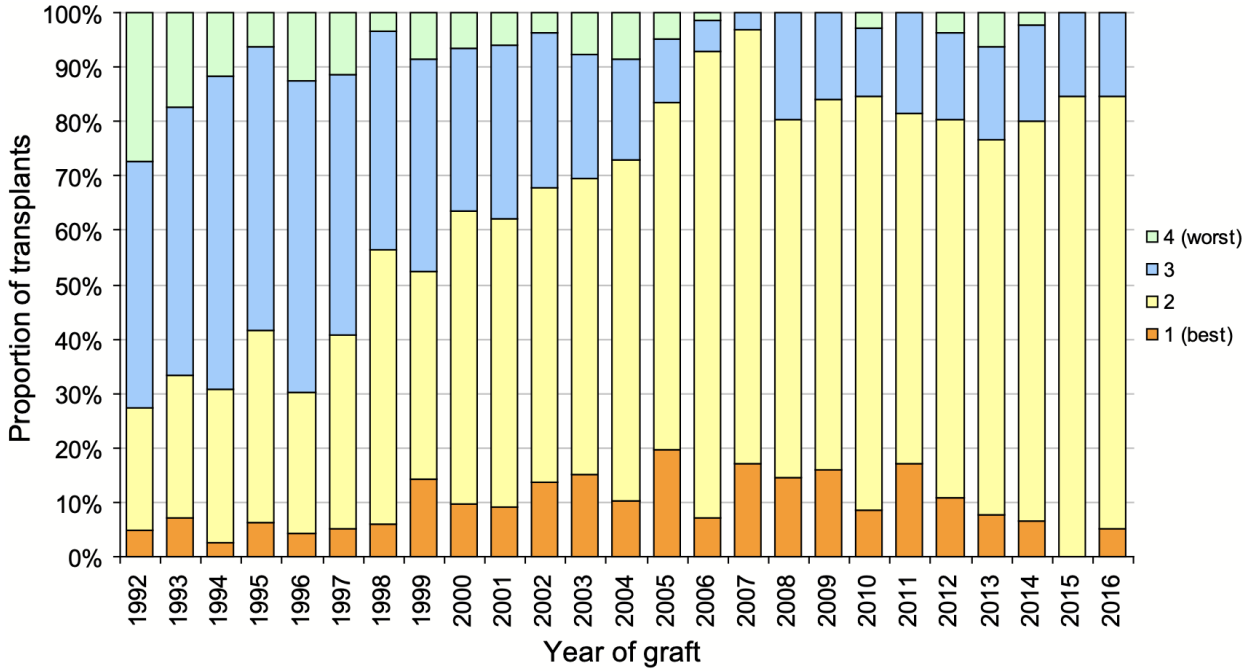
HLA mismatch level for HLA-A, B and DR	**HLA mismatch summary**
Level 1	000
Level 2	[0 DR and 0/1 B] or [1 DR and 0 B]
Level 3	[0 DR and 2 B] or [1 DR and 1 B]
Level 4	[1 DR and 2 B] or [2 DR]



Issue – improve HLA-matching for paediatric recipients

UK Outcomes





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Question

Should all patients under 18 get the same degree of priority (i.e. a child of 5 gets the same priority as an adolescent of 15)?

Issue – loss of paediatric bonus at 18 years

- This is something that we can address in a points-based system
- Eurotransplant: All paediatric patients till the age of 18 receive 100 bonus points. This bonus is then phased out up until the age of 30.
- UK system tapers age-based priority for good matching up until age 50.
- How should we taper the paediatric bonus in a points-based system?

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Question

At what age should any specific paediatric priority for reduced waiting time end?

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Question

At what age should any specific paediatric priority for better matching end?

Issue –paediatric donors

- Should we preferentially allocate kidneys from paediatric donors to paediatric recipients?
- Utility argument: maximise the utility from this scarce resource.
- Equity argument: paediatric donors cannot accept kidneys from many older adults.
- Community expectation that kidneys from paediatric donors go to young people
- However, paediatric donor kidneys aren’t necessarily the highest quality
- Possibly better addressed with KDPI (which takes into account height and weight)?

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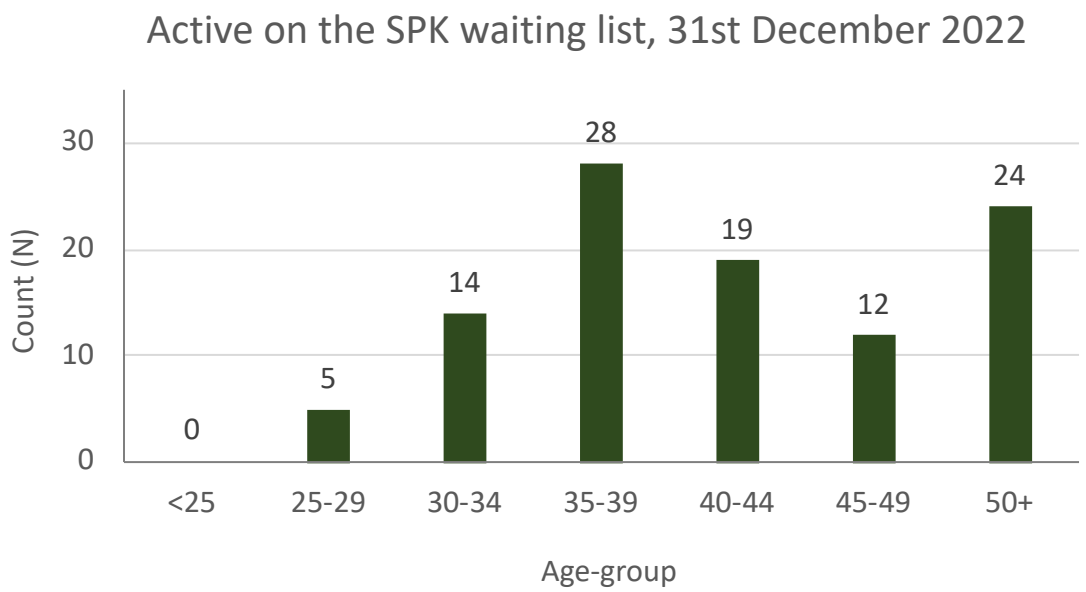
Question

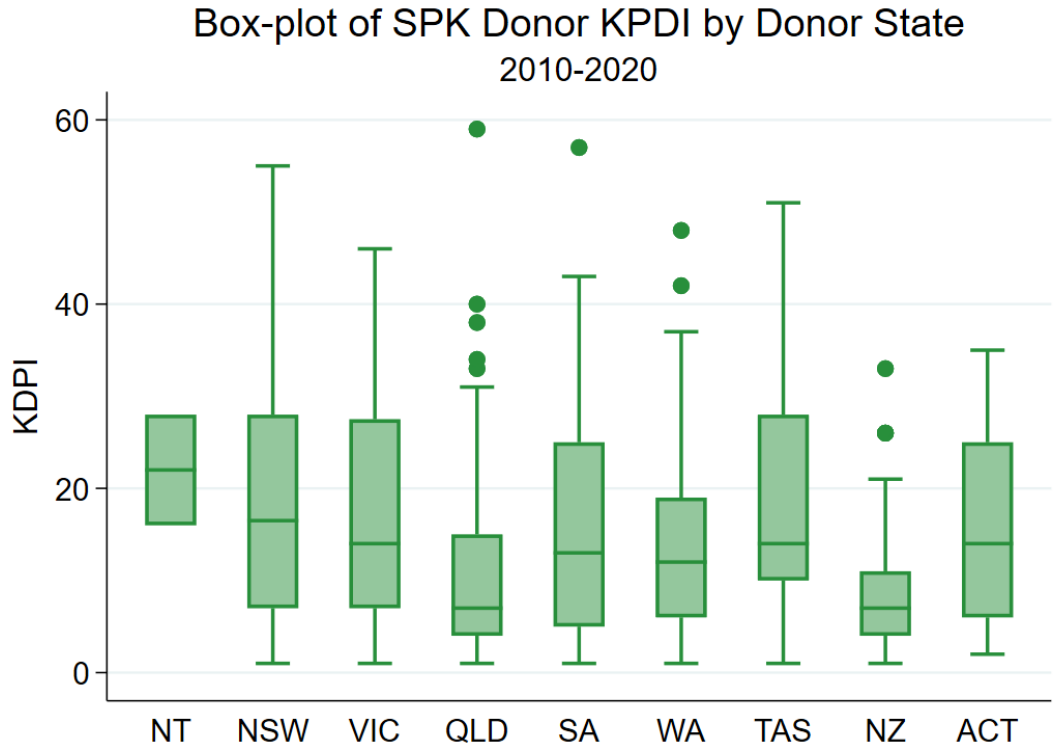
Should we aim to allocate the majority of kidneys from paediatric donors to paediatric recipients?

Issue: SPK transplantation

SPK transplantation

- Concerns around disproportionate access of T1DM patients in the SPK program to low KDPI kidneys
- Median KDPI for SPK donors is <20 (see Figure)
- Based on 2017-2019 data, 19% of the highest quality kidneys (KDPI<20) were used for SPK





Source: Sypek, M. Scoping paper on pancreas transplantation in Australia. Report to PITAC, 2022

Current Kidney Allocation Algorithm

National Allocation formula

Match level	Description	Criteria	Base score
1	Very Highly sensitised ABO Compatible	**1a** mPRA ≥99.7	99 700 000
		1b mPRA ≥99	99 000 000
		1c mPRA ≥98	98 000 000
		1d mPRA ≥97	97 000 000
		1e mPRA ≥96	96 000 000
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		3f mPRA >80 Centre credit difference ≤-9	74 000 000
		3g Centre credit difference <-20	73 000 000

SPK currently comes below Level 2 priority for kidney-only transplantation, but above state level allocation

SPK patients with the national priority bonus will be prioritized ahead of Level 2 (same priority as National urgent listing)

Sensitised SPK candidate can choose to be additionally listed for kidney-only Tx to increase their opportunity of at least getting a kidney Tx

SPK transplantation

In the last 12 months from Aug 2022 to Jul 2023:

- There were 102 donors where potential SPK recipients were identified
- **40 kidneys were accepted for SPK** transplants
- Median age of accepted SPK donors was 26
- There were **15 donors where the potential SPK recipients were out-ranked** (median donor age 32).
- From these 15 donors **12 kidneys went to Level 2 kidney-only recipients** (i.e. EPTS≤25)

Donor age	Recipient of kidney 1	Recipient of kidney 2
11	Level 1d (mPRA 97)	Level 2c
25	-	-
19	Level 2c	Level2c
45	Level 2a	Level 2d
39	Level 1a (mPRA 99.7)	Level 1c (mPRA 98)
40	Multi-organ Tx	Level 1b (mPRA 99)
19	Level 2c	Level2c
32	Level 2c	-
54	Multi-organ Tx	Level 1c (mPRA 98)
27	Level 1b (mPRA 99)	Level 1d (mPRA 97)
42	Level 1d (mPRA 97)	Level 2c
39	Multi-organ Tx	Level 1b (mPRA 99)
18	Multi-organ Tx	Level2c
32	Level 1a (mPRA 99.7)	Level 1a (mPRA 99.7)
32	Level 2c	Level2c

Issue: Pre-emptive listing

Preemptive listing

Scenarios where preemptive listing may be warranted

- People at risk of long waiting times (e.g. very highly sensitised individuals)
- Paediatric patients
- Prior living donors
- SPK candidates
- Combined organ transplants

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Question

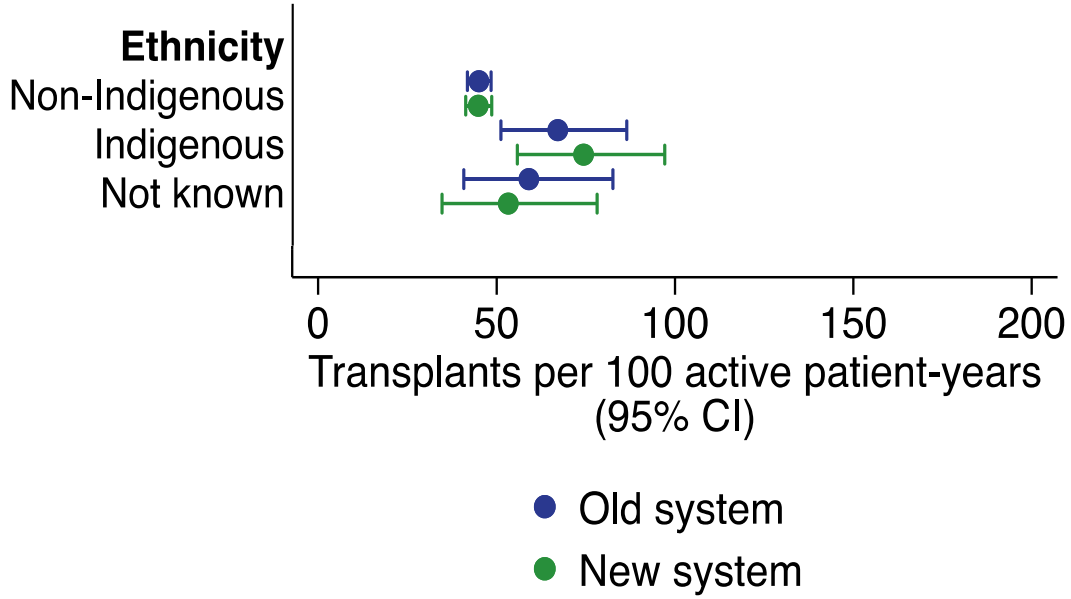
Under what circumstances should pre-emptive kidney transplantation be permitted?

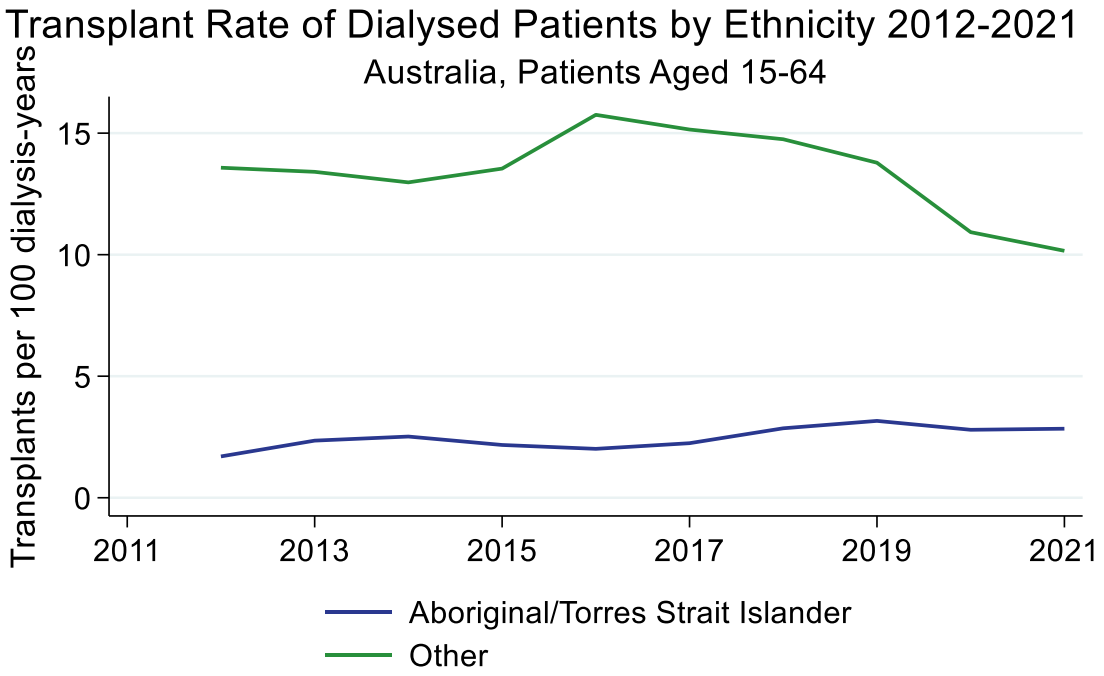
Issue: Equity

Aboriginal and Torres Strait Islander patients

Status Quo

Waitlisted First Nations patients are transplanted at a higher rate than non-Indigenous patients.





However, expressed per 100 dialysis-years, First Nations patients are transplanted at one-third the rate of non-Indigenous patients

Source: ANZDATA 45th Annual Report 2022

People with rare HLA antigens

- Concern that the emphasis on HLA-matching disadvantages ethnic minorities and people with rare HLA/HLA combinations
- In Australia, which has a highly blended population, the biggest issue is rare HLA combinations
- A solution is to offset HLA-matching points with bonus points for hard-to-match patients
- UK and France have done this

“Matchability” – UK system

Matchability

Matchability is a measure of how difficult it is to match a patient with a donor organ in the UK. The score takes into account a patient’s ***blood type, HLA type and unacceptable antigens****.*

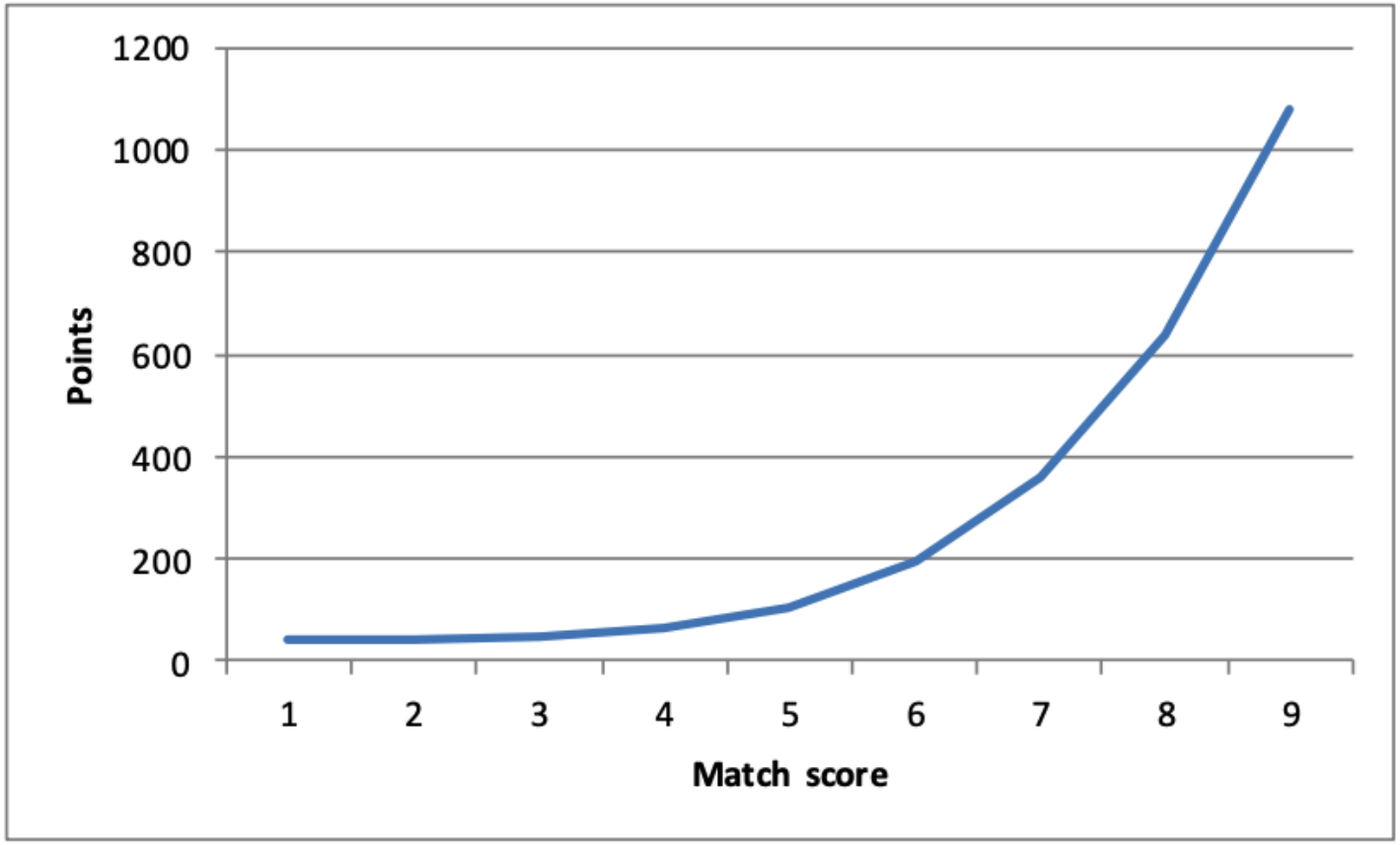
HLA type → freq in the population
Sensitisation → UA exclusions limit donor options

Matchability is calculated by counting, in the last 10,000 donors, what number were

- *Blood group identical and HLA compatible*
- *Level 1 or 2 HLA mismatch*

This number is calculated for everyone on the waiting list and the distribution is divided into deciles (1= easy to match, 10=difficult to match).

Allocation points are defined as:
$40*(1+(\text{Match score}/4.5)^{4.7})$



Matched Donor Potential - French system

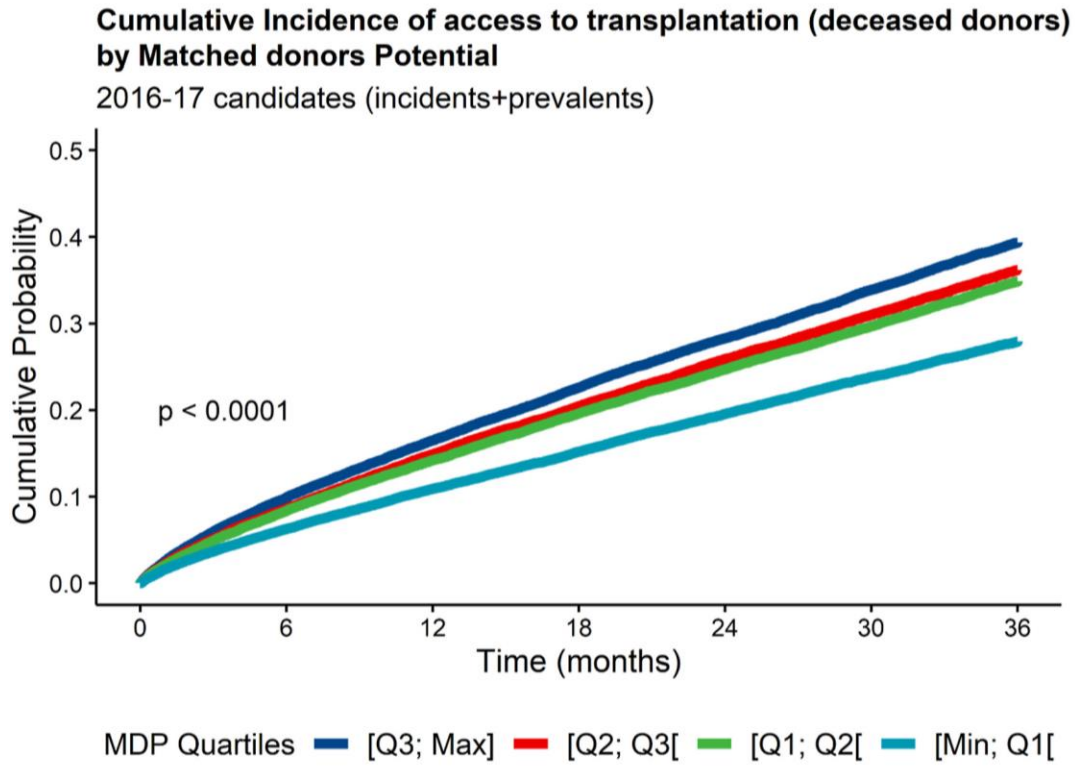
Universal Allocation Score

The UAS incorporates data on dialysis duration, time on waiting list, recipient age, donor-recipient HLA match, age matching, shipping time and the recipient's matched donor potential (MDP).

Matched donor potential

The MDP is an indicator of limited access to well-matched kidneys, and is included in the UAS as a counterbalance to the weight given to matching

Recipient MDP index is calculated based on the number of utilised deceased kidney donors over a defined interval against whom the recipient had no unacceptable antigens, with the same blood type as the patient, with a maximum sum of 3 HLA-A, -B or -DR mismatches.



Metrics for monitoring equity of system outcomes

- Age
- Indigenous status
- Ethnicity/country of birth
- Gender
- Sensitisation status
- Blood group
- Matchability
- State/territory of residence
- Area of residence (regional/remote)
- Cause of ESKD
- Combined organ transplant

Other considerations:

- Intersectionality of age, gender, ethnicity and area of residence
- Other?

What do we want a revised system to achieve?

Prognosis-matching	• *Maximise longevity of the highest quality kidneys by allocating to recipients expected to benefit the most* • *Avoid allocating best prognosis kidneys to recipients at high risk of death with a functioning graft*
Maximising benefits from scarce resources	• *Expedite access to marginal kidneys for those who might benefit from them* • *Promote the use of all available kidneys in appropriate recipients*

What do we want a revised system to achieve?

HLA-matching

- *Reduce future sensitisation for those expected to need repeat transplantation*
- *Minimise the risk of early rejection in all patients*
- *Reduce the risk of late antibody mediated rejection, extend graft survival*
- *Avoid creating inequities for specific groups/ethnicities or First Nations Australians*

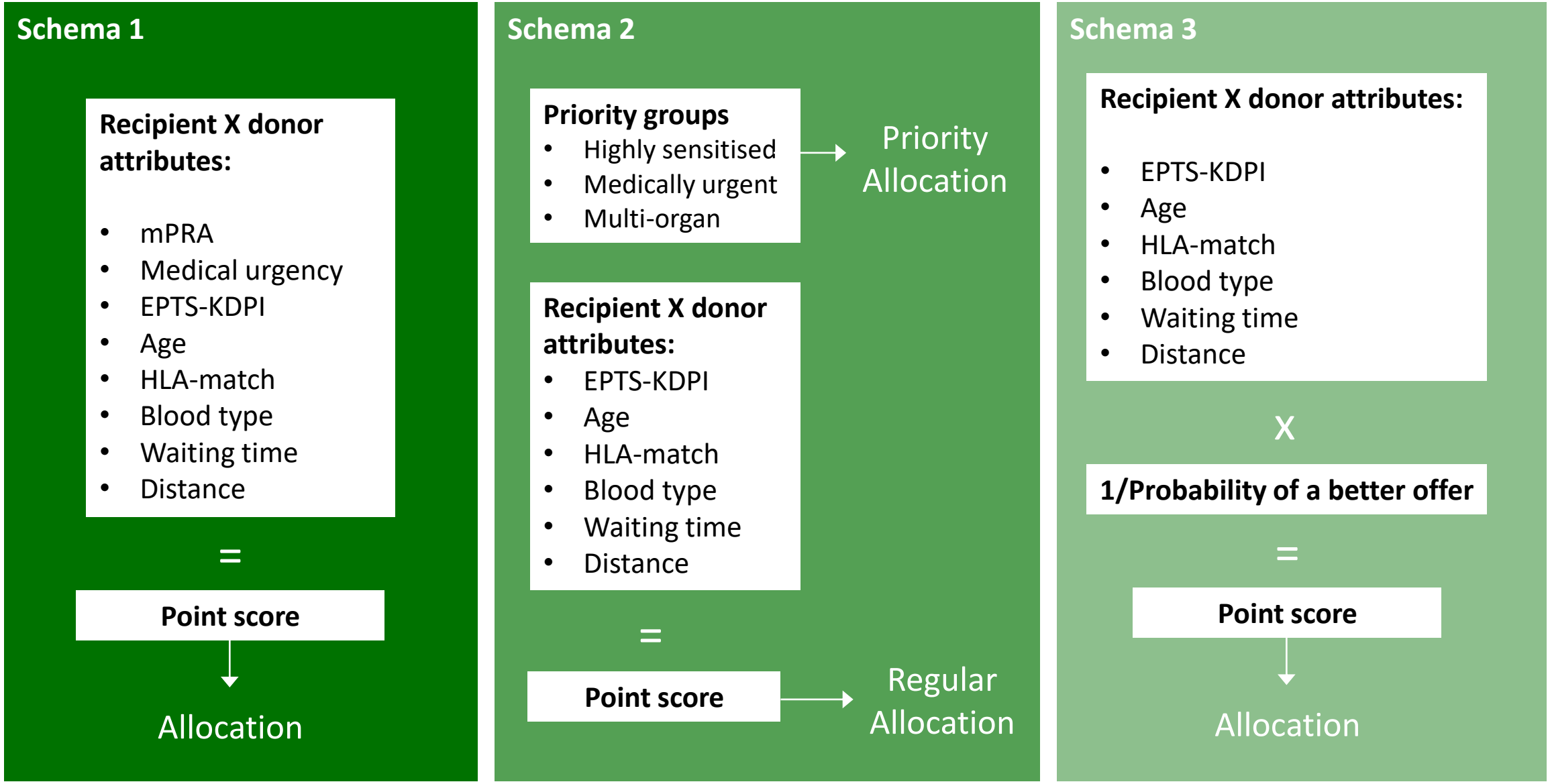
What do we want a revised system to achieve?

Paediatric patients and young people

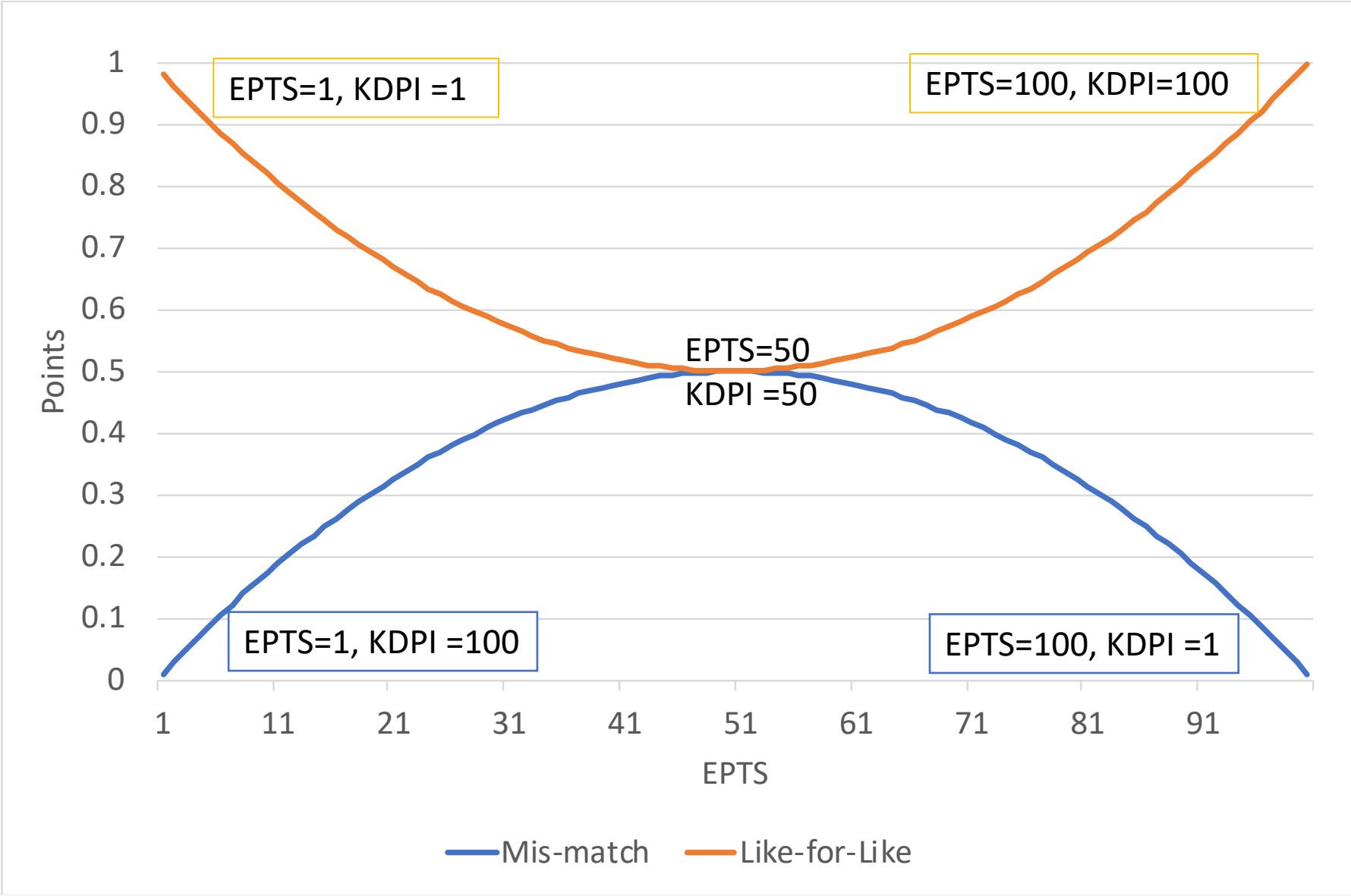
- *Good HLA matching for paediatric recipients to reduce the risk of de novo DSA, ABMR and sensitization*
- *Minimise time on dialysis for paediatric patients*
- *Increase the average longevity of grafts for younger recipients (low KDPI kidneys to low EPTS recipients)*

What do we want a revised system to achieve?

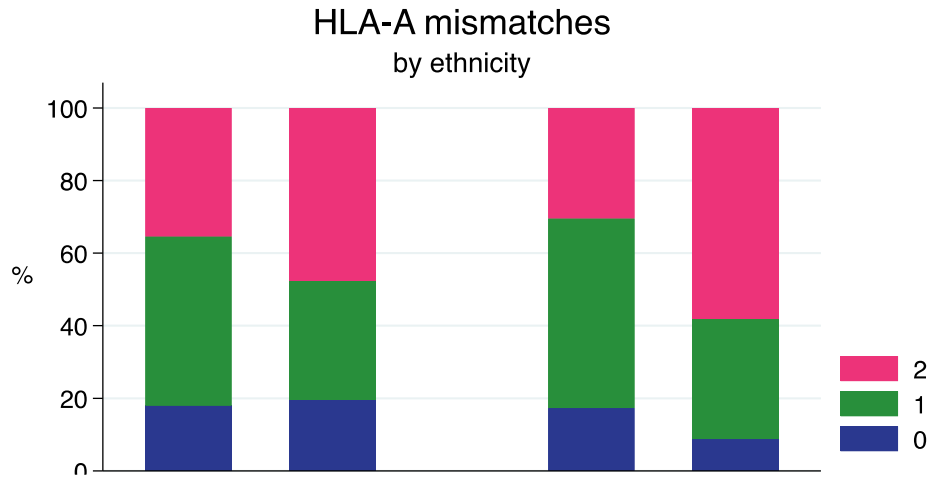
Highly-sensitised patients	• *Maximise equity in the rate of transplantation regardless of sensitisation status (i.e. minimise disadvantage caused by antibodies)*
Waiting time	• *Retain queuing equity (other relevant factors being equal, the person who has been waiting the longest has priority)* • *Minimise prolonged waiting times that are predictable*
Equity	• *Minimise differences in the rate of transplantation of waitlisted persons by gender, ethnicity, Indigenous status, location of residence.*

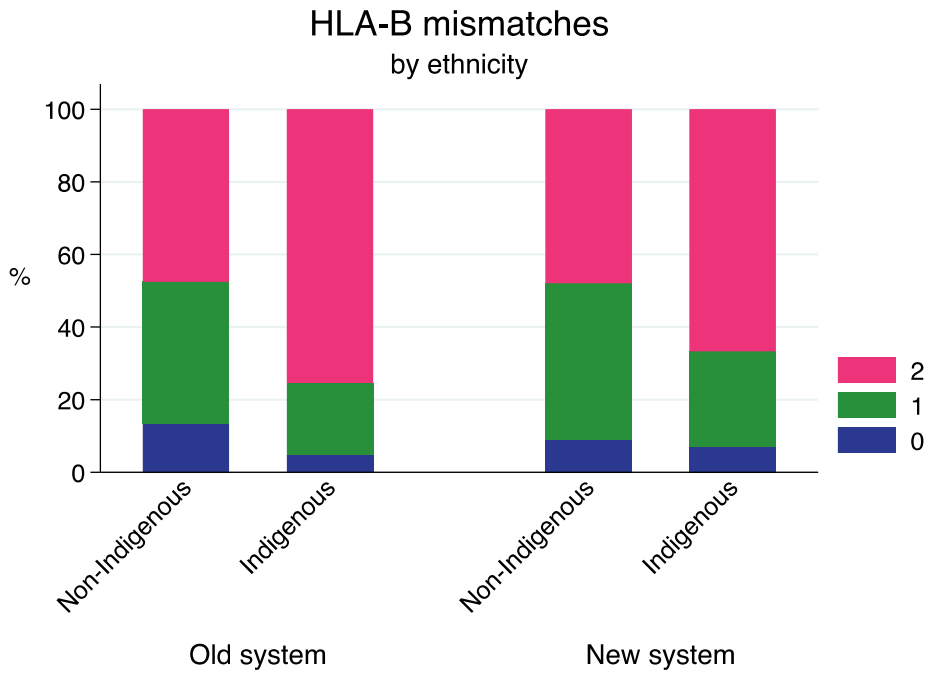

Schema 1
Recipient X donor attributes:
mPRA
Medical urgency
EPTS-KDPI
Age
HLA-match
Blood type
Waiting time
Distance
=
Point score
Allocation
Schema 2
Priority groups
Highly sensitised
Medically urgent
Multi-organ
Priority Allocation
Recipient X donor attributes:
EPTS-KDPI
Age
HLA-match
Blood type
Waiting time
Distance
=
Point score
Regular Allocation
Schema 3
Recipient X donor attributes:
EPTS-KDPI
Age
HLA-match
Blood type
Waiting time
Distance
X
1/Probability of a better offer
=
Point score
Allocation

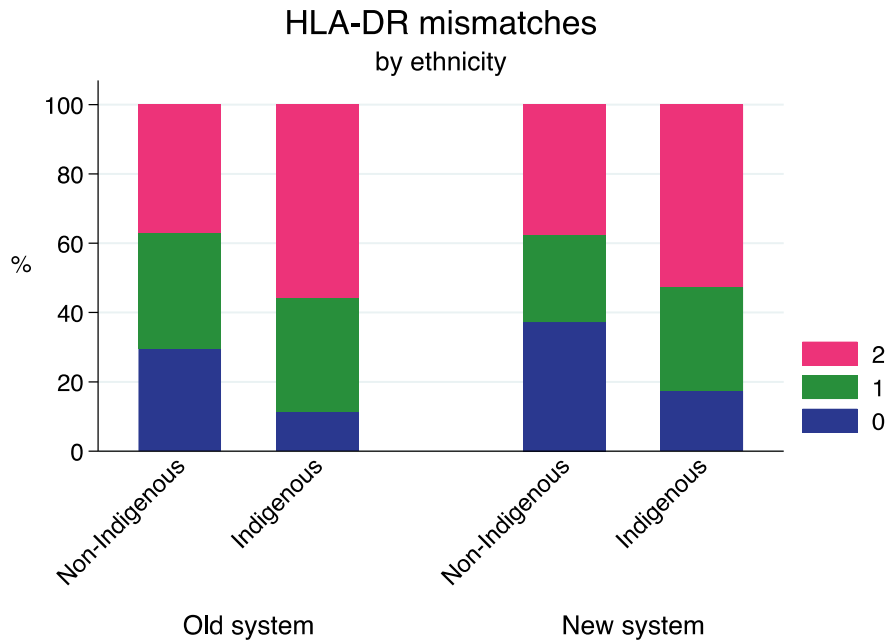
US continuous points formula



Aboriginal and Torres Strait Islander patients







Poorer HLA-A, B and DR matching for Aboriginal and Torres Strait Islander patients