

Improved Markets for Doctors, Organ Transplants and School Choice

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How do markets work?

- Commodity markets are relatively simple:
- You pay your money and you take your choice: buyers choose what they want from what they can afford.

Other kinds of markets aren't so simple:

- There are lots of things you can't simply choose, you also have to be *chosen*.
 - Jobs
 - Schools
 - Organ transplants
 - Spouses
- Some of these “matching” markets don't even use money, and even in those that do, money has a different role than in markets for commodities

Marketplaces

- Even commodity markets need *marketplaces*, clearinghouses at which lots of buyers and sellers can gather together smoothly.



Clearinghouses

Clearinghouses are important because, to work well, marketplaces need to

- Establish thickness
- Deal with congestion
- Be safe to participate in

I'll tell you briefly today about how clearinghouses help do that in

- The American market for doctors
- Kidney Exchange
- School choice in Boston, NY and (soon) SF

Matching doctors to first positions in U.S.

- The redesign in 1995 of the
 - National Resident Matching Program (NRMP) (approx. 23,000 positions, 500 couples)
- The redesign in 2005 of fellowship matches for more senior physicians
 - The Gastroenterology fellowship match

Background to redesign of the medical clearinghouses

- 1900-1945 UNRAVELLING OF APPOINTMENT DATES
- 1945-1950 CHAOTIC RECONTRACTING--Congestion
- 1950-197x HIGH RATES OF ORDERLY PARTICIPATION
(95%) in centralized clearinghouse
- 197x-198x DECLINING RATES OF PARTICIPATION
(85%) particularly among the growing number
of MARRIED COUPLES
- 1995-98 Market experienced a crisis of confidence with fears
of substantial decline in orderly participation;
 - Design effort commissioned—to design and compare alternative
matching algorithms capable of handling modern requirements:
couples, specialty positions, etc.
 - Roth-Peranson clearinghouse algorithm adopted, and employed

What makes a clearinghouse successful or unsuccessful?

- A matching is “stable” if there aren’t a doctor and residency program, not matched to each other, who would both prefer to be.
- Hypothesis: successful clearinghouses produce stable matchings.
- How to test this?

Market	Stable	Still in use (halted unraveling)
• NRMP	yes	yes (new design in '98)
• <i>Edinburgh ('69)</i>	<i>yes</i>	<i>yes</i>
• <i>Cardiff</i>	<i>yes</i>	<i>yes</i>
• <i>Birmingham</i>	<i>no</i>	<i>no</i>
• <i>Edinburgh ('67)</i>	<i>no</i>	<i>no</i>
• <i>Newcastle</i>	<i>no</i>	<i>no</i>
• <i>Sheffield</i>	<i>no</i>	<i>no</i>
• Cambridge	no	yes
• London Hospital	no	yes
• Medical Specialties	yes	yes (~30 markets, 1 failure)
• Canadian Lawyers	yes	yes (Alberta, no BC, Ontario)
• Dental Residencies	yes	yes (5) (no 2)
• Osteopaths (< '94)	no	no
• Osteopaths (≥ '94)	yes	yes
• Pharmacists	yes	yes
• Reform rabbis	yes (first used in '97-98)	yes
• Clinical psych	yes (first used in '99)	yes
• Lab experiments	yes	yes.
(Kagel&Roth QJE 2000)	no	no

Lab experiments fit nicely on the list, just more of a variety of observations that increase our confidence in the robustness of our conclusions, the lab observations are the smallest but most controlled of the markets on the list...

Stable Clearinghouses (those now using the Roth Peranson Algorithm)

NRMP / SMS:

- Medical Residencies in the U.S. (NRMP) (1952)
- Abdominal Transplant Surgery (2005)
- Child & Adolescent Psychiatry (1995)
- Colon & Rectal Surgery (1984)
- Combined Musculoskeletal Matching Program (CMMP)
 - Hand Surgery (1990)
- Medical Specialties Matching Program (MSMP)
 - Cardiovascular Disease (1986)
 - **Gastroenterology (1986-1999; rejoined in 2006)**
 - Hematology (2006)
 - Hematology/Oncology (2006)
 - Infectious Disease (1986-1990; rejoined in 1994)
 - Oncology (2006)
 - Pulmonary and Critical Medicine (1986)
 - Rheumatology (2005)
- Minimally Invasive and Gastrointestinal Surgery (2003)
- Obstetrics/Gynecology
 - Reproductive Endocrinology (1991)
 - Gynecologic Oncology (1993)
 - Maternal-Fetal Medicine (1994)
 - Female Pelvic Medicine & Reconstructive Surgery (2001)
- Ophthalmic Plastic & Reconstructive Surgery (1991)
- Pediatric Cardiology (1999)
- Pediatric Critical Care Medicine (2000)
- Pediatric Emergency Medicine (1994)
- Pediatric Hematology/Oncology (2001)
- Pediatric Rheumatology (2004)
- Pediatric Surgery (1992)

Primary Care Sports Medicine (1994)

Radiology

- Interventional Radiology (2002)
- Neuroradiology (2001)
- Pediatric Radiology (2003)

Surgical Critical Care (2004)

Thoracic Surgery (1988)

Vascular Surgery (1988)

Postdoctoral Dental Residencies in the United States

- Oral and Maxillofacial Surgery (1985)
- General Practice Residency (1986)
- Advanced Education in General Dentistry (1986)
- Pediatric Dentistry (1989)
- Orthodontics (1996)

Psychology Internships in the U.S. and CA (1999)

Neuropsychology Residencies in the U.S. & CA (2001)

Osteopathic Internships in the U.S. (before 1995)

Pharmacy Practice Residencies in the U.S. (1994)

Articling Positions with Law Firms in Alberta, CA(1993)

Medical Residencies in CA (CaRMS) (before 1970)

British (medical) house officer positions

- Edinburgh (1969)
- Cardiff (197x)

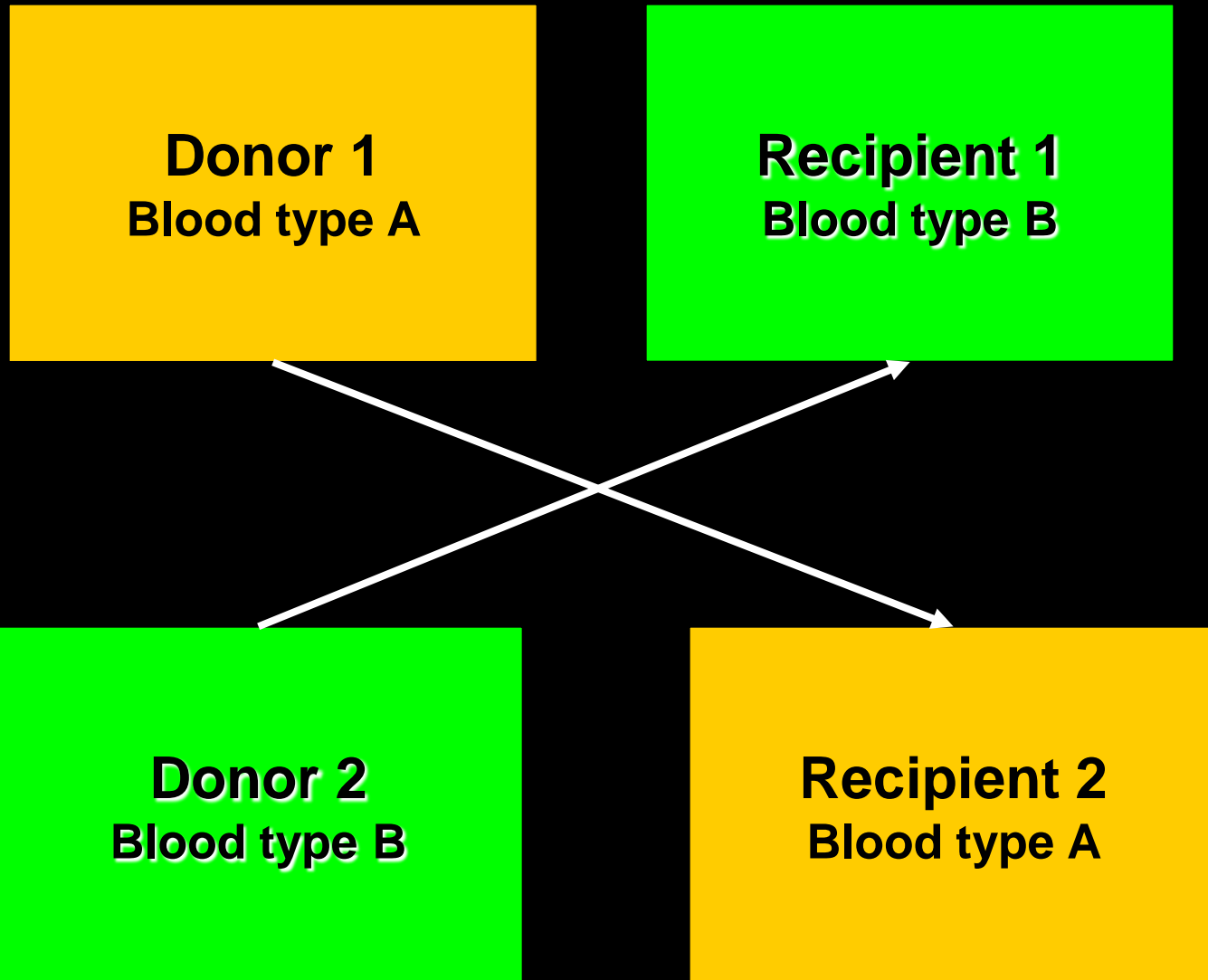
New York City High Schools (2003)

Boston Public Schools (2006)

Kidney exchange--background

- There are 83,881 patients on the waiting list for cadaver kidneys in the U.S. (as of yesterday, 3/14/10)
- In 2009 33,678 patients were added to the waiting list, and 26,893 patients were removed from the list.
- In 2009 there were 10,441 transplants of cadaver kidneys performed in the U.S.
- In the same year, 4,456 patients died while on the waiting list (and more than 1,941 others were removed from the list as “Too Sick to Transplant”).
- In 2009 there were also 6,387 transplants of kidneys from *living* donors in the US.
- Sometimes donors are incompatible with their intended recipient.
- This opens the possibility of *exchange* .

Two Pair Kidney Exchange



Section 301 of the National Organ Transplant Act

(NOTA), 42 U.S.C. 274e 1984 states:

**“it shall be unlawful for any person
to knowingly acquire, receive or otherwise transfer
any human organ for valuable consideration
for use in human transplantation”.**

Legal opinion obtained by the transplant community interpreted this as forbidding buying and selling, but allowing exchange.

But the DOJ wasn't sure...

Charlie W. Norwood Living Organ Donation Act

Public Law 110-144, 110th Congress, Dec. 21, **2007**

- Section 301 of the National Organ Transplant Act (42 U.S.C. 274e) is amended--in subsection (a), by adding at the end the following:
- **“The preceding sentence does not apply with respect to human organ paired donation.”**

“Kidney exchange” is an *in-kind* exchange



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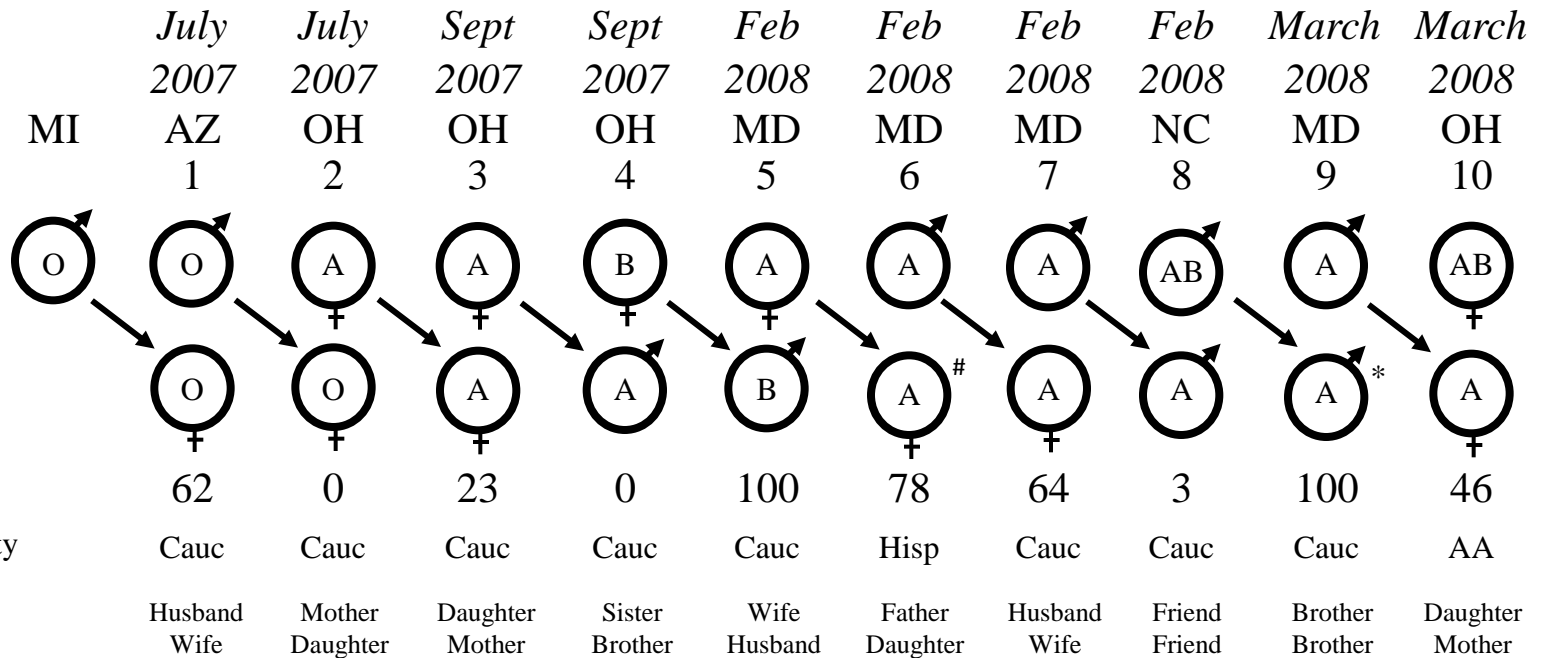
A Nonsimultaneous, Extended, Altruistic-Donor Chain

Michael A. Rees, M.D., Ph.D., Jonathan E. Kopke, B.S., Ronald P. Pelletier, M.D.,
Dorry L. Segev, M.D., Matthew E. Rutter, M.D., Alfredo J. Fabrega, M.D.,
Jeffrey Rogers, M.D., Oleh G. Pankewycz, M.D., Janet Hiller, M.S.N.,
Alvin E. Roth, Ph.D., Tuomas Sandholm, Ph.D., M. Utku Ünver, Ph.D.,
and Robert A. Montgomery, M.D., D.Phil.

SUMMARY

We report a chain of 10 kidney transplantations, initiated in July 2007 by a single altruistic donor (i.e., a donor without a designated recipient) and coordinated over a period of 8 months by two large paired-donation registries. These transplantations involved six transplantation centers in five states. In the case of five of the transplantations, the donors and their coregistered recipients underwent surgery simultaneously. In the other five cases, “bridge donors” continued the chain as many as 5 months after the coregistered recipients in their own pairs had received transplants. This report of a chain of paired kidney donations, in which the transplantations were not necessarily performed simultaneously, illustrates the potential of this strategy.

The First NEAD Chain (Rees, APD)



* This recipient required desensitization to Blood Group (AHG Titer of 1/8).

This recipient required desensitization to HLA DSA by T and B cell flow cytometry.

THE KIDNEY CHAIN

How a single organ donation changed 20 lives and created the longest-running transplant chain



Dr. Mike Rees (center, left) and his team perform a kidney transplant.

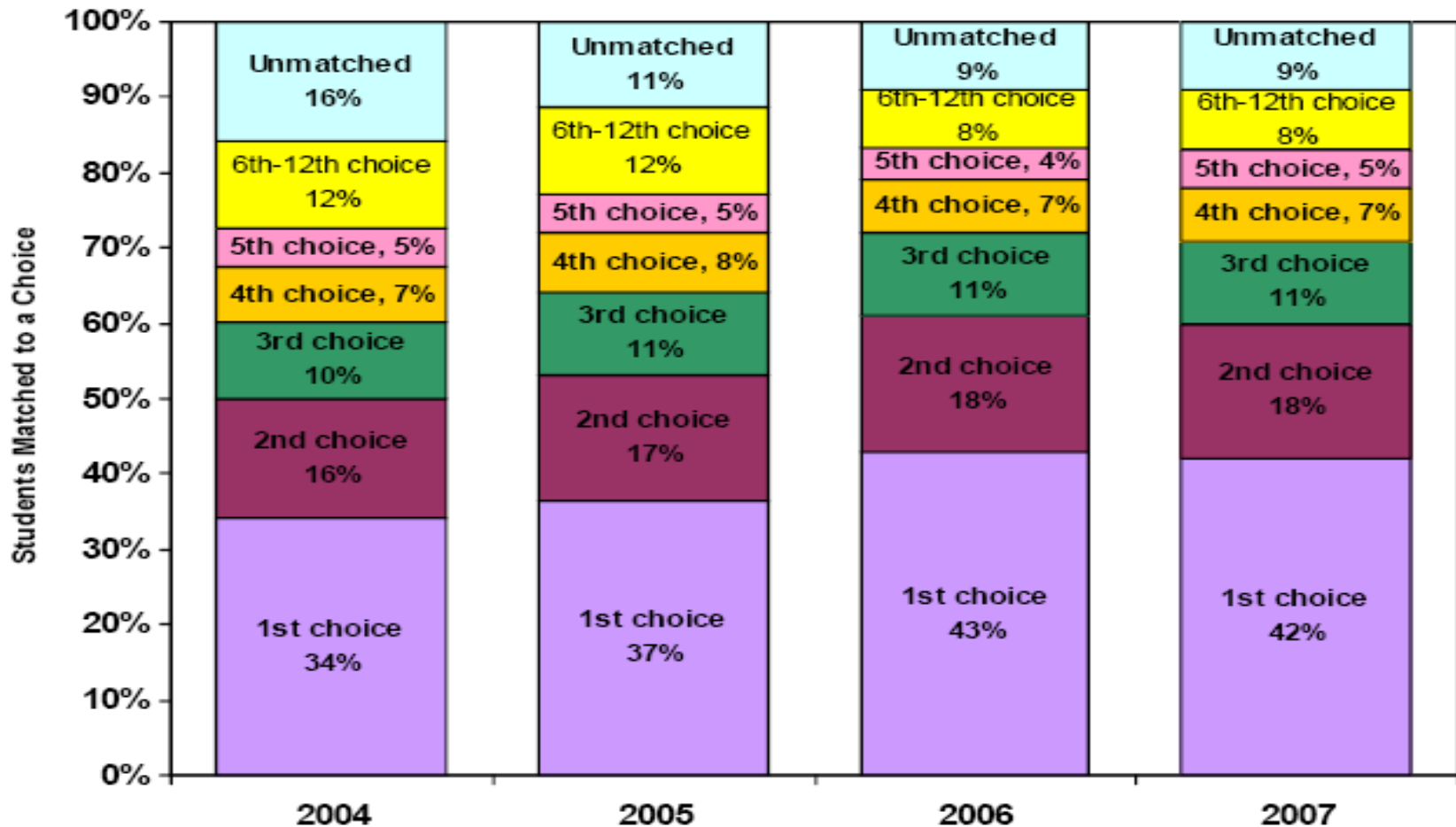
Schools

- NYC Schools: design of a centralized high school allocation procedure (implemented in 2003-04, for students entering Sept. '04)
- Boston Schools: redesign of a school allocation procedure (implemented for students entering K, 6, and 9 in Sept. 2006)
- SF—one sided problem, clearinghouse uses assignment plus transfers, decided last week.

First 4 years: NYC

Results at end of Round 2

(Schools have learned to change their reporting of capacities)



Market design

- Markets aren't just for commodities
 - They are also for *opportunities*

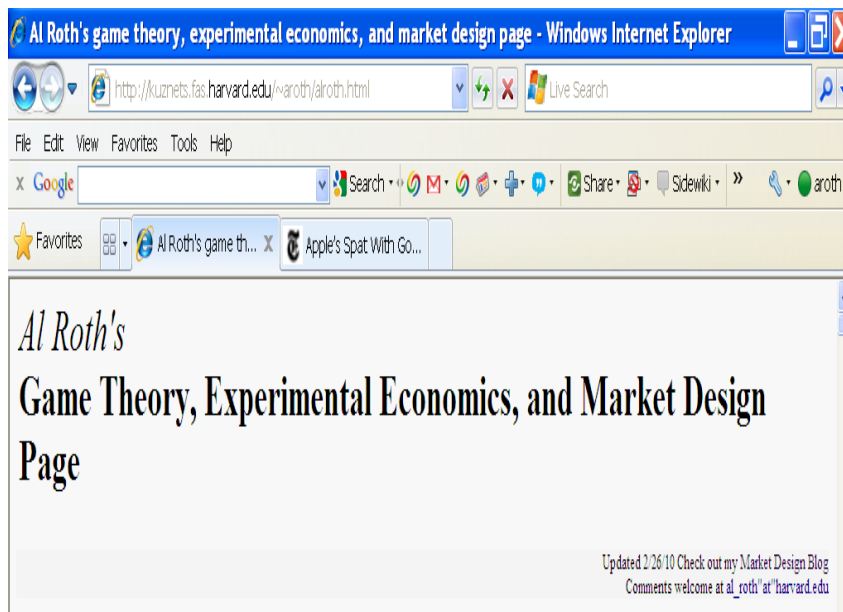
A lot of this work began with abstract, NSF-supported theory

- Even the most basic scientific work pays off in unanticipated ways
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Thank you

Further bibliography

- On my web page,
<http://kuznets.fas.harvard.edu/~aroth/alroth.html>



- Co-investigators on these market design projects:
- Atila Abdulkadiroglu, Frank Delmonico, Clayton Featherstone, John Kagel, Muriel Niederle, Parag Pathak, Elliott Peranson, Deborah Proctor, Mike Rees, Susan Saidman, Tayfun Sonmez, Utku Unver...