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Trends in US Heart Transplant Waitlist Activity and Volume During the Coronavirus Disease 2019 (COVID-19) Pandemic

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IMPORTANCE Solid organ transplants have declined significantly during the coronavirus disease (COVID-19) pandemic in the US. Limited data exist regarding changes in heart transplant (HT).

OBJECTIVE To describe national and regional trends in waitlist inactivations, waitlist additions, donor recovery, and HT volume during COVID-19.

DESIGN, SETTING, AND PARTICIPANTS This descriptive cross-sectional study used publicly available data from the United Network for Organ Sharing and US Centers for Disease Control and Prevention, using 8 prespecified United Network for Organ Sharing regions. Adult (18 years or older) HT candidates listed and deceased donors recovered between January 19 to May 9, 2020.

EXPOSURES COVID-19 pandemic.

MAIN OUTCOMES AND MEASURES Changes in waitlist inactivations, waitlist additions, deceased donor recovery, and transplant volumes from the pre–COVID-19 (January 19-March 15, 2020) to the COVID-19 era (March 15-May 9, 2020). Density mapping and linear regression with interrupted time series analysis were used to characterize changes over time and changes by region.

RESULTS During the COVID-19 era, there were 600 waitlist inactivations compared with 343 during the pre-COVID era (75% increase). Waitlist additions decreased from 637 to 395 (37% reduction). These changes were most profound in the Northeast and Great Lakes regions with high rates of COVID-19. Deceased donor recovery decreased by 26% from 1878 to 1395; the most significant decrease occurred in the North Midwest despite low COVID-19 prevalence. Heart transplant volumes were significantly reduced across all regions except the Northwest. The largest decrease was seen in the Northeast where COVID-19 case rates were highest. From the pre–COVID-19 era to the COVID-19 era, there was significant regional variation in waitlist additions (eg, 69% decrease in the Northeast vs 8.5% increase in the South Midwest; $P < .001$) and deceased donor recovery (eg, 41% decrease in North Midwest vs 16% decrease in South Midwest; $P = .02$).

CONCLUSIONS AND RELEVANCE Heart transplant volumes have been significantly reduced in recent months, even in regions with a lower prevalence of COVID-19 cases. This has been accompanied by increased waitlist inactivations, decreased waitlist additions, and decreased donor recovery. Future studies are needed to determine if the COVID-19 pandemic is associated with changes in waitlist mortality.

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Supplemental content

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The coronavirus disease 2019 (COVID-19) pandemic has had ramifications for the solid organ transplant community.[1] Many centers in the United States (US) deactivated patients on transplant waiting lists, reserving active status for the patients with the greatest illness severity with high waitlist mortality.[1] Transplant programs have been challenged with balancing patient and staff safety with hospital resources, including intensive care unit capacity and personnel.[2] In the US, there has been a substantial reduction in deceased donor solid organ transplants since the COVID-19 pandemic started.[3] However, to our knowledge, limited data exist regarding national and regional changes in heart transplant (HT) practices during this time. The purpose of this study was to examine trends in adult HT waitlists and volumes in the US during the COVID-19 pandemic.

Key Points

Question How have heart transplant listings and volumes in the US changed during the coronavirus disease 2019 (COVID-19) pandemic?

Findings In this cross-sectional analysis of heart transplant data from the United Network for Organ Sharing and the US Centers for Disease Control and Prevention, compared with the pre–COVID-19 era, the total number of waitlist inactivations has increased while new waitlist additions, deceased donor recoveries, and heart transplants have decreased across the US. During the COVID-19 era, there was significant regional variation in these practices.

Meaning Further studies are needed to determine the long-term associations between these trends and waitlist and posttransplant outcomes.

Methods

Publicly available data from the United Network for Organ Sharing (UNOS) were used. Analysis was restricted to adult (18 years or older) HT candidates. The numbers of waitlist inactivations, waitlist additions, and HT performed from January 1 to May 9, 2020, were collected in addition to deceased donor recovery data for all organs. Data were presented for 8 prespecified UNOS regions introduced in the context of COVID-19: Northwest, North Midwest, Great Lakes, Northeast, Mid-Atlantic, Southwest, South Midwest, and Southeast (eTable in the Supplement).[4] Given that data were publicly available with deidentified information, institutional review board approval and informed consent were not required as per institutional policy.

As of March 15, 2020, UNet (the electronic system managed by UNOS that allows transplant professionals to submit, store, and manage transplant-associated data) users could denote if waitlist inactivations were due to COVID-19 precautions. Therefore, for this analysis, the 8-week period from January 19 to March 15, 2020, was designated the *pre-COVID-19 era* while the 8-week period from March 15 to May 9, 2020, was designated the *COVID-19 era*.

Information regarding COVID-19 case rates was obtained from the US Centers for Disease Control and Prevention as of May 12, 2020. Case rates per 100 000 persons by state were available; these were averaged to determine regional case rates per 100 000. Density maps were produced in R, version 4.0.0 (R Foundation for Statistical Computing) using the open-source package (usmaps). Plots of national waitlist inactivations, waitlist additions, deceased donor recoveries, and transplant volumes were created by calendar week. A linear regression with interrupted time series analysis adjusting for first-order autocorrelation was used to evaluate for significant changes in outcome trends during the COVID-19 era. Cut points for each outcome were selected based on apparent trends in plots. An α threshold of $P < .05$ was used for statistical significance. Regional variation in outcomes was analyzed by testing for an interaction between the region and COVID-19 era. Statistical analyses were performed using Stata, version 15.1/IC (StataCorp).

Results

Waitlist Inactivations

During the study period, 343 waitlist inactivations occurred during the pre-COVID-19 era while 600 occurred in the COVID-19 era, a 75% increase (**Table**). Of the 600, 403 (67%) were reported to be because of COVID-19 precautions. The regions with the highest number of inactivations because of COVID-19 were the Northeast (196 [91%]), Southwest (81 [81%]), and Great Lakes (63 [66%]) (**Figure 1**). There were significant changes in national waitlist inactivations between weeks 1 and 8, 8 and 10, 10 and 13, and 13 and 16 (eg, β for weeks 8-10 is equal to 51 inactivations per week; β for weeks 10-13 is equal to −61.0 inactivations per week; $P < .001$; **Figure 2**A). From weeks 8 to 10, the number of waitlist inactivations per week increased by a mean of 51.0 (95% CI, 51.0-51.0; $P < .001$). From weeks 10 to 13, the number of waitlist inactivations decreased by a mean 67.5 per week (95% CI,−107.09 to −27.91; $P = .004$).

Waitlist Additions

During the COVID-19 era, 395 individuals were added to the HT waiting list, a 38% decrease from the prior 8-week period. Significant changes in national waitlist additions occurred between weeks 1 and 8, 8 and 12, and 12 and 16 (eg, β for weeks 8-12 is equal to −11 additions per week; β for weeks 12-16 is equal to 0.5 additions; $P = .04$; Figure 2B), with significant regional variation ($P < .001$; Table). From weeks 8 to 12, the number of waitlist additions per week decreased by a mean of 11.1 (95% CI, −14.92 to −7.28; $P < .001$). All regions except the South, Midwest, and Northwest had fewer waitlist additions, with the most dramatic decreases occurring in the Northeast (101 additions in the pre-COVID-19 era vs 31 during the COVID-19 era [69% decrease]), Great Lakes (110 additions in the pre-COVID-19 era vs 53 during the COVID-19 era [52% decrease]), and Southwest (95 additions in the pre-COVID-19 era vs 56 during the COVID-19 era [42% decrease]). Meanwhile, in the South Midwest, waitlist additions increased from 47 to 51 (8.5%).

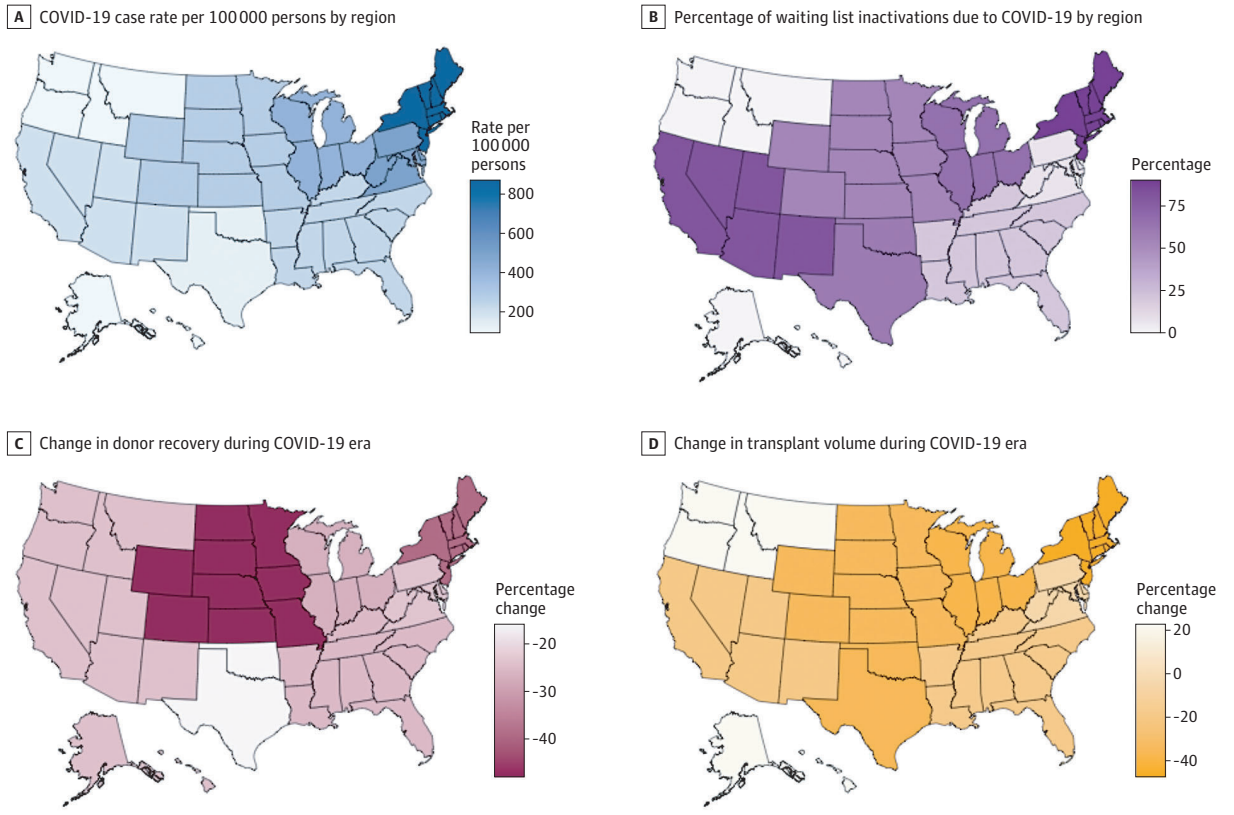
Table. COVID-19 Case Rate, Waitlist Inactivations, Waitlist Additions, Donor Recovery, and Transplant Volume by Region

Region	COVID case rate per 100 000 people	Waitlist inactivations			Waitlist inactivations because of COVID-19, No. (%)	Waitlist additions[a]			Donor recovery			Transplant volume		
		Pre-COVID-19	COVID-19	%Δ		Pre-COVID-19	COVID	%Δ	Pre-COVID-19	COVID-19	%Δ	Pre-COVID-19	COVID-19	%Δ
Northwest	95	15	11	−27	0 (0)	14	14	0	77	61	−21	9	11	22
North Midwest	281	21	41	95	22 (54)	50	28	−44	181	107	−41	38	25	−34
Great Lakes	414	70	95	36	63 (66)	110	53	−52	285	210	−26	84	52	−38
Northeast	868	46	216	370	196 (91)	101	31	−69	185	112	−39	72	38	−47
Mid-Atlantic	499	33	31	−6	2 (6)	65	57	−12	214	172	−20	58	55	−5
Southwest	196	35	100	186	81 (81)	95	56	−42	313	253	−19	84	68	−19
South Midwest	126	50	45	−10	27 (60)	47	51	8.5	181	152	−16	48	31	−35
Southeast	239	73	60	−17	12 (20)	154	103	−33	442	328	−26	132	109	−17
US	365	343	600	75	403 (67)	637	395	−38	1878	1395	−26	525	389	−26

Abbreviation: COVID-19, coronavirus disease 2019.

[a] Waitlist additions represent a combination of de novo additions and waitlist reactivations.

Figure 1. National and Regional Trends

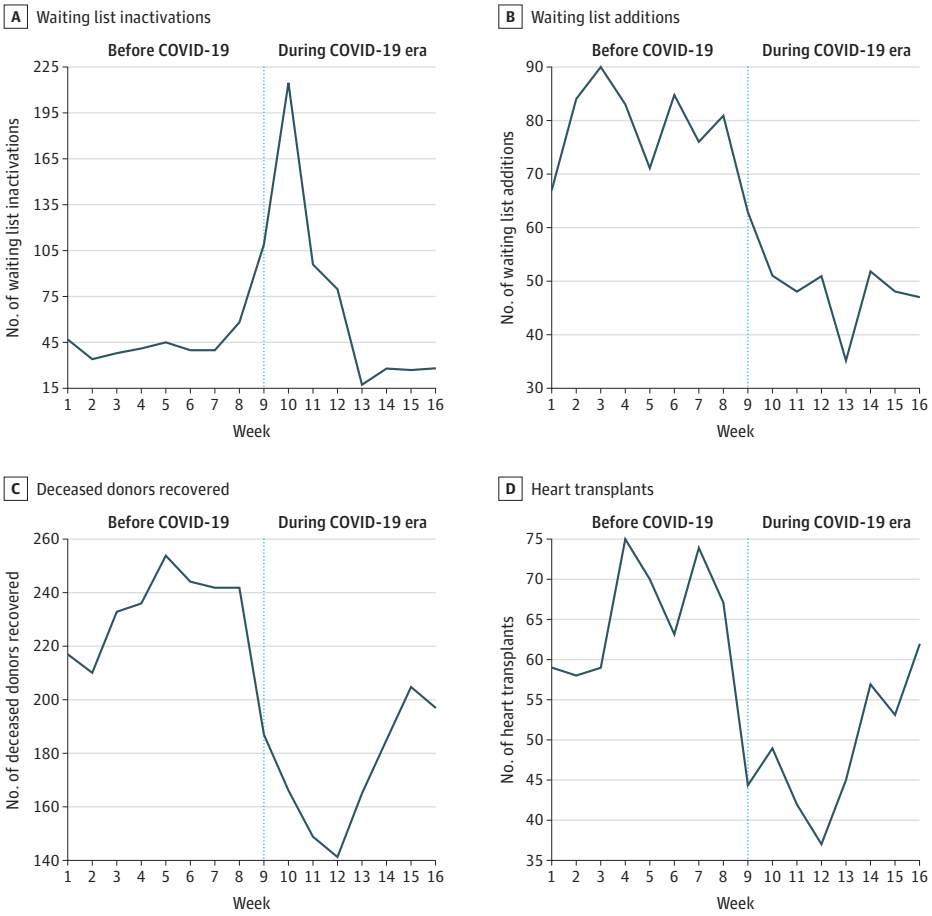


A, Regional variation in coronavirus disease 2019 (COVID-19) case rates. B, Percentage of waitlist inactivations due to COVID-19. Percentage change in deceased donor recovery (C) and heart transplant volume (D) during the COVID-19 era in the US.

Deceased Donor Recovery

Adult deceased donor recovery nationally decreased from 1878 to 1395, a decrease of 26%. This was seen across all regions, even those with a lower prevalence of COVID-19. There was significant regional variation in deceased donors recovered during the COVID-19 era (−41% change in the North Midwest vs −16% in the South Midwest; $P = .02$; Table). Donor recovery was most decreased in the North Midwest, with 181 recovered during the pre–COVID-19 era and 107 recovered during the COVID-19 era, a decrease of 41% (Figure 1C).

Figure 2. National Trends in Waitlist Inactivations and Additions, Deceased Donors Recovered, and Heart Transplants in the US Before and During the Coronavirus Disease 2019 (COVID-19) Pandemic



The blue dashed lines in each panel indicate the transition between the pre–COVID-19 and COVID-19 eras.

There were significant changes in deceased donor recovery between weeks 1 and 8, 8 and 12, and 12 and 16 eg, β for weeks 8 to 12 is equal to −30 donors recovered per week; β for weeks 12 to 16 is equal to 15.2 ($P < .001$; Figure 2C). From weeks 8 to 12, the number of deceased donors recovered per week decreased by a mean of 30.0 (95% CI, −39.90 to −20.10; $P < .001$). From weeks 12 to 16, the number of deceased donors recovered increased by an average of 15.2 per week (95% CI, 8.19-22.22; $P < .001$).

HT Volume

Heart transplant volume decreased by 26% nationally from the pre-COVID-19 era (525 transplants) to the COVID-19 era (389 transplants). Significant changes occurred in national HT volume between weeks 1 and 8, 8 and 12, and 12 and 16 (eg, β for weeks 8-12 is equal to −7 transplants per week; β for weeks 12-16 is equal to 5.8; $P = .01$; Figure 2D). From weeks 8 to 12, the number of HTs performed per week decreased by a mean of 7.0 (95% CI, −12.01 to −1.99; $P = .01$). There was no significant regional variation in transplant volume during the COVID-19 era (−17% change in the Southeast vs −19% in the Southwest; $P = .07$; Table and Figure 1D).

Discussion

In this report, we describe regional and national trends in waitlist activity and HT volume during the COVID-19 pandemic. Our major findings are that (1) there were substantial decreases in waitlist inactivations and additions, (2) donor recovery decreased nationally with significant regional variation, and (3) HT volume was significantly reduced nationally without considerable regional variation.

Waitlist inactivations for HT candidates increased by 75% as a result of COVID-19. These were driven primarily by practice changes in the Northeast and Southwest. These regions also had concurrent decreases in waitlist additions, likely highlighting the delays in elective or nonurgent evaluation due to social distancing policies. Furthermore, the decrease in heart failure hospitalizations during this time[5] could have contributed to fewer urgent HT evaluations.

Deceased donor recovery decreased nationally. Based on weekly trends, the number of recovered donors nadired at the end of March. Contributing factors may include concerns regarding COVID-19–positive donors, lack of access to COVID-19

testing to confirm donor COVID-19 status, decreased intensive care unit capacity for treating brain-dead donors, changes in the rates of unintentional death as a result of social distancing policies, and limitations in the ability of organ procurement teams to operate in the context of COVID-19–associated policies around hospital access and travel.

Across the US, HT volume has been reduced in recent months even in regions with lower COVID-19 case prevalence. This is likely multifactorial, driven by increased waitlist inactivations, decreased waitlist additions, and decreased donor recovery. Reassuringly, waitlist additions, the number of recovered donors, and HT volumes have been increasing since mid April 2020.

Limitations

Limitations to this analysis should be recognized. COVID-19 was present in some communities earlier than March 2020. Therefore, some waitlist inactivations before March 15, 2020, may have been secondary to COVID-19 but were unable to be coded as such in UNet. Nevertheless, we also examined overall trends in inactivations. Donor COVID-19 status was not available for analysis.

Conclusions

The COVID-19 pandemic has had direct and indirect associations with HT in the US. In addition to challenges regarding safety and resource allocation, changes in behaviors and activity as a result of social distancing measures will continually affect the deceased donor pool. Furthermore, we must be prepared for more inactivations and fewer transplants if and when future surges of COVID-19 cases occur. In the coming months, the consequences of these waitlist inactivations and decreased transplant volumes on waitlist mortality must be surveilled.

ARTICLE INFORMATION

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Drs DeFilippis and Sinnenberg contributed equally as co–first authors.
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Conflict of Interest Disclosures: None reported.

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