

The Impact of Race and Socioeconomic Status on Transplant Accessibility and Outcomes: A Literature Review

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Due to the high demand but low supply of donor organs, issues of organ allocation arise as patients on the waitlist are prioritized to determine who gets the next available organ. This literature review will review articles related to the racial and socioeconomic disparities in organ transplants and how they affect transplant access and outcomes. Patients of Black and minority (Hispanic and Native American) races had significantly lower rates of organ transplants as well as worse transplant outcomes including graft failure and post-operative complications (Bryce et al., 2009). Similarly, patients from lower socioeconomic status (SES) backgrounds (i.e. poverty or lack of private/commercial insurance) had lower rates of organ transplant surgeries but there has been no significant research done on the effect that SES specifically has on transplant outcomes. Further directions for future research should be investigating the role of SES on transplant outcomes. The findings of this literature review highlight the need for measures to make organ allocation more equitable; this can be done by factoring in the social determinants of health (SDOH) when prioritizing potential organ recipients to compensate for race and SES decreasing accessibility to transplants.

Keywords

social determinants of health • transplant surgery • access to healthcare • race • socioeconomic status

Introduction

Transplant surgeries are considered the golden standard of care for organ failure for patients worldwide since they give them a new organ that acts as a lifesaver and a new chance (Wang & Hart, 2021). Individuals with conditions leading to organ failure are referred by their physicians for

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organ transplants (*The Organ Transplant Process* | *Organdonor.Gov*, n.d.). Patients are then evaluated for transplant eligibility and are placed on the registry to receive a donor organ once one is available. Depending on the type of organs, donor organs can either be harvested from recently deceased individuals who have volunteered as donors or from living volunteers (*Organ Donation & Transplantation*, n.d.). The Organ Procurement and Transplantation Network then matches patients on the registry with donor organs as they become available. Matching is based on several criteria including “blood type, body size, the severity of the patient’s condition, geographic proximity to the donor, and the patient’s time spent on the registry” (Matching Donors and Recipients | *Organdonor.Gov*, n.d.).

With over 40,000 transplant surgeries performed in 2022 alone, there is still an increasing need for donor organs because every ten minutes, another person is added to the transplant waiting list (*The OPTN/SRTR Annual Data Report*, 2023). As of March 2024, more than 104,000 patients are waiting for a donor organ on the national registry (*Waiting list/process*, 2024). Due to the high demand but low supply of donor organs, issues of organ allocation arise as patients on the waitlist are prioritized to determine who gets the next available organ. The aforementioned prioritization and matching parameters – which differ for each organ but generally include factors like waiting time and the likelihood of survival – do not consider SDOH (*How we match organs* 2024). For this review, SDOH includes non-biological factors that influence health including race/ethnicity, SES, access to healthcare, education, etc. This literature review aims to answer the question “What is the Impact that Race and Socioeconomic Status have on Transplant Accessibility and Outcomes?”.

Methods

This paper reviewed articles (including studies and other literature reviews) that discuss the role of race and SES on organ transplant access and outcomes. 25 publications from the United States between 2005 and 2023 were selected for this review using PubMed and Google Scholar. Search terms inputted into the databases included “organ transplant” AND “race” OR “socioeconomic status”. All of the articles used to answer the research question were studying the impact of race and/or SES on organ transplants. More specific searches were performed to find research on the effect that SES has on the outcomes of transplant surgeries, with no success. After reading the abstracts to identify the studies’ goals and results, articles were categorized based on whether they studied race, SES, or both. Then, they were subcategorized based on whether they focused on how these factors influence access to transplant surgeries, outcomes of the surgery, or both.

Race

According to four studies on transplant disparities, access to kidney transplants appears to be impacted by race, with Black and minority (i.e. Native American, Hispanic) patients having to wait longer for a transplant or having a lower likelihood of receiving a donor organ. A prospective study that followed 1056 patients referred for kidney transplant between 2010 and 2012 and conducted follow-up interviews post-transplant found that Black patients had a lower likelihood of kidney transplant and living-donor transplant (Wesselman et al., 2021). Similarly, a cross-sectional study done by reviewing kidney transplant recipients from the Scientific Registry of Transplant

Recipients found that, compared with white recipients, Black recipients had a 37% lower likelihood of a living donor kidney transplant (Killian et al., 2021). Additionally, a retrospective study of adults undergoing dialysis between 2005 and 2014 found that non-Hispanic Black and Hispanic patients have lower access to kidney transplantation compared to non-Hispanic whites (Ku et al., 2019). The researchers compared the prevalence of comorbidities (co-existing health issues) that could potentially influence transplant eligibility between race/ethnicity groups, to prevent it from being a confounding variable (Ku et al., 2019). Lastly, a 2005 editorial mentioned that minority patients (specifically African Americans and Native Americans) are at greater risk of end-stage renal disease (ESRD) but also less likely to receive an organ transplant once ESRD develops (Gaston & Benfield, 2005). According to a medical record analysis of patients at a kidney transplant center who were referred for transplant and a longitudinal follow-up of up to five years, even when accounting for socioeconomic, demographic, and clinical factors, Black patients had a 59% lower rate of kidney transplant than white patients (Thamma et al., 2013). Despite different methodologies, all the aforementioned articles have established a relationship between race and transplant accessibility, suggesting significant disparities that limit individuals from specific racial backgrounds from accessing life-saving care.

Some of the studies done about kidney transplants, though, mention kidney transplants and living donor transplants separately. While recipients still receive the core benefit of a functioning kidney when they receive it from a deceased donor, living donor organs are considered more beneficial because, according to the University of Pennsylvania, “kidneys from a living donor are generally healthier, last up to two times longer than deceased donor kidneys, and usually start working immediately after transplant, compared with deceased donor kidneys that may have delayed function” (*Living Donor Kidney Transplant*, 2023). Additionally, the quality of life of patients before the transplant is also affected since recipients of living donor kidney transplants (LDKT) can receive the surgery without starting dialysis while patients waiting for a deceased donor organ will have to undergo dialysis while waiting for an organ. This ultimately might prevent patients from carrying out obligations like going to work, which might further impact one’s financial stability and ability to afford a transplant surgery (*Living Donor Kidney Transplant*, 2023).

Similar racial disparities were found in liver transplants as well: according to three studies, Black and Native American patients, along with racial minorities in general, are disadvantaged in access to liver transplants. One study was an analysis of discharge data from the National Inpatient Sample between 2016 and 2019, identifying adult patients with chronic liver disease who underwent a liver transplant. Researchers found that compared to white patients, Black and Native American patients had decreased liver transplant rates (Mansour et al., 2022). Similarly, a study that followed patients through the transplant process found that evaluation, waitlisting, and liver transplantation were less likely if patients were, among other characteristics, Black (Bryce et al., 2009). The study also found that differences due to these disparities were more pronounced in the evaluation and listing stages than in the transplantation stage since national oversight and review occur for the latter (Bryce et al., 2009). The results from Bryce et al. suggest a bottleneck earlier in the referral process that slows movement through the process for some showing that race plays a bigger role in referrals and evaluation than in the actual waiting period. Similarly, a 2009 literature review of racial/ethnic disparities in liver transplantation found that at each step in the transplant process, racial/ethnic minorities appear to be disadvantaged despite the inherent analytical and statistical biases present in many of the reported studies (Mathur et al., 2009).

Similar to kidneys, there are two types of liver transplants: deceased donor or living donor transplants (*Types of Liver Transplant*, 2023). In the latter, part of the liver from someone in an established relationship with the recipient is transplanted (*Types of Liver Transplant*, 2023). Due to the regenerative nature of livers, despite only half of the liver being transplanted to the recipient, both the donor and the recipient will have regenerated fully functioning livers within 6 to 8 weeks (*Types of Liver Transplant*, 2023). While living donor transplants provide added benefits, the additional requirements (i.e. the donor has to have an established relationship with the recipient, the donor has to be 18–55 years old, etc.) may pose additional obstacles in finding suitable donors (*Types of Liver Transplant*, 2023).

Some studies have focused specifically on how race influences different steps of the solid organ transplantation process. A 2022 literature review of inequities in access to organ transplants found that racial and ethnic minorities, among other groups, were less likely to be referred, evaluated, and added to the waiting list for organ transplants (Park et al., 2022). A report from The Diversity and Minority Affairs Committee of the American Society of Transplantation states that “participants noted that minority populations were more likely to be adversely affected by limited preventive medical care, lack of counseling regarding transplant options, and delays in transplant referrals for organ transplantation.” (Higgins & Fishman, 2006). They also noted that some of these consequences may be from the reduced presence of professionals from minority communities training in transplant-related specialties, which is a factor not mentioned in other studies and suggests further action to increase diversity in the population of transplant-care providers (Higgins & Fishman, 2006).

While research on the impact that race has on transplant surgery outcomes is not comprehensive, existing research predominantly suggests that African American, Black, and Hispanic patients are more likely than white patients to experience kidney graft loss and failure. A 2006 analysis of the United States Renal Data System database aimed to determine the presence of racial disparities in graft loss and death in groups with and without lupus nephritis, an autoimmune condition that affects kidney function. The study found that African-American kidney recipients with the condition, compared to non-African-American recipients, had an increased risk for graft loss (Nee et al., 2013). Additionally, in the elderly (60+) population of kidney transplant recipients on the UNOS database, Black kidney recipients were more likely than whites to experience kidney graft failure (Ilori et al., 2015). A literature review on disparities in kidney outcomes stated that studies document worse outcomes for Black patients – among other factors – and better outcomes are reported in Hispanic and Asian kidney transplant recipients but the distinct roles of racial versus socioeconomic factors remain unclear from these results (Gordon et al., 2010). Another study using the UNOS database with a retrospective cohort methodology found that “the estimated 10-year probability of graft survival was 56% for African-Americans and 64% for Hispanics compared to 75% for whites” (Press et al., 2005). While access to treatment may be affected by race due to mediating factors like SES, location, and lack of insurance, the outcome of the transplant surgery being affected by one’s race with no known biological factor is concerning. More research should be done to determine the association between race and the quality of the transplant center in which the surgery takes place. It might be plausible that, due to redlining and other historically racist housing segregation policies, Black and other minority patients get transplants done at local, lower-quality facilities than white patients. A 2023 cohort study examining the impact of redlining on the treatment and survival of breast cancer in women aged 60–99 years found that historical redlining is associated with differential treatment receipt, lower likelihood of receiving surgery, and poorer

survival of breast cancer-specific mortality (Bikomeye et al., 2023). While not studying transplant surgeries, this research sheds light on the potential effects that historically racist policies may have on organ transplant access and outcomes.

Socioeconomic Status

For kidney transplants, three studies show that SES and health insurance are associated with the likelihood a patient has of getting the transplant they need; Bryce et al., 2009, Mansour et al., 2022, Park et al., 2022, and Wesselman et al., 2021 have been mentioned in previous sections as they found that race had a significant impact on transplant accessibility. A prospective study that followed patients referred for kidney transplants mentioned earlier also found that lower income and public insurance – along with race – were each associated with a lower probability of any kidney transplant, with an alarming subdistribution hazard ratio of 0.49 for LDKT (Wesselman et al., 2021). A literature review of disparities affecting pediatric kidney transplants found that the absence of health insurance poses an important barrier to transplant (Amaral & Patzer, 2013). However, even after adjustment for insurance status and neighborhood poverty, disparities persist; this goes to show that lack of insurance is not the only barrier or determinant affecting pediatric kidney transplants (Amaral & Patzer, 2013).

Similarly, three studies found that private and commercial insurance seems to be positively associated with liver transplant accessibility. Firstly, a study that analyzed pediatric patients (aged 5 to 15) from the Scientific Registry of Transplant Recipients found that after adjusting for socioeconomic factors like neighborhood deprivation and insurance, racial disparities were not present for wait-list mortality (Wadhvani et al., 2021). This suggests an interplay between SES and race, potentially indicating that the racial disparities seen in transplant accessibility may be due to SES disparities between races. It was also found that patients who lacked commercial insurance were less likely to undergo evaluation, waitlisting, and liver transplantation (Bryce et al., 2009). In an analysis of discharge data from the National Inpatient Sample between 2016 and 2019, by identifying adult patients with chronic liver disease who underwent a liver transplant, researchers found that patients with private insurance had a liver transplant rate almost twice as high as that of those with Medicare, while patients without insurance had the lowest rate of transplantation (Mansour et al., 2022). Insurance access can be used as a proxy for SES since employment offers health insurance and private insurance is available for purchase, if an individual uses Medicaid or Medicare or if they are uninsured, it can reasonably be assumed that they are of low SES. This assumption allows a connection between SES and transplant accessibility for liver transplants.

For solid organ transplants in general, lower SES was also seen to be associated with decreased accessibility to transplant services. A 2022 literature review of inequities in access to organ transplants found patients in lower socioeconomic status groups were less likely to be referred, evaluated, and added to the waiting list for organ transplants (Park et al., 2022). Similarly, a retrospective analysis of medical charts for 183 pediatric kidney, liver, and heart transplant candidates who had been referred for evaluation found that the most common barrier to listing was financial, with public insurance being indirectly associated with time to listing – ultimately, delayed time to listing for pediatric transplant patients is associated with increased risks of mortality and morbidity (Steinberg et al., 2021). An analysis of the UNOS registry data, including 33,893 adult heart transplant recipients between 1994 and 2014, found significant associations between lower SES markers

(including neighborhood SES, Medicare, and Medicaid) and negative heart transplant outcomes (including death, retransplant, and hospitalization), independent of baseline clinical characteristics (Wayda et al., 2018).

There was no significant research available about the relationship between SES and transplant outcomes, suggesting a gap in the literature that future research should try to cover.

Discussion

With the same trends being consistently found by studies investigating different organ transplants, it is concerning that there is little to no policy being made or action being taken to reduce these disparities.

The wide scope of this literature review is a limitation of its findings as it included a broad range of transplant studies including kidney, liver, and heart transplants. Race and SES might play distinct roles in different types of transplants. However, the decision to include all organs was taken to evaluate common trends and disparities in transplants as a whole. Further research should be done to determine the different roles these disparities play in the transplant process of each organ. Since UNOS coordinates transplants for all organs, the enlisting process should not vary significantly, except between deceased donors and living donors since the latter is not available for all organs (What is UNOS, 2023).

Additionally, another limitation of the review is that it included studies regarding pediatric transplants as well as adult transplants. While UNOS is also responsible for organ allocation for pediatric patients, they get “pediatric priority” on the waitlist for organs like kidneys because being on dialysis may cause developmental delays (*Pediatric transplants*). Since just listing before the individual’s 18th birthday is enough for a patient to be considered “pediatric” even if they receive the transplant after they become an adult, it might be counterintuitive to count patients above 18 as pediatric for research (*Pediatric transplants*). Another limitation of this review and the research included in it is that only a limited number of the included studies discuss data from races other than white, Black, Hispanic, and Native American minorities. Since there was no filter to include only these groups in the review, this is likely the result of fewer studies focusing on other races. This points to another future direction that researchers should take to make research more inclusive and generalizable.

Furthermore, more disparities affect one’s likelihood of organ transplantation: research shows that other factors cause differences in transplant rates. For example, a 2022 cross-sectional study that investigated the impact of SDOH on additions to state-level kidney and liver transplant waitlists found that urbanicity was independently associated with waitlisting (Johnson et al., 2022). Innovations are being developed, though, to combat the temporal and geographical constraints and disparities in organ transplants. For example, the ex-vivo heart perfusion mechanism allows prolonged perfusion time so donor hearts can last longer outside of the body between organ harvest and transplant, thereby reducing temporal disparities and allowing time for more tests to confirm organ viability and recipient matching (Bryner et al., 2021). This would allow for more equitable allocation of the organ where travel and time constraints do not prevent those who need the organ the most from receiving it.

Research shows consistent reports that race and SES affect the accessibility of transplant surgeries, but significant action is yet to be taken to make these procedures more equitable. In

March 2023, lung organ allocation in the US shifted to a continuous distribution system that prioritized patients based on a composite allocation score (CAS) that considers medical and biological factors like waitlist survivability, blood type, and height to determine their priority for a lung transplant (Calhoun et al., 2023). If a similar measure that included SDOH – like race or SES – could be developed, access and outcomes of transplants may become more equitable since differences in access would be accounted for. Such measures, however, may generate feelings of disadvantage to those who do not explicitly benefit from adding these measures, so changes to the practice must be made carefully. Additionally, a review of 10 national data sources related to transplant surgeries concluded that there is a need for improved SDOH data collection systems in end-stage organ disease and transplant patients “via enhanced inter-registry collaboration, incorporation of standardized SDOH variables into existing data sources, and transplant center and consortium-based investigation and innovation” (Chan et al., 2022). Taking measures to increase the collection of SDOH data and making it accessible to researchers will allow more study on the different disparities that exist within the field of organ transplants, and ultimately, allow for more equitable outcomes.

Conclusion

To answer the research question, the literature review of studies and reviews regarding the role of race and SES in organ transplants shows that patients of Black and minority (Hispanic and Native American) races had significantly lower rates of organ transplants as well as worse transplant outcomes. Additionally, patients of lower SES (i.e. poverty or lack of private/commercial insurance) had lower rates of transplant but there was no significant research on the effect of SES on transplant outcomes. Therefore, the research question cannot be fully answered based solely on current research findings. Future directions for research include investigating the role of SES on transplant outcomes.

References

- Amaral, S., & Patzer, R. (2013). Disparities, race/ethnicity and access to pediatric kidney transplantation. *Current Opinion in Nephrology and Hypertension*, 22(3), 336–343. <https://doi.org/10.1097/mnh.0b013e32835fe55b>
- Bikomeye, J. C., Zhou, Y., McGinley, E. L., Canales, B., Yen, T. W. F., Tarima, S., Ponce, S. B., & Beyer, K. M. M. (2023). Historical redlining and breast cancer treatment and survival among older women in the United States. *Journal of the National Cancer Institute*, 115(6), 652–661. <https://doi.org/10.1093/jnci/djad034>
- Bryce, C. L., Angus, D. C., Arnold, R. M., Chang, C.-C. H., Farrell, M. H., Manzarbeitia, C., Marino, I. R., & Roberts, M. S. (2009). Sociodemographic differences in early access to liver transplantation services. *American Journal of Transplantation*, 9(9), 2092–2101. <https://doi.org/10.1111/j.1600-6143.2009.02737.x>
- Bryner, B. S., Schroder, J. N., & Milano, C. A. (2021). Heart transplant advances: Ex vivo organ-preservation systems. *JTCVS open*, 8, 123–127. <https://doi.org/10.1016/j.xjon.2021.04.020>
- Calhoun, K., Smith, J., & Gray, A. L. (2023). Social and biologic determinants in lung transplant allocation. *Current Opinion in Organ Transplantation*, 28(3), 163–167. <https://doi.org/10.1097/mot.0000000000001069>

- Chan, N. W., Moya-Mendez, M., Henson, J. B., Zaribafzadeh, H., Sendak, M. P., Bhavsar, N. A., Balu, S., Kirk, A. D., & McElroy, L. M. (2022). Social determinants of health data in solid organ transplantation: National data sources and Future Directions. *American Journal of Transplantation*, 22(10), 2293–2301. <https://doi.org/10.1111/ajt.17096>
- Gaston, R. S., & Benfield, M. (2005). The relationship between ethnicity and outcomes in solid organ transplantation. *The Journal of Pediatrics*, 147(6), 721–723. <https://doi.org/10.1016/j.jpeds.2005.08.069>
- Gordon, E. J., Ladner, D. P., Caicedo, J. C., & Franklin, J. (2010). Disparities in kidney transplant outcomes: A Review. *Seminars in Nephrology*, 30(1), 81–89. <https://doi.org/10.1016/j.semnephrol.2009.10.009>
- Higgins, R. S. D., & Fishman, J. A. (2006). Disparities in solid organ transplantation for ethnic minorities: Facts and solutions. *American Journal of Transplantation*, 6(11), 2556–2562. <https://doi.org/10.1111/j.1600-6143.2006.01514.x>
- How we match organs*. UNOS. (2024, January 3). <https://unos.org/transplant/how-we-match-organs/>
- Ilori, T. O., Adedinsewo, D. A., Odewole, O., Enofe, N., Ojo, A. O., McClellan, W., & Patzer, R. E. (2015). Racial and ethnic disparities in graft and recipient survival in elderly kidney transplant recipients. *Journal of the American Geriatrics Society*, 63(12), 2485–2493. <https://doi.org/10.1111/jgs.13845>
- Johnson, W. R., Rega, S. A., Feurer, I. D., & Karp, S. J. (2022). Associations between social determinants of health and abdominal solid organ transplant wait-lists in the United States. *Clinical Transplantation*, 36(11). <https://doi.org/10.1111/ctr.14784>
- Killian, A. C., Shelton, B., MacLennan, P., McLeod, M. C., Carter, A., Reed, R., Qu, H., Orandi, B., Kumar, V., Sawinski, D., & Locke, J. E. (2021). Evaluation of community-level vulnerability and racial disparities in living donor kidney transplant. *JAMA Surgery*, 156(12), 1120. <https://doi.org/10.1001/jamasurg.2021.4410>
- Ku, E., Lee, B. K., McCulloch, C. E., Roll, G. R., Grimes, B., Adey, D., & Johansen, K. L. (2019). Racial and ethnic disparities in kidney transplant access within a theoretical context of medical eligibility. *Transplantation*, 104(7), 1437–1444. <https://doi.org/10.1097/tp.0000000000002962>
- Living Donor Kidney Transplant*. Pennmedicine.org. (2023). <https://www.pennmedicine.org/for-patients-and-visitors/find-a-program-or-service/transplant-institute/living-donor-kidney-transplant#:~:text=Improved%20survival%3A%20Kidneys%20from%20a,to%20better%20long%2Dterm%20health.>
- Mansour, M. M., Fard, D., Basida, S. D., Obeidat, A. E., Darweesh, M., Mahfouz, R., & Ahmad, A. (2022). Disparities in social determinants of health among patients receiving liver transplant: Analysis of the National Inpatient Sample from 2016 to 2019. *Cureus*. <https://doi.org/10.7759/cureus.26567>
- Matching Donors and Recipients | organdonor.gov. (n.d.). Retrieved March 9, 2024, from <https://www.organdonor.gov/learn/process/matching>
- Mathur, A. K., Sonnenday, C. J., & Merion, R. M. (2009). Race and ethnicity in access to and outcomes of Liver Transplantation: A critical literature review. *American Journal of Transplantation*, 9(12), 2662–2668. <https://doi.org/10.1111/j.1600-6143.2009.02857.x>
- Nee, R., Jindal, R. M., Little, D., Ramsey-Goldman, R., Agodoa, L., Hurst, F. P., & Abbott, K. C. (2013). Racial differences and income disparities are associated with poor outcomes in kidney transplant

- recipients with lupus nephritis. *Transplantation*, 95(12), 1471–1478. <https://doi.org/10.1097/tp.0b013e318292520e>
- Organ Donation & Transplantation. (n.d.). Cleveland Clinic. Retrieved March 9, 2024, from <https://my.clevelandclinic.org/health/treatments/11750-organ-donation-and-transplantation>
- Park, C., Jones, M.-M., Kaplan, S., Koller, F. L., Wilder, J. M., Boulware, L. E., & McElroy, L. M. (2022). A scoping review of inequities in access to organ transplant in the United States. *International Journal for Equity in Health*, 21(1). <https://doi.org/10.1186/s12939-021-01616-x>
- Pediatric transplants*. Organ Procurement and Transplantation Network. (n.d.). <https://optn.transplant.hrsa.gov/patients/about-transplantation/pediatric-transplants/>
- Press, R., Carrasquillo, O., Nickolas, T., Radhakrishnan, J., Shea, S., & Barr, R. G. (2005). Race/ethnicity, poverty status, and renal transplant outcomes. *Transplantation*, 80(7), 917–924. <https://doi.org/10.1097/01.tp.0000173379.53347.31>
- Steinberg Christofferson, E., Ruzicka, E. B., Bolt, M., Lyons, E., Wachs, M., Buchanan, C. L., Schmiede, S. J., & Monnin, K. (2021). Understanding disparities and barriers associated with pediatric transplant evaluation and time to listing: Moving toward a more comprehensive picture. *Pediatric Transplantation*, 26(2). <https://doi.org/10.1111/petr.14182>
- Thammana, R. V., Knechtle, S. J., Romero, R., Heffron, T. G., Daniels, C. T., & Patzer, R. E. (2013). Racial and socioeconomic disparities in pediatric and young adult liver transplant outcomes. *Liver Transplantation*, 20(1), 100–115. <https://doi.org/10.1002/lt.23769>
- The OPTN/SRTR Annual Data Report*. OPTN/SRTR Annual Data Report. (2023, March 2). <https://www.srtr.org/reports/optnsrtr-annual-data-report/#:~:text=The%20OPTN%2FSRTR%20Annual%20Data%20Report&text=Since%20the%20mid%2D2000s%2C%20there,to%20the%20transplant%20waiting%20list.>
- The Organ Transplant Process | organdonor.gov. (n.d.). Retrieved March 9, 2024, from <https://www.organdonor.gov/learn/process/transplant-process>
- Types of Liver Transplant*. Stanford Health Care (SHC) - Stanford Medical Center. (2023). <https://stanfordhealthcare.org/medical-treatments/l/liver-transplant/types.html>
- Wadhvani, S. I., Ge, J., Gottlieb, L., Lyles, C., Beck, A. F., Bucuvalas, J., Neuhaus, J., Kotagal, U., & Lai, J. C. (2021). Racial/ethnic disparities in wait-list outcomes are only partly explained by socioeconomic deprivation among children awaiting liver transplantation. *Hepatology*, 75(1), 115–124. <https://doi.org/10.1002/hep.32106>
- Waiting list/process*. Gift of Life Michigan. (2023, October 11). <https://giftofflifemichigan.org/who-we-serve/recipients/waiting-list-process#:~:text=More%20than%20104%2C000%20people%20are,nearly%202%2C400%20are%20Michigan%20residents.>
- Wang, J. H., & Hart, A. (2021, August 19). *Global Perspective on Kidney Transplantation: United States*. Kidney360. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8785833/>
- Wayda, B., Clemons, A., Givens, R. C., Takeda, K., Takayama, H., Latif, F., Restaino, S., Naka, Y., Farr, M. A., Colombo, P. C., & Topkara, V. K. (2018). Socioeconomic disparities in adherence and outcomes after heart transplant. *Circulation: Heart Failure*, 11(3). <https://doi.org/10.1161/circheartfailure.117.004173>

Wesselman, H., Ford, C. G., Leyva, Y., Li, X., Chang, C.-C. H., Dew, M. A., Kendall, K., Croswell, E., Pleis, J. R., Ng, Y. H., Unruh, M. L., Shapiro, R., & Myaskovsky, L. (2021). Social determinants of health and race disparities in kidney transplant. *Clinical Journal of the American Society of Nephrology*, 16(2), 262–274. <https://doi.org/10.2215/cjn.04860420>

What is UNOS?: About United Network for Organ Sharing. UNOS. (2023, October 19). <https://unos.org/about/#:~:text=UNOS%20is%20involved%20in%20many,that%20occurs%20in%20the%20U.S.>