

Data and the State

PUBPOL 2130 / INFO 3130



Geography and Health

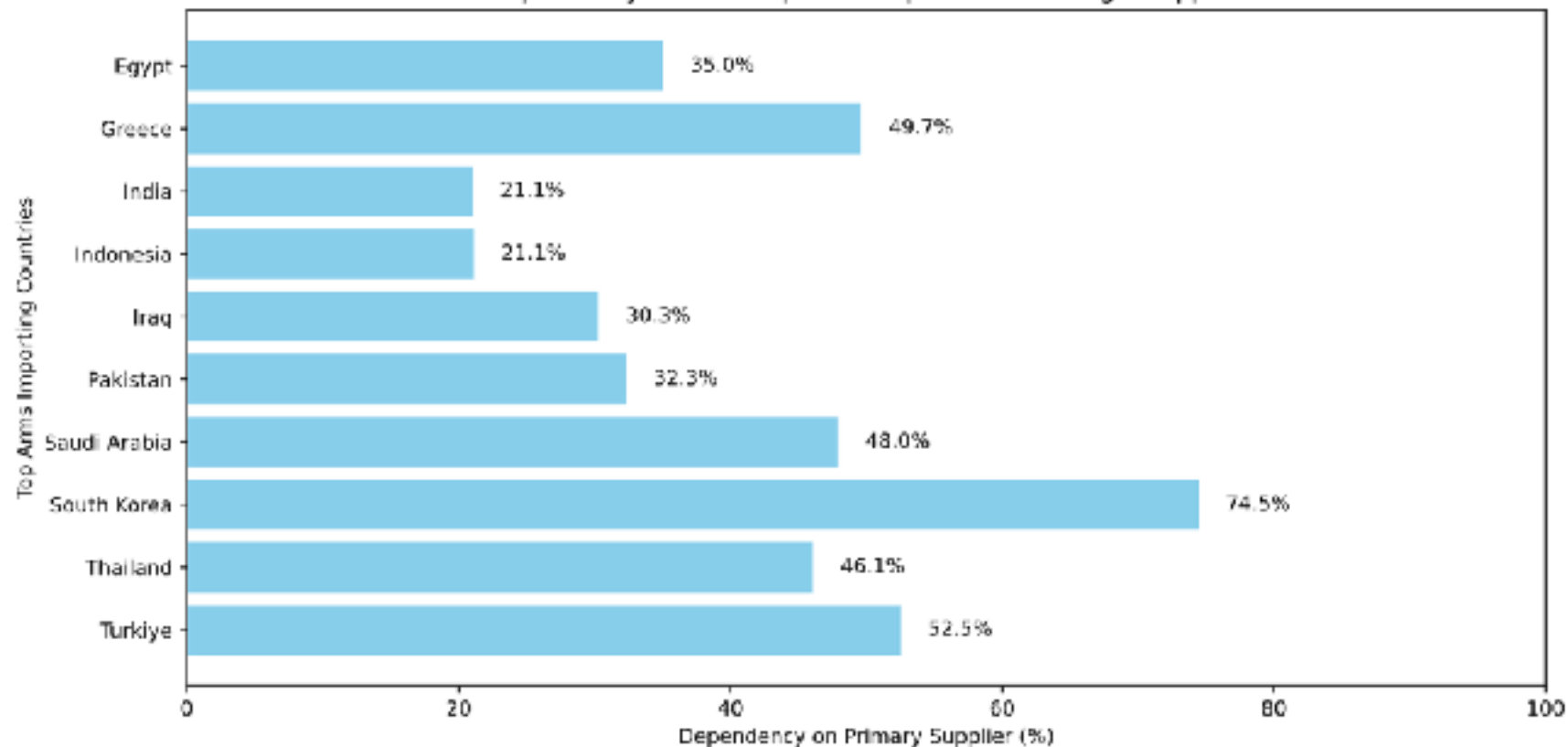
Lecture 13, Tuesday Mar 11

Announcements

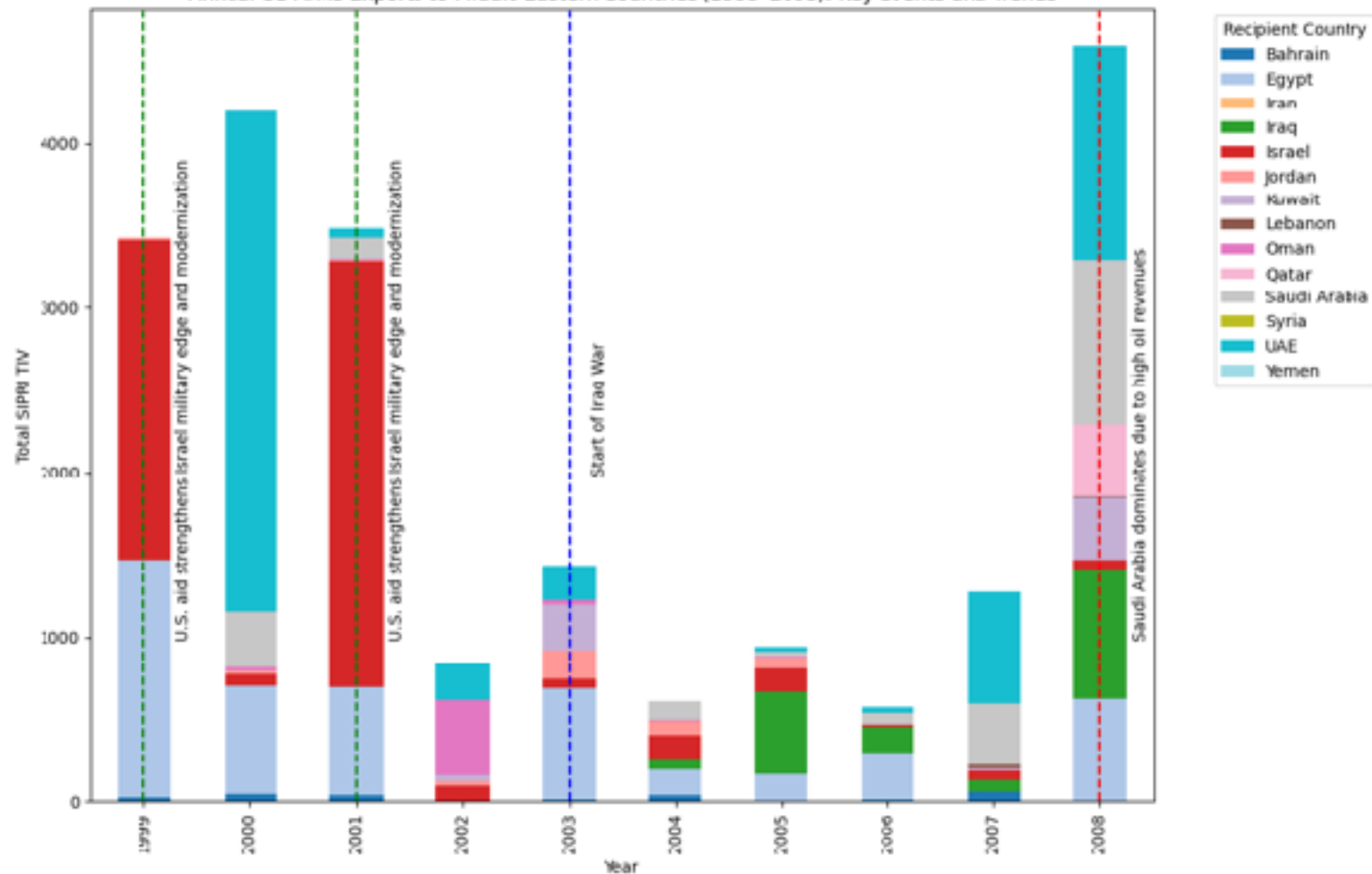
- Please start homework early! Suggested pacing: receive notebook **Friday**, mess around over the weekend, come to Tuesday evening office hours if you need support, and aim to submit by **Friday** when you receive the next notebook. Remember that the 11-day deadline has an extension built in.
- Structure of the course is roughly in thirds.
 - **intro to Census and geography** / basic dataframes and data products — Exam 1
 - **change and flows** (weapons, elections, mobility, demography, organs, transit) — Exam 2 will be March 25 in class
 - **zones and regions** (policing, housing, neighborhoods, districts) — syllabus anticipates final projects rather than a final exam.
- Heads up: **I am considering the possibility of an Exam 3**, either as an **option** for those who missed Exam 1 or as a **backup** plan in case of graduate student strike.

some of your work from HW4

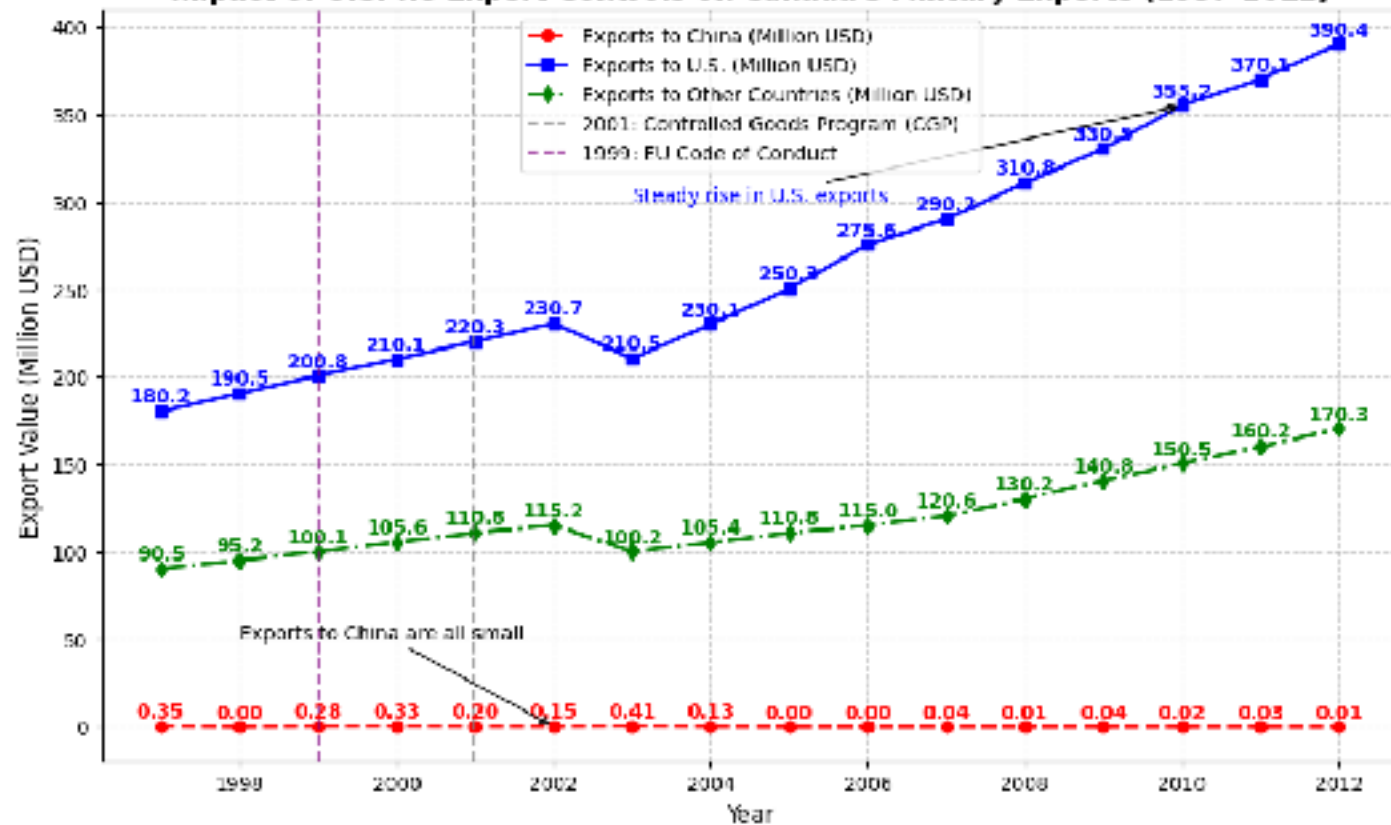
Dependency Rates of Top Arms Importers on a Single Supplier



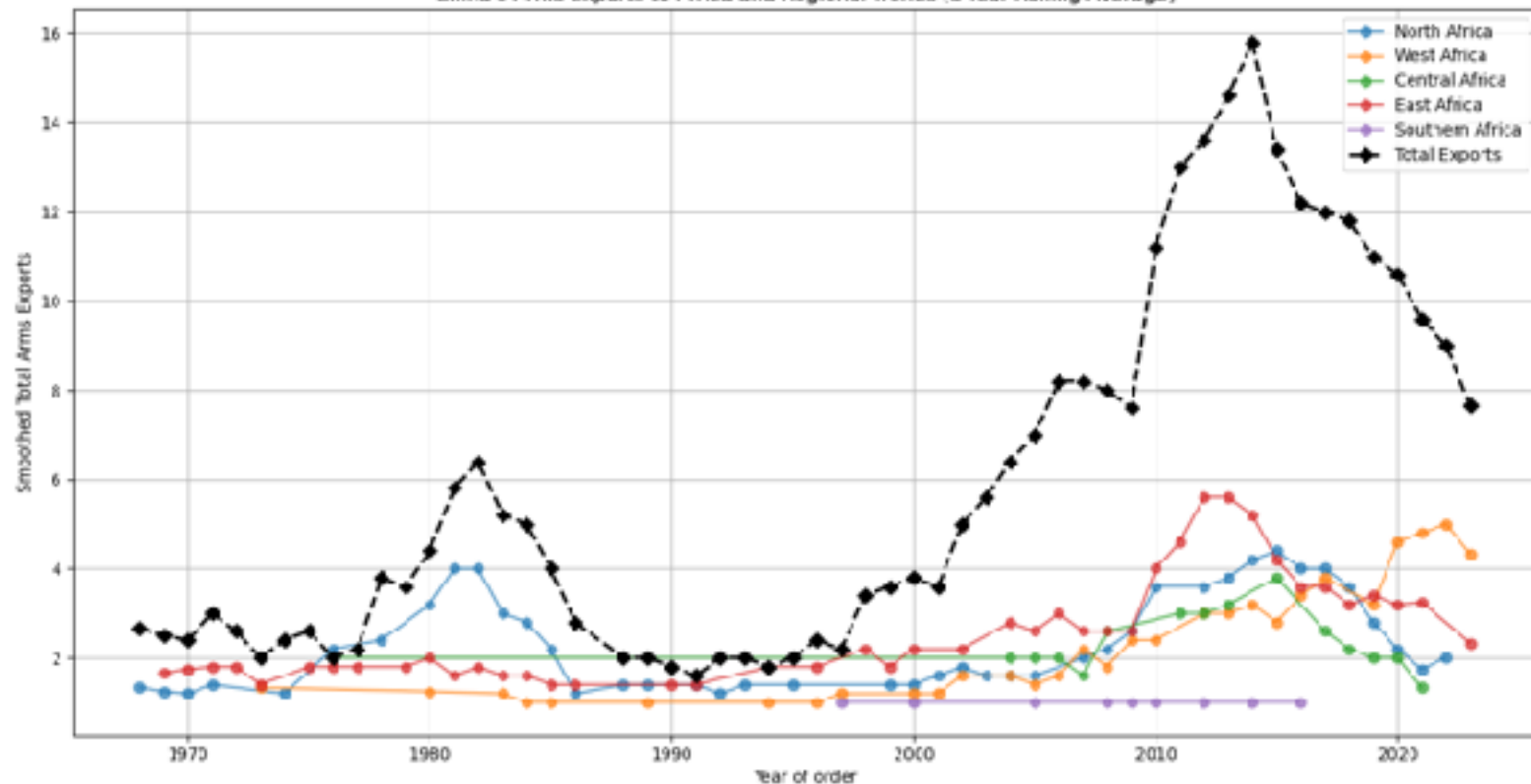
Annual US Arms Exports to Middle Eastern Countries (1999-2008): Key Events and Trends



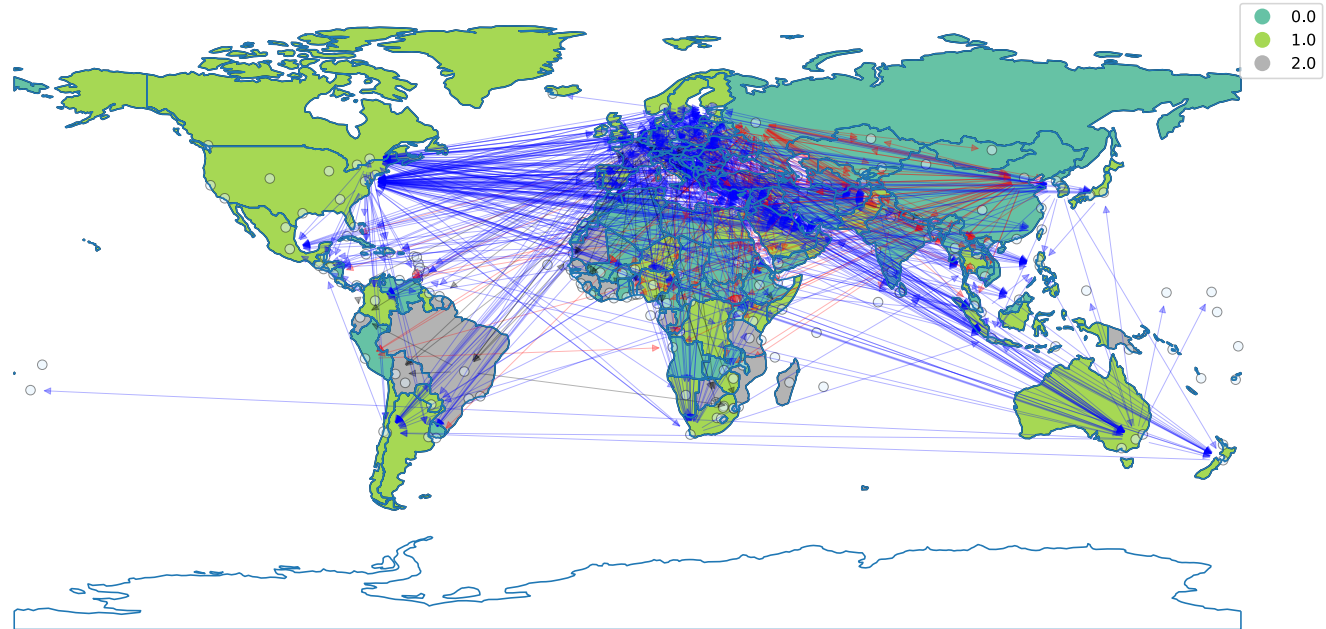
Impact of U.S. Re-Export Controls on Canada's Military Exports (1997-2012)



China's Arms Exports to Africa and Regional Trends [5-Year Rolling Average]



Military Transfer Cliques of The 21st Century



“cliques” (AKA clusters)

countries with patterns of
mutual trade

found by network analysis

new topic: **health**
particularly organ donation

New **datasets**

- STAR — Status of Transplant Activities and Registrations
- OPTN — Organ Procurement and Transportation Network
- CDC Wonder — Wide-ranging Online Data for Epidemiologic Research

***Organ data is carefully controlled because it contains a great deal of sensitive and potentially identifying information, from smoking to drug use to comorbidities. I have personally attested that the limited data I share with you will be handled carefully — I'll give you a password-protected download and ask that you delete it completely at the end of the semester.*

New **methods**

- Network methods — clustering
- Fitting lines and curves — tools for linear and logistic regression
- Geolocation / geocoding
- Linear programming / integer programming

Recent NYT exposé





Marcus was at the top of the waiting list — the first in line.



But the kidney didn't go to him.

Guest: Sommer Gentry

- Professor in the Department of Surgery at NYU, formerly in Mathematics at US Naval Academy
- Background in **operations research** — the science of planning and optimization
- Has worked for years on planning projects around organ donation
- Her research was the primary basis of the NYT story this month





CSTAR

Center for Surgical and Transplant
Applied Research

SOMMER GENTRY, PHD
PROFESSOR OF SURGERY
NEW YORK UNIVERSITY
GROSSMAN SCHOOL OF MEDICINE



Part I: What is the geography of organ allocation?

The Liver Transplant Divide

The map governing who gets an organ transplant favors some regions over others

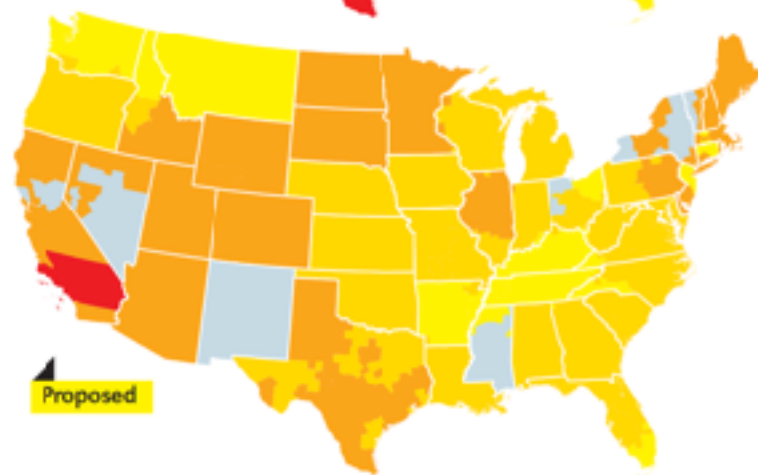
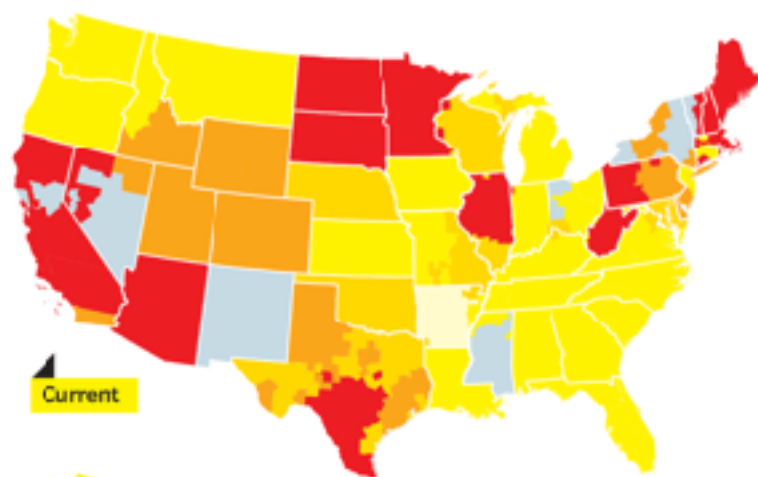
If you need a liver and live in Boston, your chance of getting one in time is about 53 percent. Drive a couple of hours southwest to Connecticut, and your chances jump to 85 percent.

The difference is encapsulated in the national organ transplant map, which divides the U.S. into self-contained districts of organ allocation. Among other factors, areas with lots of highways—and the accompanying traffic fatalities that make healthy organs available for transplant—will generally have a shorter wait time.

With optimization techniques used to draw political districts, a group of researchers from the Johns Hopkins University School of Medicine has found a potential path to help correct the liver imbalance. The researchers have proposed a redrawn map that levels the odds of receiving a liver throughout the country. A similar approach could possibly help curb inequities for other organs as well.

"By using an optimized map, we would be able to cut geographic disparities in liver allocation in half,"

STATISTICS: JONATHAN DODD/STATISTA.COM



Median MELD (Model for End-Stage Liver Disease) Score at Time of Liver Transplant





Geographic Disparity in Deceased Donor Liver Transplant Rates Following Share 35

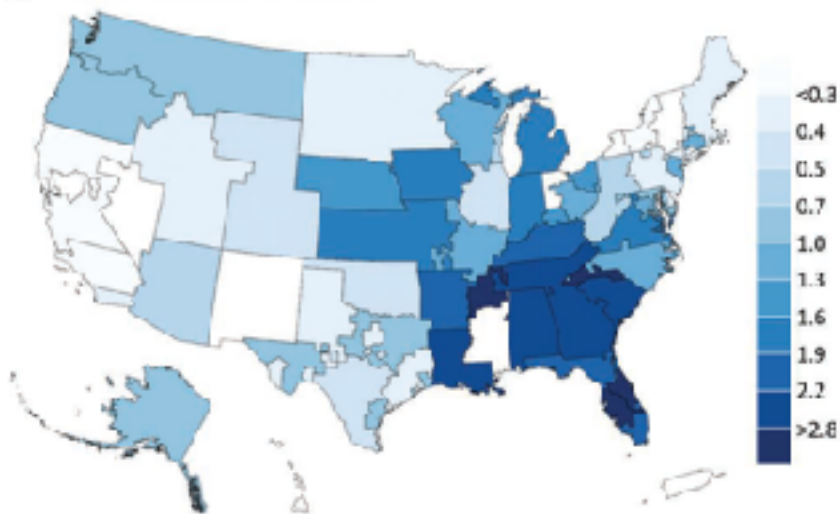
Mary G. Bowring, MPH,¹ Sheng Zhou, ScM, MBBS,¹ Eric K.H. Chow, MSC,¹ Allan B. Massie, PhD,¹ Dorry L. Seggev, MD, PhD,¹⁻³ and Sommer E. Gentry, PhD^{1,4}

“Share35” was a proposed regionalization scheme

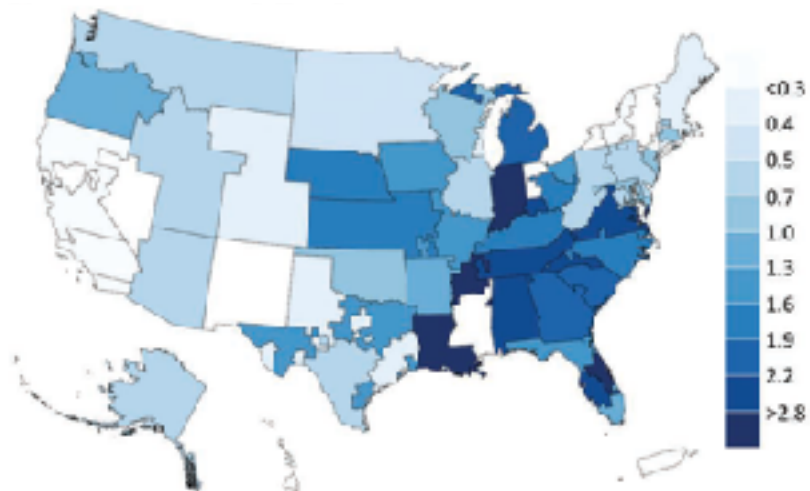
- Share35 mandated regional sharing of livers for candidates with MELD \geq 35
- MIRR measures geographic disparity: Both before and after Share35, two candidates with the same MELD in different donation service areas were expected to have a more-than-two-fold difference in their transplant rates
- Pre-Share35 MIRR was 2.18, and post-Share35 MIRR was 2.16

Geographic disparity in liver transplant rates remained high after Share35

Pre-Share35 liver transplant rate per person-year



Post-Share35 liver transplant rate per person-year

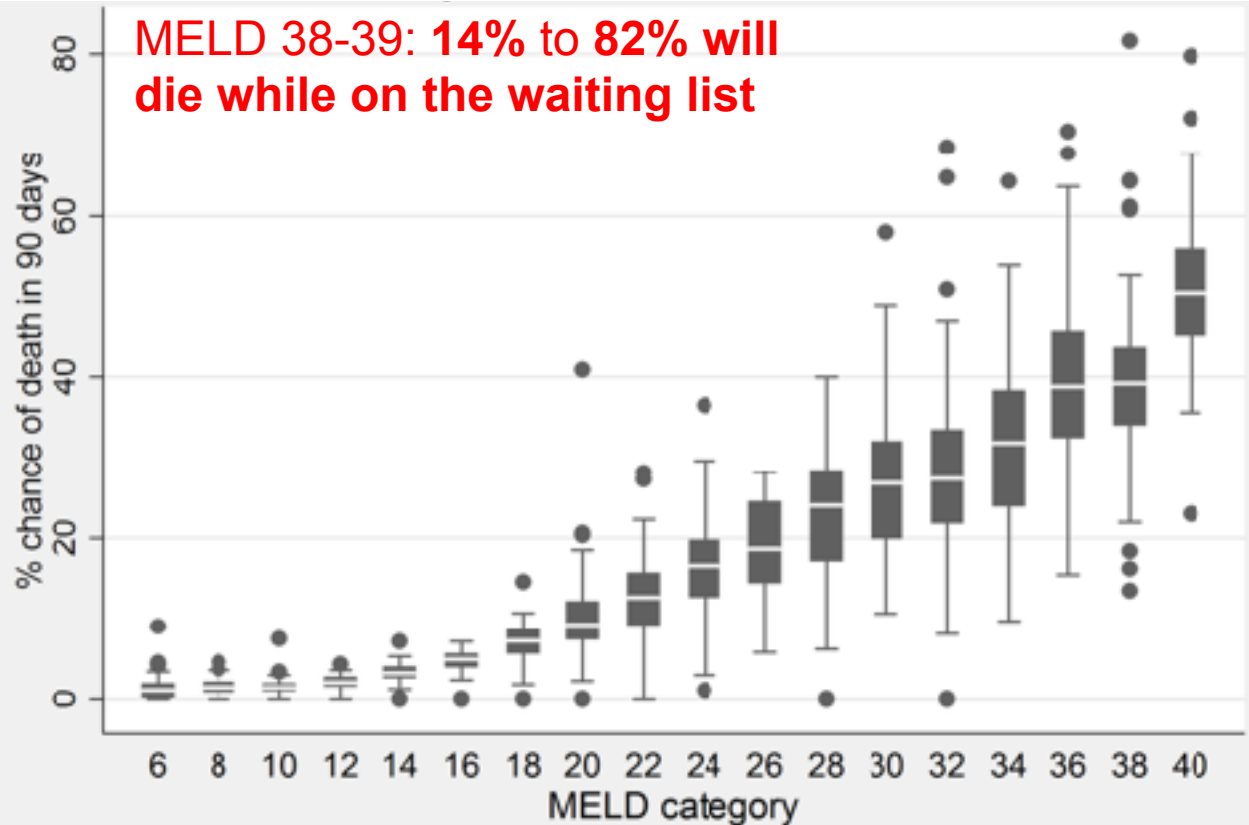


DSFs were excluded (white) if they did not have a liver transplant program during the study period (n=6) or included only programs with low transplant volume (n=3).

No difference!

Range of waiting list death rate, by DSA


MELD (Model for End-Stage Liver Disease) is a numerical scale to determine your priority for a liver transplant, based on measured lab values alone



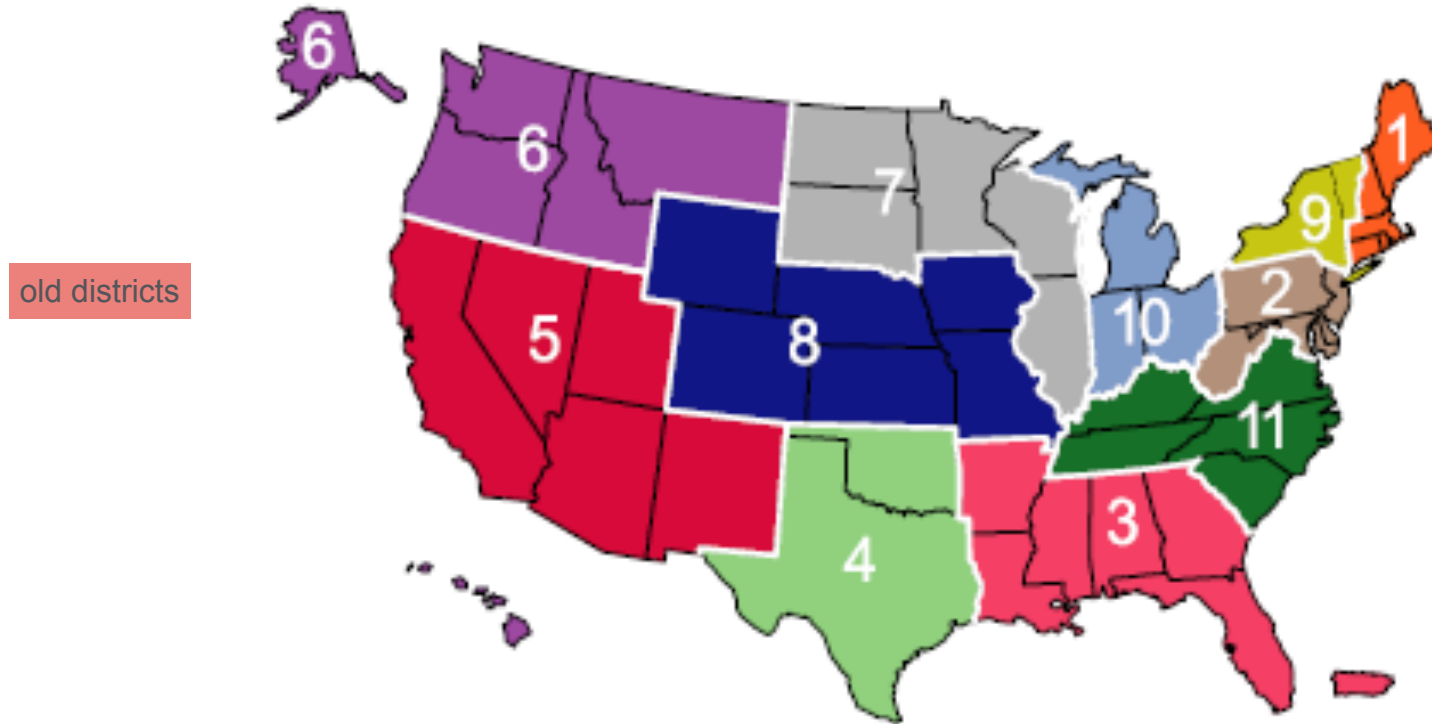
Department of Health and Human
Services Final Rule (1998)
42 CFR Part 121.8(b)

“Neither place of residence nor
place of listing shall be a major
determinant of access to a
transplant.”

Optimization to reduce geographic disparities

- Redistricting uses integer programming to design geographic boundaries for new regions
- What is the **objective** we are trying to optimize?
(Minimize pre-transplant deaths?)
(Minimize variation in MELD at transplant or waiting time?)

- What are the **constraints**?
 - Keep current OPOs intact? (nonprofit organizations that link hospitals)
 - How many regions?
 - How compact should the regions be? Contiguous?

DSAs are partitioned into regions

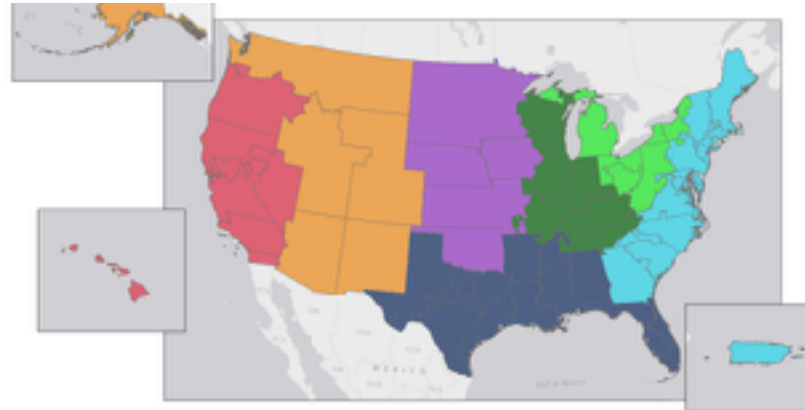


Partition DSAs (donation service areas) into districts



Under redistricting, livers would be allocated to the sickest candidate anywhere in the district

Gentry's team proposed new districts made up out of old geographical areas that would leave the nonprofit OPO links intact



Addressing Geographic Disparities in Liver Transplantation Through Redistricting

S. E. Gentry^{1,2,3}, A. B. Massie^{1,4}, S. W. Cheek²,
K. L. Lentine⁵, E. H. Chow¹, C. E. Wickliffe¹,
N. Dzebashvili⁵, P. R. Salvalaggio⁶,
M. A. Schnitzler⁵, D. A. Axelrod⁷ and
D. L. Segev^{1,3,4,*}

Key words: Broader sharing, geographic disparities, liver allocation, Liver Simulated Allocation Model

Abbreviations: DSA, donation service area; LSAM, Liver Simulated Allocation Model; MELD, Model of End-Stage Liver Disease; OPTN, Organ Procurement and Transplantation Network.

Wrote academic papers about the optimization model and argued that it balanced multiple objectives well

Gerrymandering for Justice: Redistricting U.S. Liver Allocation

Sommer Gentry

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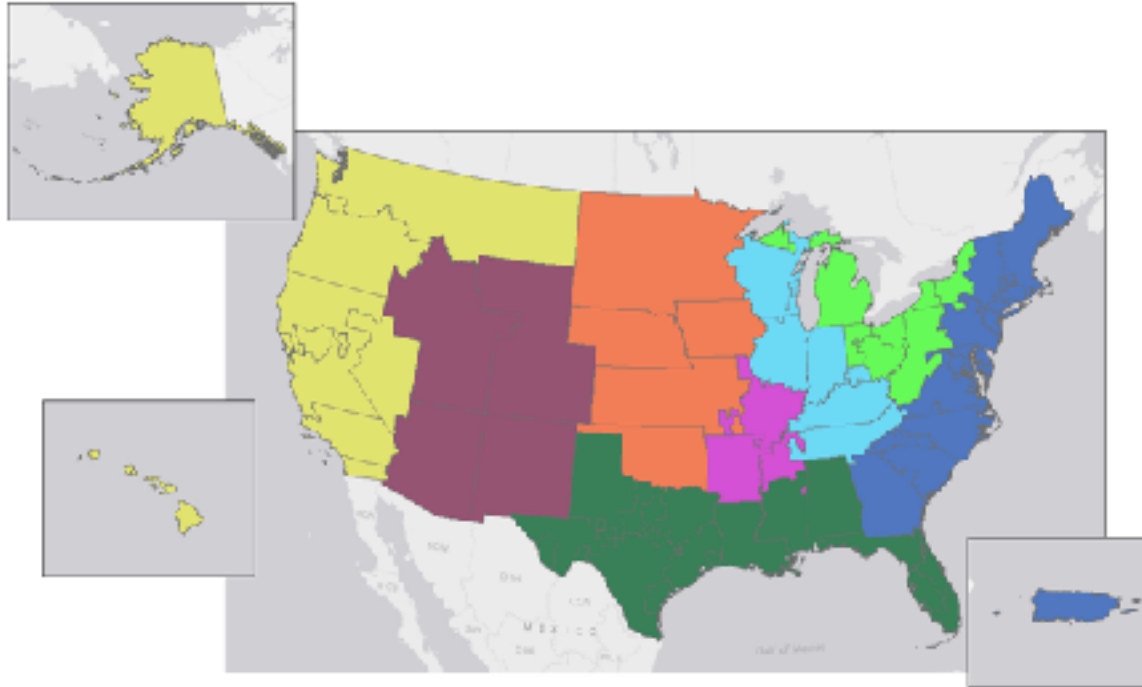
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Johns Hopkins University School of Public Health, Baltimore, Maryland 21287 {amassie@jhmi.edu, dorry@jhmi.edu}

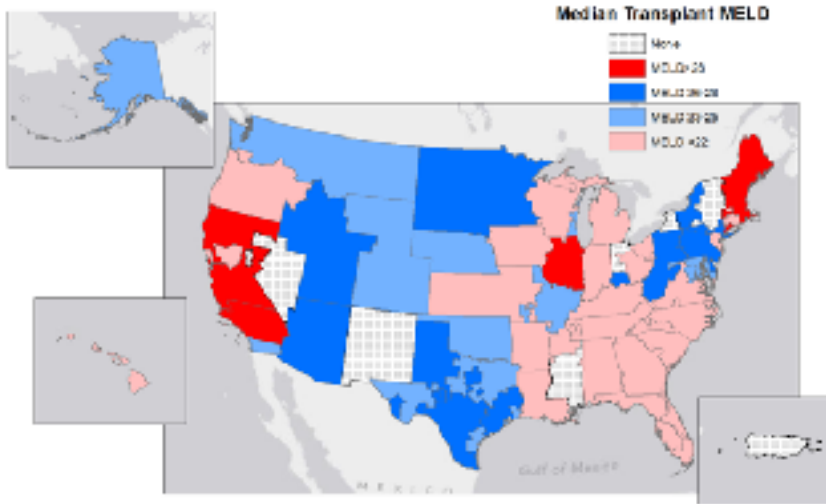
8 districts, 3 hour limit



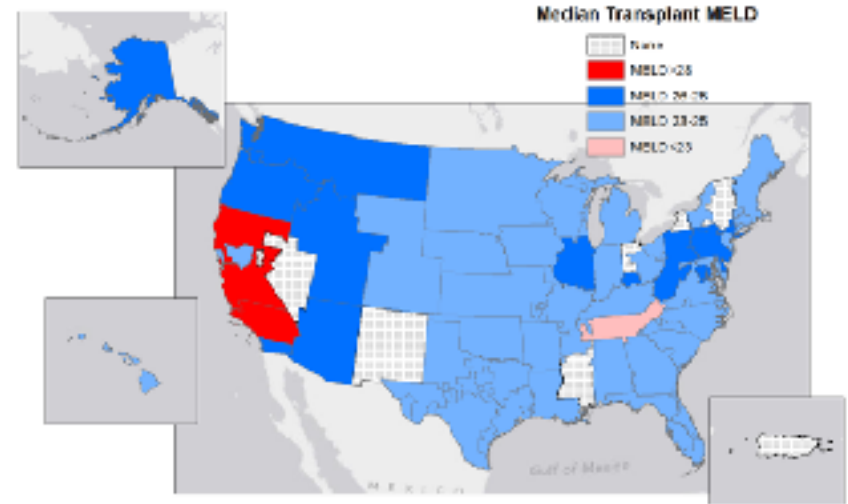
Proposed several variants

Redistricting would reduce geographic disparity

DSA-based allocation MELD at transplant



Redistricted allocation MELD at transplant



Argued many people wouldn't have to get as sick (high MELD) before receiving the liver

But after many lobbyists were hired and many dollars were spent, the redistricting proposal was defeated for political reasons and was never enacted.

OPTN Board Resolution

The existing geographic disparity in allocation of organs for transplant is **unacceptably high**.

The Board directs organ-specific committees to define the metric of fairness and any constraints for each organ system.

The Board requests that **optimized systems** utilizing overlapping versus non-overlapping geographic boundaries be compared, including using or disregarding current DSA and region boundaries in allocation.

One positive outcome: the OPTN board agreed with the reasoning and passed a resolution supporting the main principles of Gentry's team.

Part II: Who gets kidneys out of sequence? (who jumps the line?)

Out of Sequence (OOS) Allocation

- US organ procurement organizations can choose to offer organs OOS to a transplant center (for anyone, open offer)
- Should be exceptional, should be hard-to-place organs
- Offered to centers believed to be more likely to transplant a hard-to-place kidney, who have experience with these

Methods

OPTN STAR (Standard Transplant Analysis and Research) data

PTR (offers to Potential Transplant Recipient) data

Dates: January 1, 2022 – December 31, 2023

Methods

OOS Placement Identification

- Transplants received after one or more candidates higher on the match run were bypassed for reasons coded by:

861

Operational OPO

862

Donor Medical Urgency



863

Offer not made due to expense

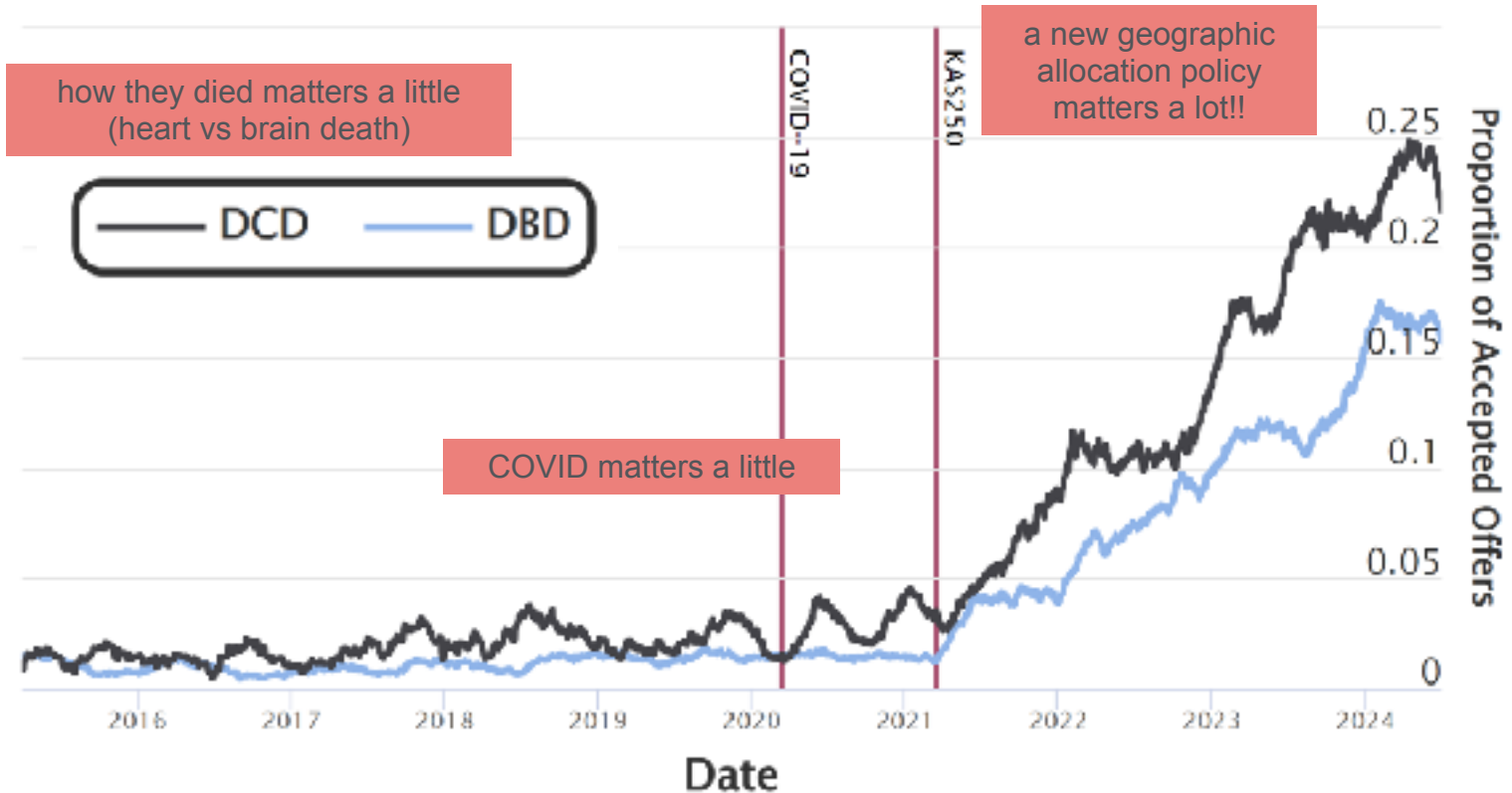


Original Article

Contemporary prevalence and practice patterns of out-of-sequence kidney allocation

Luckmini N. Liyanage¹  , Daniyar Akizhanov¹, Suhani S. Patel¹,
Dorry L. Segev^{1 2}, Allan B. Massie¹, Darren E. Stewart^{1 †},
Sommer E. Gentry^{1 2 †}

Skyrocketing fraction of kidneys are allocated OOS



Recipients of OOS kidneys compared to recipients of standard allocation kidneys

OOS kidney recipients waited less than standard allocation recipients (258 days OOS vs. 411 days standard).

OOS kidney recipients were older (median (IQR); 61y (52, 68)) than standard allocation recipients (55y (43, 64)).

Only 0.1% of OOS kidney recipients were <18, while 3.0% of standard allocation recipients were <18.

Recipients of OOS kidneys compared to recipients of standard allocation kidneys

26% of OOS recipients had pre-emptive transplants, while 16% of standard recipients had pre-emptive transplants.

Median sequence number for OOS recipients was 812, while the median sequence number for standard recipients was 9.

2.6% of OOS kidney recipients had end CPRA >80, while 25% of standard allocation recipients had end CPRA >80.

when the line is
jumped, it's
jumped by a lot

Comparing waitlisted candidates at Top OOS centers to Non-OOS centers

	Top OOS	Non-OOS	p-value
Gender (Female)	38.9%	34.0%	<0.001
Age at initial waitlisting	55 (44, 63)	52 (38, 62)	<0.001
Pediatric (age<18) at initial waitlisting	1.3%	12.8%	<0.001
Centers primarily pediatric*	0% (0 of 20)	61.1% (33 of 54)	<0.001
Race			<0.001
White	39.9%	35.2%	
Black	31.8%	20.5%	
Hispanic	17.6%	29.3%	
Asian	8.6%	9.5%	
Other	2.1%	5.4%	

“Top OOS” hospitals are best resourced, most likely to get out-of-sequence transplants. They are less likely to have kids, somewhat more likely to have White and Black patients, but less likely Asian and especially Hispanic.

Comparing waitlisted candidates at Top OOS centers to Non-OOS centers

	Top OOS	Non-OOS	p-value
Highest education among adults (≥18)			<0.001
None or not applicable (<5 years)	0.3%	0.9%	
High school or less	40.7%	46.3%	
College/technical school	23.9%	25.5%	
Associate/bachelor degree	24.8%	20.9%	
Post-college graduate degree	10.3%	6.4%	
Private insurance	41.3%	29.7%	<0.001

Top OOS hospitals skew more educated and patients much more likely to have private insurance.

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