

Market Design for Organ Transplantation: How to Succeed at Influencing Policy and Changing Institutions

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NOTA, OPTN & UNOS

- To address the organ donation shortage in the US and improve its organ matching process, the Congress passed the [National Organ Transplant Act \(NOTA\)](#) in 1984.
- The act established the [Organ Procurement and Transplantation Network \(OPTN\)](#) to maintain a national registry for transplantation.
- [United Network for Organ Sharing \(UNOS\)](#) is the non-profit organization that manages the OPTN since 1986 under contract with the federal government.

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- [United Network for Organ Sharing \(UNOS\)](#) is the non-profit organization that manages the OPTN since 1986 under contract with the federal government.
- A lot is happening these days in US transplantation policy, especially in relation to UNOS.

Transplantation News: Liver Exchange in the US

- In January 2023, UNOS launched the first national liver exchange pilot program with the participation of 15 transplant centers.



- It is the first multi-center liver exchange program in the US.
- Many of us in this event have experience in research and policy on liver exchange. Hopefully we can contribute to this exciting initiative.

Transplantation News: Deceased Donor Policies in the US

- **Continuous Distribution System:** For allocation of various organs from deceased donors, UNOS has been developing a new system for the last few years.

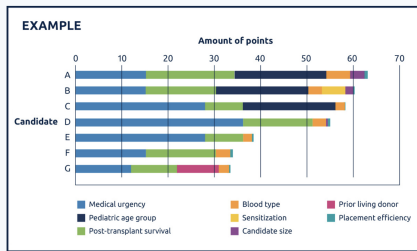
Creating a new system: Goals and driving principles

The Organ Procurement and Transplantation Network is developing a more equitable system of allocating deceased donor organs. The new approach is called **continuous distribution**.

The goals of the new continuous distribution framework are consistent with allocation requirements in the [National Organ Transplant Act \(NOTA\)](#) and the [OPTN Final Rule](#).

Continuous distribution goals

- Prioritize sickest candidates first to reduce waitlist deaths
- Improve long-term survival after transplant
- Increase transplant opportunities for patients who are medically harder to match
- Increase transplant opportunities for candidates with distinct characteristics like candidates under the age of 18 or prior living donors
- Promote the efficient management of organ placement



- It is a **priority point system**.
- UNOS promotes it as a **more equitable** system.
- **Continuous Distribution System for Lung:** Launched in March 2023.

Transplantation News: Deceased Donor Policies in the US

- The new system in development, however, has already created anxiety in some groups.

STAT

FIRST OPINION

Living kidney donors rely on a promise to protect our future health. We're scared it will go away

By Martha Gershun March 22, 2023

Reprints

- **E.g.** Living donors have highest priority under the current system. They are worried that, under the new system this will change, and their prior living donor status will merely be one of several factors that determine priority.
 - As it is often the case in the design of such allocation systems in the field, there is an oversight of **incentives** considerations.
- This is another important setting where expertise from market design can be very valuable.

Transplantation News: Possible End to UNOS Monopoly

- Perhaps the most significant transplantation news came recently in March 2023: The White House announced the plans to end the UNOS monopoly in the US transplantation policy.

The Washington Post

Democracy Dies in Darkness

Troubled U.S. organ transplant system targeted for overhaul

Federal health official announces plans to break up monopoly power of group that has run system for decades



By [Lenny Bernstein](#)

Updated March 22, 2023 at 6:29 p.m. EDT | Published March 22, 2023 at 8:00 a.m. EDT

- Some of the main concerns about the UNOS include:
 - Too many organs being discarded, damaged or not being collected
 - Faulty technology sometimes jeopardizing transplants
 - Poor performers facing little accountability

Transplantation News: Possible End to UNOS Monopoly

- According to the Washington Post story, one of the objectives under the proposed federal reform is “bringing more **transparency** to the sometimes opaque process of how patients and organs are matched.”
- Another key feature of the proposed reform is highlighted in the story as follows:

“HRSA [Health Resources and Services Administration], however, is proposing a ‘modular’ system of improvements that could be tested independently of one another and gradually knit together into a new structure while the old one is still running.”

- **Bottomline:** There are lots of opportunities for market designers! However, our ideas are unlikely to make any policy impact unless they are **transparent** and in **harmony** with the rest of the system.

Policy Relevance of Research in Market Design

- So which factors contribute to a possible success of market design research in the field?
- Building on my experiences with policymakers and experts from a range of areas since late 1990s, in the rest of my talk I will offer my perspective on this question.

Kidney Exchange

- One of the most unexpected applications of market design which contributed to visibility and success of the field is **kidney exchange (KE)** (Roth, Sönmez & Ünver, 2004, 2005, 2007).
 - Within a few years after its introduction as a market design application, our formal approach transformed living donor kidney donation in many countries.
 - Within a decade, it started saving more than a thousand lives annually.
- Why unexpected?
 - Way outside the traditional domain of economics.
 - Help from economists was volunteered as “outsiders” and it was not solicited.

Outreach Efforts in Kidney Exchange

- How did three economists manage to develop the tools for and helped to establish the infrastructure which regularly touches so many lives?

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- The key was convincing stakeholders (e.g. policymakers, system operators) that we can help them to improve their institution
 - in aspects they care about,
 - by using the tools they are familiar with (or at least they are comfortable to use), and
 - without creating any issues.

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 - in aspects they care about,
 - by using the tools they are familiar with (or at least they are comfortable to use), and
 - without creating any issues.
- To have a realistic chance to influence policy, an aspiring market designer needs to have an in depth understanding of the mission of the institution along with a **practical** and **transparent** plan to improve it.
 - Often the **history** of the institution can be instructive.
 - Policy aspiration usually has strong implications on viable designs, and therefore also on the research program.

Early Phases of Kidney Exchange in New England

- Approved by the UNOS Board of Trustees in Fall 2000, the first kidney exchange program in the US was established in New England (UNOS Region 1) in February 2001 (Delmonico et al. 2004).
- In order to overcome barriers to living donation due to biological incompatibilities, the program made two types of arrangements:
 1. **Paired (2-way) Kidney Exchange:** A direct exchange of donors between two patients with incompatible donors.
 2. **List Exchange:** An indirect exchange between an incompatible pair and the deceased-donor (DD) list. (Priority in the list in exchange for a kidney of the incompatible donor).

Paired Kidney Exchange (PKE)

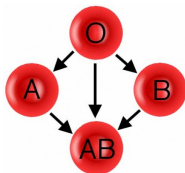
- Originally proposed by a transplant surgeon in Rapaport (1986).
- First carried out in South Korea in 1991 (Park et al., 1999).
- Transplantation community issued a **consensus statement** in 2000 declaring it as **ethically acceptable** (Abecassis et al., 2000).
 - Considered as a high praise in medical community.
 - The consensus statement urged all four operations to be carried out simultaneously.
- The first PKE in the US was carried out in Rhode Island in 2000.

List Exchange (LE)

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- There are four blood types A, B, AB and O.



- Type AB patients can receive a kidney of any type
 - Type A patients can receive a kidney of types A or O
 - Type B patients can receive a kidney of types B or O
 - Type O patients can only receive a kidney of type O
 - Type O patients are disadvantaged because of this “**natural injustice.**”
- The consensus statement (Abecassis et al., 2000) highlighted the ethical concerns that involve type O patients.

Early Phases of Kidney Exchange in New England

- Despite the ethical concerns, New England included LE in its program. This decision was defended by its leadership as follows:

“This exchange program has a clear utilitarian goal: to have more recipients undergo successful transplantation by expanding the pool of compatible live donors.”

Delmonico et al. (2004)

- Reflecting the concerns, however, much of the discussion in Delmonico et al. (2004) involves the precautions taken to mitigate the adverse impact of LE on type O patients on the DD waiting list.

Early Phases of Kidney Exchange in New England

- Despite being the less preferred type of KE, most transplants arranged by the New England's program in its early phases were from LE.
 - # of LE Transplants (Feb. 2001– Dec. 2003): 17
 - # of PKE Transplants (Feb. 2001– Dec. 2003): 8 in 4 PKEs
- **No Database:** Prior to our involvement in Fall 2004, the program in New England did not collect data on living donors of kidney patients.
 - Explains the small number of transplants from PKE in early years of the program.

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- **No Database:** Prior to our involvement in Fall 2004, the program in New England did not collect data on living donors of kidney patients.
 - Explains the small number of transplants from PKE in early years of the program.
- While arranging a LE does not require a patient-donor database, organizing them also involved operational challenges in New England.

Early Phases of Kidney Exchange in New England

- A prerequisite for eligibility for LE was to assure that no PKE is feasible between the patient and any other patient registered in all 14 transplant centers in the system.

“[...] the general practice has been to ask such pairs to wait a minimum of one month, in order to avoid flooding the system with ‘unnecessary’ list exchanges. If no such pair is identified, the center can proceed with the live donor list exchange process.”

Delmonico et al. (2004)

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- **Timing is Everything!** Under these circumstances, we shared the first draft of RSÜ (2004) with Dr. Delmonico in Fall 2003, and conveyed our interest to collaborate with them to improve their KE program.

Early Market Design Research in Kidney Exchange

- While we were both faculty members at Koc University-İstanbul, my colleague Utku Ünver visited Alvin Roth at Harvard University for the academic year 2002-2003.
- During his visit, Roth alerted him that the **house allocation with existing tenants** model (Abdulkadiroğlu & Sönmez, 1999) has an unusual application in kidney transplantation.
 - Patients with living donors are analogous to existing tenants
 - Paired-donor kidneys are analogous to occupied houses
 - Patients on DD list are analogous to newcomers
 - DD kidneys are analogous to vacant houses
- Consequently, **you request my house - I get your turn (YRMH-IGYT)** mechanism (Abdulkadiroğlu & Sönmez, 1999) also had an application.

Early Market Design Research in Kidney Exchange

- Regulating the claims for “unattached” houses (either vacant or vacated during the procedure) with an **exogenous priority list**, YRMH-IGYT mechanism organizes two types of exchanges:
 1. **Cycle**: Existing tenants trade their current houses
 - PKE corresponds to a cycle with two individuals
 2. **Chain**: One individual trade her priority for an “unattached” house and the remaining individuals trade their current houses
 - LE corresponds to a chain with two individuals
- While regulating chains through an exogenous priority list (as in YRMH-IGYT) is also a viable policy for KE, we observed that other **chain selection rules** may mitigate (and even eliminate) the adverse impact of LE on type O patients on the DD list.
- **RSÜ (2004)**: Addressed both goals of the transplantation community with this generalization of the YRMH-IGYT mechanism.

The Birth of a Partnership Between Economists & Doctors

- Our **informed** and **cautious** approach resonated with Dr. Delmonico, the Chief Medical Officer at New England Organ Bank.

Subsequently, he made the following requests:

1. Given the scale of simulated welfare gains from our system, we should drop the more controversial LE altogether.
 2. Due to logistical constraints, we should only allow for PKE.
 3. To avoid a situation where patients and hospitals may compete for donors with certain characteristics, we must assume that patients are indifferent between all compatible donors.
- We accommodated all requests in **RSÜ (2005)**, which formed the basis of the New England Program for Kidney Exchange (NEPKE).
 - Approved by the Renal Transplant Oversight Committee of New England in September 2004, NEPKE became the first KE system that adapted analytical techniques from market design and optimization.

Subsequent Policy Influence

- Our team coded and ran NEPKE's software for several years. Our partnership resulted in a number of additional breakthroughs.
- **Larger Exchanges:** With New England data, early on it became clear that inclusion of 3-way KE is especially important from a utilitarian perspective (RSÜ, 2007).
 - We convinced our medical partners to include 3-way KE to NEPKE software, and together advocated for it to the broader transplantation community in Saidman et al. (2006).
- **NDD-chains:** Together with our NEPKE partners, we introduced and advocated for non-simultaneous implementation of chains, when they initiate with a non-directed living donor kidney (Roth et al., 2007).
 - While NEPKE did not adopt NDD-chains, a second KE program we supported in its early years, **Alliance for Paired Donation (APD)**, did.
 - Today, a sizable part of the welfare gains from KE are due to NDD-chains (Agarwal et al., 2019).

Limited Progress: Compatible Pairs

- Since preferences are assumed to be strict, compatible pairs participate KE in RSÜ (2004).
- RSÜ (2005) made our collaboration possible, but it restricted participation to compatible pairs.
 - **Major Welfare Loss:** non-O patients with O donors rarely join KE.
 - **Implication:** A large majority remain unmatched among O patients with non-O donors.

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 - **Implication:** A large majority remain unmatched among O patients with non-O donors.
- **What can be done to include these harder-to-match pairs in KE?**
- One possibility is **Global Kidney Exchange (GKE)** (Rees et al., 2017): Match them with patient-donor pairs from countries where there is no possibility for living donor transplantation.
 - # of GKE transplants (01/2015 – 02/2022): **52** (17 Intl. & 35 US) (Rees et al., 2022)
Reference: # of KE transplants US (01/2015 – 02/2022): **6000+**
 - A big challenge is the mixed reaction in the transplantation community.

Importance of Ethical Norms

- Dr. Delmonico—key for initial collaboration between economists and medical doctors—is a leading figure in the opposition against GKE.

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LETTER TO THE EDITOR | [Free Access](#)

Opposition to irresponsible global kidney exchange

Francis L. Delmonico  Nancy L. Ascher

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The **DECLARATION** of **ISTANBUL**
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**STATEMENT OF THE DECLARATION OF ISTANBUL CUSTODIAN GROUP
CONCERNING ETHICAL OBJECTIONS TO THE PROPOSED GLOBAL KIDNEY EXCHANGE PROGRAM**

- According to the Opposition on GKE:
 - The program exploits poor countries and individuals
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 - Helping poor patients in exchange for “donated” organs constitutes organ trafficking
 - GKE increases the risk that organs will come from paid sources
- The contrast between the early success on KE and the opposition on GKE highlights the role of cautious approach in building partnerships with experts in other disciplines and policymakers.

Improving Welfare w/o Challenging Ethical Norms: Kidney

- **Incentivized Kidney Exchange** (Sönmez & Ünver, 2015, Sönmez, Ünver & Yenmez, 2020)
- For certain compatible patient-donor pairs, their participation in KE increases the total number of transplants.
 - Especially, non-O patients with O donors
- **Main Idea:** Incentivize such pairs to join KE by giving the patient some form of a priority increase in the DD list in the event of another renal failure in the future.
 - A living donor kidney functions, on average, 12 to 20 years.

Improving Welfare w/o Challenging Ethical Norms: Kidney

- In the last several years, about 1100 patients in the US received transplants via KE annually.
 - For each 10% of incentivized pairs, the number of transplants can be increased by about 180 (Sönmez, Ünver & Yenmez, 2020).
 - KE transplants can be doubled if 60% of compatible pairs can be incentivized.
- Ethics of this policy favorable discussed by several members of Canadian transplantation community in Gill et al. (2017).
- Can be considered as part of the on-going reform of the UNOS-DD allocation system for kidney (Continuous Distribution system).
- **Challenge:** Broader consensus needed to influence national policy.

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- **Challenge:** Broader consensus needed to influence national policy.
- For other organs, it may be possible to incentivize blood-type compatible pairs to join donor exchange through more local policies.

Improving Welfare w/o Challenging Ethical Norms: Liver

- **Liver Exchange:** Utilize **size-compatibility** requirements in living donor liver transplantation and the difference between donor risk from left vs. right-lobe donation (Ergin, Sönmez & Ünver, 2020)
- Living donors for liver typically donate (i) the larger right lobe (60-70% liver mass), (ii) the smaller left lobe (30-40% liver mass), or (iii) part of the left lobe (Segment 2/3) for small children.
 - Morbidity/Mortality risk to donor is several times higher under right lobe transplantation.
 - To survive the operation, the patient needs a graft of at least 40% of the volume of his dysfunctional liver.
- These aspects of liver transplantation result in a natural instrument to incentivize blood-type compatible pairs to join liver exchange:
 - **Reducing donor risk:** Instead of donating the right lobe to her intended patient, a donor can instead donate her left lobe to a smaller patient through liver exchange.

Liver Exchange at İnönü University (Malatya-Turkey)

- These ideas resulted in a partnership between the liver transplant group under the leadership of Dr. Sezai Yilmaz at İnönü University (Malatya-Turkey), and our team of design economists.
 - The second largest liver transplant group worldwide (250-300 living donor liver transplants annually)
Reference: In 2022, the US total was an all-time high of 603.
 - Agreement for the liver exchange program was approved in September 2019, but the system was launched in June 2022 due to Covid-19.
- In less than a year, **15** patients received liver transplants through the program in four 2-way, one 3-way and one 4-way liver exchanges.
 - The **4-way** liver exchange conducted in July 2022 is a **world first**.

A New Institution Design Paradigm

- Our integrated research and policy efforts in [Kidney Exchange](#) and [School Choice](#) in late 1990s and early 2000s resulted in an institution design paradigm I call [minimalist market design](#) (Sönmez, 2023).
 - Can be especially useful for [aspiring](#) market designers who “volunteer” their ideas as outsider critics.
- After the initial success of the approach in early phases of the field, I followed this paradigm systematically in many other settings, and often succeed in influencing policy.

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- After the initial success of the approach in early phases of the field, I followed this paradigm systematically in many other settings, and often succeed in influencing policy.
- In the last part of my talk, I summarize the philosophy and some of the key features of this institution design paradigm.

Minimalist Market Design [▶ LINK TO PDF](#)

- Consider an economic, political, or social institution that is deployed to fulfill a number of objectives.
 - Typically it has many components, each serving its own purposes, and interacting with each other in various ways.

Example (Auction Design): A component collects private information from the participants, a second component processes this information, a third component is used to determine the pricing of outcomes, and a fourth component is used to ensure a fair outcome.

- Now suppose that the institution fails in some of its objectives. Maybe some of its components are broken, or maybe there is an issue with the interface between various components.
- How can a design economist be helpful in addressing these failures?

Minimalist Market Design

- How would experts in other areas would respond to similar challenges?
 - How would a surgeon address an analogous failure on a human body?
 - What about a mechanic on a broken car?
- These experts would first identify the **root cause** of the failure, whether it has to do with a component itself or an interface between various components, and directly address the failure at its source.
 - A surgeon would remove diseased tissue or organs, repair body systems, or replace diseased organs with transplants.
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 - A surgeon would remove diseased tissue or organs, repair body systems, or replace diseased organs with transplants.
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- **Minimalist market design** (Sönmez, 2023) is a paradigm under which a design economist operates in a similar way.

Main Tasks under Minimalist Market Design

1. Identify the primary objectives of the system operators in designing the institution.
 - Potentially includes key objectives that remain outside the scope of mainstream economics.
 - The **history** of the institution may be instructive.
2. Find out whether the current institution satisfies these primary objectives or not.
 - If it doesn't, then there is potential for policy impact with a compelling alternative design.
 - To materialize this potential into a successful redesign, the root causes of the failures should be identified.
3. The failures of the current institution are addressed by interfering only with its flawed components and interfaces, as if a surgeon performs a **"minimally invasive"** procedure.

Policy Impact through Minimalist Market Design

- **Kidney Exchange:** NEPKE, APD, NDD-Chains etc. (RSÜ, 2004, 2005, 2007)
- **Liver Exchange:** İnönü University, Malatya/Turkey (Yilmaz et al., 2023)
- **School Choice:** 2005 reform at Boston Public Schools (Abdulkadiroğlu & Sönmez, 2003)
- **US Army's Branching System:** 2020 reform at West Point and ROTC (Sönmez & Switzer, 2013, Sönmez, 2013, Greenberg, Pathak & Sönmez, 2021)
- **Pandemic Rationing of Scarce Medical Resources:** Covid-19 (Pathak, Sönmez, Ünver & Yenmez, 2020)
 - **Vaccine Rollout** in 15+ states and jurisdictions (Schmidt et al., 2021)
 - **Therapeutic Agents** in PA (White et al., 2022)
 - **Monoclonal Antibodies** in MA (Rubin et al., 2021)

External Validity for Minimalist Market Design

- **External Validity:** In other applications, policymakers themselves reached the same conclusions in our earlier published (or circulated) papers without direct design economist involvement.
 - Especially valuable, because, design via minimalist market design aims to “mimic” the natural evolution of institutions.
- **School Choice:**
 - 2007 reform of School Admissions Code in England (Pathak & Sönmez, 2013)
 - 2009 reform at Chicago Public Schools (Pathak & Sönmez, 2013)
- **Affirmative Action Laws in India:** Prediction of the rescission of a 1995 Supreme Court judgment, the mandates of its amendment, and the endorsed mechanism (Sönmez & Yenmez, 2022)

Recommendations for Aspiring Market Designers

1. Find a “Goldilocks” problem which is neither too simple nor too hard.
2. Understand clearly what the objectives of the stakeholders are.
3. Assuming there is one, identify an inconsistency between the objectives of the stakeholders and the actual working of the institution.
4. Propose as few changes to what they are doing as are required to solve the issue.
5. Identify specific individuals who have a stake in solving the problem to approach with your proposal.
6. The axiomatic approach can be a very effective way to communicate with policymakers.
7. Learn from your mistakes to improve your next design.