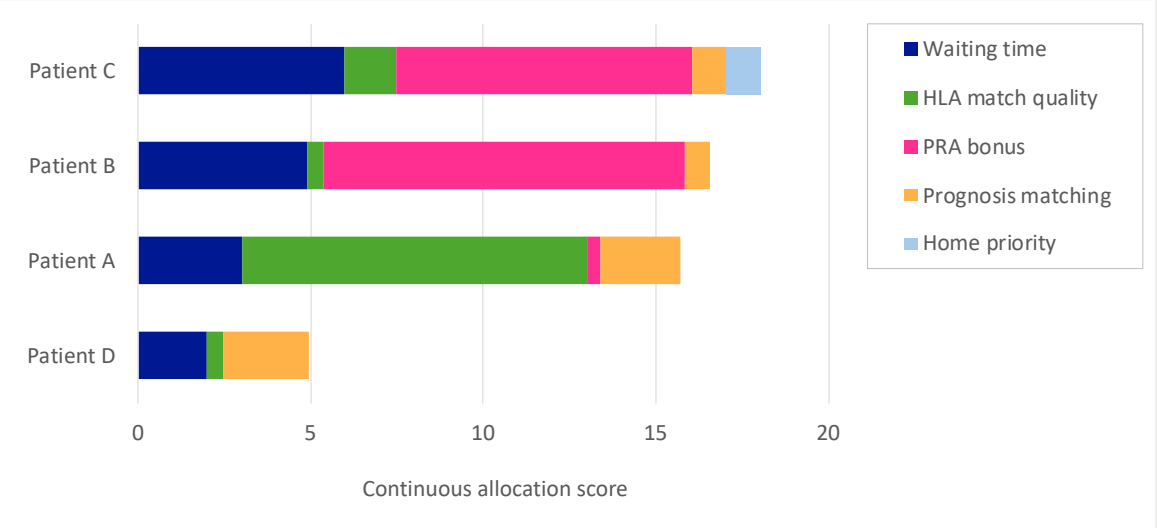
TSANZ
The Transplantation Society of Australia and New Zealand

Proposal for a Revised Australian Deceased Donor Kidney Allocation Algorithm - 2025

CONTENTS

Summary

- In Australia, the order in which kidneys from deceased donors are offered to people on the kidney transplant waiting list is determined by an algorithm.
- This algorithm takes into account recipient characteristics (such as waiting time and sensitisation level) as well characteristics of the donor-recipient match itself (the quality of the immunological match and the expected lifespan of the kidney compared to the recipient).
- The current algorithm is effective at delivering fair allocation outcomes that respect waiting times, while also addressing the needs of specific high priority groups.
- However, the current algorithm also has limitations. In particular, it is based on a series of priority categories, defined by hard cut-offs. These hard cut-offs at the transition from one level of priority to the next can produce allocation outcomes that may seem arbitrary or unfair.
- The TSANZ Renal Transplant Advisory Committee established a Working Group in 2023 to address these limitations. Over an 18-month period, the Working Group consulted with stakeholders, established the objectives of the new system, identified options, and reviewed simulated outcomes of these options.
- The new design proposed by the Working Group is based on a continuous points score. Waitlisted individuals receive points for various attributes and these points are added together to give a final allocation score. This will change the way that patients are ranked in allocation by considering multiple patient factors simultaneously.



A person's total allocation score will determine their rank order in offers. In this example, Patient C receives the most points and would get the first offer.

- Compared to the current algorithm, modelling predicts that the new algorithm would achieve:
  - Better matching of recipients to donors based on the expected lifespan of the kidney
  - Better immunological matching of donors to recipients
  - More equal waiting times across different ethnic groups
  - Lower waiting times for 18-34 year-olds (average of 6 months shorter waiting time), but slightly higher waiting times for 50-64 year olds (average of 2 months longer waiting time).

About Kidney Allocation in Australia

Australians who are on the waiting list for a deceased donor kidney transplant are offered kidneys according to an algorithm that is run by OrganMatch each time that a suitable deceased donor is referred. The kidney allocation algorithm is a set of rules that determine which kidneys will be offered to which waitlisted patients, and in what order.

Although we commonly refer to the "waiting list", a more accurate description would be a "waiting pool". When a deceased donor becomes available, the allocation algorithm creates a ranked list of potential compatible recipients from the pool of eligible recipients. Whether a potential recipient ranks high or low on this list will depend on recipient characteristics such as length of waiting time, but it will also depend on how well-matched they are with that specific donor. The order of the list is therefore slightly different for every donor, with better-matched recipients closer to the top.

Kidney allocation in Australia is based on the following principles:

- All eligible waitlisted persons, regardless of ethnicity, gender, or state/territory of residence, have an equal right to transplantation
- People who have been on dialysis for longer should have higher priority
- Priority should be given to people for whom it is particularly difficult to find a compatible kidney, to give them a more equal chance at getting transplanted
- The allocation system should seek to maximise the life years saved from available donor organs
- Children and young people should receive priority over older adults for well-matched kidneys.

The rules which govern the allocation of deceased donor kidneys are separate from the rules that determine who is eligible to go on the kidney transplant waiting list (i.e. eligibility criteria).

Eligibility criteria consider factors such as comorbid conditions and the current health status of the patient, their risk of complications and capacity to benefit from a transplant, and their ability to adhere to complex medical treatment post-transplant. Once a person is determined to meet the eligibility criteria and is added to the deceased donor kidney transplant waiting list, the cause of their kidney disease, their comorbid conditions, and their health-related behaviours do not influence kidney allocation.

The Current Algorithm

How does it work?

The current Australian deceased donor kidney allocation algorithm includes a "National Allocation Algorithm" and a "State Allocation Algorithm". Kidneys are offered first via the National Algorithm, then via the State Algorithm.

Technical details are provided in the section: *The Current Australian Kidney Allocation* Algorithm.

FIRST TIER OF ALLOCATION	**National Allocation Algorithm** Kidneys are first offered by the National Allocation Algorithm to high priority recipients in the following order: National Priority Level 1 – Very highly sensitised individuals (PRA ≥95%) National Urgent Status – National urgent listings (exceptional circumstances) National Priority Level 2 – Good immunological matches for young recipients
SECOND TIER OF ALLOCATION	**State Allocation Algorithm** If not allocated at the National level, kidneys are offered to recipients in the same state as the donor in the following order: State Urgent Status – Persons deemed as urgent by the State Renal Advisory Committee Priority Level 1 – Good immunological matches Priority Level 2 – Persons who have been waiting the longest.

The National Algorithm is designed to give first access to kidneys, regardless of where they were donated, to patients who meet certain priority criteria. These priority criteria are:

1. Very highly sensitised individuals* (PRA ≥95%) who need extra priority and access to a larger donor pool to find a compatible kidney
2. National urgent listings (a category only used in exceptional circumstances: e.g. dialysis access is failing in an infant)
3. Where the donor is a good immunological match for a young recipient.

About one-third of kidneys are currently allocated via the National Algorithm. The rest are allocated according to the State Algorithm, which gives priority to recipients in the same state as the donor in the following order:

1. Persons deemed as urgent by the State Renal Advisory Committee (again, only applies in exceptional circumstances)
2. Good immunological matches*
3. Persons who have been waiting the longest.

In addition, the State Algorithm gives extra priority where the expected life span of the kidney is well-matched to the expected post-transplant survival of the recipient. This is called "prognosis matching" and

is achieved by matching the Kidney Donor Profile Index (KDPI) with the Expected Post-Transplant Survival (EPTS) score for the recipient.*

Bonus points for paediatric patients are given as part of both the National and State Allocation Algorithms. These bonus points mean that, all else being equal, a recipient under 18 years will get priority over an adult recipient.

Lastly, waiting time is used to differentiate between potential recipients who are otherwise similar. That is, all else being equal, the person who has been waiting longest has priority.

*Definitions of sensitisation, immunological matching, KDPI and EPTS scores, and prognosis matching are found in the *Additional Resources* section.

Why does the algorithm need to change?

The current algorithm is largely effective at delivering fair allocation outcomes that respect waiting times (i.e. the person who has been waiting the longest will get the offer) and addressing the needs of very highly sensitised individuals. However, it does have some limitations and areas where it could be further optimised. The key limitations of the current system are as follows:

- It is based on a series of hierarchical levels of priority, defined by hard cut-offs. These hard cut-offs at the transition from one level of priority to the next can produce allocation outcomes that seem arbitrary or even unfair.
- The system could do more to maximise the number of life-years saved from kidney transplantation (system utility). The current criteria for matching the expected lifespan of the kidney with the expected lifespan of the recipient are very broad and still permit very wide differences in prognosis.
- The current rules around immunological matching mainly benefit those individuals who are easy to match; persons with uncommon HLA profiles are at a disadvantage.
- Minority ethnic groups (including First Nations Australians) have longer average waiting times, related in part to the greater difficulty of finding a good immunological match.
- The paediatric bonus ends at age 18, causing anxiety for waitlisted young people as their 18th birthday approaches.

The design of a new allocation system presents an opportunity to address these limitations. Any new system, however, will still be constrained by the number of deceased donor kidneys available for transplantation in Australia. Although we may be able to make changes that bring differences in waiting times between different population groups to within acceptable limits, a new allocation system cannot reduce waiting times overall, as to do this would require an increase in the number of available donors.

Creating a new system

How was the new system developed?

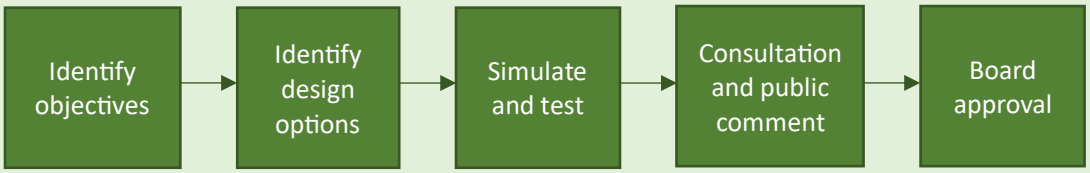
A Working Group was formed by the Renal Transplant Advisory Committee of the Transplantation Society of Australia and New Zealand in 2023, with the task of developing a new algorithm for the allocation of deceased donor kidneys in Australia. This Working Group included representatives from all Australian transplant regions (QLD, NSW/ACT, VIC/TAS, SA/NT, WA) and met monthly for approximately 18 months. A Biostatistics Focus Group, formed from the wider Working Group, developed and ran simulations and tested various proposals.

The development of the new algorithm involved 4 main phases:

1. Identification of the limitations of the current system and the objectives of the redesign
2. Identification of the ideal future state and options for how to get there
3. Running of simulations and sensitivity analyses for different options, followed by evaluation of outcomes
4. Consultation with stakeholders.

The consultation phase of this project involved presentations to and discussions with the wider nephrology community, transplant clinicians, donor coordinators, transplant nurses, transplant recipients and waitlisted patients. A public comment window supported with an information website was opened to comments from any interested parties in April/May 2025.

Algorithm development process



Goals and objectives

The objectives of the new allocation algorithm are summarised below.

Domain	Objectives
Equity	• Minimise differences in waiting times by gender, ethnicity, Indigenous status, location of residence
Waiting time	• All other factors being equal, the person who has been waiting the longest has priority (queuing equity) • Minimise prolonged waiting times that are predictable (i.e. the differences between groups in their waiting times should be within acceptable limits)
Sensitised patients	• Minimise the disadvantage caused by antibodies/sensitisation status
Immunological matching	• Reduce future sensitisation for those expected to need repeat transplantation • Reduce the risk of antibody mediated rejection and extend graft survival • Avoid creating inequities for specific groups/ethnicities
Maximising life years from transplantation	• Maximise longevity of the highest quality kidneys by allocating to recipients who are expected to benefit the most from them • Faster access to kidneys with a shorter expected lifespan for those who might benefit from them • Promote the use of all available kidneys in appropriate recipients
Paediatric patients and young people	• Reduce the risk of sensitisation against future transplants • Minimise time on dialysis for paediatric patients • Match younger recipients with kidneys with a long expected lifespan

The Proposed New System

How is it different to the current system?

Instead of a system based on levels of priority and hard cut-offs, the new proposed system is based on a continuous points score. The advantage of this approach is that it considers the complete picture of a person when determining their rank in the offer list, not simply whether they meet the criteria for a single priority category. It will change the way that patients are ranked in allocation by considering multiple patient factors simultaneously.

Internationally, the UK and France have already incorporated continuous points scores into their kidney allocation systems. The United States are also in the process of introducing a continuous points score (https://optn.transplant.hrsa.gov/policies-bylaws/a-closer-look/continuous-distribution/#CD_Points).

How would the new system work?

Figure 1 illustrates how a continuous points-based approach to allocation would work. Waitlisted individuals receive points for various attributes (represented by the different coloured bars, the length of the bar indicates the number of points given). The points are added together to give a final allocation score.

Each attribute has a specific weight, meaning some attributes will have more effect than others on the total allocation score, yet no one attribute will decide an organ match. A individuals' total score will determine their rank order in the offer list. In this example, Patient C receives the most points and would get the first offer.

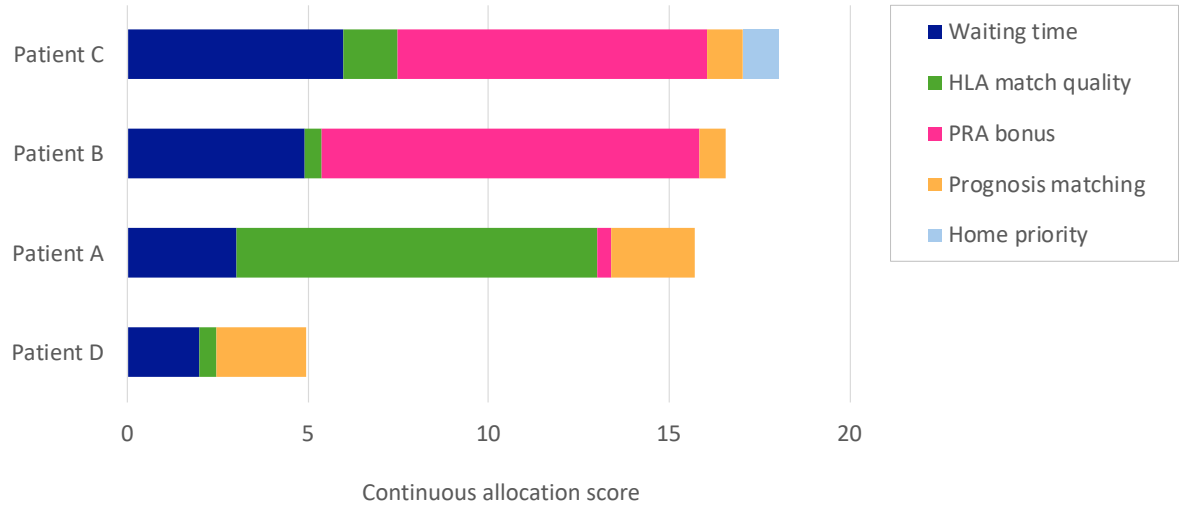


Figure 1: Conceptual schema of the proposed continuous points system.

Under the proposed new Australian kidney allocation algorithm, all waitlisted patients will receive a continuous allocation score based on the sum of points awarded for the following attributes:

- Waiting time
- The quality of the HLA match (is this a good immunological match for this person?)

- PRA value (more sensitised = higher points)
- Prognosis matching (difference between EPTS and KDPI – see *Key concepts: Prognosis matching*)
- Home state bonus (1 bonus point for recipients in the same region as the donor)
- Urgent or other priority status (applies in limited specific situations).

The technical specifications for the calculation the continuous allocation score is provided here: *Proposed New Algorithm: Technical Specifications*

How will patients benefit?

A computer simulation of the proposed new allocation system was constructed to examine predicted outcomes, including waiting times, the quality of the immunological matching, and the extent of prognosis matching. Predicted outcomes for the new system were then compared to the observed outcomes for the current system.

The key predicted changes compared to the current system are:

- Better prognosis matching overall (see *Key concepts: Prognosis matching*)
- Better immunological matching of donors to recipients, especially for younger people and for ethnic minority groups
- Less disparity in waiting time by ethnicity (i.e. waiting times are more equal across ethnic groups)
- Slightly reduced waiting times for highly sensitised patients
- Lower waiting times for 18-34 year-olds (average of approximately 6 months shorter waiting time), but slightly higher waiting times for 50-64 year olds (average of approximately 2 months longer waiting time)
- Slightly reduced waiting times for 65+ age group and closer prognosis matching.

Summary of predicted outcomes of KOALA versus current allocation system

Age group	Waiting time	Quality of immunological matching	Average KDPI value
0-17	Slightly lower	Significantly Improved	Unchanged
18-34	Lower	Significantly Improved	Unchanged
35-49	Lower	Significantly Improved	Unchanged
50-64	Slightly higher	Improved	Unchanged
65+	Slightly lower	Improved	Higher

How will I be affected?

The new system would potentially affect which kidneys are offered to you and, in some cases, how long you will need to wait.

The new system is specifically designed to offer *better*-matched kidneys to waitlisted patients, both in terms of their expected longevity and the quality of the immunological match. Our simulations indicate that you will be more likely to be offered a kidney that is a good immunological match for you personally. Offers are also predicted to be more closely matched in terms of expected longevity.

The following hypothetical cases describe how the new system would affect patients at the individual level.

"Ben"

Age: 21
Blood group: A
PRA: 0%
Ethnicity: Caucasian

Modelling indicates remaining waiting time would be slightly reduced under the new system, due to greater emphasis on good matches for young people. The quality of HLA-matching of offers would be improved.

"Sophie"

Age: 35
Blood group: B
PRA: 85%
Ethnicity: Caucasian

Modelling indicates remaining waiting time would be significantly reduced under the new system, due to greater emphasis on good matches for young people and changes to how sensitised individuals are prioritised. The quality of HLA-matching of offers would be improved.

"Margaret"

Age: 54
Blood group: A
PRA: 20%
Ethnicity: Caucasian

Modelling indicates remaining waiting time would be slightly increased under the new system. This is because of additional priority going to young people.

"John"

Age: 42
Blood group: A
PRA: 0%
Ethnicity: Aboriginal

Modelling indicates remaining waiting time would be reduced under the new system. Changes to how HLA-matching is prioritised increases transplant opportunities for Aboriginal and Torres Strait Islander patients, ethnic minorities and difficult to match patients.

"An"

Age: 52
Blood group: O
PRA: 0%
Ethnicity: Asian

Modelling indicates remaining waiting time would be slightly reduced under the new system, due to changes to blood group compatible rules that reduce inequities for blood group O patients

"Claire"

Age: 56
Blood group: A
PRA: 98%
Ethnicity: Caucasian

Modelling indicates remaining waiting time would be reduced under the new system, due to changes to how sensitised individuals are prioritised. The quality of HLA-matching of offers would be improved.

Multiorgan transplants

Simultaneous pancreas-kidney (SPK) transplantation

The majority of solid organ pancreas transplants in Australian are undertaken as simultaneous pancreas and kidney (SPK) transplants in recipients with both type 1 diabetes and kidney failure.

Under the current Australian allocation system, when a pancreas is donated for SPK transplantation, one of the donor kidneys is also allocated to the same recipient. The second kidney is then made available to be allocated to a kidney-only recipient according to the standard kidney allocation algorithm. However, if there are two potential kidney-only recipients who qualify for Level 1 or Level 2 National priority (due to being highly sensitised or a very good immunological match) then the allocation to the SPK patient will not occur (i.e. will be vetoed) and the kidneys will be allocated to the two kidney-only patients instead.

Under the proposed new allocation system, when a suitable pancreas is donated for SPK transplantation, one of the kidneys will also be allocated with the pancreas unless there are two potential kidney-only recipients with allocation scores of 15 points or higher.

In practical terms, this means that approximately 15% of kidney-only patients would be given priority ahead of SPK patients, compared to approximately 20% under the current system. It is predicted that this new rule would lead to a small reduction in waiting time for SPK patients.

SPK patients can also be dual-listed on the kidney-only waiting list. If they receive an offer from the kidney list and the pancreas is suitable and available, an SPK transplant can proceed. This is particularly relevant to SPK patients who are also highly sensitised and need the large points bonus that is given to highly sensitised patients in order to increase their chance of receiving any transplant.

Other multi-organ transplantation

Under the current kidney allocation system, recipients who need a combined kidney-liver, kidney-heart, kidney-lung or other multi-visceral transplant have priority over all kidney-only and SPK transplants. When a suitable liver, heart or lung arises, the kidney is offered along with the other organ and is not offered to the kidney-only list.

Under the proposed new allocation system, kidney-liver, kidney-heart, kidney-lung, and other multi-visceral transplants will continue to have priority over kidney-only and SPK transplants.

Public Feedback on the New Algorithm

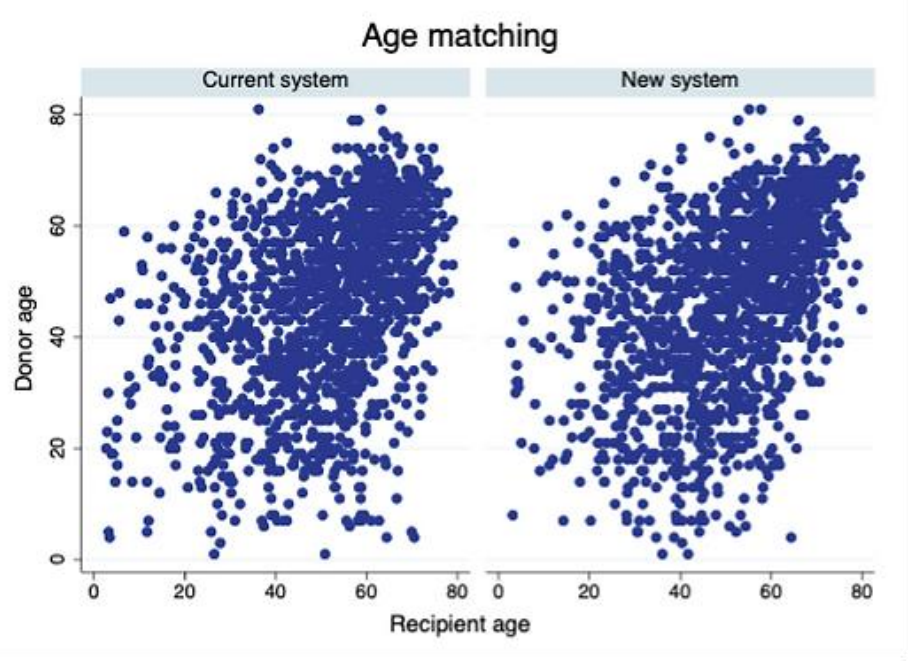
Is there a role for donor versus recipient age-matching in the new system?

The proposed new algorithm uses "prognosis matching" to minimise differences in the expected lifespan of the donor kidney and the recipient. Prognosis matching points are calculated based on the difference between the Kidney Donor Profile Index (KDPI) score and the Expected Post Transplant Survival (EPTS) score of the recipient, with higher points awarded for like-for-like matches. The largest prognosis points scores go to low-KDPI to low-KDPI matches and high-KDPI to high-EPTS matches.

The KDPI and EPTS scores are largely driven by age; prognosis matching, therefore, is very similar to age matching. However, prognosis matching has the advantage of also taking into account other relevant factors that impact on kidney quality, such as history of diabetes, history of hypertension, kidney function, stroke as cause of death and circulatory versus brain death.

Simulations of the new system indicate that prognosis matching would be improved compared to the status quo. Age matching would also be improved: in particular, there are fewer instances of young donor kidneys going to older recipients in the simulation.

The options of direct age matching or penalties for very wide disparities in donor and recipient age were considered and tested. These options, however, did not deliver better system outcomes compared to, or in addition to, prognosis matching.



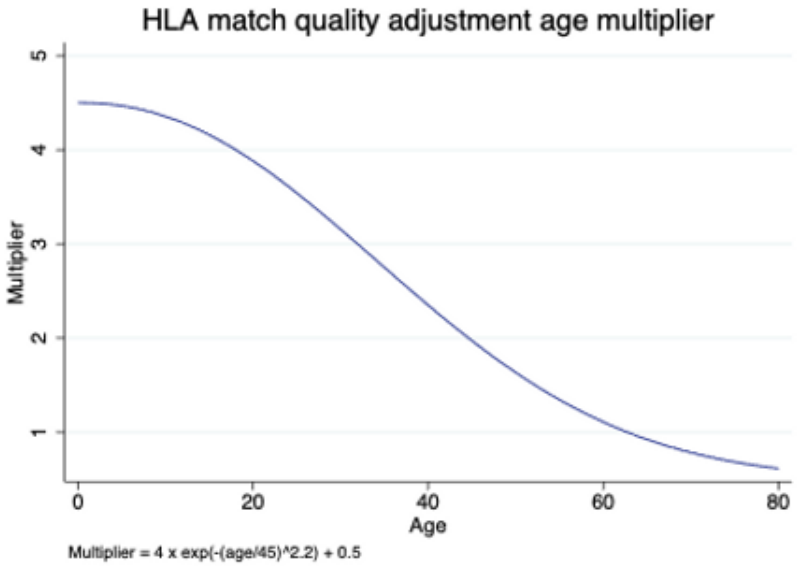
How does the new algorithm address the needs of paediatric patients?

The goals of the new algorithm with respect to children and young people are to (i) reduce the risk of sensitisation against future transplants (ii) minimise time on dialysis and (iii) match young recipients with kidneys with a long expected lifespan.

Instead of a simple waiting time bonus, the new algorithm gives priority to paediatric patients and young people in proportion to the quality of the immunological match with the donor. The quality of the immunological match is reflected by an HLA match score. Age-based waiting is then applied to HLA match scores, to give particular emphasis to good HLA matches for young people. Therefore, for a given paediatric candidate, when a donor arises that is a good HLA match for them personally (taking into account that some patients are harder to match than others) this match will be given a large points bonus.

Put another way, instead of simply being "first in line" for the next kidney offer, paediatric patients will get very high priority for any kidneys that are a good immunological match for them personally. The age-based weighting applied to HLA matching scores is shown below. Weighting declines gradually until age 18, then more rapidly thereafter.

Simulations indicate that the new algorithm will result in paediatric patients getting better quality, better matched, offers. That is, it is predicted that the new algorithm will result in paediatric patients being transplanted with kidneys that are likely to last longer and cause less sensitisation.



What is the reasoning for giving priority to prior living donors?

Under the new algorithm, prior living donors would get 10 bonus points. Ten points is equivalent to 10 years of waiting time in terms of its impact on a person's continuous points score. This value was chosen on the basis that (a) highly sensitised, urgent, and excellent matches for young people would still automatically out-rank prior living donors and therefore would not be impacted by this rule and (b) it would allow prior living donors to decline bad matches while getting offers frequently enough to enable them to be transplanted reasonably quickly.

A consumer consultation on the proposed new algorithm was undertaken as part of this project and engaged 23 consumers (transplant recipients and currently waitlisted patients) in a series of small group sessions. The participants in the consumer consultation expressed strong, unanimous support for giving prior living donors priority in allocation.

If, after being appropriately screened for living donation, a living donor goes on to develop kidney failure, then priority in allocation reflects the principle of reciprocity. The donor has contributed to meeting the needs of the community and priority on the waiting list mitigates the physical harms they have voluntarily incurred through this act. This is consistent with consumer views: the consumers that were consulted for this project stated that priority for prior living donors is something they would consider fair and just. Consumers frequently referred to living donation as an altruistic act and a gift; importantly however, the purpose of a priority bonus for prior living donors is not a reward for an altruistic act – it is intended as fair and just response to harms incurred through the act of living donation.

Could additional priority be considered for people living in remote areas who have to travel long distances for dialysis?

An underlying principle of the Australian kidney allocation system is that waitlisted patients, regardless of gender, ethnicity or location of residence, have an equal right to transplantation. Where the system gives additional priority, this is to address biological barriers that make it more difficult for some people to find a compatible kidney or in specific urgent or otherwise exceptional cases. Children and young people are also given priority over older recipients for well-matched kidneys; this is also largely for biological/clinical reasons.

The many challenges of having to travel long distances for dialysis are acknowledged. Giving priority to certain waitlisted candidates based on location of residence so that they get transplanted faster than other candidates would not, however, be consistent with equity goals. There are also some practical limitations to consider. In particular, many people move in order to access dialysis, making it difficult to accurately and fairly determine who would qualify for a theoretical remoteness bonus.

Poor access to dialysis facilities in remote parts of Australia is a real issue, but not necessarily one that is best addressed via the kidney allocation algorithm.

When will HLA matching for antibody epitopes be introduced?

The potential for epitope matching was discussed by the Working Group and with the heads of Australian Tissue Typing labs during stakeholder consultations. The expert view was that scientific and technical limitations currently preclude the incorporation of eplet matching into the allocation algorithm. Specifically:

- Real-time donor typing is not universally at a sufficiently high resolution to support eplet matching
- Eplets are not yet sufficiently defined – i.e. we do not yet have a complete picture of the significance of all mismatches and this knowledge base would need to be more advanced before we could design an approach that would yield consistent outcomes.

However, it is anticipated that this situation will change in future. The proposed approach to how we assign points for HLA matching in the new algorithm – based on the relative quality of a given match versus what the candidate can expect from the donor pool – can be readily adapted to a future matching paradigm based on eplets instead of antigens.

Will the new algorithm be monitored for unintended consequences?

Monitoring and evaluation of the new allocation algorithm is essential, as is system transparency. A monitoring and evaluation plan has been prepared that includes recommendations for regular data monitoring and formal reporting at 12 and 24 months post-implementation. These reports will include detailed data on system outcomes and an assessment of how well the new system is meeting its stated objectives. It will also describe plans to address any unintended consequences or aspects of the algorithm that are not meeting benchmarks. These reports will be accessible by all stakeholders (including patients and families).

Monitoring the new system

Following implementation, the outcomes of the new algorithm would be closely monitored (with the oversight of the TSANZ Renal Transplant Advisory Committee) for any unintended consequences of the change. A detailed monitoring plan has been prepared as part of this project, based around carefully chosen metrics.

If unintended or unexpected outcomes of the system become apparent through monitoring, steps will be taken to make revisions the new algorithm, to bring outcomes back in line with system objectives.

Additional Resources

The Current Australian Kidney Allocation Algorithm

National Allocation Algorithm

- Within OrganMatch it is possible for a patient with their nephrologist to indicate a specific maximum level of KDPI (KDPI max) that they are willing to accept. In the National Allocation Algorithm, the KDPI max value is applied to Level 2 and Level 3 allocation only.
- A maximum KDPI value of 20 is applied to kidneys retrieved from donors <18 years

Match Level	Description/Notes	Criteria	Base score
1	Very highly sensitised	**1a** mPRA ≥99.7	99 700 000
	ABO compatible matches allowed	**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 matches allowed	Recipient National urgency >0	90 000 000
2	HLA matching with EPTS restriction	**2a** 0 mismatches at HLA-A or HLA-B and EPTS ≤25	89 000 000
	Prioritises good HLA matches for low EPTS recipients	**2b** 1 mismatch at HLA-A or HLA-B and EPTS ≤25	88 000 000
	Recipients must be matched at HLA-DRB1 and ABO matched	**2c** 2 mismatches at HLA-A or HLA-B and EPTS ≤25	87 000 000
		2d 0 mismatches at HLA-A or HLA-B and EPTS ≤60	86 000 000
3	HLA matching and highly sensitised	**3a** 0 mismatches 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 mismatch at HLA-A or HLA-B or HLA-DRB1 and mPRA >80	77 000 000
	Centre credit difference (interstate pay-backs)	**3d** Matched at HLA-DRB1, 1 mismatch at HLA-A or HLA-B, mPRA ≤80 and centre credit difference ≤-3	76 000 000
	Restricted to EPTS-KDPI difference of <50 points	**3e** Matched at HLA-DRB1, 2 mismatch at HLA-A or HLA-B, mPRA ≤80 and centre credit difference ≤-6	75 000 000
		3f mPRA >80 and centre credit difference ≤-9	74 000 000
		3g Centre credit difference <-20	73 000 000

Other parameters	Bonus points added	
Paediatric bonus	0-17 years	250 000
	18 years	218 750
	19 years	187 500
	20 years	156 250
	21 years	125 000
	22 years	93 750
	23 years	62 500
	24 years	31 250
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	

State Allocation Algorithm

- Allocation initially matched with a restriction applied (EPTS-KDPI difference ≤50).
- KPDI max at clinician's discretion. If specified in OrganMatch, it will be applied to all Levels of State Allocation.
- A maximum KDPI value of 20 is applied to kidneys retrieved from donors <18 years.

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-matching	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

Additional bonuses applied at the State Level	Bonus points added	
Paediatric bonus	0-17 years	10 000 000
Restricted algorithm – state HLA matching	18 years	8 750 000
Points = 10 000 000 – ((10 000 000/(25-17))*(age-17)	19 years	7 500 000
	20 years	6 250 000
	21 years	5 000 000
	22 years	3 750 000
	23 years	2 500 000
	24 years	1 250 000

Paediatric bonus	0-17 years	100 000
Restricted algorithm – state waiting	18 years	87 500
Points = 100 000 – ((100 000/(25-17))*(age-17)	19 years	75 000
	20 years	62 500
	21 years	50 000
	22 years	37 500
	23 years	25 000
	24 years	12 500
Recipient and Donor are HLA DRB1 homozygote	500 000 to state HLA matching algorithm only	

In the event that more than one patient has the same score, the ranking of the patients with identical scores is randomized.

Interstate Utilisation Algorithm

In rare situations there may not be enough patients in a given state to be able to accept the available kidneys. Most often this occurs if the donor has a rarer blood group, such as AB. If there are not enough patients to receive the kidneys locally, the interstate utilisation algorithm is run. This list incorporates patients from across the country, to ensure that the kidneys do not go to waste.

Kidneys that are offered via the interstate utilisation algorithm and eventually accepted at offer rank 20 or higher are excluded from the calculation of the centre credit balance.

Level	Description	Details	Restricted base score	Unrestricted base score
State HLA	HLA mismatches A/B/DRB1	**1a** 0 0 0	19 000 000	9 000 000
		1b 1 0 0 or 0 1 0	18 000 000	8 000 000
		1c 1 1 0	17 000 000	7 000 000
		1d 0 0 1	16 000 000	6 000 000
		1e 2 0 0 or 0 2 0	15 000 000	5 000 000
		1f 1 0 1 or 0 1 1	14 000 000	4 000 000
		1g 2 1 0 or 1 2 0	13 000 000	3 000 000
State Waiting	Months on dialysis	Number of months x 1	10 000 000	0

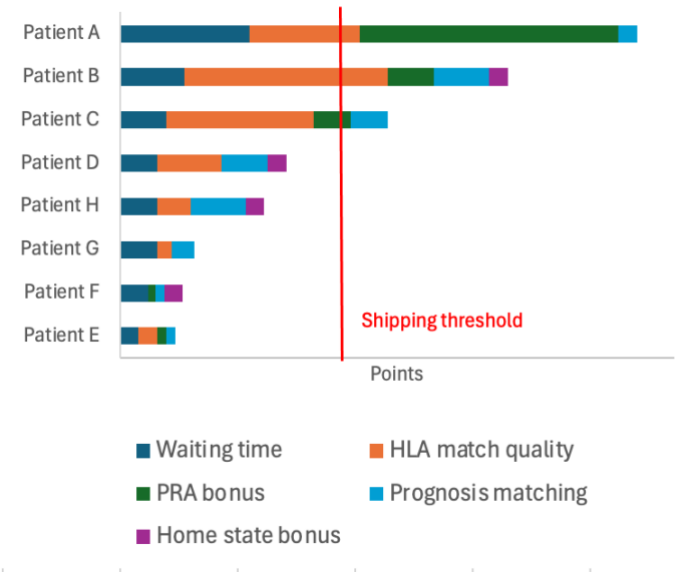
Proposed New Algorithm: Technical Specifications

A universal continuous points allocation score is calculated as the sum of points awarded for each of the following attributes:

1. Waiting time
2. HLA match adjustment
3. PRA bonus
4. Prognosis match bonus
5. Same state bonus
6. Urgent/priority bonus: National urgent bonus, State priority bonus, Prior living donor bonus, or kidney-after-other-organ bonus

Interstate shipping is allowed when the total score is at least as high as the shipping threshold, or if there are no local recipients.

The shipping threshold is a floating threshold that depends on the net debt between states and is calculated as 12 - 0.5 x net kidneys owed to recipient state, with a maximum value of 15.



If recipient score ≥ shipping threshold OR the recipient is within the same state as the donor, 100 points are added to the final score to ensure interstate recipients below the shipping threshold never outrank a same-state recipient. This effectively creates a separate tier equivalent to the interstate utilisation tier in the current allocation system.

For example, for a donor arising in WA:

Recipient state	Raw score	Final Score	Offer rank
VIC	25	125	1
WA	18	118	2
WA	9	109	3
NSW	8	8	4
QLD	7	7	5

POINTS CALCULATION FOR EACH COMPONENT OF THE ALLOCATION SCORE

1. Waiting time

Measured in years, not rounded, not weighted

$$\frac{days\ since\ dialysis\ start}{365.25}$$

2. HLA match quality

The intention of the HLA-match quality adjustment is to identify and prioritise what would constitute a good HLA-match for a given patient, considering the potential donor pool and the recipient's HLA-profile.

An "ABDRDQ mismatch score" is calculated to assess the HLA-match quality of individual donor-recipient pairs, based on the total number of Class I and Class II mismatches:

Each A mismatch = 1 point
Each B mismatch = 1.5 points
Each DR mismatch = 3 points
Each DQ mismatch = 3 points
ABDRDQ mismatch score = total (range 0-17 points)

For each patient, the square root of their ABDRDQ mismatch score versus a reference pool of 1000 donors is calculated. The mean and standard deviation (SD) of this sqrt(score) is calculated and stored in OrganMatch for reference.

For each individual potential donor-recipient combination, the square root of their ABDRDQ mismatch score is calculated and compared against the recipient's mean and SD (versus the reference population) to calculate a z-score, as follows:

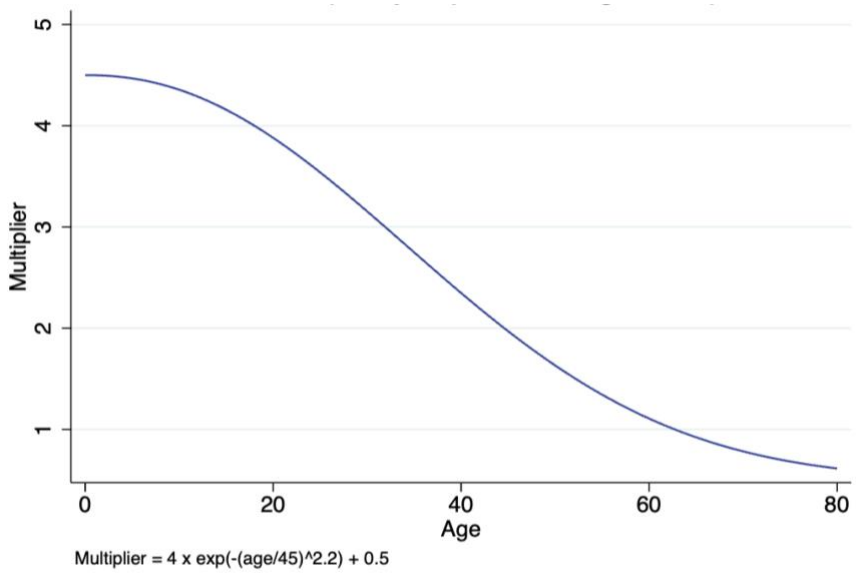
$$\frac{mean - \sqrt{ABDRDQ\ score}}{SD} \times\ age\ dependent\ scaling\ factor$$

Notes on this score:

- ABDRDQ score = the weighted sum of the number of mismatches at the A/B/DR/DQ loci
- Weights for calculating the A/B/DR/DQ score: 1:1.5:3:3
- Mean = the mean of the square-root ABDRDQ mismatch scores calculated versus a reference panel of 1000 donors
- SD = the standard deviation of the square-root ABDRDQ mismatch scores calculated versus a reference panel of 1000 donors
- The mean score is calculated against the entire reference panel, not restricted to within blood group
- The mean score is calculated when a patient is listed, and the mean and SD are stored in OrganMatch

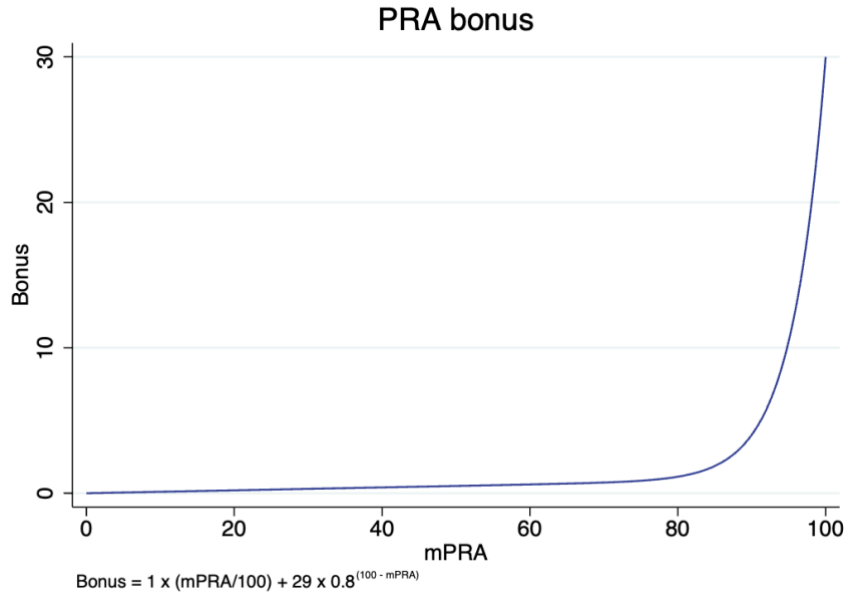
- The HLA match quality score is adjusted by a recipient age-dependent scaling factor that gives the most emphasis to good HLA matches in younger recipients
- Age-based tapering does not fall all the way to zero because it is still worth prioritising a perfectly matched 65 year-old ahead of a mismatched 65 year-old, for example, all other parameters being roughly equal

Age dependent scaling factor



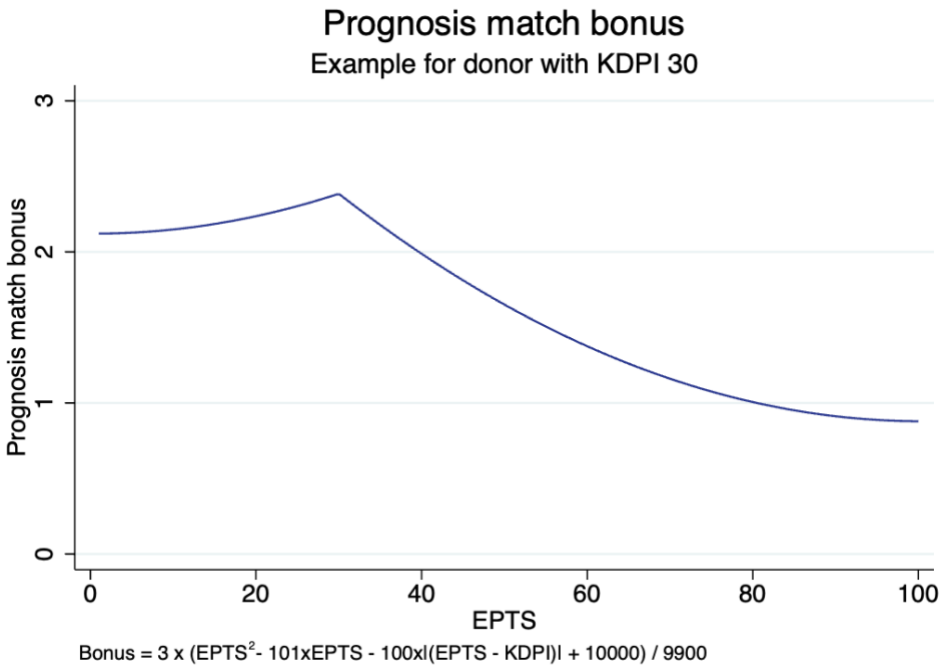
3. PRA bonus

Range 0 to 30. The parameters are: maximum 30, linear component 1, decay parameter 0.8.



4. Prognosis match bonus

Score quantifying the degree of KDPI-EPTS matching. Full details of derivation given in Appendix C. Maximum value 3.



5. Home state bonus

If the donor and recipient are in the same state, 1 bonus point is given. For all other recipients, this is set to 0.

6. Urgent or Priority bonuses

National Urgent

The "National Urgent" category applies to medically urgent cases (e.g. imminent loss of dialysis access, approved by RTAC) and to orphaned ANZKX patients.

This category receives 15 bonus points and access to all ABO compatible kidneys.

State Priority

The "State Priority" category applies to cases where an individual state Advisory Committee – for whatever reason – approves additional priority for that patient at the state level.

This category receives 12 bonus points for donors within their state only. Normal ABO rules apply.

Prior Living Donor

Prior living donors receive 10 bonus points.

Kidney-after-other organ transplants

Patients requiring kidney transplantation shortly after heart, lung, or liver transplantation (according to eligibility criteria and protocols specified by the relevant Advisory Committees) receive 12 bonus points.

SHIPPING RULES

Interstate shipping is allowed when the total score is at least as high as the shipping threshold, or if there are no local recipients.

The shipping threshold is a floating threshold that depends on the net debt between states and is calculated as (12 - 0.5 x net kidneys owed to recipient state), with a maximum value of 15.

ABO COMPATIBILITY RULES

Proposed rule

1. ABO identical transplants are always allowed.
2. A to AB transplants are allowed if the combination of points for HLA match quality adjustment, PRA bonus and prognosis match is at least 5
3. O to B transplants are allowed if the combination of points for HLA match quality adjustment, PRA bonus and prognosis match is at least 12

4. All other ABO non-identical transplants are allowed if the combination of points for HLA match quality adjustment, PRA bonus and prognosis match is at least 18.
5. Patients with National Urgent Status can access all ABO compatible kidneys.

OTHER RULES

1. Interstate utilisation offers with rank above 20 do not count towards state debt calculations.
2. Tie-break rule in the event that two potential recipients have identical scores:
    i. Same state
    ii. ABO identical
    iii. Waiting time
    iv. Age-HLA match points
    v. PRA
    vi. Prognosis matching
    vii. Random

MULTI-ORGAN TRANSPLANTS

SPK transplants

When a suitable pancreas donor arises, one of the kidneys will also be allocated with the pancreas UNLESS there are two potential kidney-only recipients with raw allocation scores of 15 points or higher.

SPK patients can also be dual listed on the kidney-only list and – if offered a kidney through the kidney list – the pancreas can also be requested. For SPK patients on the kidney-only list, 2 bonus points are to be added to their kidney allocation score if they accept the pancreas along with the kidney offer

Other multi-organ transplants

Offers for simultaneous kidney-liver, kidney-heart and kidney lung transplantation are to be made prior to offers to the kidney-only list (as per the status quo).

Calculation of Australian EPTS

What is the EPTS?

The United States Estimated Post Transplant Survival (US EPTS) Score was developed by the United Network for Organ Sharing (UNOS) in the USA. It is a score that combines four clinical parameters (age, time on dialysis, prior solid organ transplant and diabetes) to estimate the post-transplant survival of kidney transplant recipients. It is used in the US kidney allocation system to prioritise the allocation of kidneys with a favourable prognosis to recipients with a favourable prognosis.

What is the Australian EPTS?

This is very similar to the UNOS EPTS, except that it omits diabetes as a parameter. The Australian EPTS was developed by re-fitting the US EPTS, without diabetes, to the Australian/NZ deceased donor transplant population over 2002-2013.

How does the Australian EPTS scoring system work?

The Australian expected post-transplant survival (EPTS) score is calculated as:

Raw EPTS =
0.049 x max(age - 25, 0) +
0.493 x prior kidney transplant +
0.287 x log(years on dialysis + 1) +
0.598 x (years on dialysis = 0)

The raw EPTS score is then converted into an EPTS percentile (range 1% to 100%) by comparing it with the distribution of raw EPTS scores in patients on the Australian kidney waiting list at the end of the previous year.

An EPTS of 1% is at the best end of the spectrum
An EPTS of 100% is at the worst end of the spectrum
An EPTS of 50% is the median score (equivalent to an “average” patient on the waiting list)

A score of 25% indicates that the recipient has a relative risk of mortality that is better than 75% of other patients.

Calculation of Australian KDPI

What is the KDPI?

The Kidney Donor Profile Index (KDPI) was originally described by The United Network for Organ Sharing (UNOS) in the USA. It is a score that combines various donor factors to estimate the prognosis of deceased donor kidneys relative to other deceased donor kidneys.
(https://optn.transplant.hrsa.gov/resources/allocation-calculators/kdpi-calculator/)

What is the Australian KDPI?

The Australian KDPI is a simplified version of the UNOS KDPI, using less parameters but the concept is exactly the same. It has been validated in the Australia/New Zealand donor population using transplant outcomes in ANZDATA. It is designed to predict the expected quality of a deceased donor kidney and to predict a kidney's relative risk of failure over time.

How does the KDPI scoring system work?

A score of 1-100% is derived from a raw index score (the KDRI or Kidney Donor Risk Index). The scores are based on the outcomes of kidneys that were transplanted in Australia in the previous 3 years. The KDRI is converted to a percentile to become the KDPI.

The formula for the Australian KDRI is:

Exp(-0.0194 x minimum(donor age - 18, 0) + 0.0128 x (donor age - 40) + 0.0107 x maximum(donor age - 50, 0)
+ 0.126 if donor has a history of treated hypertension
+ 0.130 if donor has a history of diabetes
+ 0.220 x ((creatinine/88.4) - 1) - 0.209 x (creatinine/88.4) - 1.5) if (creatinine/88.4)>1.5
+ 0.0881 if cause of death stroke (including spontaneous intracranial haemorrhage)
- 0.0464 x ((height - 170)/10)
- 0.0199 x ((weight - 80)/5) if weight<80kg
+ 0.133 if planned donation pathway is DCD)

A KDPI of 1% is at the best end of the spectrum
A KDPI of 100% is at the worst end of the spectrum
A KDPI of 50% is the median score (equivalent to an "average" donor over the preceding 3 years)

A score of 20% indicates that the kidney has a relative risk of failure that is worse than only 20% of kidneys utilised for transplantation in the preceding 3 years(i.e. better than 80% of other transplanted kidneys). In other words, it is perceived to be among the best 20% of acceptable kidneys and is therefore better than the average kidney.

A score of 90% indicates that the kidney has a relative risk of failure that is worse than 90% of kidneys utilised for transplantation in the preceding 3 years (i.e. better than only 10% of other transplanted kidneys). In other words, it is perceived to be among the worst 10% of acceptable kidneys and is therefore worse than the average kidney.

Key concepts: Prognosis matching

Prognosis matching is an approach to kidney allocation whereby we seek to prioritise the allocation of kidneys with a favourable prognosis to recipients with a favourable prognosis, and vice versa. Alternatively put, prognosis matching attempts to match the expected lifespan of the kidney with expected lifespan of its recipient.

Prognosis matching has 3 main goals:

1. Maximise the benefits (in terms of life years saved) from the highest quality kidneys by allocating these to recipients who are expected to benefit the most from them (i.e. recipients with the longest expected life-span post-transplant – typically younger)

2. Avoid allocating kidneys with a very favourable prognosis to recipients with a poor prognosis (i.e. recipients with the shorted expected life-span post-transplant)
3. Prioritise allocation of kidneys with a poor prognosis to recipients who might benefit from them, who would be willing to accept a lower quality kidney in exchange for reduced time on dialysis.

The extent of the prognosis match between a donor and recipient is determined by the difference in the recipient EPTS and donor KDPI scores. A low EPTS score indicates a recipient with a favourable prognosis; a low KDPI score indicates a donor with a favourable prognosis. The closer in value the KDPI and EPTS scores, the better the prognosis match, i.e.:

EPTS 1, KDPI 1 = excellent prognosis match
EPTS 15, KDPI 40 = OK prognosis match
EPTS 20, KDPI 95 = bad prognosis match

The new kidney allocation system puts greater emphasis on prognosis matching compared to the current Australian kidney allocation system. Figure 3 shows the outcome of this change in terms of the extent of the correlation between KDPI and EPTS values in the two systems.

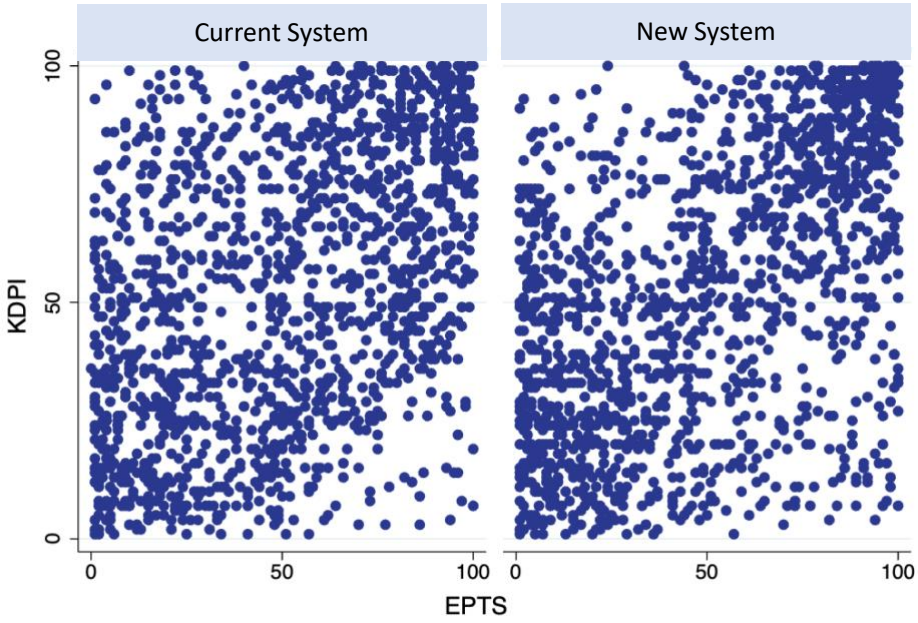


Figure 2: Simulated prognosis matching outcomes, current kidney allocation algorithm versus new proposed system

Key concepts: Immunological matching

Your immune system uses human leucocyte antigens (HLA) to determine which cells belong in your body, and which do not. HLA matching is performed prior to kidney transplant to establish whether a kidney is a good match or not.

A good HLA match reduces the risk of graft loss. It also prevents the development of antibodies that would sensitise against future transplants.

We give priority in allocation to immunological matching because:

- A good immunological match is relatively rare, so is given priority when one is found
- For younger patients who need a second transplant, avoiding sensitisation is important.

Key concepts: Sensitisation

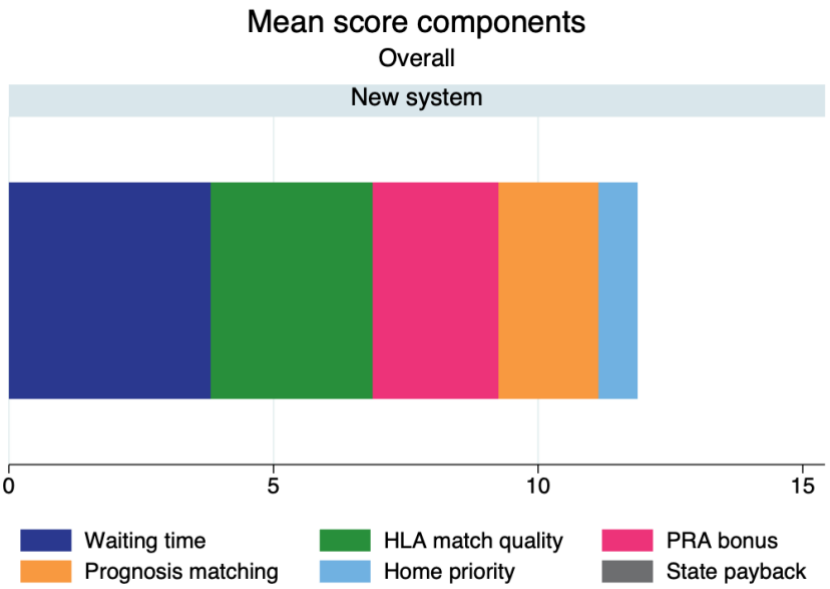
Sensitisation is the prior exposure to non-self HLA. It can occur due to prior transplantation, blood transfusions and/or pregnancies.

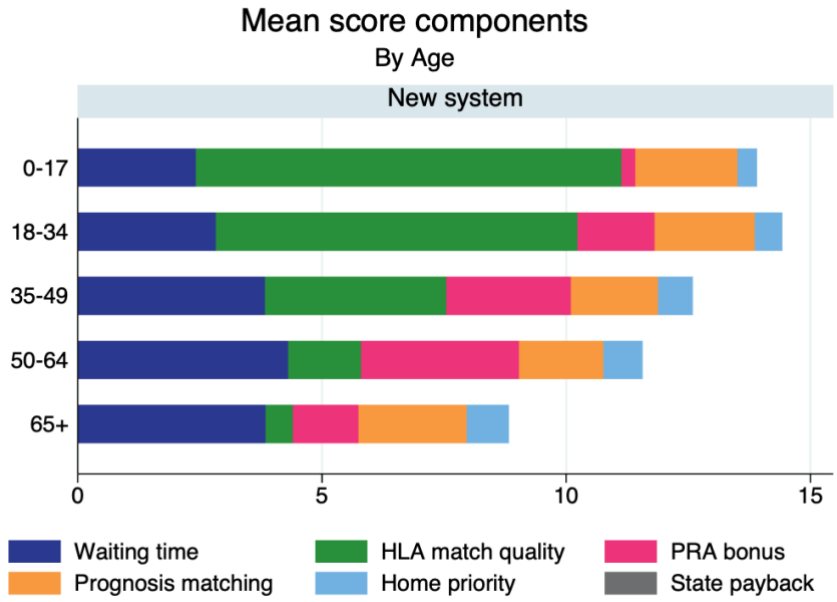
Screening for HLA antibodies is performed using a panel reactive antibody (PRA) test. A high PRA% means a high percentage of donors will be unacceptable to the recipient because of the presence of circulating antibodies that will react with one or more of the donor's HLA antigens.

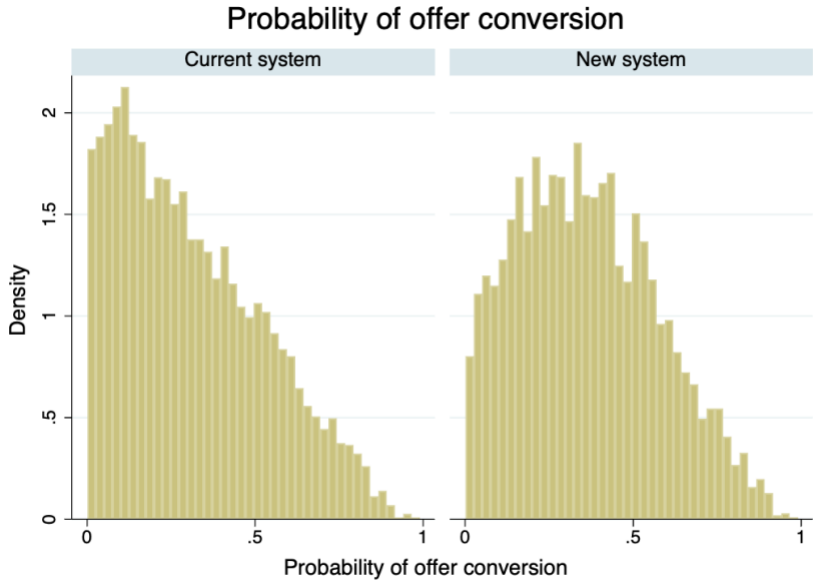
e.g. a PRA of 80% indicates that 80% of donors will be unacceptable to that recipient
For very highly sensitised patients (i.e. PRA 95% and above), finding any acceptable match is difficult, therefore the highest priority is given when one arises

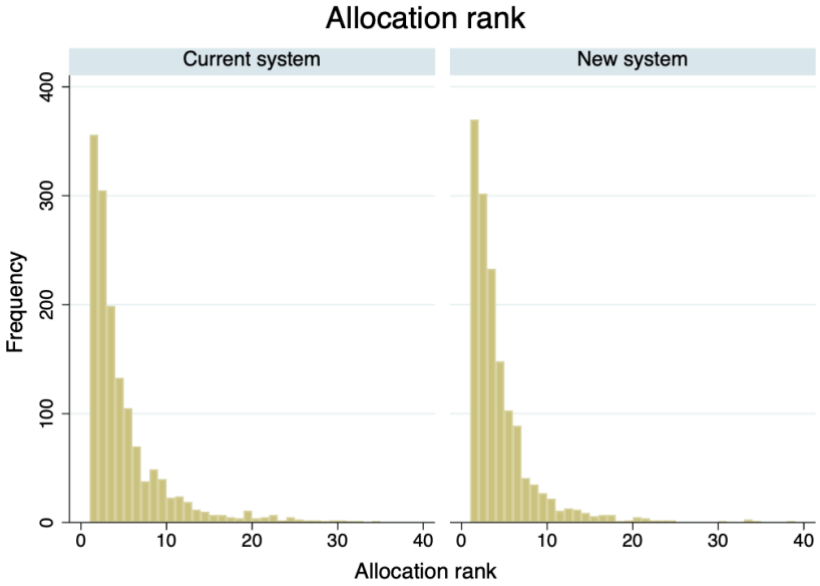
Simulated outcomes

- Under the new allocation algorithm, each potential recipient of a given donor kidney will be given a continuous allocation score for that match. This continuous allocation score will them be used to rank potential recipients relative too each other.
- Simulations of the new algorithm indicate that, on average, kidney allocation scores will be driven mainly by waiting time.
- A breakdown of the mean score components by age, however, indicates that the quality of the HLA match contributes far more to the allocation score at younger ages. That is, on average, a patient's rank in allocation is driven by HLA matching at younger ages, and by waiting time at older ages.



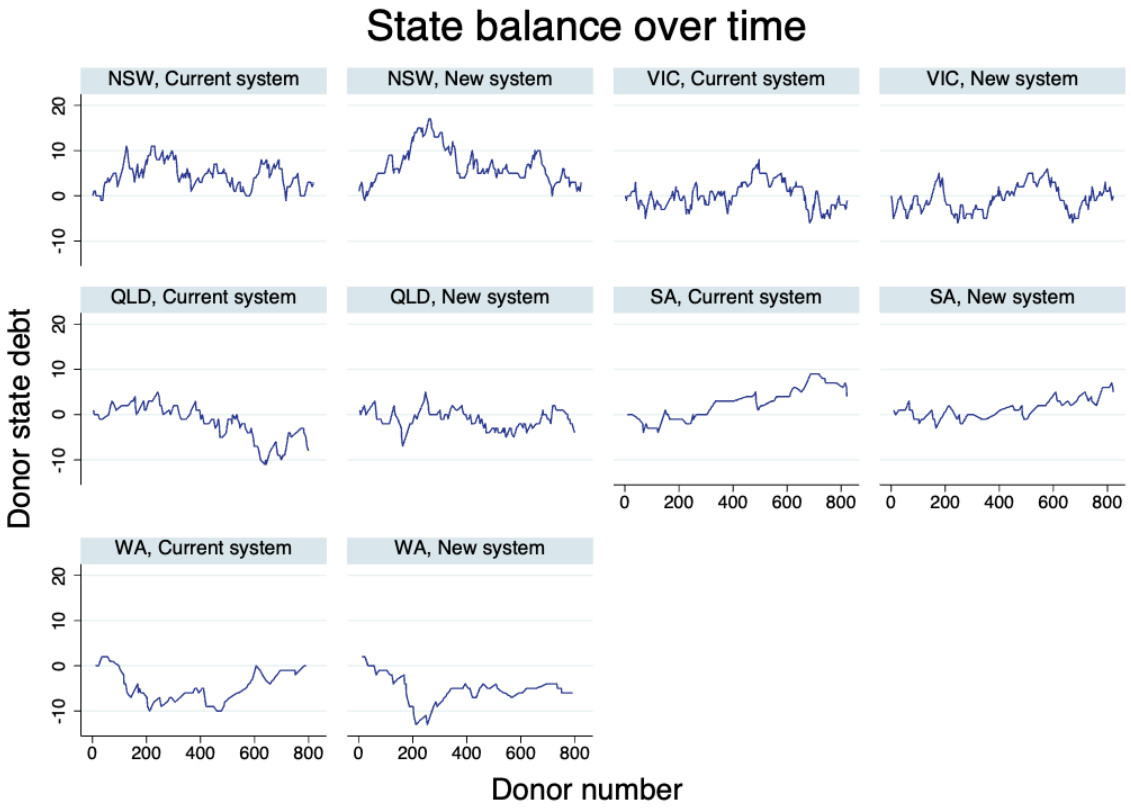


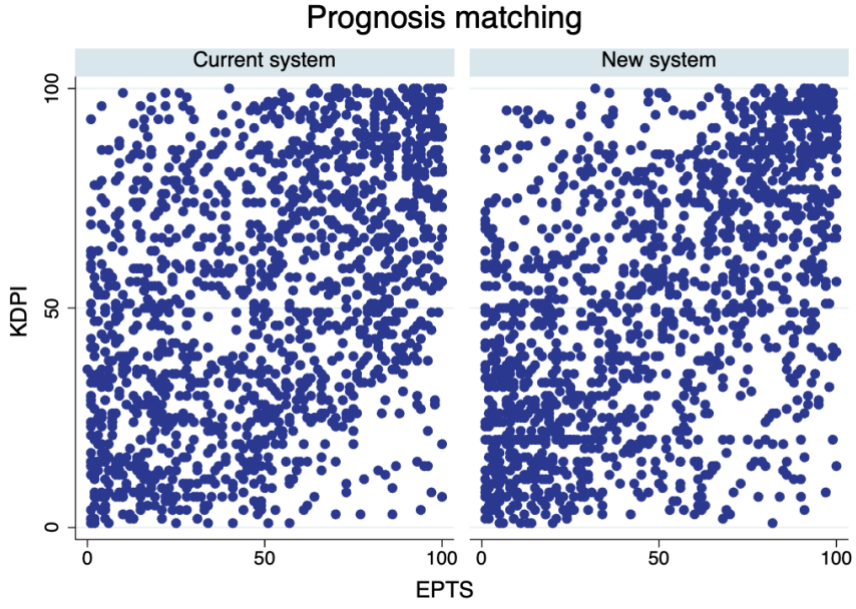


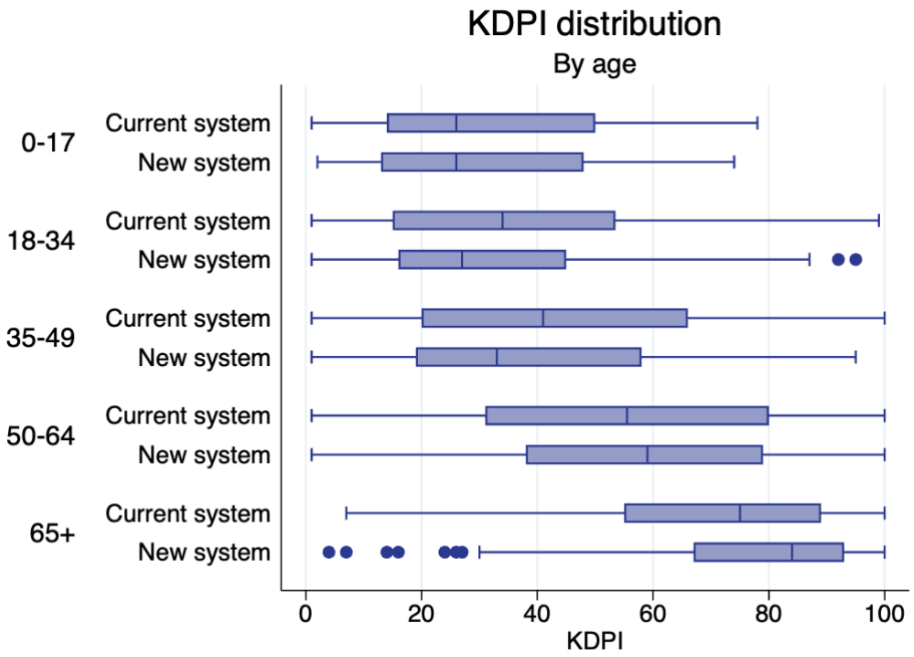


- The probability of offer conversion is higher under the new algorithm, meaning fewer offers would need to be made.
- Simulations of the new algorithm indicate fewer allocations above rank 15 and more below rank 5, indicating greater system efficiency overall.
- The new algorithm would result in a similar amount of shipping of kidneys interstate compared to the current system
- State balancing under the new system would be preserved relative to the status quo.

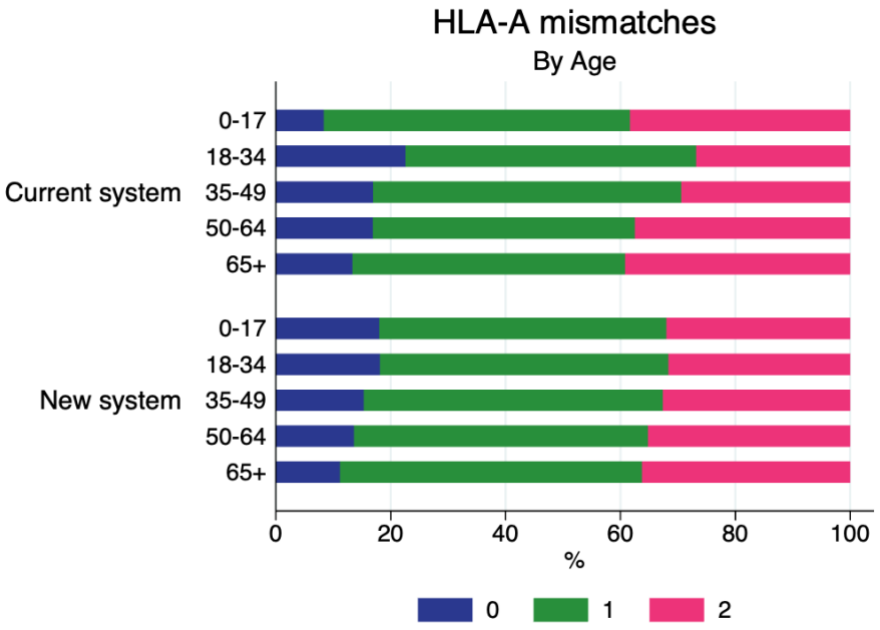
Model	Not shipped	Shipped
Current system	1087 (74.7%)	368 **(25.3%)**
New System	1082 (76.5%)	377 **(25.8%)**

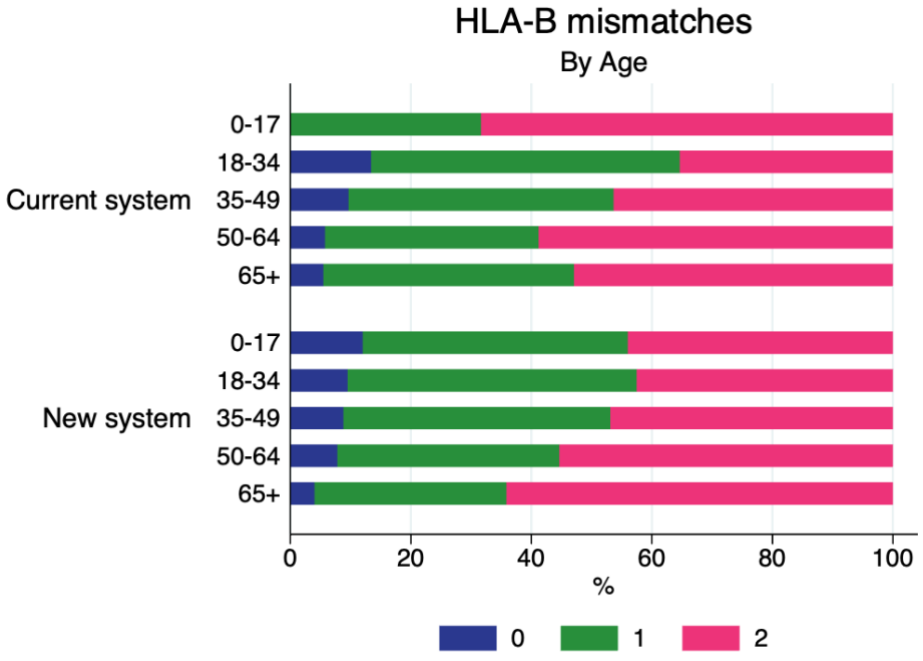

State balance over time
NSW, Current system
NSW, New system
VIC, Current system
VIC, New system
QLD, Current system
QLD, New system
SA, Current system
SA, New system
WA, Current system
WA, New system
Donor state debt
-10
0
10
20
0
200
400
600
800
Donor number

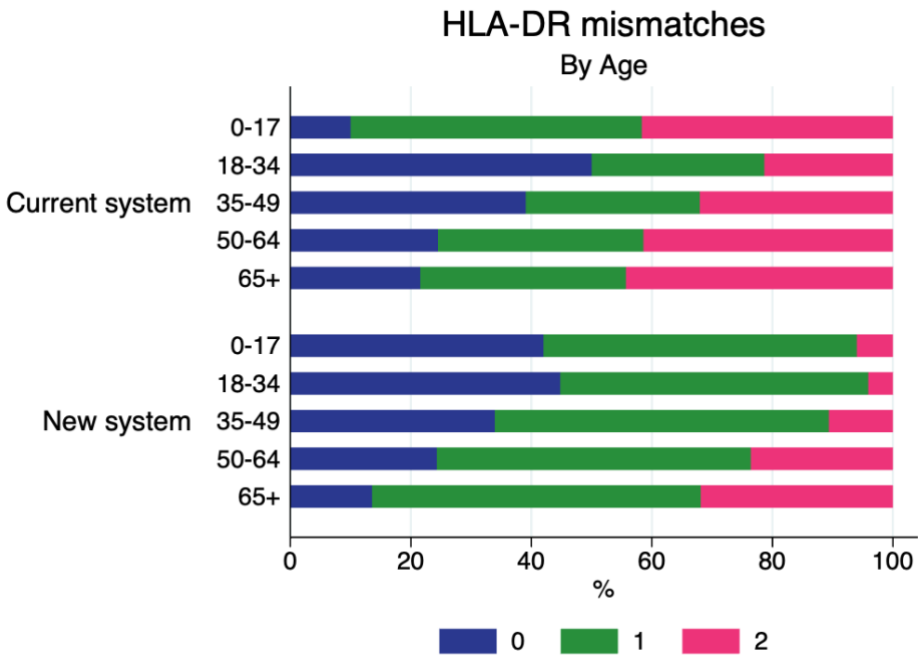

Prognosis matching
Current system
New system
KDPI
0
50
100
EPTS

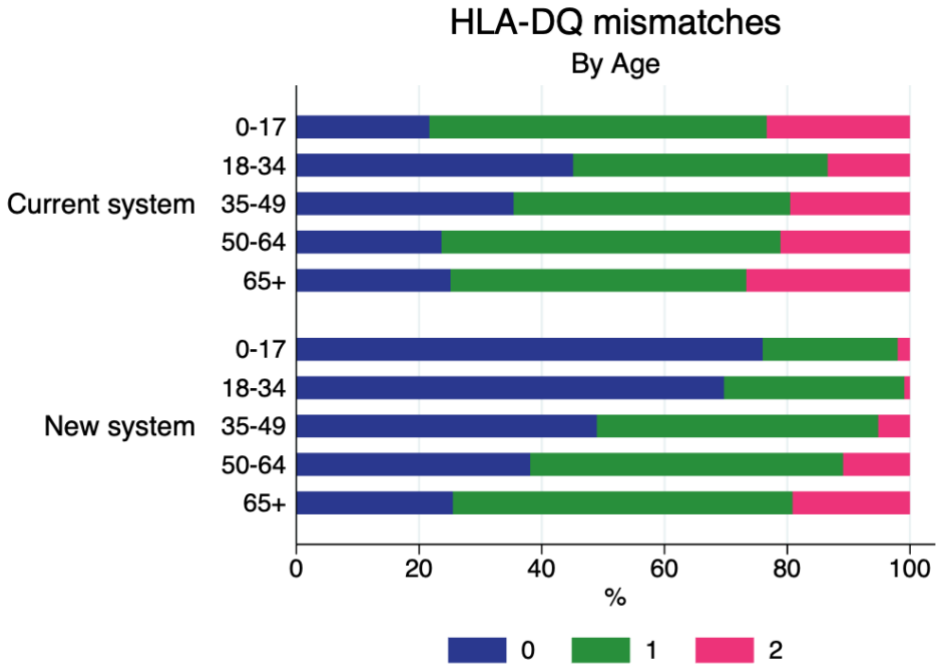


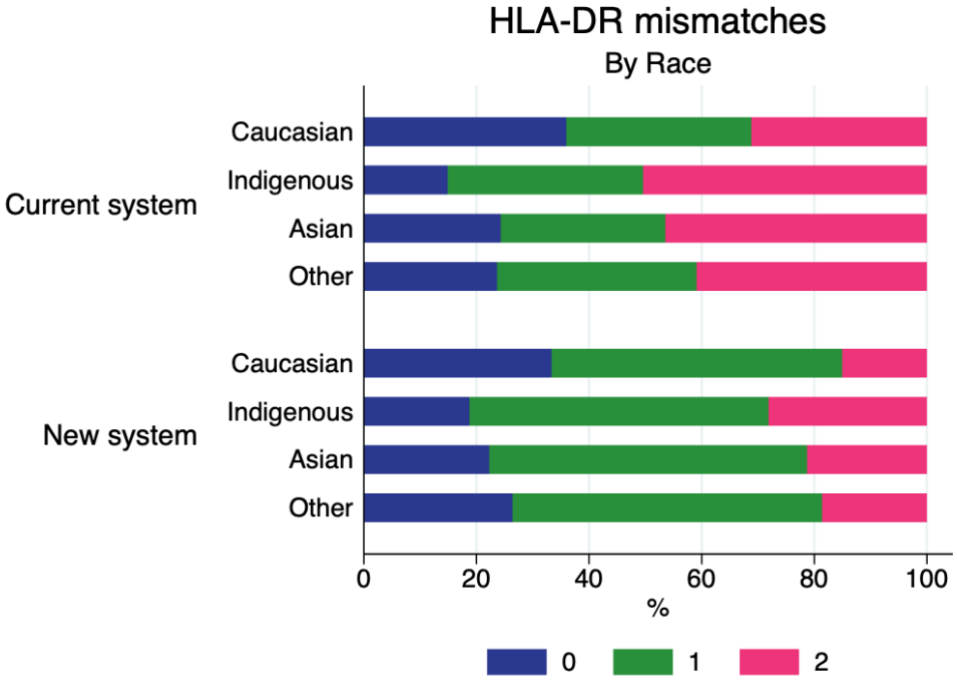
- Simulations indicate that the extent of prognosis matching would be improved by the new algorithm, with a greater concentration of low KDPI kidneys allocated to low EPTS recipients and high KDPI kidneys to high EPTS recipients.
- Older patients are allocated higher KDPI kidneys under the new allocation algorithm. This is driven by the extra weighting of prognosis matching at each extreme of the matching – including extra weighting for high KDPI to high EPTS transplants.
- Simulations indicate much better HLA-DR matching under the new allocation system, especially for young people especially, with far fewer 2-DR or 2-DQ mismatches observed.
- HLA-matching outcomes are also significantly improved for ethnic minority groups under the new system, with fewer 2-DR or 2-DQ mismatches observed.

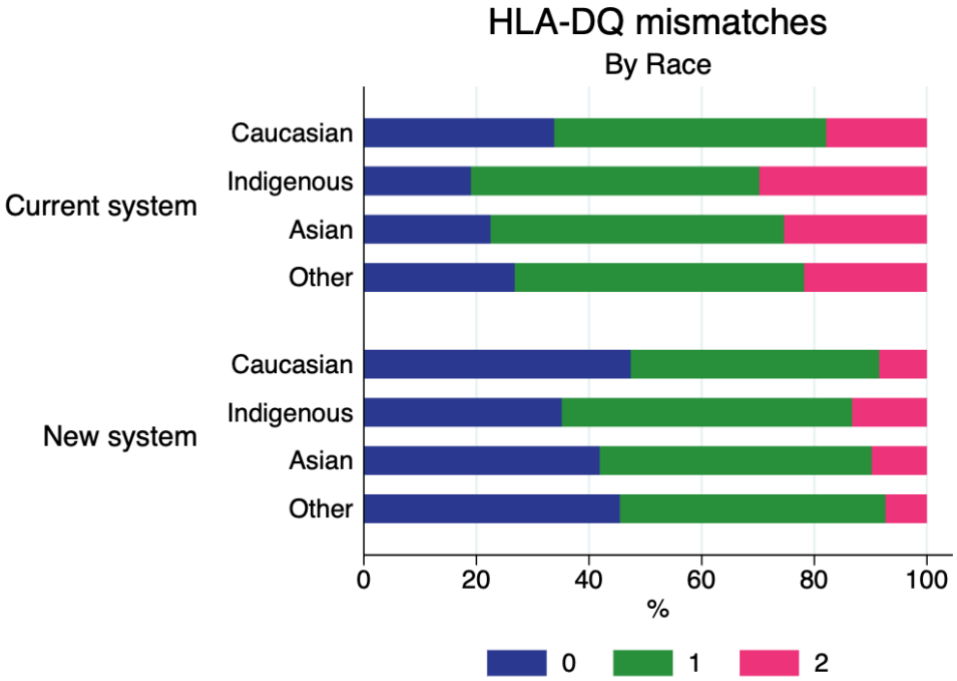

HLA-A mismatches
By Age
Current system
New system
0-17
18-34
35-49
50-64
65+
0
20
40
60
80
100
%
0
1
2


HLA-B mismatches
By Age
Current system
New system
0-17
18-34
35-49
50-64
65+
0
20
40
60
80
100
%
0
1
2


HLA-DR mismatches
By Age
Current system
New system
0-17
18-34
35-49
50-64
65+
0
20
40
60
80
100
%
0
1
2

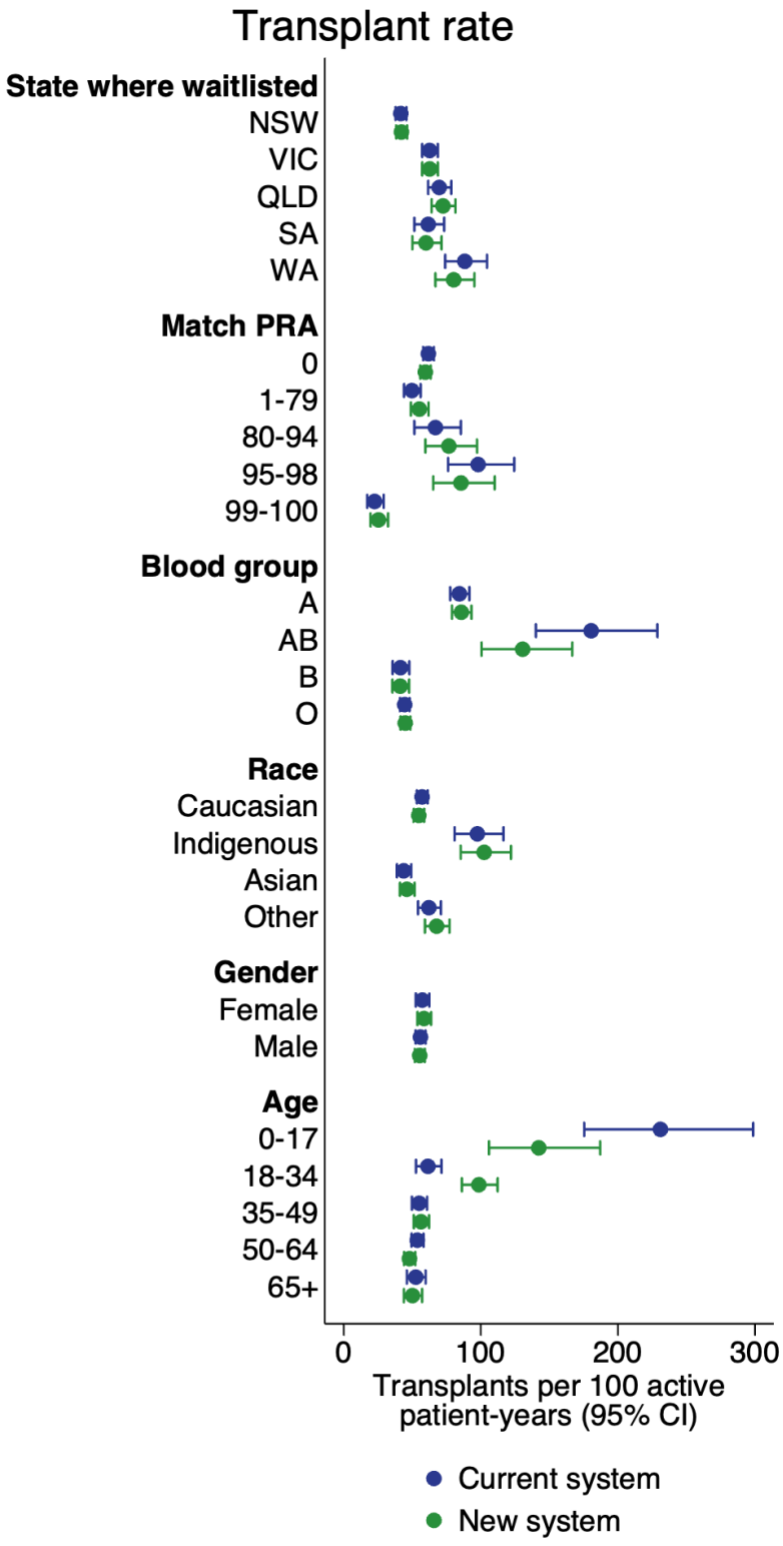

HLA-DQ mismatches
By Age
Current system
New system
0-17
18-34
35-49
50-64
65+
0
20
40
60
80
100
%
0
1
2

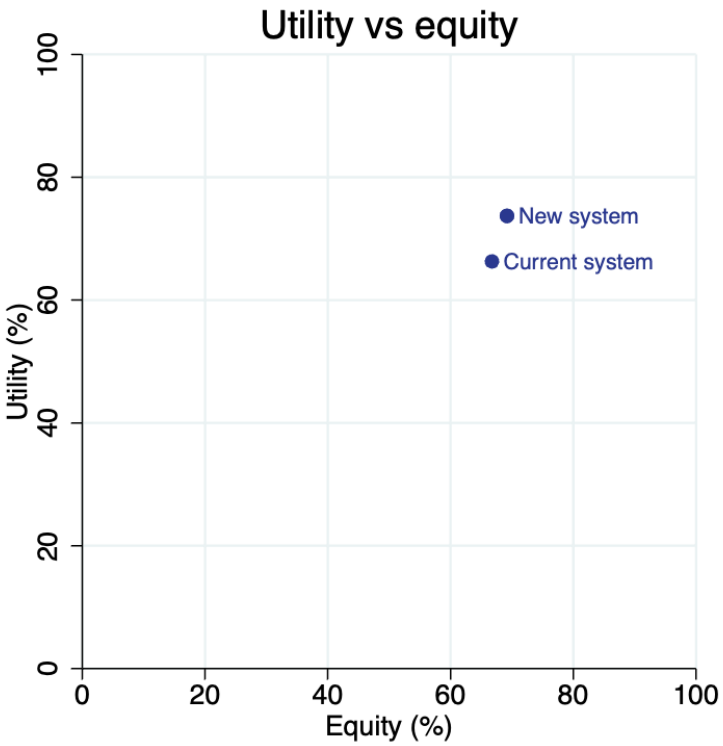

HLA-DR mismatches
By Race
Current system
New system
Caucasian
Indigenous
Asian
Other
Caucasian
Indigenous
Asian
Other
0
20
40
60
80
100
%
0
1
2


HLA-DQ mismatches
By Race
Current system
New system
Caucasian
Indigenous
Asian
Other
Caucasian
Indigenous
Asian
Other
0
20
40
60
80
100
%
0
1
2

Model	Donor blood group	Recipient blood group				
Current system		**A**	**AB**	**B**	**O**	
	A	555	**21**	0	0	7.5% of O kidneys diverted to other blood groups
	AB	0	41	0	0	
	B	0	**5**	157	0	
	O	**21**	**2**	**28**	625	
New System		**A**	**AB**	**B**	**O**	
	A	558	**16**	0	0	6.6% of O kidneys diverted to other blood groups
	AB	0	46	0	0	
	B	0	**1**	161	0	
	O	**16**	2	**24**	635	

- The blood group rules that have been applied under the new algorithm are designed to
    a. Expand the available donor pool for very highly sensitised A and B patients
    b. Expand the available donor pool for moderately to highly sensitised AB patients
    c. Expand the donor pool for very hard to match patients
    d. Expand the donor pool to facilitate good prognosis matches for young AB patients
    e. Avoid diverting too many O kidneys from O recipients
- These rules have produced a modest reduction in the rate at which O kidneys are diverted from O donors
- Transplant rates are expressed per 100 active patient years and take into account waiting time accumulated by patients who have not yet been transplanted. They do not reflect, however, accumulated waiting time on dialysis before being listed for transplantation, therefore transplant rates for certain subgroups (e.g. Indigenous Australians) need to be interpreted with caution.
- The most significant change in the transplant rate as indicated by the simulations is the increase for the 18-34 year age group. This is the outcome of greater weighting given to good HLA matches in this age group under the new algorithm.


Transplant rate
State where waitlisted
NSW
VIC
QLD
SA
WA
Match PRA
0
1-79
80-94
95-98
99-100
Blood group
A
AB
B
O
Race
Caucasian
Indigenous
Asian
Other
Gender
Female
Male
Age
0-17
18-34
35-49
50-64
65+
0
100
200
300
Transplants per 100 active patient-years (95% CI)
Current system
New system


Utility vs equity
Utility (%)
0
20
40
60
80
100
Equity (%)
0
20
40
60
80
100
New system
Current system