

Changes in Liver Transplant Center Practice in Response to Coronavirus Disease 2019: Unmasking Dramatic Center-Level Variability

TO THE EDITOR:

The coronavirus disease 19 (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has been devastating to health care delivery in many parts of the United States and has had a significant impact on organ transplantation. With shelter-in-place orders, outpatient clinics transitioning to telemedicine, and the threat of hospitals being overrun with COVID-19 patients, liver transplant programs have been faced with the challenge of balancing patient and staff safety while operating in a resource-limited environment.

The transplant community has debated the ethical pillars of access to transplant in this setting, with some contending that there may be a significant risk of waitlist mortality among certain patients and, therefore, arguing for proceeding with transplant despite warnings.⁽¹⁾ Conversely, in areas with the highest prevalence

of SARS-CoV-2, there have been concerns about a lack of access to critical resources (eg, intensive care unit [ICU] beds and blood products), risks of perioperative transmission, and logistics of organ procurement. Several societies have authored position papers and guidance documents framing how programs could approach these difficult decisions.⁽²⁻⁵⁾ However, no federal regulations have been instituted to enforce changes to current policies. As a result, there may be variability in how individual programs have changed practices, even within the same region. We therefore sought to examine regional- and center-level changes in adult deceased donor liver transplantation (DDLT) volume in the month before (February 2020) and after (March 2020) the inception of the US COVID-19 epidemic.

We evaluated center and region reports for donors and recipients each month of 2020 from the publicly available Organ Procurement and Transplantation/United Network for Organ Sharing (UNOS) Web site (<https://optn.transplant.hrsa.gov/data/>). Data for 2019 were obtained from a Standard Transplant Analysis and Research file. Because of the institution of the Acuity Circles policy on February 4, 2020, we included 2019 data to assure changes observed from February to March in each year were not a result of allocation policy change. We performed a series of analyses:

1. Evaluated the correlation between region-level changes in deceased donors (procurement region) and adult DDLTs from February to March using Pearson correlation coefficients.
2. Compared relative region-level changes in donors versus recipients from February to March in each calendar year (to determine whether the magnitude of change in donors and recipients within a region was similar in 2019 and 2020).
3. Evaluated center-level changes in adult DDLT volume from February to March in 2019 and 2020.

Abbreviations: COVID-19, coronavirus disease 2019; DDLT, deceased donor liver transplantation; ICU, intensive care unit; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; UNOS, United Network for Organ Sharing.

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In 2019, a 21.3% increase in deceased donors from February ($n = 855$) to March ($n = 1037$) resulted in a 21% increase in DDLT nationally (from 600 to 726, respectively), with a very strong positive correlation ($r = 0.93$) between the change in the number of deceased donors procured in a region and the number of adult DDLTs performed in that region (Fig. 1A). Conversely, in 2020, an 11% decrease in deceased donors from February ($n = 1083$) to March ($n = 964$) resulted in a 24.7% decrease in adult DDLTs nationally (from 738 to 556, respectively), with a weak correlation at the regional level ($r = 0.43$; Fig. 1B). The pattern and magnitude of region-level changes in DDLTs relative to deceased donors were not the same in 2019 and 2020 (Fig. 1C). Regions 2 and 9 performed more DDLTs in March of 2019 and 2020 relative to the change in deceased donors, while regions 3, 4, and 5 performed fewer DDLTs than expected; and the magnitude of this change was similar in 2019 and 2020. In contrast, although regions 1, 8, and 10 had fewer DDLTs from February to March in 2019, their decrease in DDLTs relative to donors was much more pronounced in 2020 (-8 to -13 , -5 to -15 , and -9 to -35 , respectively). Finally, although regions 7 and 11 had fewer DDLTs than expected given the change in donors from February to March in 2019, there was significantly more DDLTs than expected in 2020 (-6 to $+9$, -3 to $+9$, respectively).

Center-level changes in DDLT volume from February to March revealed a significant increase in intraregional variability in 2020, evidenced by a wider interquartile range and overall range in 8 of 11 UNOS regions (Fig. 1D; data on 113 transplant centers in Fig. 1E). When examining the center-level changes in the number of DDLTs from February to March year to year, 69 of the 113 (61%) centers nationally had a difference of ≤ 5 between 2019 and 2020 (eg, a center performing 2 fewer DDLTs from February to March 2019 and 2 more DDLTs from February to March 2020 would have an absolute difference of 4 between 2019 and 2020). A total of 44 (38.9%) centers had a difference of ≥ 6 between 2019 and 2020, of which 32 (72.7%) had a decrease in DDLT volume from February to March in 2020 but no decrease in 2019 (blue box in Fig. 1E), whereas the other 12 (27.3%) had an increase from February to March 2020, of which 10 had a decrease during the corresponding period in 2019. The wide within-region variability in center practice was seen in both regions with high rates (eg, region 9, New York

and low rates (eg, region 4, Texas and Oklahoma) of COVID-19 based on the number of confirmed cases. Most notably, in region 9, the state with the highest COVID-19 burden in the United States, the center-level changes in adult DDLT volume from February to March in 2020 ranged from -7 to $+9$, with 1 center performing 18 adult DDLTs in March of 2020.

Regional and center-level variability in LT practice patterns, although not new, has predictably been influenced by knowable factors impacting organ availability, allocation, and recipient and donor selection. However, the unmitigated strain precipitated by COVID-19 could not have been anticipated. Its full impact on our vulnerable transplant population, although undoubtedly grave, is yet wholly unknown. With this report, we take a first look into the early impact of COVID-19 on availability of organs and on regional and center transplant volume.

The negative impact of COVID-19 on our LT practice has been unequivocal, as reflected in the significant decrease in the number of deceased donors and DDLTs from February to March 2020 in contrast to a comparative increase in both during the same 1-month period in 2019. Although changes in regional donors were highly correlated to the number of DDLTs in 2019, there was poor correlation in 2020. This lack of correlation in 2020 is unlikely to be due to the recent change in allocation policy because the February to March comparisons in 2019 and 2020 operated under the same allocation rules in each year.

A detailed analysis of center-level changes in DDLT volume reveals a much greater variability in 2020 within the same region, assuming that centers in the same region have an ostensibly similar prevalence of COVID-19. This unpredictable chaos in center behavior is perhaps best highlighted looking at center-specific changes in volume. Even using a high threshold (≥ 6) of what may be considered a significant change in practice between 2019 and 2020, nearly 40% of the transplant centers displayed a February to March change in DDLT volume in 2020 that was opposite to their 2019 behavior. Perhaps more interesting was that 10 of the 12 centers with a significant increase in DDLT volume in the COVID-19 era had a decrease in DDLT volume from February to March of 2019. This phenomenon cannot be explained by the local COVID-19 prevalence because each of these centers had neighboring programs that significantly decreased their DDLT volume.

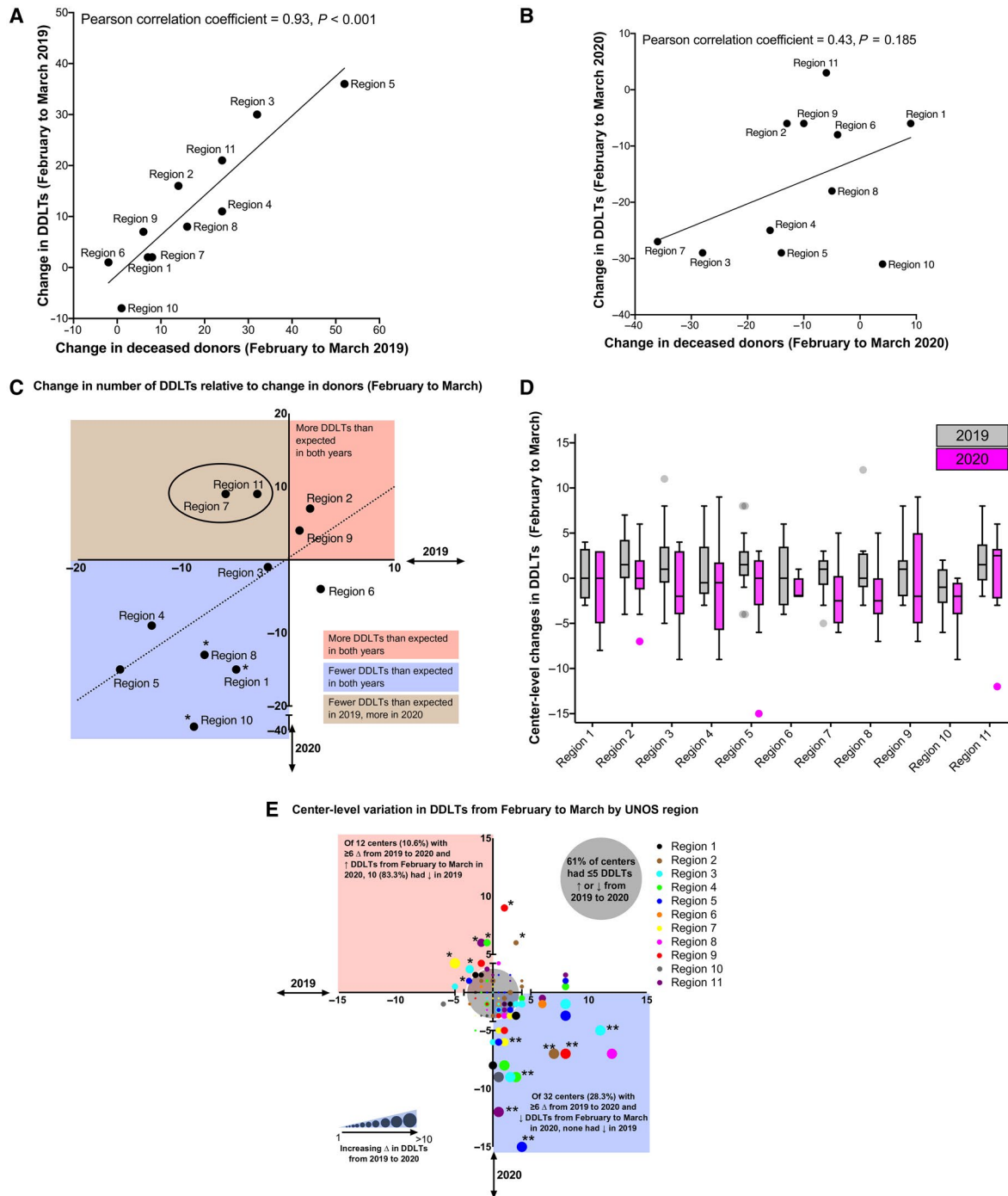


FIG. 1. (A) A scatterplot of the correlation of change in deceased donors and the corresponding change in DDLTs across UNOS regions from February to March 2019. (B) A scatterplot of the correlation of change in deceased donors and the corresponding change in DDLTs across UNOS regions from February to March 2020. (C) The change in the number of DDLTs relative to the change in deceased donors over a 1-month period from February to March 2019 versus 2020. Zero indicates a perfect 1:1 correlation; positive numbers indicate more DDLTs than expected for a given change in donors, and negative numbers indicate fewer transplants than expected for given change in donors. *Regions with fewer DDLTs than expected in 2019, but to a far greater degree in 2020. **Regions with fewer DDLTs than expected in 2019, more in 2020. (D) Box and whisker plot of center-level changes in DDLT volume from February to March 2019 versus 2020, stratified by UNOS region. (E) Intraregional and interregional center-level variation in the change in DDLTs from February to March 2019 versus 2020. Asterisks are limited to regions with at least 1 center with an increase in DDLT volume from February to March 2020 and at least 1 center with a decrease in DDLT volume. *A center with a significant increase in DDLT volume from February to March 2020. **A center with a significant decrease in DDLT volume.

Although COVID-19 has had a profound impact on liver transplantation, it has not been restricted to areas with the highest COVID-19 burden. Furthermore, center-level practices have differed dramatically in the same geographic area, including those hit hardest by COVID-19 (eg, New York). The variability in center behavior cannot be attributed to changes in donor organs, allocation policy, or even the local prevalence of COVID-19. Although hospitals differ in their baseline ICU capacity and their daily ICU census, data suggest that baseline ICU capacity was not associated with adult DDLT volume in March 2020 in the New York City metropolitan area, which is the area hardest hit by COVID-19 (Pearson correlation coefficient: -0.31 evaluating baseline hospital ICU bed capacity and March 2020 adult DDLT volume). Additionally, widely disparate center-level behaviors in the same metropolitan areas (eg, New York and Los Angeles) suggest that distance between donor hospitals and centers would not explain our results. The differences across centers more likely reflect the different allocation and prioritization of hospital resources for COVID-19 relative to liver transplantation, center capabilities to rapidly test and rule out COVID-19 in recipients, and concerns with respect to donors (ie, accuracy of donor COVID-19 testing), recipients (eg, impact of COVID-19 in immunosuppressed transplant recipients), and transplant team members (ie, risks of hospital-acquired COVID-19). Additionally, although data on expedited organ placements are not available, differences in center aggressiveness in accepting organ offers, including those turned down by other centers, likely contributed to differences in center volumes. These numerous factors collectively influence the individual transplant program's perception of risk that drives variable behavior. It is impossible to know which approach is correct. Further data on wait-list outcomes, posttransplant incidence of COVID-19 infection, and survival outcomes in our LT recipients

will undoubtedly help inform practical guidance and restore some order to this chaos.

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