

**Race and Income:**  
The Inequality of Organ Transplantation

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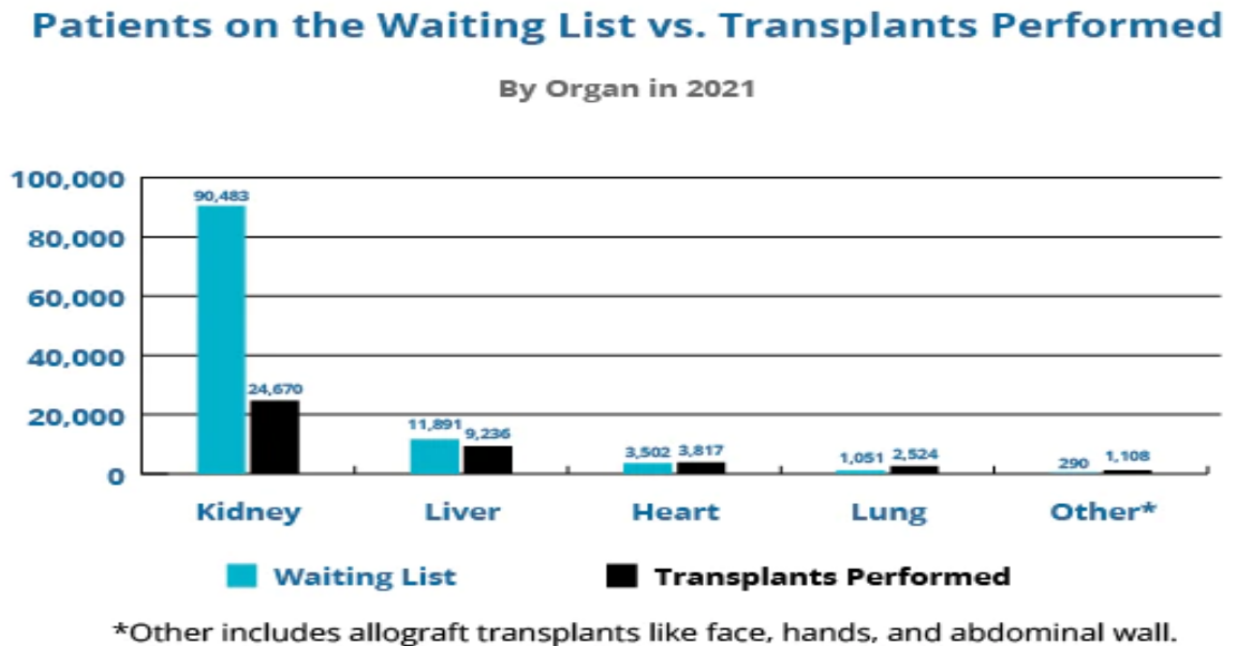
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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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## Introduction:

According to the United States Health Resources and Services Administration, over 6,000 people die every year while waiting for an organ transplant. In 2020, there were 37,584 organ transplants performed, nevertheless, over 115,000 patients remained on the waitlist (*Organ Donation Statistics | Organdonor.Gov, 2022*) The vast majority of patients waiting for an organ are in need of a kidney transplant, as shown below in figure 1.



**Figure 1:** A breakdown of the number of patients on the waitlist for different organs. This graphic shows that more Americans are waiting for a kidney than all other organs combined. (*Organ Donation Statistics | Organdonor.Gov, 2022*)

This is a massive problem; in addition to the thousands of patients who die every year waiting for a lifesaving organ that will never come, those on the waitlist must endure

myriad chronic health problems and quality of life issues, such as having to undergo regular dialysis, until they either die or are matched with a donor for a transplant.

The Uniform Anatomical Gift Act (UAGA) and the National Organ Transplant Act (NOTA) are intended to ensure a fair and equitable distribution of these lifesaving organ transplants. A key tenet of NOTA was to prevent the commercialization of organs by making it illegal to assign any kind of monetary value to organs. The purpose of this was to prevent the socioeconomic status of a recipient from having any bearing on who receives an organ transplant (Simmerling, 2007, Introduction). Despite these laws that are already in place to ensure equitable organ distribution, organ transplantation is a field that is rife with inequality. There are significant barriers to transplantation that exist for minority patients as well as patients of low socioeconomic status which result in fewer transplants and higher death rates from organ failure for those groups (Simmerling, 2007, Only the Appearance of Equity). These barriers can have far reaching effects. Researchers for the American Journal of transplantation concluded that black patients could be up to 59 percent less likely to receive a transplant at any given time compared to white patients (Patzner et al., 2012, Discussion). Throughout this paper, I explore the racial and socioeconomic inequalities that exist for minority patients and patients of low socioeconomic status regarding access to organ transplants. However, determining the causes of inequalities is very difficult due to the scale of the nationwide organ selection system that is currently in place. Other complicating factors include the cultural and technical nuances that make it less likely that some will donate organs in the first place. Disparities in kidney transplants will be the focus of my analysis, due to the fact that kidneys represent more than 83% of total organ transplants

(*Organ Donation Statistics | Organdonor.Gov*, 2022). In this paper, I will examine the inequalities that exist in the field of organ transplantation and analyze how these how these inequalities result in lower rates of transplantation and worse health outcomes for marginalized racial and socioeconomic groups.

## **Part I: Organ Donation as a Sociotechnical System**

Although the racial and socioeconomic disparities that exist in organ transplantation are well documented, the exact mechanism by which these factors cause these inequalities is unknown (Press et al., 2005, Discussion). In this section, I describe the different components of the organ transplantation process. Further, I make connections between this process and the unequal outcomes observed for different groups based on race and socioeconomic status.

### **How Organs are Assigned for Transplant**

In the early days of organ transplants, possible donors and recipients were tracked only on a local level by individual hospitals and transplant centers. In this system, there was no way for donated organs to be matched to anyone outside of the immediate geographic area of the donation, and this led to many organs being thrown out unused. NOTA, passed by congress in 1984, called for an Organ Procurement and Transplantation Network (OPTN). To fulfill this role, the United Network for Organ Sharing (UNOS) was created as a private nonprofit organization to establish an organ sharing system that can match patients and donors from across the country(UNOS, *How We Match Organs*, 2022).

To get on the waiting list to receive an organ, a patient must first visit a transplant center or a hospital that is a part of the UNOS network to receive a consultation. During the consultation, the hospital will record information on the patient such as their height, weight, and health status. A blood sample is also taken to determine a patient's blood type and HLA antigen profile. Once all this information is processed, it is input into the UNOS national database, which uses an algorithm to match donors and recipients from across the country. The matching algorithm considers many factors such as a patient's height, weight, age, survival benefit, distance from the donor, wait time, pediatric status, and immune system compatibility (UNOS, *How We Match Organs*, 2022). All these factors are weighted and assigned points to generate a total score which can then be used to determine which patient will receive a given organ. Every time a cadaver organ becomes newly available, or a possible donor is input into the system, this algorithm checks for possible matches to ensure that these precious organs are used to their maximum benefit. Once an organ is matched to a recipient using this system, the patient is immediately contacted so that a transplant can be scheduled (UNOS, *How We Match Organs*, 2022).

### **The Cost of a Kidney**

Even though the previously mentioned legislation (UAGA and NOTA) is supposed to guarantee a level playing field for rich and poor alike in the organ selection process, this does not translate to equality in access. Poverty still exists as a significant barrier to patients of low socioeconomic status who need an organ transplant (Simmerling, 2007, n.p). This is because the total cost of a kidney transplant for a patient is on average \$260,000 without insurance (*2020 U.S. Organ and Tissue*

*Transplants*, Milliman Report). Additionally, almost every one of the 250 transplant centers across the nation requires patients to verify how they will pay for their transplant before receiving any treatment (ABC News, 2018, Organ Transplants). This means that patients who have no insurance or are underinsured must rely on Medicare to help pay for their transplant. Although Medicare is traditionally only available for people over the age of 65, patients who have been diagnosed with end stage renal disease (critical kidney failure) also qualify for Medicare due to its classification as a disability (*The Organ Transplant Process | Organdonor.Gov, 2022* , Can Medicare or Medicaid help me?). However, Medicare still does not cover the full costs of a kidney transplant. Medicare Part A, which is free, only covers inpatient care that is directly related to the transplant surgery; however, Medicare Part B, which covers other medical care that is related to the transplant, requires patients pay expensive premiums (Yang, 2022 , The Cost of a Kidney Transplant). A visualization of these expenses is shown below in figure 2; the large amount of pre and post surgery costs acts as a significant barrier to those of low socioeconomic status seeking an organ transplant.

### Kidney Transplantation Cost Itemized Breakdown

Pre-surgery Costs	Surgery Cost	Post-surgery Costs
Physical examination	Surgery team fees	Medications cost
Doctor's consultation	Anesthesia charges	Other special consumables
Recipient's work-up	OT charges	Any additional service availed
Donor's work-up	Other consumables and medicines	Dialysis
Blood tests	Laboratory charges	Any other consultation
Dialysis		Complications management
Psychiatrist evaluation		Unanticipated care
Cardiac check-up		Follow-up sessions
Medications		DJ stent removal
Pre-operative preparation		
Documentation		

**Figure 2:** A breakdown of different costs associated with kidney transplants. Only the items shown in the middle column under “Surgery Cost” are fully covered by Medicare. All other items will require a patient to pay premiums(Yang, 2022 , The Cost of a Kidney Transplant).

### Organ Compatibility and Racial Disparities in Organ Transplants

The single largest limiting factor in organ transplants is donor - recipient compatibility. For all organ transplants, the donor and recipient must have compatible ABO blood types; if these are mismatched, then the organ will be rejected. Secondary to this is the compatibility of the donor and recipient’s HLA and MHC antigens, which are types of immune system markers that can result in poor organ function and lifetime if not properly matched (Press et al., 2005, Discussion; Saidi & Hejazii Kenari, 2014, Utilization of Marginal and ECD Organs). These traits are based on each patient's own DNA and are unchangeable. Additionally, as shown in table one below, different variations of these traits are found more commonly in different racial groups, meaning that it is easier to find a compatible organ donor if they are the same race as the

recipient (Kasiske et al., 1991, ABO Blood Groups and MHC Antigens). The demographic makeup of the United States is not evenly distributed; according to the most recent census data, White Americans make up more than 60% of the total population, while Black, Hispanic, and Asian Americans make up 13.4%, 18.5%, and 5.9% respectively. This can make it especially difficult to match organs to patients belonging to minority groups because there are less possible donors (Kasiske et al., 1991, ABO Blood Groups and MHC Antigens).

**Distribution of ABO Blood Groups in the United States, According to Race.\***

<b>ABO GROUP</b>	<b>WHITE</b>	<b>BLACK</b>	<b>NATIVE AMERICAN</b>	<b>ASIAN</b>
	<i>percent</i>			
<b>O</b>	<b>45</b>	<b>49</b>	<b>79</b>	<b>40</b>
<b>A</b>	<b>40</b>	<b>27</b>	<b>16</b>	<b>28</b>
<b>B</b>	<b>11</b>	<b>20</b>	<b>4</b>	<b>27</b>
<b>AB</b>	<b>4</b>	<b>4</b>	<b>&lt;1</b>	<b>5</b>

**\*Data adapted from Widmann.<sup>22</sup>**

**Table 1:** The distribution of ABO blood type is shown for different racial groups. The different distributions of blood type make it more likely that a proper match will be found from a member of a patient’s own race/ethnic group (Kasiske et al., 1991, ABO Blood Groups and MHC Antigens).

As shown by this literature review, organ transplantation is a diverse system with many wide-ranging components, or actors. With the lives of thousands patients at stake each year, the issue of inequality in organ transplantation is paramount (UNOS, *Issues and Advocacy*, 2022). In the next two sections, I will continue to explore the causes on inequality in the field of organ transplants, and I will analyze the mechanisms behind



these sources of inequality, using the cartography of controversies as a research method.

## **Part II: Exploring Organ Inequality Using the Cartography of Controversies as a Research Method**

In his journal article, “Diving in Magma: How to Explore Controversies with Actor Network Theory” (Venturini, 2010, pg 3), Tomasso Venturini presents a model on how to explore complex controversies using actor network theory with the cartography of controversies as a research method. Actor Network Theory (ANT) is a process in which a problem is broken down into its simplest components, which are individual actors and networks. This is useful for a very complex problem such as this one because it enables one to break down a complex problem into much more manageable parts. However, this is complicated by the fact that actors and networks have significant overlap; multiple actors can make up a single network and networks can make up an actor. Additionally, it can be very difficult to get a consensus on what these actors and networks are and understanding how they fit in together with each other can be challenging. Venturini describes the cartography of controversies as an educational version of ANT, which avoids overly conceptual complications and is thus more accessible. The cartography of controversies can be approximated as, “the practice of ANT unburdened by all theoretical subtleties.” Despite suggesting that the cartography of controversies is a simpler alternative to ANT, Venturini warns that it is not a method designed to make a researcher's life any easier. As described by Venturini, the basis of using the cartography of controversies as a research model is to, “Just observe and describe

controversies” (Venturini, 2010, pg 3). Although this sounds simple, this research model demands that researchers investigate all actors and components of a controversy to encompass as many viewpoints as possible. Because the issue of inequity in organ transplantation is a controversy involving a massive sociotechnical system, I will utilize the cartography of controversies as a research method to uncover how technical, organizational, and cultural actors interact to contribute to inequality in the field of organ transplantation. For this analysis, the technical actors of the sociotechnical system are considered to be the medical factors that limit the compatibility of organs between donor and recipient. The organizational actors are considered to be the high costs that prevent patients from affording their transplant, and the cultural actors are considered to be any stressor that reduces the organ donation rates of minority populations, such as distrust of the medical system.

### **Technical Actors Contributing to Organ Inequity**

Inequity in organ transplantation is caused at least in part by scientific constraints in the organ matching process. Different racial groups have different distributions of ABO blood type, as well as different antigen profiles which make it more difficult to find suitable organ matches for minority populations. These biologic constraints constitute the technical actors of the system. “The Effect of Race on Access and Outcome in Organ Transplantation” details a study commissioned by the American Society of Transplant Physicians to investigate racial inequity in transplantation (Kasiske et al., 1991). In this journal article, published data was gathered from transplant centers across the country to better understand the causes of racial disparities in organ transplants.

Although Black Americans make up approximately 12 percent of the U.S. population, they account for 28 percent of patients with end stage renal disease (ESRD). There is no single cause that this has been attributed to, but the higher prevalence of chronic health conditions such as hypertension and diabetes in Black Americans has been suggested as a major risk factor. Data from the Health Care Financing Administration (HCFA) found that only 21 percent of those undergoing a kidney transplant were black, despite representing 28 percent of the total patients needing one. Further analysis concluded that 24 percent of patients receiving cadaver kidneys were black, but only 12 percent of patients receiving kidneys from living donors were black; it is important to note that while organs from both living and deceased donors are usable in patients, organs from live donors are preferred due to their superior function (Bratton et al., 2011, *Minority Disparities and Living Donation*).

Although it is unknown why Black Americans have received a proportionally lower number of kidney transplants than White Americans, differences in the frequencies of ABO blood groups between racial groups could be a contributing factor, as previously mentioned. Without a compatible donor ABO blood group, an organ cannot be transplanted. Furthermore, better antigen matches increase the chances that the transplant will be successful and increase the lifetime and function of organs in patients. As previously shown in table 1, 40 percent of whites have type A blood, compared to only 27 percent of blacks. On the other hand, blacks are almost twice as likely as whites to have type B blood. These differences in blood type distributions, mean that twice as many Black Americans were waiting for a much smaller supply of

kidneys from donors with type B blood at the time of the study (Kasiske et al., 1991, ABO Blood Groups and MHC Antigens).

Although the first step in the kidney matching process is the compatibility of ABO blood type, the level of secondary antigen matching, which also differs in frequency by race, is still considered. There is an ongoing debate on how much of a role antigen matching should play in the kidney selection process. Critics of the current system argue that reducing the requirements for antigen matching would increase the number of kidneys available for minority patients. However, the degree of antigen matching has been shown to correlate with the lifespan and function of the transplanted organ. To investigate this further, we can compare the organ survival rates over time between Black and White Americans. Data from kidney transplant registries, shown below in table 2, has shown that the one year kidney transplant survival rate is lower in blacks than in whites. However, this disparity used to be much more pronounced.

In the Collaborative Transplant Study, for years before 1983, the one-year survival rate in blacks was almost 10 percentage points lower than whites (Kasiske et al., 1991, Race and Allograft Survival). In 1983, cyclosporine was approved as a drug for medical use. Cyclosporine is an immunosuppressant drug that is considered critical today for mitigating the adverse immune responses that are part of every transplant. After 1983, the one year survival rates for kidney transplants increased astronomically for all races in the study, and the gap in survival rates for black and white patients was also reduced to an average of 6.5 percentage points. This translates to the percentage disparity between Black and White Americans dropping from 17% to only 9% after the introduction of Cyclosporine in 1993 (Kasiske et al., 1991, Race and Allograft Survival ).

**Influence of Race on the Survival of Cadaver Renal Allografts.**

STUDY ORIGINATOR*	NO. OF CENTERS SURVEYED	DATE	NO. OF WHITES	NO. OF BLACKS	1-YR GRAFT SURVIVAL		3-YR GRAFT SURVIVAL		CYCLOSPORINE TREATMENT
					WHITE	BLACK	WHITE	BLACK	
					<i>percent</i>		<i>percent</i>		
UCLA <sup>41</sup>	>100	1970–1975	3,581	978	47	37	35	25	No
KTHS <sup>42</sup>	42	1974–1976	1,173	292	51	44	40	34	No
SEOP <sup>42</sup>	39	1977–1980	942	607	59	50	50	41	No
HCFA <sup>43</sup>	—	1977–1980	5,578	1624	58	50	47	40	No
CTS <sup>44</sup>	259	1983–1988	24,072	1807	—	—	70	50	Yes
UCLA <sup>45</sup>	>100	1984–1988	12,373	2963	77	70	65	49	Yes
HCFA <sup>9</sup>	—	1985	5,366	1473	77	71	64	53	Yes†

\*UCLA denotes UCLA Transplant Registry, KTHS Kidney Transplant Histocompatibility Study, SEOP South Eastern Procurement Foundation, HCFA Health Care Financing Administration, and CTS Collaborative Transplant Study.

†Not all patients received cyclosporine.

**Table 2:** A breakdown of time period and graft survival rate by race is shown. The introduction of Cyclosporine in 1983 resulted in the gap between the survival rates of blacks and whites closing significantly (Kasiske et al., 1991, Race and Allograft Survival).

One popular explanation for this effect is that the immunosuppressive effect of cyclosporin was able to overcome and compensate for the comparatively poor antigen matching in black kidney recipients. It is important to mention that the researchers noted that the disparities observed in the one-year survival rates between Black and White Americans were not totally accounted for by antigen matching.

### Organizational Actors Contributing to Organ Inequity

The ability to pay for one's organ transplant can prevent patients of low socioeconomic status from receiving a transplant due to the high cost. Additionally, the costs of the numerous pre-op doctors appointments needed before a transplant can prevent patients from even getting on the kidney transplant waiting list, and the costs of the required post post-op medications can force patients to stop taking them. These

barriers that exist for poor patients will be considered organizational actors because they are influenced directly by the organizations that dictate the organ transplant process, such as health insurance and costs set by transplant centers.

In her journal article, “Beyond Scarcity: Poverty as a Contraindication for Organ Transplantation”, Mary Simmerling discusses how the socioeconomic status of a patient can affect their likelihood of receiving a successful organ transplant (Simmerling, 2007, Only the Appearance of Equity). As previously mentioned, NOTA and UAGA are laws already on the books whose goal is to ensure a fair chance for anyone to be assigned an organ. According to Simmerling, this is clearly not the result. Simmerling points out that there are large disparities based on socioeconomic class and emphasizes that equal access to organs is not the same thing as equal access to a successful organ transplantation. A kidney transplant patient on Medicare insurance will only receive 80% coverage for 3 years’ worth of post – op immunosuppressants, even though this medication must be taken for the remainder of a patient’s life. Simmerling points out that these medications can cost up to 2,000\$ per month, which would require a full time minimum wage worker to pay over 30 percent of their monthly income to afford their medication, even with 80% coverage. After the three years, the cost becomes insurmountable and patients must often stop taking their medication, which will lead to organ failure and potentially death. In addition to resulting in catastrophic health outcomes, the cost of these medications can stop a patient from even seeking a transplant at all (Simmerling, 2007, Only the Appearance of Equity).

### **Cultural Actors Contributing to Organ Inequity**

The high prevalence of kidney disease risk factors such as diabetes, hypertension, obesity, and hepatitis in minority populations has resulted in a disproportionate amount of racial minority patients that need a kidney transplant. Reduced organ donation rates among minority populations have only compounded this problem (Bratton et al., 2011, Decreased Donation). In this section, I will analyze the cultural actors that have caused the disparity between the need for organs and donation rates among minority populations.

The journal article “Racial Disparities in Organ Donation and Why” details the racial disparities that exist on the kidney transplant waiting list and in organ donation rates (Bratton et al., 2011). The researchers found that while organ donation rates for Black Americans were significantly lower than White Americans decades ago, since the early 1990’s, they been roughly consistent with population percentages. Due to the previously mentioned health risk factors, Black Americans have a greater proportional need for kidney transplants, as shown in table 3.

All ethnicities	<i>N</i>	Percent of waiting list
White	36 166	38.86
African-American	31 740	34.10
Hispanic	16 822	18.07
Asian American	6544	7.03
AI/AN	910	0.98
PI	468	0.50
Unknown	0	0
Multiracial	419	0.45
Total	93 069	100

Kidney transplant waiting list November 2010

**Table 3:** The demographics of the kidney transplant waiting list. Note that the amount of African American patients on the waiting list is nearly as high as the number of White patients (Bratton et al., 2011, Decreased Donation).

This disparity exacerbates many of the problems already discussed. As previously mentioned, it is easier to find a match for an organ if the donor and recipient are of the same ethnic background. This means that it is often more difficult to find a match for black patients because a disproportionately large amount of recipients are having to compete over a relatively small supply of donor organs. (Bratton et al., 2011, Understanding and Overcoming Barriers).

### **Part III: The Connections Between Technology, Organization, and Culture**

As previously stated, the single largest barrier in the organ transplant field is the lack of available organs. This limited supply of organs, when compounded with the immense difficulty and importance in finding a compatible donor for a patient, complicates the problem even more. Still, there are many more factors that contribute to the inequality that this sociotechnical system faces in organ selection and patient outcomes for racial minorities and those of low socioeconomic status. However, by analyzing the different technical, organizational, and cultural components of this complex system, I can effectively present an understanding of the causes of inequality in the field of organ transplantation.

#### **Emerging Technology Will Continue to Fight Inequalities**



The goal of the technical section was to investigate the causes of inequality in organ matching and patient outcomes, specifically through the lens of the compatibility issues between different racial groups. As previously mentioned, differences in the distribution of ABO blood type and antigen distributions between racial groups make it harder to find good organ matches for minority patients. Even if a match can be found, a less than perfect match can greatly reduce the organ life and function in the patient. This problem affects minority patients disproportionately due their smaller population proportions. After the introduction of cyclosporine in 1983, the 1 year kidney transplant survival rates for both black and white patients both drastically increased, but this increase was larger for black patients (Kasiske et al., 1991, Race and Allograft Survival). The reason for this was that the drug cyclosporine helps mitigate adverse immune reactions which are found more frequently in organs with inferior matching. Organs transplanted to minority patients on average have worse immune system matching, which is why the immunosuppressant drug cyclosporine had a larger effect on those populations. As new and better medications are invented, this gap will only continue to close. An example of this is the emerging technology of artificial organs. Artificial organs, once in use, will create an even more equal transplantation process. This is because artificial organs do not contain any of the antibodies of a donor because they are created from a patient's own cells (*Bioartificial Organ Manufacturing Technologies - Xiaohong Wang, 2019, Material Basis of Organ Manufacturing*). This means any racial inequalities that result from the difficulty of matching a donor and recipients ABO blood group and secondary antigens will be eliminated. The lack of any adverse immune reactions will also mean that a patient will not have to take expensive,

lifelong immunosuppressant medication The elimination of secondary organ transplant costs such as this will serve to make organ transplantation even more accessible.

### **Community Outreach Addresses Cultural Stressors**

Since the early 1990's, there has not been a significant disparity in the proportion of organs donated by each racial group, however, this was not always the case. In 1982, the percentage of organs nationwide donated by Black Americans was only 3%, when we would expect roughly 12% based on demographics. A seminal study, conducted by Dr. Clive Callender, interviewed a random sample of African American participants from across the country to identify the barriers that result in decreased donation. The study found that lack of awareness, religious beliefs, distrust of the medical community, fear of racism, and fear of premature declaration of death after signing a donor card were the five largest stressors for reduced donation rates among African Americans (Callender et al., 2002, Results). The National Minority Organ Tissue Transplant Education Program (MOTTEP), founded in 1991 by Dr. Callender, was created to tackle misconceptions and increase minority participation in organ donations through community outreach programs. Based on the results of the previously mentioned study, it was hypothesized that increased face to face dialogue, using culturally sensitive and ethnically similar messengers who were healthcare providers or organ recipients themselves would be most effective in tackling disparities in minority communities.

The effectiveness of Callender's approach is impossible to ignore. In 1993, only two years after the founding of MOTTEP, the donation rate of organs from African Americans reached population averages at 11.6% (Bratton et al., 2011, Understand and

Overcoming Barriers). Increased outreach to minority communities is a proven way to reduce disparities in organ transplantation. However, more outreach is needed if we hope to increase minority organ donation rates to match their respective need for organs.

### **The Intersection of Actors in the Sociotechnical System of Organ Transplantation**

The most difficult aspect of analyzing the field of Organ Transplantation as a sociotechnical system, is the sheer size and complexity of the system. It is very difficult to make connections based on studies that are decades apart and cover the entirety of the United States. Despite these difficulties, it is still possible to see how the different actors of the system interact with each other, and sometimes aggravate each other. For example, reduced donation rates among minority communities, caused by cultural factors such as distrust of the medical community, aggravate existing technical and organizational factors in the organ selection process. It is already more difficult to match organs to minority patients due to their small demographic share of the population, and poorer quality immune system matching can result in worse health outcomes for minorities as shown in table 4. For example, the 10 year rate of transplanted organ failure for African Americans is 1.8 times that of White Americans. Extreme disparities such as this one reduce the amount of trust that minority populations have in the medical system, which starts the whole cycle over again.

Graft failure and functional status over 10 years of follow-up by race/ethnicity					
	Race/Ethnicity				P value <sup>a</sup>
	White	African-American	Hispanic	Other	
n	2,478	728	252	148	
Graft status <sup>b</sup>					
Failed grafts (n)	1,494	560	161	87	
Person-years of observation	19,982	5,006	2,025	1,273	
Rate of graft failure per 1000 person-years	126	220	157	114	
Rate ratio (95% CI)	1.0	1.8 (1.7-1.8)	1.3 (1.1-1.4)	0.9 (0.7-1.1)	<0.001
Functional status					
Days impaired (median)	2386	654	247	149	
Days impaired, % (IQR)	9 (0-37)	23 (0-50)	17 (0-41)	7 (0-24)	
Rate ratio (95% CI)	1.0	1.6 (1.3-1.9)	1.1 (0.9-1.4)	0.8 (0.6-1.1)	<0.001

<sup>a</sup>  $\chi^2$  or Kruskal-Wallis.

<sup>b</sup> Data missing for n=864.

Graft failure and functional status over 10 years of follow-up by race/ethnicity

**Table 4:** The 10 year failure rate of organs based on the patients race. Note the rate ratio is 1.8 for African Americans, meaning that the rate of failure for their organs transplants is on average almost twice that of whites (Press et al., 2005, Statistical Analysis).

Although this is not a perfect example, I have demonstrated the power of using the cartography of controversies as a research method for large, real world sociotechnical systems. By breaking down organ transplantation into its constituent technological, organizational, and cultural actors, I was able to draw effective comparisons and visualize how these actors contribute to inequality.

## Conclusion

Organ transplantation is supposed fair and blind process. Despite this, disparities in organ transplantation clearly exist between different racial and economic groups regarding their access to organ transplants, as well as their health outcomes after organ transplants. In this research paper, I assert that the cartography of controversies is an effective method to analyze the sociotechnical system of organ transplantation. I have

demonstrated the effectiveness of this method by breaking the system down into its individual technological, organizational, and cultural actors to gain a better understanding of how they interact with each other. Even though some of the relationships between these actors have changed over time, due to the decades of data that are covered, the numerous studies covered in this paper demonstrate the compatibility and financial constraints of organ donation, and present possible solutions to these problems with the introduction of better medical technology and extensive community outreach.

The conclusions of this research demonstrate that the cartography of controversies is an effective research method that can be used to gain a better understanding of massive, real life systems. The conclusions established in this paper could be very useful for legislators trying to build a better organ donation system in the future. While there is still a long road to full equality in organ transplants, my research establishes an advanced understanding of the root causes of inequality that exist in organ transplantation.

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