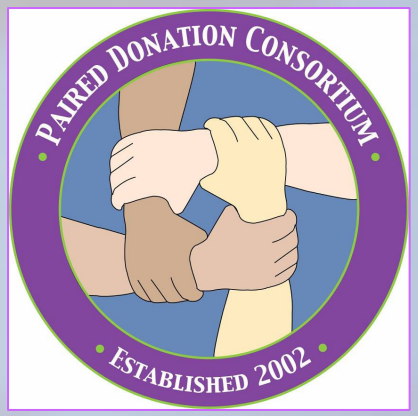
The Paired Donation Network

E. Steve Woodle, M.D.
Division of Transplantation
University of Cincinnati



ASTS
American Society of Transplant Surgeons

Paired Donation: Definition

- In a paired donation, two living kidney donor/recipient pairs (both of whom cannot undergo transplantation because of ABO or crossmatch incompatibility) are paired so that the donated kidneys are transplanted into the matched recipients (not the original intended loved ones) thereby circumventing immunologic barriers and allowing both recipients to receive a living donor kidney transplant

ASTS
American Society of Transplant Surgeons

Paired Donation for ABO Incompatibility

	Pair 1	Pair 2
Donor ABO Blood Type	A	B
Recipient ABO Blood Type	B	A

ASTS
American Society of Transplant Surgeons

Wait List Paired Donation

Incompatible Donor/Recipient Pair

Donor donates → DD wait list

Recipient → Increased wait list priority

ASTS
American Society of Transplant Surgeons

Wait List Paired Donation: Definition

- In a wait list paired donation, a living kidney donor (who cannot donate to his or her loved one because of ABO or crossmatch incompatibility) donates a kidney that is distributed to the deceased donor wait list, and in return, his or her loved one receives increased priority on the deceased donor wait list. In this scenario, a deceased donor kidney is received in return for the donated live donor kidney.

ASTS
American Society of Transplant Surgeons

Wait List Paired Donation Programs

- Primary ethical and medical problem is that a living donor kidney is donated and a deceased donor kidney (i.e., a kidney of comparatively lesser medical quality) is received in return

ASTS
American Society of Transplant Surgeons

Paired Donation: Historical Aspects

Transplant Proc 18: Supp 2: 5-9, 1986

- Rapaport - first published record suggesting living kidney donor exchanges
  - Two living donor/recipient pairs
  - Separate transplant centers
  - Simultaneous procedures
  - Exchange of kidneys by courier

ASTS
American Society of Transplant Surgeons

Paired Donation: Historical Aspects

- Before paired donation could become a clinical reality, unrelated living donor transplantation had to become an accepted procedure in the transplant community
- By the mid-1990's, a significant number of unrelated living donor transplants were being performed in the transplant community

ASTS
American Society of Transplant Surgeons

First Full Length Publication on Paired Donation

The New England Journal of Medicine 336:1752-1755 (June 12), 1997

Sounding Board

ETHICS OF A PAIRED-KIDNEY-EXCHANGE PROGRAM

ALTHOUGH transplantation is the best treatment for many people with end-stage renal disease, the gap between the number of organ donors and the number of potential recipients continues to widen.[1] Patients are often treated with dialysis for years while awaiting transplants, and many die.[1] At the University of Chicago, between 10 and 20 percent of patients with available living donors cannot receive transplants from them because of ABO incompatibility. We propose to increase the supply of organs by using kidneys from living donors who are ABO incompatible with the intended recipients but are ABO compatible with other recipients. Through an exchange arrangement between two donor–recipient pairs, Donor A provides a kidney to (ABO com-

matches) make some donations unacceptable under current standards of care. Although several trials of renal transplantation between ABO-incompatible donors and recipients have had good results,[9-11] these trials were small, and such transplantations are not routinely performed in the United States.[12-14]

In 1986, Rapaport set forth the idea of paired kidney exchanges.[15] He envisioned a process in which the two donor–recipient pairs would be treated at their separate transplantation centers, and the procedures would be performed simultaneously, with an immediate exchange of the two kidneys by special courier.

A PROPOSAL FOR A PILOT STUDY

To increase the number of successful kidney transplantations, we propose a pilot study of the clinical and ethical aspects of paired kidney exchanges, with all the procedures to be performed at a single hospital. The study will work as follows. If all a recipient's potential living donors are determined to be unsuitable, a potential donor rejected solely on the basis of ABO incompatibility will be offered the op

LAINIE FRIEDMAN ROSS, M.D., PH.D.
DAVID T. RUBIN, M.D.
MARK SIEGLER, M.D.
MICHELLE A. JOSEPHSON, M.D.
J. RICHARD THISTLETHWAITE, JR., M.D., PH.D.
E. STEVE WOODLE, M.D.
University of Chicago
Chicago, IL 60637

- Provided ethical and scientific foundations for clinical trials of paired donation

ASTS
American Society of Transplant Surgeons

Paired Donation Programs: Ethical Issues

- Coercion
- Right to withdraw consent
- Privacy and confidentiality
- Commercialization and exploitation
- Informed consent and the right to medical knowledge
- Altruism balance

ASTS
American Society of Transplant Surgeons

Ethical Issues

- Coercion
  - In the absence of exchange programs, unwilling or ambivalent donors may be relieved that they are excluded by ABO or HLA incompatibility.
  - Exchange programs remove these medical exclusions, thereby creating the potential for increased coercion for the hesitant or unwilling donor

ASTS
American Society of Transplant Surgeons

Ethical Issues

- **Right to Withdraw Consent**
  - Potential donors must be reminded throughout the evaluation process that they may withdraw consent, and that withdrawal will be on the basis of medical, not psychological grounds
  - Potential donors must be ***specifically*** asked throughout the process if they have doubts or reservations about the process. These conversations must be held in a nonthreatening environment.

ASTS
American Society of Transplant Surgeons

Ethical Issues

- Privacy and Confidentiality
- Informed Consent and the Right to Medical Knowledge
  - All patients have a right to privacy, and a right to confidentiality of their medical condition and medical records.
  - Patients also have the right of informed consent and a right to medical knowledge

ASTS
American Society of Transplant Surgeons

Ethical Issues

- Medicolegal Protection
  - Untoward outcomes, or unexpected transmission of tumor or disease via the donor kidney, even when inadvertent and unpreventable, creates potential medical-legal liabilities.
  - These issues must be covered in the informed consent process.

ASTS
American Society of Transplant Surgeons

Ethical Issues

- Commercialization and Exploitation
  - In most western civilizations, it is illegal to purchase or sell organs or to participate in such commercial activities.
  - Despite these laws, and adoption of these principles by transplant programs, the possibility still exists that covert arrangements for such compensation may still occur.

ASTS
American Society of Transplant Surgeons

Paired Donation for ABO Incompatibility

	Pair 1	Pair 2
Donor ABO Blood Type	A	B
Recipient ABO Blood Type	B	A

Problem: only represents 12% of combinations

ASTS
American Society of Transplant Surgeons

Predicted ABO Frequencies for Live Donor Recipients with ABO Incompatible Donors

Race	O (%)	A	B	AB	ABOi O Recips (%)	ABOi A, B recips (%)	ABO Compatible (% of pairs)
Cau	45	40	11	4	25%	12%	63%
AA	49	27	20	4	25%	14%	61%

ASTS
American Society of Transplant Surgeons

The O blood group donor shortage problem exists for paired donation also

ASTS
American Society of Transplant Surgeons

Solving the O blood group shortage:

1) Include crossmatch positive D/R pairs
2) Educate donors/recipients about the need for O blood group donors to participate
3) Allow listing of each recipient with multiple donors

0041-1337/00/6908-1539/0
TRANSPLANTATION

Vol. 69, 1539–1543, No. 8, April 27, 2000
Printed in U.S.A.

Transplantation®

OVERVIEW

ETHICAL ISSUES IN INCREASING LIVING KIDNEY DONATIONS BY EXPANDING KIDNEY PAIRED EXCHANGE PROGRAMS

LAINIE FRIEDMAN ROSS[1,2] AND E. STEVE WOODLE

Department of Pediatrics and the Department of Medicine, MacLean Center for Clinical Medical Ethics, University of Chicago, Chicago, Illinois, and Department of Surgery, Division of Transplantation, University of Cincinnati, Cincinnati, Ohio

Living Unrelated Organ Donation: An Exchange Proposal

Francis L. Delmonico, Jeffrey S. Stoff, Edgar Milford, William E. Harmon and E. Steve Woodle

First US Consortium Based Paired Donation Program: 6 New England States

ASTS
American Society of Transplant Surgeons

Hierarchical Paired Donation Programs: "Bailout" Phenomenon

Initial Consideration: Paired Donation

↓

Not Possible

↓

Secondary Consideration: Wait List Paired Donation

The overall ratio of paired donations:
wait list paired donations that are performed is a function of how frequently paired donation matches are achieved.

ASTS
American Society of Transplant Surgeons

Wait List Paired Donation: PDC Policy

- Wait list paired donation is a medically and ethically inferior option to paired donation
- Waiting times for almost all groups appear to be shorter with paired donation than on the deceased donor wait list
- Wait list paired donation should only be allowed when there is convincing evidence that it will provide a transplant more quickly than will paired donation
- The negative effects of wait list paired donation on paired donation waiting times must be carefully weighed

ASTS
American Society of Transplant Surgeons

Korean Paired Donation Program

- Initiated by Dr. Kil Park in Seoul in 1991
- Experience first reported in 1999
- Not performed under rigid prospective protocol
- First used to circumvent crossmatch positive transplants
- First used living related donors

ASTS
American Society of Transplant Surgeons

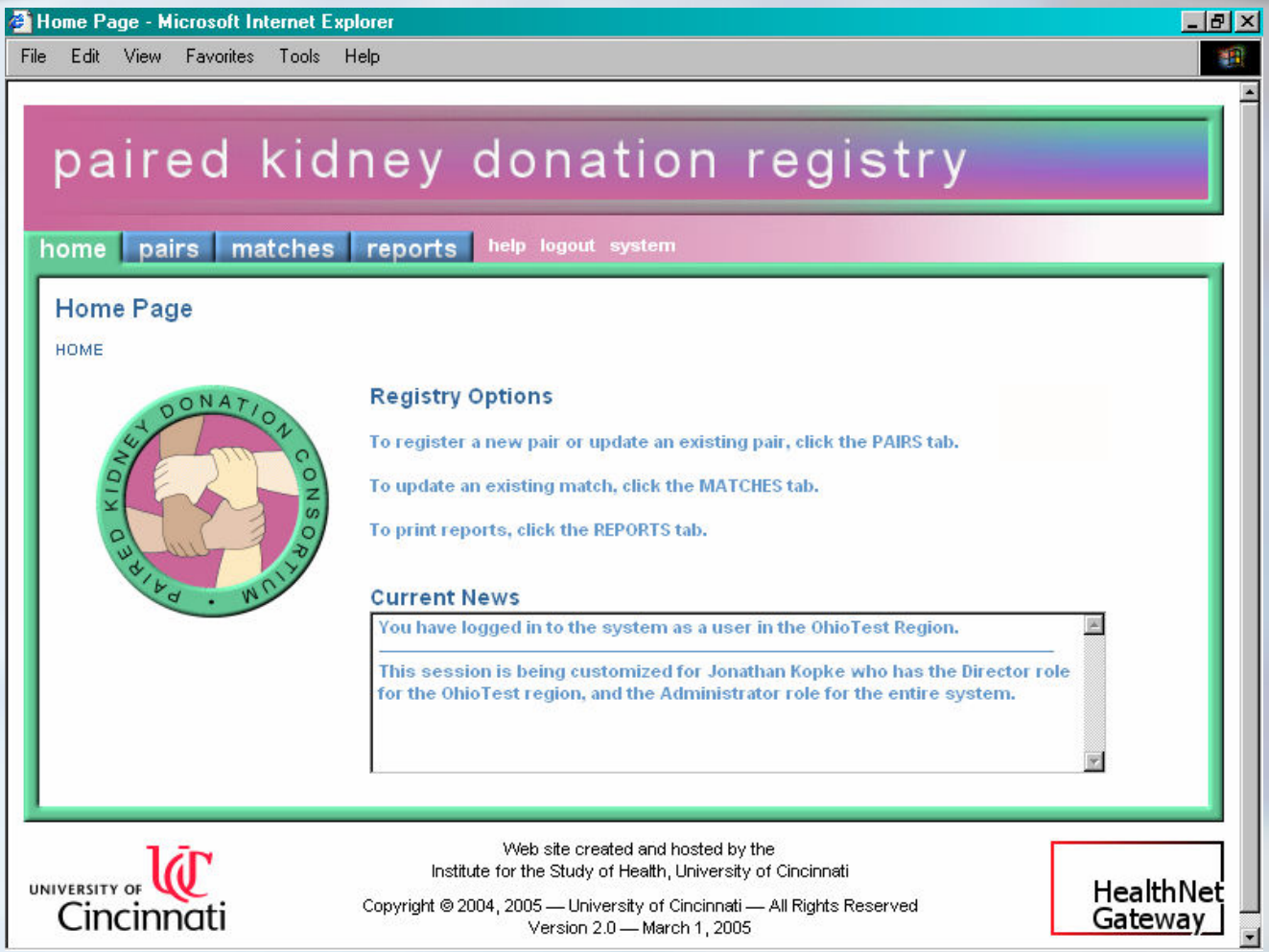
Korean Paired Donation Program

Transplantation 67:336, 1991

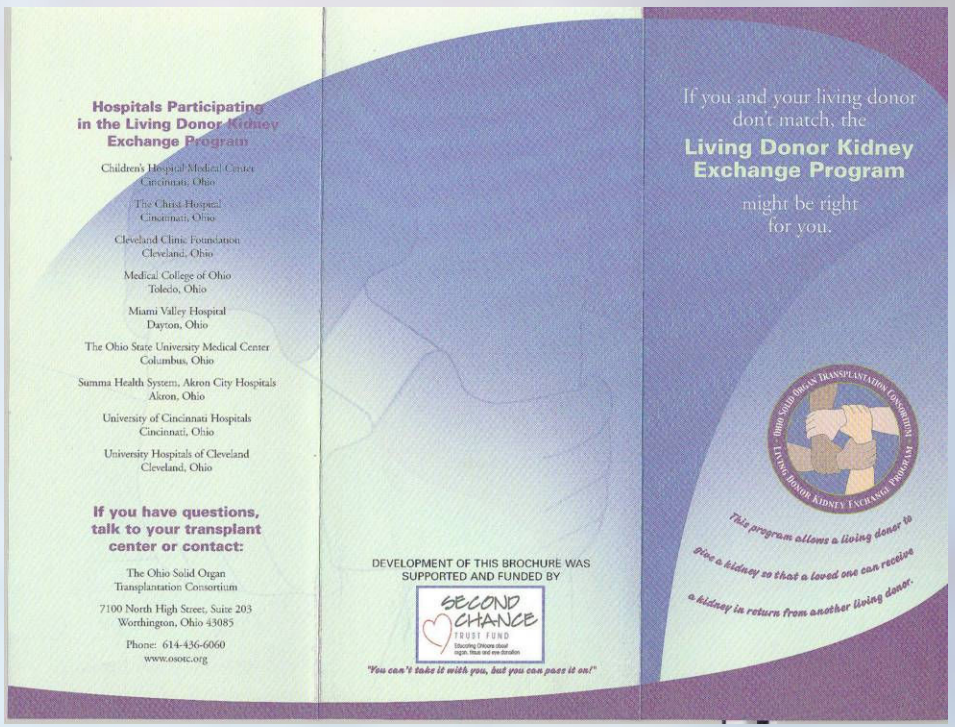
- 110 transplants performed (55 exchanges)
- Graft survival
  - 95% 1 year
  - 82% 5 year
- No difference in graft survival between HLA haploidentical controls

ASTS
American Society of Transplant Surgeons

Paired Donation Network
Web-based Computer Matching



PDN Patient Education Brochure



Hospitals Participating in the Living Donor Kidney Exchange Program

Children's Hospital Medical Center
Cincinnati, Ohio

The Christ Hospital
Cincinnati, Ohio

Cleveland Clinic Foundation
Cleveland, Ohio

Medical College of Ohio
Toledo, Ohio

Miami Valley Hospital
Dayton, Ohio

The Ohio State University Medical Center
Columbus, Ohio

Summa Health System, Akron City Hospitals
Akron, Ohio

University of Cincinnati Hospitals
Cincinnati, Ohio

University Hospitals of Cleveland
Cleveland, Ohio

If you have questions, talk to your transplant center or contact:

The Ohio Solid Organ
Transplantation Consortium

7100 North High Street, Suite 203
Worthington, Ohio 43085

Phone: 614-436-6060
www.osotc.org

DEVELOPMENT OF THIS BROCHURE WAS SUPPORTED AND FUNDED BY

SECOND CHANCE TRUST FUND

"You can't take it with you, but you can pass it on!"

If you and your living donor don't match, the

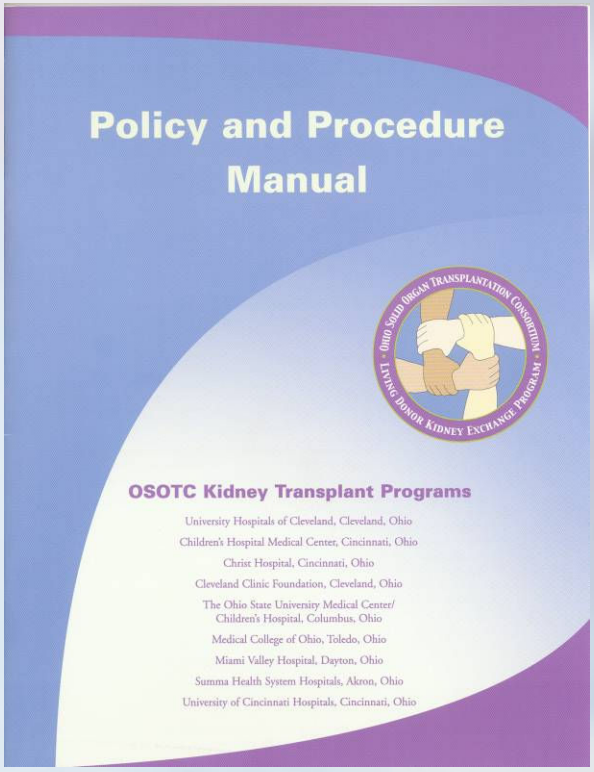
Living Donor Kidney Exchange Program

might be right for you.

OHIO SOLID ORGAN TRANSPLANTATION CONSORTIUM · LIVING DONOR KIDNEY EXCHANGE PROGRAM

This program allows a living donor to give a kidney so that a loved one can receive a kidney in return from another living donor.

PDN Policy and Procedure Manual



PDN Computer Matching

- Match run frequency can be variable
- Initial version: manual rank order determination
- Matching criteria: waiting time, distance, age, HLA matching, PRA, serologies
- Crossmatching performed after match run completed
- 2 pair and 3 pair matches currently considered

ASTS
American Society of Transplant Surgeons

PDC Transplant Rates

8 of 43 (24%) registered recipients transplanted in first year

10 of 68 (15%) registered recipients transplanted to date

4 additional recipients have completed evaluations and have scheduled paired donation procedures

ASTS
American Society of Transplant Surgeons

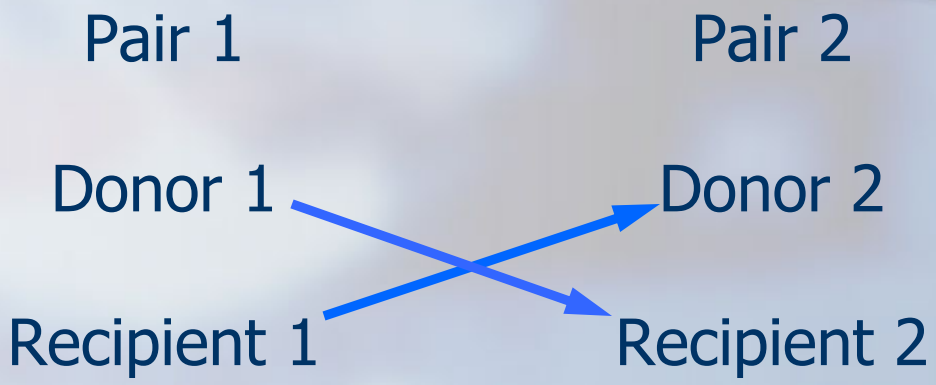
Optimization Approaches

- Scaled Optimization
  - Two pair donation
  - Three or four pair donation
- Rank Order Optimization
  - Manual v Computer-based v First Accept
  - Pre-Crossmatching v Post-Crossmatching

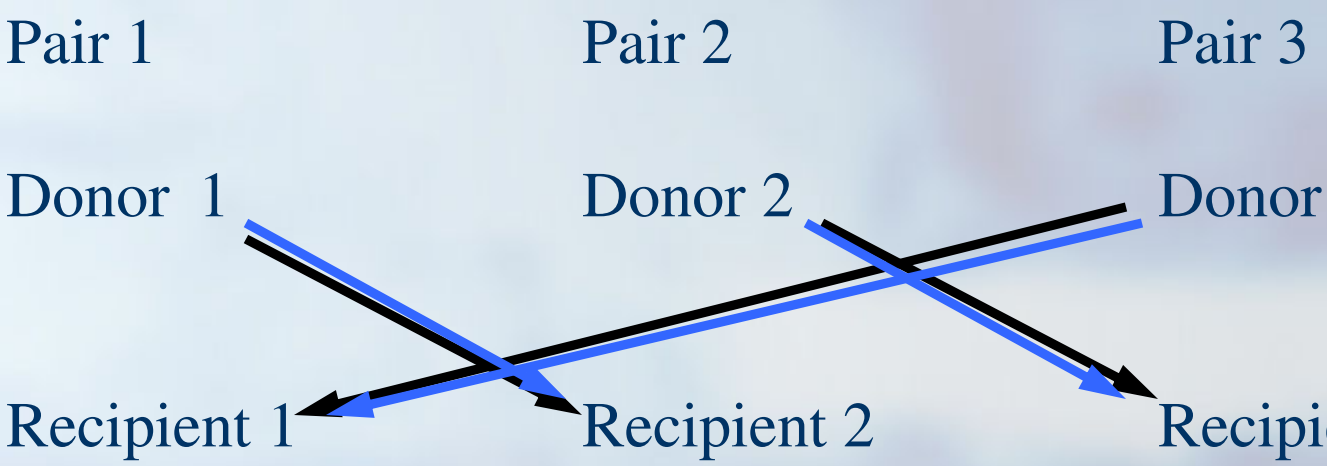
ASTS
American Society of Transplant Surgeons

Scaled Optimization

2 Pair Donation



3 Pair Donation



"First Accept" Approach

- 35 D/R pairs in match run
- Matches

	Points
Match 1) Pair 3: Pair 4	20
Match 2) Pair 5: Pair 6	18
Match 3) Pair 3: Pair 20	15
Match 4) Pair 4: Pair 21	13
Match 5) Pair 5: Pair 25	12
Match 6) Pair 6 : Pair 26	9

- Transplanting first 2 matches excludes the next four matches and transplants four patients and 38 points

ASTS
American Society of Transplant Surgeons

Rank Order Optimization

- 35 D/R pairs in match run
- Matches

Matches	Points
Match 1) Pair 3: Pair 20	15
Match 2) Pair 4: Pair 21	13
Match 3) Pair 5: Pair 25	12
Match 4) Pair 6 : Pair 26	9
Match 5) Pair 3: Pair 4	20
Match 6) Pair 5: Pair 6	18

- Rank order optimization provides the greatest number of transplants (8 transplants) and the greatest number of points (49)

ASTS
American Society of Transplant Surgeons

Optimization Modeling: Hopkins Approach

Kidney Paired Donation and Optimizing the Use of Live Donor Organs

Dorry L. Segev, MD
Sommer E. Gentry, MS
Daniel S. Warren, PhD
Brigitte Reeb, MFA
Robert A. Montgomery, MD, DPhil

Context Blood type and crossmatch incompatibility will exclude at least one third of patients in need from receiving a live donor kidney transplant. Kidney paired donation (KPD) offers incompatible donor/recipient pairs the opportunity to match for compatible transplants. Despite its increasing popularity, very few transplants have resulted from KPD.

Objective To determine the potential impact of improved matching schemes on the number and quality of transplants achievable with KPD.

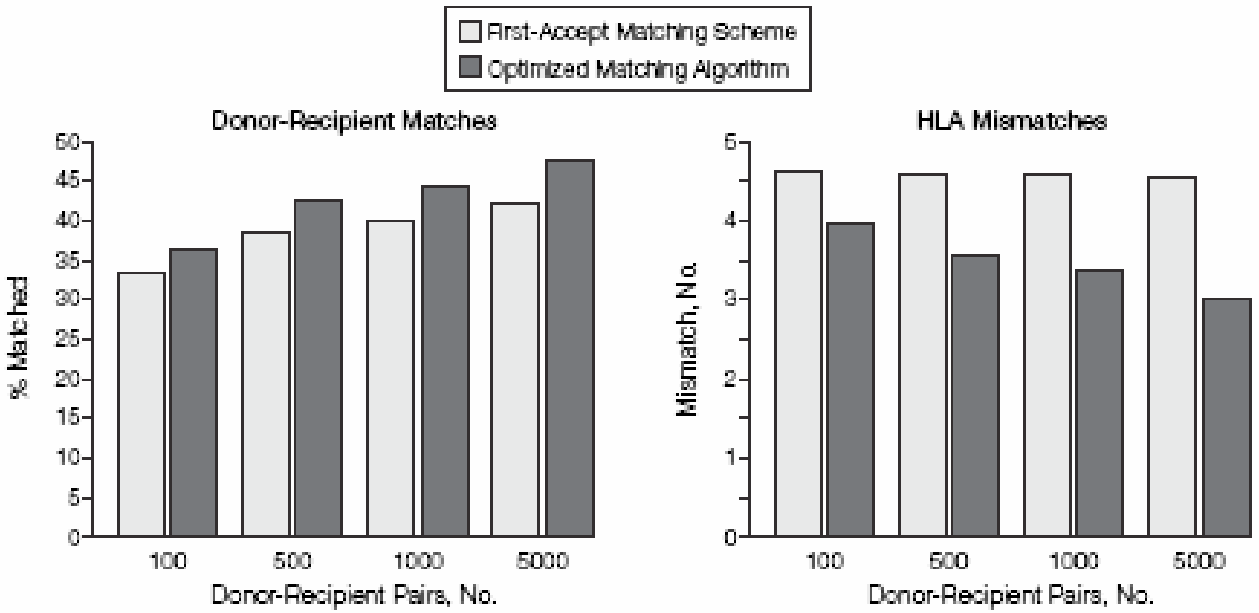
Design, Setting, and Population We developed a model that simulates pools of incompatible donor/recipient pairs. We designed a mathematically verifiable optimized matching algorithm and compared it with the scheme currently used in some centers and regions. Simulated patients from the general community with characteristics drawn from distributions describing end-stage renal disease patients eligible for

RENAL TRANSPLANTATION HAS emerged as the treatment of choice for medically suitable patients with end-stage renal

ASTS
American Society of Transplant Surgeons

First Accept v Optimized

Figure 2. Potential Matches Using Mathematical Optimization Compared With the Currently Used Practice of First-Accept Matching



Hopkins Model: Shortcomings

American Journal of Transplantation 2005; 5: 1787–1788
Blackwell Munksgaard

doi: 10.1111/j.1600-6143.2005.01004.x

Editorial

The Potential of Paired Donation Programs: Modeling and Reality

E. Steve Woodle

Department of Surgery, University of Cincinnati, Cincinnati, Ohio, USA
Corresponding author: E. Steve Woodle, woodlees@uc.edu

Received 18 April 2005, revised 3 May 2005 and accepted for publication 5 May 2005

Densely populated regions are inherently ideal for paired donation consortia, as geographic distances are limited and the number of potential donor/recipient pairs in a given consortium should be relatively high. More heavily populated regions of the United States (e.g. the east and west coasts) are advantageous. In contrast, the sparsely populated areas of the United States (e.g. Wyoming, Montana, Idaho, western Kansas and Nebraska) will suffer from the substantial geographic barriers to paired donation.

Hopkins Model: Shortcomings

Several assumptions in the modeling approaches of the present study warrant consideration. First and foremost, the authors modeled a *national*-paired donation program, but in reality, the geographic barriers (i.e. large travel distances) in a nationalized program will present a substantial barrier. In the Paired Donation Consortium (PDC) (for-

The model also assumed that a relatively large number of donor/recipient candidates would be available for matching. To date, no paired donation program has yet to have substantially more than 20 donor/recipient pairs available for matching at any point of time. Although modeling of

The model used in this study assumed 100% referral rates of ABO- and cross-match-incompatible pairs to the national-paired donation program. Experience from the

Midwest PDC Member Programs

- Ohio
  - Case Western Reserve
  - Cleveland Clinic
  - University Hospital – Cincinnati
  - The Christ Hospital
  - Medical College of Ohio
  - Ohio State University
  - Miami Valley Hospital
  - Summa Health System, Akron
  - Cincinnati Children's Medical Center
- Indiana
  - Methodist Hospital, Indianapolis
- Kentucky
  - University of Kentucky
- Illinois
  - University of Illinois, Chicago
- Maryland
  - University of Maryland
- Michigan
  - University of Michigan
  - Henry Ford Hospital, Detroit
  - Harper University Hospital, Detroit
  - St. John's Hospital, Detroit
  - Children's Hospital of Michigan
  - Hurley Medical Center, Flint
  - St Mary's Hospital, Grand Rapids
  - William Beaumont Hospital, Royal Oak
- West Virginia
  - University of West Virginia
  - Charleston Medical Center
- Pennsylvania
  - University of Pittsburgh
  - Pittsburgh VA Medical Center
  - Pittsburgh Children's Hospital
  - Allegheny Medical Center
- Wisconsin
  - St. Luke's Medical Center
- New York
  - SUNY Buffalo

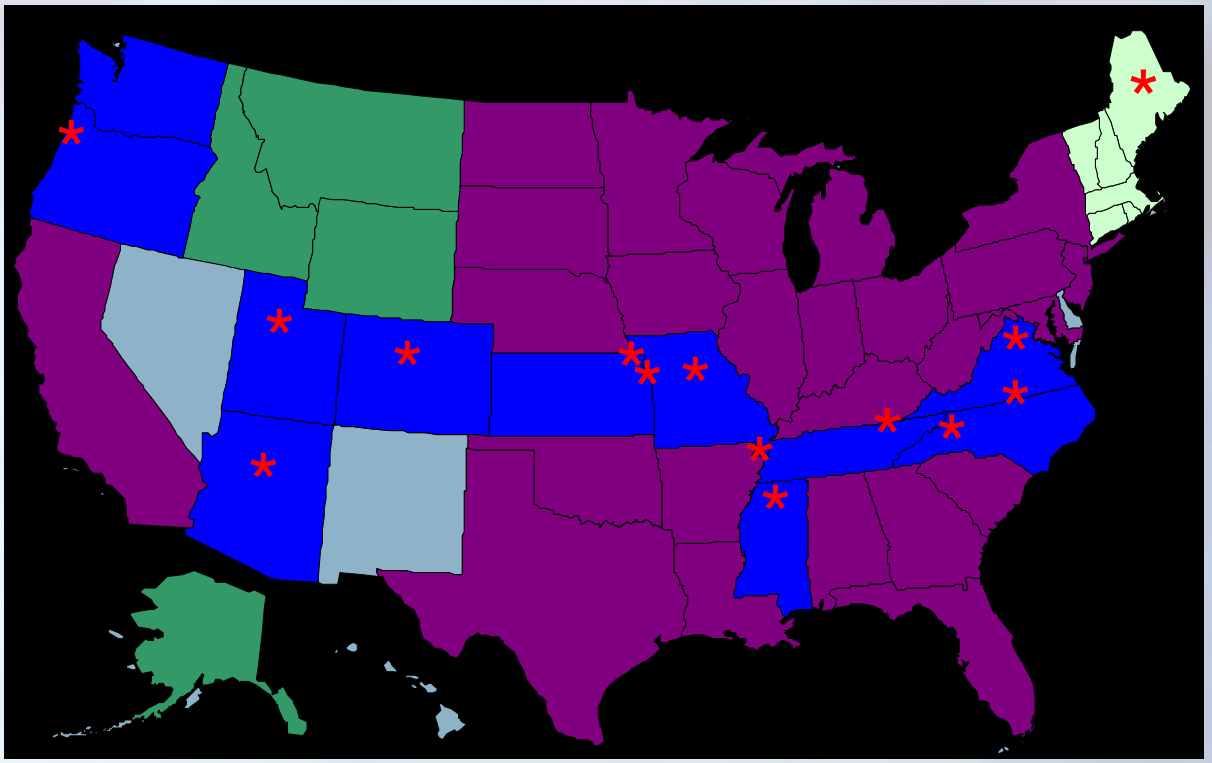
PDN: Regional Consortia Membership as of 12/1/05

- Formed
  - PDC (10 states, 30 programs)
  - New Jersey PDC (1 state, 6 programs)
  - Southeastern PDC (4 states, 18 programs)
  - Southwestern PDC (4 states, 19 programs)
  - Southern California PDC (1 state, 2 programs)

- In process of formation
  - Upper Midwest (three states)
  - Great Plains (four states)
  - Northern California (6 programs)
  - Eastern Seaboard (12 programs, six states)
  - Rocky Mountain (four states)

ASTS
American Society of Transplant Surgeons

PDC Nationalization



- States with tx Programs that have agreed to join PDC
- States with test website(s)
- No kidney transplant programs
- * Transplant Centers with test websites

ASTS
American Society of Transplant Surgeons