



Saving lives UK-wide

Computer scientists help to enable over 500 kidney transplants

- **Computer scientists at the University of Glasgow have developed algorithms (well-defined sets of instructions that direct computers to solve problems) that enable more kidney failure patients to receive compatible transplants**
- **Potentially saving around £35.5 million for the NHS over the next 10 years**

Over five thousand patients in the UK are on the waiting list for a kidney transplant. Hundreds of these patients have a friend or family member who is willing to donate a kidney, but has an incompatible blood or tissue type. Researchers at the University of Glasgow have developed a matching algorithm to enable so-called “pairwise exchanges” and “three-way exchanges” (as illustrated overleaf), allowing patients to effectively “swap” their donors. These exchanges result in a greater number of transplants, improved health outcomes, and reduced long-term healthcare costs.

Previously the NHS could only identify pairwise exchanges, but the new algorithm can additionally find possibilities for three-way exchanges. Furthermore the algorithm can find “chains” of transplants initiated by “altruistic” donors, who wish to give a kidney but without necessarily having a friend or family member in need. Out of all possible sets of exchanges, the researchers’ algorithm finds an optimal solution according to a set of criteria developed by clinicians and other specialists at NHS Blood and Transplant.

In total, 517 transplants identified by the new algorithms have proceeded to surgery so far. It is estimated that the research increased the number of kidney transplants under the NHS’s kidney exchange scheme by 148, between 2008 and 2015. Compared to dialysis, every additional kidney transplant which this research has enabled saves the NHS approximately £240,000 over 10 years. That’s £35.5 million total savings.

What if you needed a kidney transplant and you had a willing donor but they but didn’t have the right blood or tissue type?

“ I can now go back to work, get out and about more. Have a life rather than just existing

Chris Brent

“ I feel like I've got my life back

Andrea Mullen

Both **Andrea Mullen** and **Chris Brent** (quoted above from a BBC news story) were recipients of kidney transplants through a three way exchange identified by the University of Glasgow's matching algorithm.

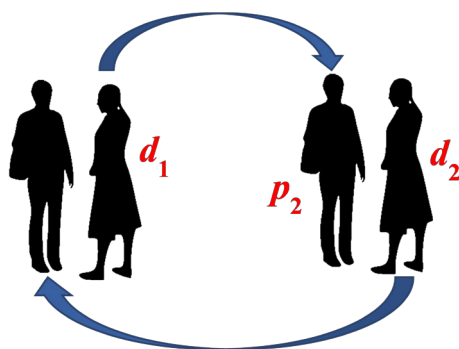
Find out more

Transplants relieve kidney failure patients of dialysis, allowing them to live a normal life again and doubling or tripling their life expectancy. Patients who receive kidneys from living donors also have a longer life expectancy than those with transplants from deceased donors. University of Glasgow's solution enables more living donor transplants.

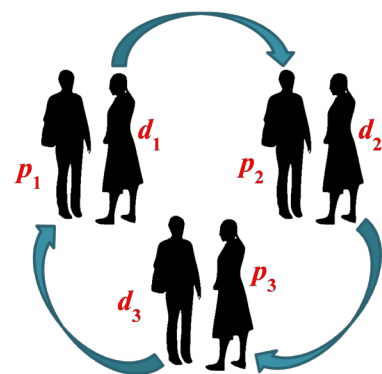
Glasgow's algorithm builds on a history of EPSRC-supported research. Dr David Manlove, who led research on the algorithm, explains the complexity of finding a solution for three-way exchanges: 'We are dealing with a computational problem that is inherently difficult technically; in fact it can be proved that no "efficient" algorithm exists to solve the problem.' Furthermore it was a situation where increasing the amount of data the computer has to deal with by just a small amount, could make the computational time impractically slow. Despite this complexity, the algorithm has been able to find optimal solutions in less than a second.

As well as connecting up patients who already have willing donors, the algorithm has enabled altruistic donors, who volunteer to donate to a stranger, to start a chain of donations. So far, over 50 such transplant chains have been successfully carried out.

One of the first three-way kidney exchanges, enabled by this research, took place in 2009. In Aberdeen, Andrea Mullen's husband wanted to donate one of his healthy kidneys to her, but he wasn't a compatible donor. On the south coast of England, Chris Brent also needed a transplant. His sister was happy to give him one of her kidneys, but again there was no match. In Hertfordshire, a newly-wed Lynsey Thakrar wanted to donate one of her kidneys to her husband, but she too wasn't a compatible donor. The solution was to pair up the couples and transplant the kidneys in a cyclic fashion. Three healthy kidneys were removed, transported across the UK and transplanted into the recipients on the same day.



Pairwise exchange



Three-way exchange

p_1 p_2 p_3 = Patients

d_1 d_2 d_3 = Donors

Information and Communication Technologies programme

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