Exacerbation of Racial Disparities in Living Donor Kidney Transplantation During the COVID-19 Pandemic

Neeraj Singh,1 Ruixin Li,2 Tarek Alhamad,3 Mark A. Schnitzler,1 Roslyn B. Mannon,4 Mona D. Doshi,5 Kenneth J. Woodside,5 Benjamin E. Hippen,6 Matthew Cooper,7 Jon Snyder,8 David A. Axelrod,9 and Krista L. Lentine1

Key Points
- The coronavirus disease 2019 (COVID-19) pandemic profoundly impacted transplant services, with a particularly strong impact on living donor kidney transplantation.
- The COVID-19 pandemic appears to have disproportionately impacted Black patients’ access to living donor kidney transplantation.
- As the pandemic evolves through surges and vaccine acceptance disparities persist, ongoing attention to transplant disparities is needed.

Introduction
Equitable access to organ transplantation is a guiding principle of the US organ allocation system. The revision to the Kidney Allocation System in December 2014 mitigated racial disparity in access to deceased donor kidney transplantation (DDKT) from the point of listing (1), and the rate of DDKT for Black candidates after listing has been comparable with that of White candidates (2,3). However, unequal access to the waiting list for those suffering with ESKD persists and is related to multiple factors, including referral delays, and deficiencies in education and support for timely evaluation completion (4). As living donor kidneys are not allocated but rather potential living donors must be identified by transplant candidates and go through their own evaluation and surgery, it is unsurprising that racial disparity in access to living donor kidney transplantation (LDKT) has persisted. LDKT rates have remained lowest for Black patients (5).

The declaration of the coronavirus disease 2019 (COVID-19) pandemic in March 2020 profoundly impacted transplant services (6,7) because scarce hospital resources were directed to the care of COVID-19 patients. LDKT also halted initially during the pandemic to avoid risk of COVID-19 among living donors. Nevertheless, the year 2020 witnessed the largest number of DDKT compared with previous years, despite the pandemic, but a lower number of LDKT compared with previous years. Some commentators have expressed concern that the pandemic may have exacerbated inequities in transplantation for non-White patients (8). We sought to assess whether the COVID-19 pandemic disproportionately and specifically affected LDKT access according to race.

Methods
The publicly available data analyzed in this paper are Institutional Review Board exempt. This analysis used data from the Scientific Registry of Transplant Recipients (SRTR). The SRTR system includes data on all donors, waitlist candidates, and transplant recipients in the United States, submitted by the members of the Organ Procurement and Transplantation Network (OPTN). The Health Resources and Services Administration (HRSA), US Department of Health and Human Services, provides oversight to the activities of the OPTN and SRTR contractors. We compared counts of LDKT and DDKT procedures in the first year after the COVID-19 pandemic (March 2020–February 2021) with counts in the same period in the preceding 12 months according to patient race and other factors. Race and ethnicity were defined by transplant center reporting to the OPTN. Chi-squared testing was applied to examine these trends pre and post COVID-19 pandemic.

1John C. McDonald Regional Transplant Center, Shreveport, Louisiana
2Saint Louis University Center for Abdominal Transplantation, St. Louis, Missouri
3Washington University, St. Louis, Missouri
4University of Nebraska Medical Center, Omaha, Nebraska
5University of Michigan, Ann Arbor, Michigan
6Fresenius Medical Care, Charlotte, North Carolina
7Medstar Georgetown Transplant Institute, Washington, DC
8Hennepin Healthcare Research Institute Minneapolis, Minnesota
9University of Iowa, Iowa City, Iowa

Correspondence: Dr. Krista L. Lentine, MD, PhD, Saint Louis University Center for Abdominal Transplantation, Saint Louis University Hospital, 1201 S. Grand Blvd., St. Louis, MO 63104. Email: krista.lentine@health.slu.edu
Results
Counts of LDKT declined more for Black patients in the 12 months after the onset of the pandemic, compared with counts in the same period in the preceding 12 months. LDKT counts among Black patients fell by 36% compared with a 27% overall decline for White patients ($P < 0.02$). This pattern of a larger decrease in LDKT counts among Black patients occurred in all areas of the country except for the South Midwest (Figure 1A). Along with recipient race, other factors associated with a significant decline in LDKT counts included public insurance and Black living donor race (Table 1).

In contrast, DDKT counts for both Black and White candidates declined initially during the COVID-19 pandemic and then recovered above pre-pandemic levels overall, although increases in this period were limited to half of the geographic areas (Figure 1B). DDKT counts in Black patients were 2% higher in March 2020–February 2021 than in the preceding year.
versus the prior year, compared with a 5% period increase among White patients, although this difference did not reach significance ($P=0.19$; Table 1). Notably, Hispanic patients experienced a decline in DDKT compared with White patients (5% decline versus 5% increase; $P=0.003$). Other factors associated with lower overall DDKT counts

Table 1. Changes in volume of LDKT and DDKT procedures in the post-pandemic period of March 2020–February 2021, compared with the preceding year, by baseline factors

| Sub-Group                                      | Transplant Counts from 3/1/19–2/29/20 | Transplant Counts from 3/1/20–2/28/21 | % Change | P Value |
|------------------------------------------------|----------------------------------------|----------------------------------------|----------|---------|
| **LDKT recipients**                            | n=6807                                 | n=4952                                 | −27      | 0.02    |
| Recipient race and ethnicity                   |                                        |                                        |          |         |
| Black (non-Hispanic)                           | 876                                    | 558                                    | −36      | Ref.    |
| White (non-Hispanic)                           | 4364                                   | 3190                                   | −27      | Ref.    |
| Hispanic                                       | 1045                                   | 824                                    | −21      | 0.15    |
| Other                                          | 522                                    | 380                                    | −27      | 0.95    |
| Recipient education level                      |                                        |                                        |          |         |
| College and Higher                             | 4375                                   | 3209                                   | −27      | Ref.    |
| Grade/High School                              | 2151                                   | 1485                                   | −31      | 0.14    |
| Unknown                                        | 281                                    | 258                                    | −8       | 0.01    |
| Recipient employment status                    |                                        |                                        |          |         |
| Working                                        | 3150                                   | 2292                                   | −27      | 0.92    |
| Not working/unknown                            | 3657                                   | 2660                                   | −27      | Ref.    |
| Primary source of payment                      |                                        |                                        |          |         |
| Private                                        | 3712                                   | 2828                                   | −24      | Ref.    |
| Public                                         | 3095                                   | 2124                                   | −31      | 0.006   |
| Donor race and ethnicity                       |                                        |                                        |          |         |
| White (non-Hispanic)                           | 4830                                   | 3524                                   | −27      | Ref.    |
| Black (non-Hispanic)                           | 577                                    | 359                                    | −38      | 0.02    |
| Hispanic                                       | 993                                    | 754                                    | −24      | 0.45    |
| Other                                          | 407                                    | 315                                    | −23      | 0.45    |
| Location                                       |                                        |                                        |          |         |
| Northwest                                      | 191                                    | 118                                    | −25      | 0.23    |
| Southwest                                      | 980                                    | 734                                    | −28      | 0.64    |
| North Midwest                                  | 693                                    | 501                                    | −18      | Ref.    |
| South Midwest                                  | 752                                    | 620                                    | −30      | 0.1     |
| Great Lakes                                    | 1077                                   | 758                                    | −30      | 0.72    |
| Northeast                                      | 1142                                   | 810                                    | −25      | 0.8     |
| Mid Atlantic                                    | 815                                    | 603                                    | −29      | 0.77    |
| Southeast                                      | 1157                                   | 808                                    | −26      | 0.64    |
| **DDKT recipients**                            | $N=17,047$                             | $N=17,428$                             | 2        |         |
| Recipient race                                 |                                        |                                        |          |         |
| Black                                           | 5525                                   | 5633                                   | 2        | 0.19    |
| White                                           | 6429                                   | 6779                                   | 5        | Ref.    |
| Hispanic                                       | 3495                                   | 3307                                   | −5       | 0.003   |
| Other                                          | 1598                                   | 1709                                   | 7        | 0.72    |
| Recipient age, yr                              |                                        |                                        |          |         |
| ≤18                                            | 573                                    | 539                                    | −6       | 0.01    |
| 19–30                                          | 932                                    | 1041                                   | 12       | 0.86    |
| 31–44                                          | 2978                                   | 3296                                   | 11       | Ref.    |
| 45–59                                          | 6059                                   | 6007                                   | −0.9     | <0.001  |
| ≥60                                            | 6505                                   | 6545                                   | 0.6      | 0.002   |
| Recipient education level                      |                                        |                                        |          |         |
| College and higher                             | 8520                                   | 8906                                   | 5        | Ref.    |
| Grade/high school                              | 7891                                   | 7730                                   | −2       | 0.003   |
| Unknown                                        | 636                                    | 792                                    | 25       | 0.002   |
| Recipient employment status                    |                                        |                                        |          |         |
| Working                                        | 4387                                   | 4635                                   | 6        | Ref.    |
| Not working/unknown                            | 12,660                                 | 12,793                                 | 1        | 0.07    |
| Primary source of payment                      |                                        |                                        |          |         |
| Private                                        | 3941                                   | 4417                                   | 12       | Ref.    |
| Public                                         | 13,106                                 | 13,011                                 | −0.7     | <0.001  |
| Donor type, deceased (KDPI)                    |                                        |                                        |          |         |
| <20                                            | 3551                                   | 4618                                   | 30       | <0.001  |
| 20–85                                          | 12,141                                 | 11,682                                 | −4       | Ref.    |
| >85                                            | 1355                                   | 1128                                   | −17      | <0.001  |
in the pandemic period included candidate age \( \leq 18 \) or \( \geq 45 \) years, nonworking status, and public insurance. There were also fewer high kidney donor profile index transplants performed during the post-pandemic period.

**Discussion**

Racial disparities in access to LDKT are well known (5) but, despite recognition, have worsened over time. The 2-year cumulative incidence rates of LDKT after waitlisting in 2014 versus 1995 by race and ethnicity were: White, 11% versus 7%; Black, 2.9% versus 3.4%; Hispanic, 6% versus 7%; and Asian, 6% versus 5%, and the relative likelihood of LDKT in Black versus White candidates worsened from 65% lower compared with White patients in 1995–1999 to 73% lower in 2010–2014 (10). Our analysis of a contemporary patient cohort demonstrates that one consequence of the COVID-19 pandemic has been an exacerbation of these long-standing disparities. We observed that LDKT counts among Black patients declined further with the onset of the COVID-19 pandemic compared with LDKT counts among White patients.

The causes of a more pronounced decline in LDKT among Black Americans during the pandemic are likely multifactorial. The pandemic affected regions across the nation at varying time points. As a result, LDKT programs resumed their activities asynchronously, which in turn adversely affected the number of kidney paired donations. Previous reports have found Black patients to be less certain about their preference for kidney transplantation (11). Uncertainty towards pursuit of transplantation might have been intensified during the pandemic, especially for LDKT, which was often regarded as “elective” and possible to delay at the start of the pandemic. The economic impact of the pandemic disproportionately impacted Black families (12), which may have reduced the number of potential Black living donors with adequate financial security to pursue donation because the financial impacts of living donation are a concern among potential donors (13) and transplant candidates. Importantly, financial repercussions of the pandemic are expected to persist after the end of the public health emergency, which may have sustained implications for the trends reported in this study.

The relative decrease in LDKT counts trended higher among Black compared to White patients in all parts of the country except for the South Midwest. For DDKT, only the Northwest, South Midwest and Northeast witnessed a higher drop in transplant counts for Black compared with White patients. Although reasons for regional variation in racial disparities in kidney transplantation are speculative, local and regional COVID-19 surge conditions had, and continue to have, variable effects. Initially, the Northeast (particularly New York City) and some urban cities in the Midwest (particularly Detroit) were affected. Because both donors and recipients are affected by local hospital resources in the context of local surge conditions, it is conceivable that living donor-recipient pairs are differentially impacted by such a surge, especially if hospital resources are reallocated from transplant activities to COVID-19 support and related care. This hypothesis is supported by the lower overall impact of the pandemic on DDKT counts. Furthermore, LDKT is more likely to occur within a year of waitlisting, whereas DDKT typically transpires after years on the waiting list. Given the time required to conduct recipient candidate evaluations for new listings, and donor evaluations prior to LDKT, the observed lag in LDKT is not surprising, particularly in regions where the health care systems were completely overwhelmed—nor is the worsened disparity surprising.

This study has limitations. This was a retrospective, observational study identifying associative rather than causal relationships that is subject to potential unobserved confounding. We sought to examine and quantify reduced use of LDKT among Black patients during the pandemic as a point of fact to stimulate discussions of disparities. It is possible that additional explanatory variables (measured or unmeasured) are colinear with the observed disparities by race, which should be a topic of ongoing study. We examined data from the national transplant registry. Although the SRTR database has many advantages including national capture, it lacks granular information including on social determinants of health.

In summary, the COVID-19 pandemic appears to have exacerbated challenges in access to LDKT for Black patients. Although the current rate of DDKT procedures recovered, LDKT in 2021 continued to lag behind 2019 levels (14), and it is unclear when LDKT rates will recover to

| Table 1. (Continued) |
|----------------------|
| Sub-Group | Transplant Counts from 3/1/19–2/29/20 | Transplant Counts from 3/1/20–2/28/21 | % Change | P Value |
| Location | | | | |
| Northwest | 630 | 645 | 2 | 0.62 |
| Southwest | 2821 | 2856 | 1 | 0.32 |
| North Midwest | 1454 | 1539 | 6 | Ref. |
| South Midwest | 1718 | 1676 | –2 | 0.1 |
| Great Lakes | 2287 | 2458 | 8 | 0.74 |
| Northeast | 2019 | 1888 | –7 | 0.01 |
| Mid Atlantic | 2115 | 2005 | –5 | 0.02 |
| Southeast | 4003 | 4361 | 9 | 0.5 |

Ref. reference; LDKT, living donor kidney transplantation; DDKT, deceased donor kidney transplantation; KDPI, kidney donor profile index.
parity, especially as the pandemic evolves through new surges, and disparities in vaccine acceptance and utilization persist (15). Ongoing attention to transplant disparities during the course and aftermath of the public health emergency is warranted.

Disclosures

T. Alhamad reports consultancy for CareDx, Mallinckrodt, and Veloxis; research funding from Angion, CareDx, Europhines, and Natera; honoraria from CareDx, Sanofi, and Veloxis; an advisory or leadership role for CareDx, Europhines, and QSANT; and participation in a speakers’ bureau for CareDx, Sanofi, and Veloxis. D.A. Axelrod reports consultancy for CareDx and Talaris; ownership interest in CareDx; and service on the NKF policy committee. M. Cooper reports consultancy for CareDx, Natera, and Specialist Direct; honoraria from CareDx; and an advisory or leadership role for the American Foundation for Donation and Transplant, Angion Pharmaceuticals, Donate Life America, International Pancreas and Islet Cell Transplant Association, National Kidney Foundation, National Kidney Registry, Quark Pharmaceuticals, Transplant Genomics, and UNOS. B.E. Hippen reports being employed by Fresenius Medical Care; ownership interest in Interwell Health; prior service on the board of directors for InterWell Health; and currently an (uncompensated) scientific advisory board member of eGenesis Bio. K.L. Lentine reports consultancy for CareDx; participation in a speakers’ bureau for Sanofi; service on the ASN Policy and Advocacy Committee, and the NKF Transplant Advisory Committee; and is chair of the AST Living Donor Community of Practice, and a senior scientist of the SRTR. R.B. Mannon reports consultancy for Scientific Advisory Committee and Verici DX; research funding from Astellas, CareDx, CSL Behring, Mallinckrodt, Quark Pharmaceuticals, Transplant Genomics, and Verici DX; honoraria from CSL Behring, Hansa, Novartis, Sanofi, and Vitaeiris; patents or royalties from Eurofins; an advisory or leadership role with the Steering Committee of Vitaeiris VKTX01 IMAGINE Trial; and is chair of the DSMB, NIDDK/NIH, ASN Policy and Advocacy Committee, Women in Transplantation, on the Program Committee for TTS 2020 and 2022, and is co-chair of the SRTR Review Committee. M. Schnitzler reports consultancy for CareDx and honoraria from OPTUM. N. Singh reports consultancy for CareDx, Mallinckrodt, Natera, Transplant Genomics, and Veloxis Pharmaceutics; research funding from CareDx and Transplant Genomics; honoraria from CareDx, Mallinckrodt, Natera, Transplant Genomics, and Veloxis; and is co-chair of AST KPCOP; and participated in a speakers’ bureau for CareDx, Mallinckrodt, Natera, Transplant Genomics, and Veloxis. J. Snyder reports research funding from Astellas, Atara Biotherapeutics, CSL Behring, Novartis, and Vertex; is a board member of the Organ Donation and Transplantation Alliance and Donate Life America, and on the Clinical Policy Board LifeSource; is associate editor of Transplantation and statistical editor of American Journal of Transplantation; and is director of the Registry of Transplant Recipients (RTR). K.J. Woodside reports consultancy for Laminolate; ownership interest in NephroSite; research funding from Laminate; and an advisory or leadership role for the Gift of Life Michigan-Organ Committee. All remaining authors have nothing to disclose.

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Author Contributions

R. Li was responsible for the formal analysis and visualization; N. Singh, M.A. Schnitzler, R.B. Mannon, M.D. Doshi, K.J. Woodside, B.E. Hippen, D.A. Axelrod, and K.L. Lentine, were responsible for the investigation and the methodology; M.A. Schnitzler, D.A. Axelrod, and K.L. Lentine, were responsible for supervision; K.L. Lentine and M.A. Schnitzler were responsible for project administration and validation; N. Singh and K.L. Lentine wrote the original draft of the manuscript; and all authors reviewed and edited the manuscript, contributed to the study design, data interpretation, and critical editing of the manuscript, and approved and agreed to be accountable for ensuring the accuracy and integrity of the final manuscript.

Data Sharing Statement

SRTR data are publicly available. Anonymized data created for the study are or will be available in a persistent repository upon publication: Aggregated Data, Scientific Registry of Transplant Recipients (SRTR), https://www.srtr.org/about-the-data/the-srtr-database/.

References

1. Zhang X, Melanson TA, Plantinga LC, Basu M, Pastan SO, Mohan S, Howard DH, Hockenberry JM, Garber MD, Patzer RE: Racial/ethnic disparities in waitlisting for deceased donor kidney transplantation 1 year after implementation of the new national kidney allocation system. Am J Transplant 18: 1936–1946, 2018
2. Lentine KL, Smith JM, Hart A, Miller J, Skeans MA, Larkin L, Robinson A, Gauntt K, Israni AK, Hirose R, Snyder JJ: OPTN/SRTR 2020 Annual Data Report: Kidney. Am J Transplant 22 Suppl 2: 21–136, 2022
3. Kuppachi S, Norman SP, Lentine KL, Axelrod DA: Using race to estimate glomerular filtration and its impact in kidney transplantation. Clin Transplant 35: e14136, 2021
4. Schold JD, Mohan S, Huml A, Buccini LD, Sedor JR, Augustine JJ, Poggio ED: Failure to advance access to kidney transplantation over two decades in the United States. J Am Soc Nephrol 32: 913–926, 2021
5. Lentine KL, Mandelbrot D: Addressing disparities in living donor kidney transplantation: A call to action. Clin J Am Soc Nephrol 13: 1909–1911, 2018
6. Lentine KL, Mannon RB, Josephson MA: Practicing with uncertainty: Kidney transplantation during the COVID-19 pandemic. Am J Kidney Dis 77: 777–785, 2021
7. Li MT, King KL, Husain SA, Schold JD, Mohan S: Deceased donor kidneys utilization and discard rates during COVID-19 pandemic in the United States. Kidney Int Rep 6: 2463–2467, 2021
8. Irwin MD, Amanuel Y, Bickers B, Nguyen MA, Russell OW: Impacts of the COVID-19 pandemic on preexisting racial and ethnic disparities, and results of an integrated safety net response in Arlington County, Virginia. Health Secur 19: S62–S71, 2021
9. United Network for Organ Sharing (UNOS). COVID-19 and solid organ transplant. Available at: https://unos.org/covid/. Accessed March 7, 2022
10. Purnell TS, Luo X, Cooper LA, Massie AB, Kucirka LM, Henderson ML, Gordon EJ, Crews DC, Boulware LE, Segev DL: Association of race and ethnicity with live donor kidney transplantation in the United States from 1995 to 2014. JAMA 319: 49–61, 2018
11. Ayanian JZ, Cleary PD, Weissman JS, Epstein AM: The effect of patients’ preferences on racial differences in access to renal transplantation. N Engl J Med 341: 1661–1669, 1999
12. Edwards K, Lopez MH: Black Americans Say Coronavirus Has Hit Hard Financially, but Impact Varies by Education Level Age. Available at: https://www.pewresearch.org/fact-tank/2021/05/12/black-americans-say-coronavirus-has-hit-hardfinancially-but-impact-varies-by-education-level-age/. Accessed March 7, 2022
13. Zaidi H, Klassen AC, Fleetwood J et al. Living Organ Donor Health Care Priorities During the COVID-19 Pandemic. Kidney Int Rep 6:1151-1155, 2021
14. Organ Procurement and Transplantation Network (OPTN): Transplants by Donor Type. Available at: https://optn.transplant.hrsa.gov/data/view-data-reports/national-data/. Accessed March 7, 2022
15. Berger M: Omicron Could Derail Efforts to Reverse Vaccine Inequality and End the Pandemic, Experts Warn. Available at: https://www.washingtonpost.com/world/2021/12/23/omicron-coronavirus-vaccine-inequality/. Accessed March 7, 2022

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