



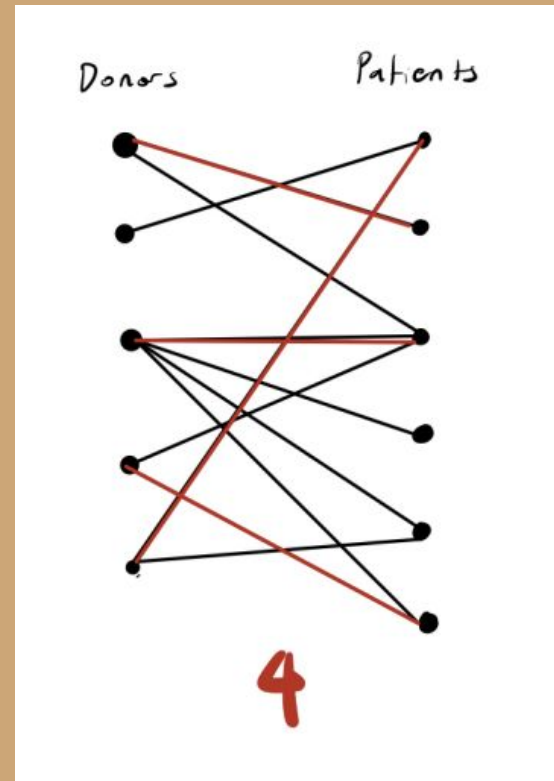
Matching Algorithms for Ethical Organ Distribution

CS 120 Embedded EthiCS Module
Megan Entwistle
PhD Candidate, Philosophy



Maximum Matching

The question: what is the greatest number of patients we can give kidneys to?



Graph-theoretic representation of a maximum matching solution.

Maximum Matching in conditions of scarcity

A new question: *which patients* ought to be prioritized under a maximum matching scheme?

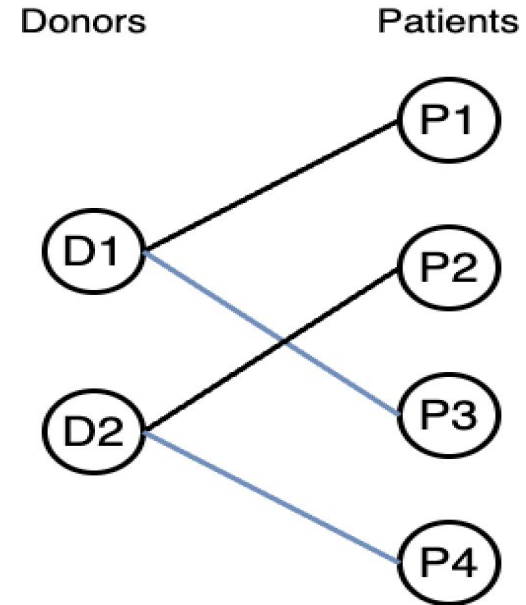
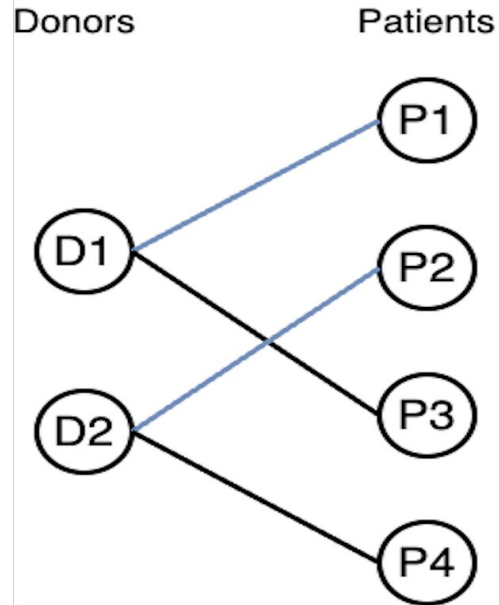
Currently in the US, there are four times as many patients on the waiting list to receive a kidney transplant as there are donors available.

This creates a **scarce resource problem**: decisions need to be made about *which patients* receive transplants (and which patients don't).

Today's Agenda

1. Identify some ethically relevant factors for decisions about allocating scarce resources
2. Look at an outcomes-based approach (“Maximization”)
3. Look at a needs-based approach (“Maximin”)
4. Compare the potential problems with each; briefly consider a middle way

Under conditions of scarcity, there will typically be more than one way to maximize matches (based on compatibility alone).



We will have to decide which pairs, $\{d1p1, d2p2\}$ or $\{d1p3, d2p4\}$, should be matched. **What further information should guide our decision?**

What considerations are ethically relevant?

A good starting point is to look at actual practice.

According to the Report of the U.S. Task Force on Organ Transplantation, and the United Network for Organ Sharing (UNOS), kidney transplant decisions are made based on:

- Donor/patient compatibility (blood type, immune system)
- Likelihood of a successful outcome
- Patient need
- Waiting time
- Distance from donor hospital

What considerations are ethically relevant?

A good starting point is to look at actual practice.

According to the Report of the U.S. Task Force on Organ Transplantation, and the United Network for Organ Sharing (UNOS), kidney transplant decisions are made based on:

- Donor/patient compatibility (blood type, immune system)
- **Likelihood of a successful outcome**
- **Patient need**
- Waiting time
- Distance from donor hospital



An outcomes-based approach



An outcomes-based approach

Utilitarianism: an ethical theory which says the right thing to do is to *act in a way that maximizes the greatest total welfare*.

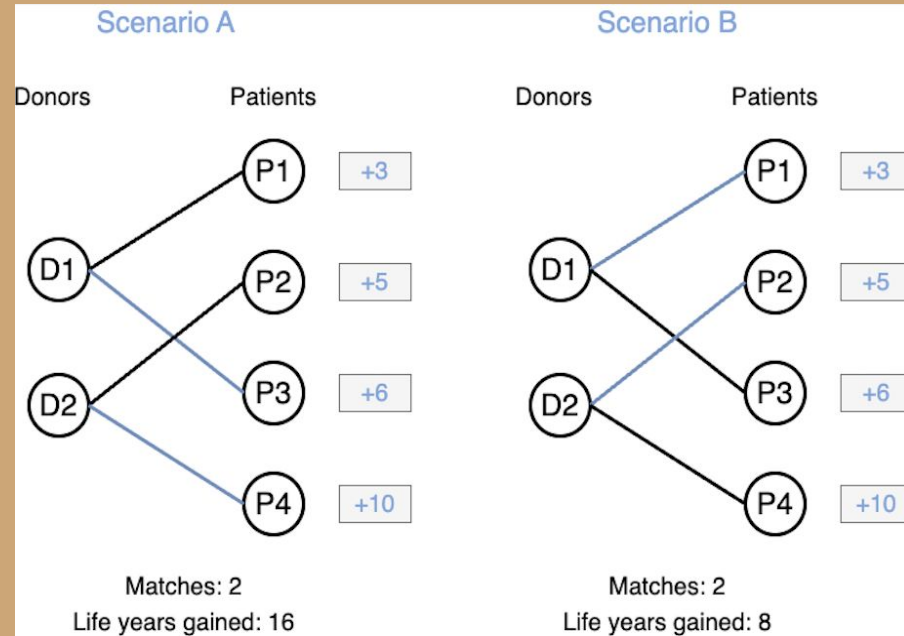
Applied to the kidney exchange case, we get the following decision principle:

Maximization. Match donors to patients in a way that maximizes the total additional life years the patients are expected to gain as a result of the transplants.

→ Ethical intuition: by following the maximization principle, we do the most good we can with the kidneys available.

Maximization

Match donors to patients in a way that maximizes the total additional life years the patients are expected to gain as a result of the transplants.



The principle will rule in favor of **Scenario A** over Scenario B.

Problems with maximization?

What's wrong with looking solely at outcomes?

Notice that P1 and P2 don't end up receiving kidneys because they can't convert transplant donations into as many years of life as P3 and P4 can.

These patients might think it's unfair to be passed over in favor of patients with better expected outcomes.

Why?

Your turn (1)

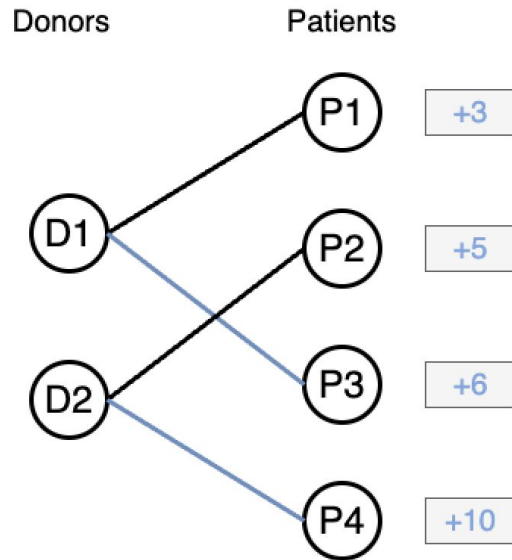
Activity:

In pairs, imagine the perspectives of P1 and P2 in Scenario A.

*How might you argue that the maximization decision procedure, which determines that you don't get matched with donors, **is unfair?***

[Hint: think of some reasons why P1 and P2 might have lower expected outcomes.]

Scenario A



Matches: 2

Life years gained: 16

Problems with maximization? (cont'd)

The maximization principle will tend to prioritize those who are (already) better off, relative to other patients. This seems especially unfair in a healthcare context.

Perhaps P1 and P2 have lower expected outcomes because:

- P1 and P2 have more severe renal diseases
- P1 and P2 are older
- P1 and P2 have been waiting for transplants longer, so their immune systems are damaged (increasing the chances of post-surgery complications)

What considerations are ethically relevant?

- Donor/patient compatibility (blood type, immune system)
- Likelihood of a successful outcome
- **Patient need**
- Waiting time
- Distance from donor hospital



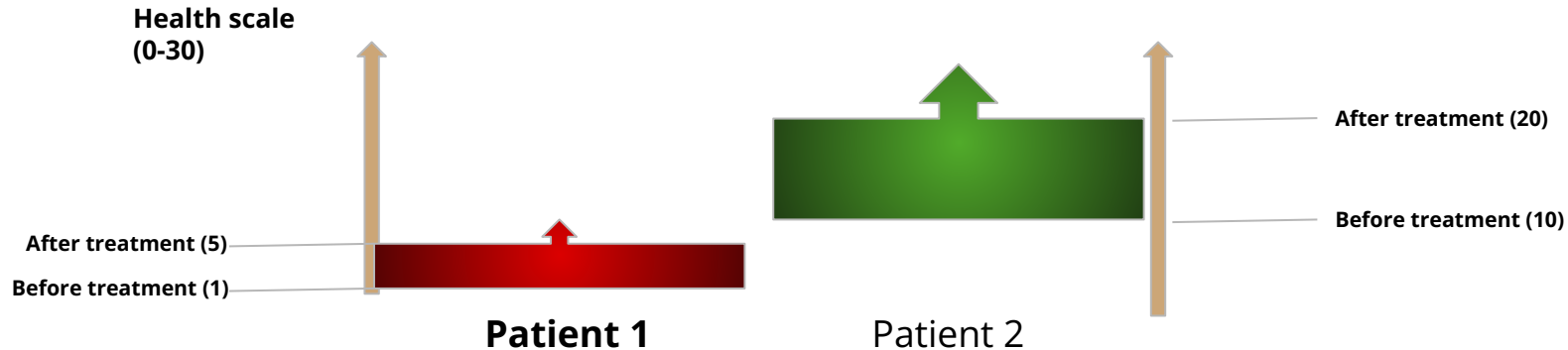
A needs-based approach



A needs-based approach

Priority health care: scarce medical resources ought to go to those who need them the most, even if the resulting benefit to those patients is smaller.

Example: if you can either help a very sick person (Patient 1) a little bit, or a mildly sick person (Patient 2) a lot, you should do the *former*.



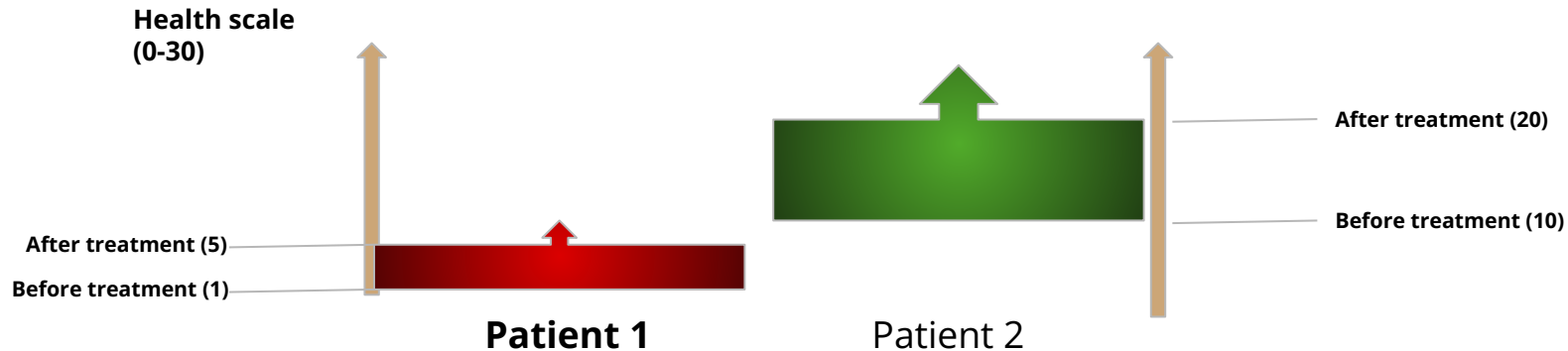
A needs-based approach

The Maximin decision principle: pick the distribution of outcomes in which whoever is least well-off is better off than whoever is least well-off in any other distribution.

If we help P1: P1 (5), P2 (10)

vs.

If we help P2: P1 (1), P2 (20)



Who is the “least well off”?

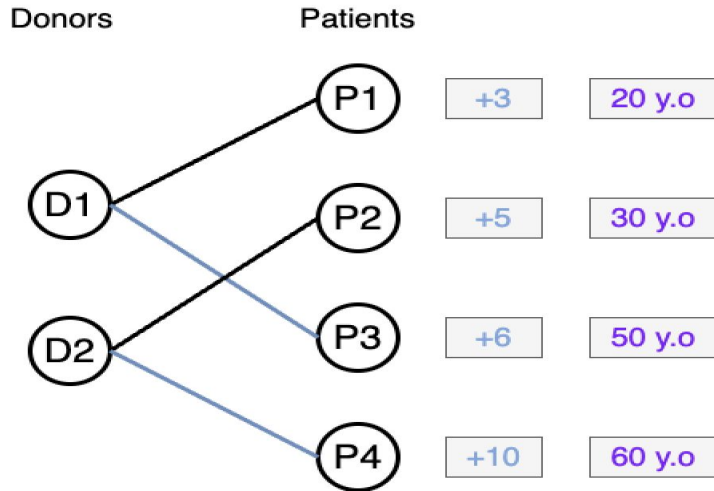
There is more than one way to think about this. A standard approach is to measure ***total welfare over a person's lifetime*** (e.g. 'QALY')*.

For simplicity, we might consider the least well off individual to be the person who will have lived the least by the time they die (Kamm 1993).

→ For example, someone who is 30 and needs a kidney to live until 40 is worse off than someone who is already 60 years old (all else equal).

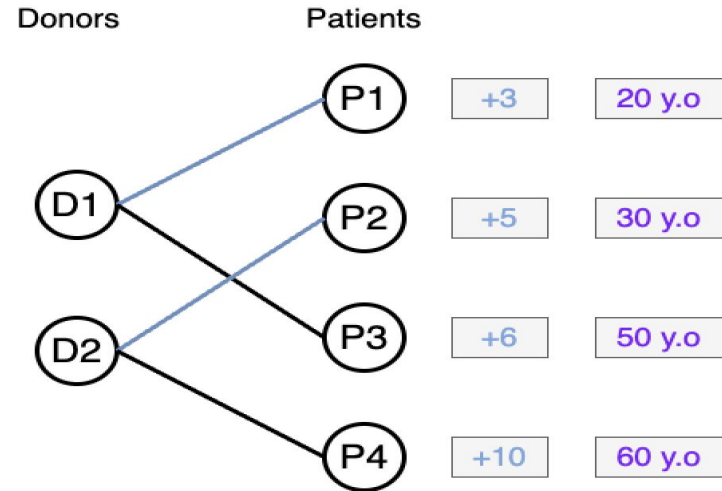
Maximin applied

Scenario A



P1 (20), P2 (30), **P3 (56), P4 (70)**

Scenario B

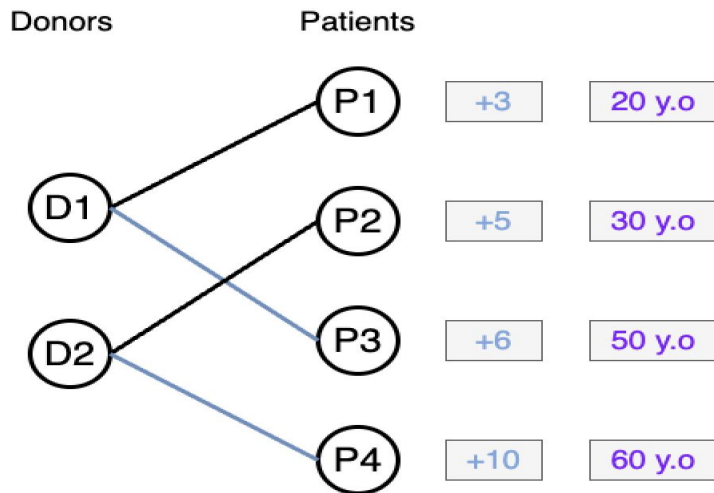


P1 (23), P2 (35), P3 (50), P4 (60)

Which distribution of kidneys (Scenario A or B) maximizes the welfare of the least well-off?

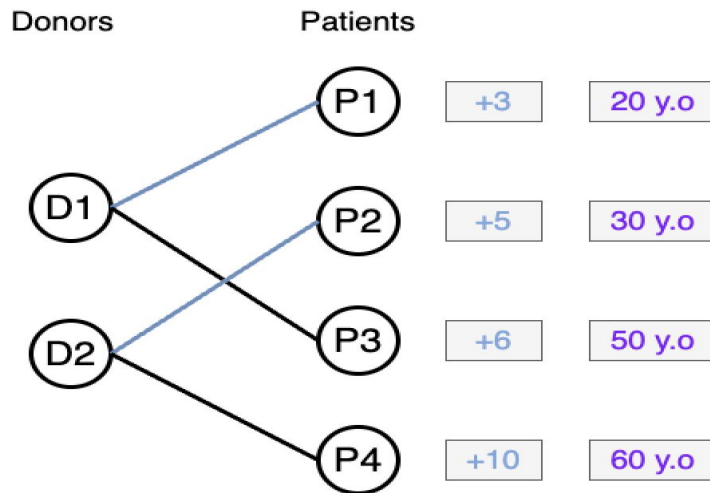
Your turn (2): maximization, or maximin?

Scenario A



P1 (20), P2 (30), **P3 (56), P4 (70)**

Scenario B



P1 (23), P2 (35), P3 (50), P4 (60)

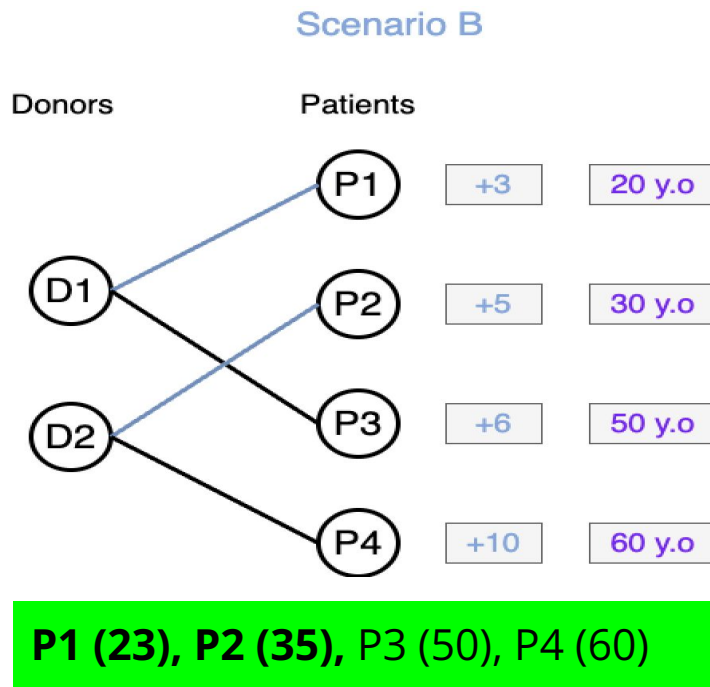
Do you think it is better to maximize total life years gained (Scenario A) or help the worst-off (Scenario B)?

Your turn (3): problems with maximin?

Even if you think Scenario B represents the ethically better outcome in this particular case...

Can you spot any problems with the maximin approach in general?

(Hint: what if the marginal benefits to P1 or P2 are *very small*?)

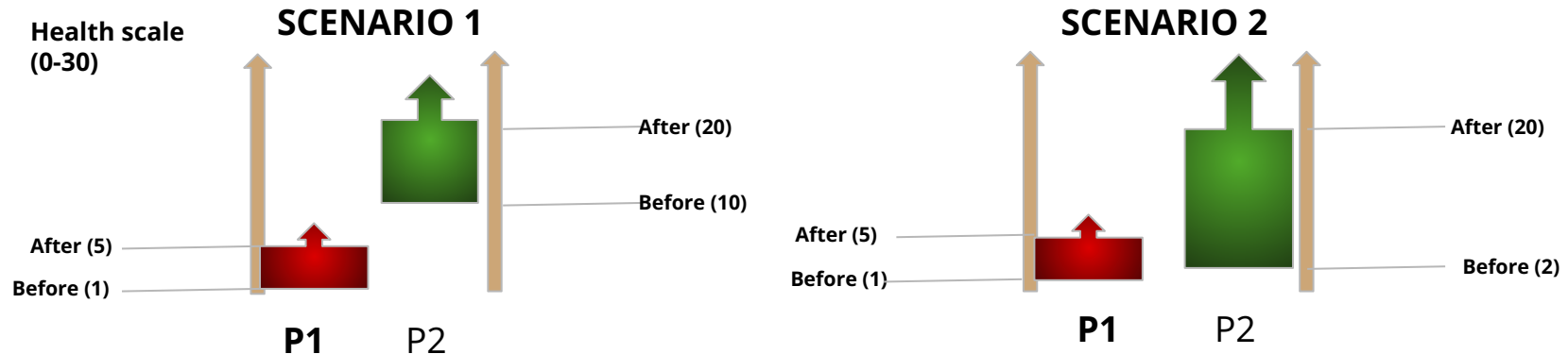


Problems with maximin?

In **both** scenarios below, maximin says to treat P1 rather than P2

→ even though (in Scenario 2) P2 is only marginally better off (initially) than P1

→ even though (in Scenario 2) the benefit to P2 is much greater than the benefit to P1



Taking stock

| | Maximization | Maximin |
|-----------------|--|---|
| Moral Intuition | We ought to do the most total good with the resources available. | We ought to distribute resources to those who need them the most. |
| Pros | Sensitive to scale. (More years should count for more!) | Sensitive to starting points. (Prioritize the least well-off!) |
| Cons | Insensitive to starting points; doesn't protect the concerns of the neediest patients. | Insensitive to scale. Lexical ordering disregards any amount of benefits to other patients. |

A middle way

Is there a way to accommodate maximization's sensitivity to scale, and maximin's sensitivity to starting points?

→ Yes! The view is called **Prioritarianism**. (Parfit 2002)

The core idea: increases in utility have decreasing moral value.

Marginal benefits are weighted higher when the starting point is lower, but *all benefits* are taken into account.



Suggestion for further reading:

D. Parfit, "Equality or Priority?" in Matthew Clayton & Andrew Williams (eds.), *The Ideal of Equality*. New York: Palgrave Macmillan. pp. 81-125 (2002)

One more solution...

Reduce scarcity. Please consider becoming an organ donor!

For more information: <https://unos.org>



Thank you!

<https://tinyurl.com/CS120F22>



Survey