

OPTN/SRTR 2020 Annual Data Report: COVID

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1 Introduction

On March 13, 2020 a national emergency was declared for the COVID-19 pandemic. In the following months, the pandemic affected every aspect of the healthcare system in the United States, including solid organ transplants. Early in the pandemic, noted trends included increased waiting list mortality among some transplant candidates,¹⁻³ decreased new waiting list additions, increased inactivation among waiting list candidates^{2,4} and, initially, decreased transplants, particularly living donor transplants.³

Between March of 2020 and March of 2021, there were roughly three waves of the pandemic in the United States. The first wave was in March and April of 2020; the second in July and August of 2020; and the third and dramatically largest wave was mid-October of 2020 to mid-February of 2021, ending as vaccination efforts had begun. This chapter presents monthly trends in solid organ transplant system metrics, including listings, transplant rates, offer acceptance rates, waiting list mortality rates, and graft failure rates, from March 13, 2019, one year before the onset of the pandemic, until March 12 2021, one year into the pandemic for the entire United States, as well as by organ procurement organization (OPO) donation service areas (DSA). The Scientific Registry of Transplant Recipients (SRTR) maintains an online app that tracks these metrics, as well as more detailed subgroup and adjusted analyses, at www.srtr.org/tools/covid-19-evaluation.

2 Kidney

The US kidney transplant system had marked responses to the waves of the COVID-19 pandemic. The number of prevalent listings declined from 104,682 candidates on this list the month before the pandemic (February 12 to March 13, 2020) to 99,889 candidates from February 12 to March 13, 2021 (Figure COV 1). The volume of new adult listings dropped by about 900 per month for the first three months of the pandemic, and while the numbers of new monthly adult listings rebounded some after the third month of the pandemic, they have generally remained below those before the pandemic (Figure COV 2).

Both deceased (Figure COV 3) and living donor (Figure COV 4) transplant rates dropped in the first two months of the pandemic, though both rates returned to or even exceeded pre-pandemic levels by the third month of the pandemic. Living donor rates dropped almost to zero in the first two months of the pandemic (Figure COV 4). By May 2020, deceased donor transplant rates even outpaced 2019 rates (Figure COV 3), while living donor transplant rates remained near 2019 levels (Figure COV 4). Thus, the total number of deceased donor kidney transplants in 2020 was greater than that in 2019, though the number of living donor transplants and the combined total number of kidney transplants in 2020 was less than in 2019. The number of deceased donor transplant offers made to adults dropped only in the first month of the pandemic (Figure COV 5), and there was no noticeable change in offer acceptance rates correlating with waves of the pandemic (Figure COV 6).

Adult kidney waiting list mortality rates have mirrored the waves of the pandemic (Figure COV 7). Kidney waiting list mortality rates were sharply higher in the first two months of the pandemic. There was a small second wave in summer 2020 and a large rise in October, November, and December 2020, corresponding to the large winter wave of the pandemic in the United States. Similarly, all-cause graft failure rates at any time posttransplant among adults showed a similar pattern, with a rise in the first two months of the pandemic and a more dramatic rise in winter 2020 (Figure COV 8). The rise in mortality among kidney transplant candidates and recipients during the pandemic may be due directly to deaths from COVID-19 or to delaying for-cause medical care. No data is available to the SRTR/OPTN on COVID-19 diagnoses for kidney candidates and recipients that would allow further quantifying of the direct and indirect effects of the pandemic.

Considered by DSA, the difference in risk-adjusted hazard ratios for kidney waiting list mortality in the year after the onset of the COVID-19 compared with the year before ranged from 0.88 to 1.14 (Figure COV 9); the difference in risk-adjusted kidney transplant rate before and after the onset of COVID 19 ranged from 0.79 to 1.60 (Figure COV 10); the difference in the risk-adjusted all-cause graft failure rate from before to after the onset of COVID 19 was 0.89 to 1.24 (Figure COV 11).

3 Pancreas

The prevalent number of pancreas listings did not change notably during the pandemic (Figure COV 12). The number of new adult pancreas listings (Figure COV 13) and the adult deceased donor transplant rate (Figure COV 14) declined in the first two months of the pandemic but returned near to pre-pandemic levels after the third month, although it varied month to month. Unlike with kidney transplant, the pancreas waiting list mortality rate did not differ noticeably after the pandemic compared with before (Figure COV 15). All-cause posttransplant pancreas graft failure rates were slightly higher during the pandemic as compared to before (Figure COV 16).

Considered by OPO DSA, the difference in risk-adjusted hazard ratios for pancreas waiting list mortality in the year after the onset of the COVID-19 compared with the year before ranged from 0.81 to 1.14 (Figure COV 17). The difference in risk-adjusted pancreas transplant rate from before to after the onset of COVID 19 ranged from 0.72 to 1.62 (Figure COV 18), and the difference in risk-adjusted graft failure rate before and after the onset of COVID-19 ranged from 0.83 to 1.21 (Figure COV 19).

4 Liver

The US liver transplant system did not appear to be substantially impacted by the COVID-19 pandemic. The previously noted downward trend in prevalent listings for liver transplant remained during the pandemic (Figure COV 20), and there was not an ongoing shift in the number of new listings for liver transplant per month after the onset of the pandemic (Figure COV 21).

The deceased donor transplant rate (Figure COV 22) and pediatric living donor transplant rate (Figure COV 23) decreased slightly in the first months of the pandemic, and visually seemed to return and even exceed pre-pandemic levels after the first two months. In 2020, the total number of transplants was stable, because the number of living donor transplants fell despite the rise in number of deceased donor transplants. The number of liver offers increased markedly (Figure COV 24), while the rate of offer acceptance declined substantially (Figure COV 25) around the onset of the pandemic, although the acuity circle policy for liver distribution began just before the pandemic, and it is not possible to attribute changes in offers and offer acceptance to the acuity circle policy nor to the pandemic.

Liver waiting list mortality after onset of the pandemic was similar to that before (Figure COV 26). The all-cause graft failure rate after the start of the pandemic was slightly higher than before the pandemic (Figure COV 27), with a noticeable peak during the winter 2020 wave.

Considered by OPO DSA, the difference in risk-adjusted hazard ratios for liver waiting list mortality before and after the onset of COVID-19 ranged from 0.93 to 1.03 (Figure COV 28). The difference in risk-adjusted liver transplant rate before and after the onset of COVID-19 ranged from 0.65 to 1.61

(Figure COV 29), and the difference in risk-adjusted graft failure rate from before to after the pandemic began ranged from 0.97 to 1.04 (Figure COV 30).

5 Intestine

The numbers of patients receiving or waiting for an intestine transplant were very small, making it difficult to detect any trends related to the pandemic (Figure COV 31 to Figure COV 37), with the exception of a decrease in the number of prevalent pediatric candidates and increase in the number of prevalent adult candidates during the pandemic (Figure COV 31).

6 Heart

The number of prevalent heart transplant listings continued the slight downward trend from prior to the COVID-19 pandemic (Figure COV 38). New adult listings per month declined after the onset of the pandemic but returned to, and remained at, pre-pandemic levels by the second month (Figure COV 39). Similarly, adult and pediatric transplant rates declined in the first month after the onset of the pandemic but then returned to, or were slightly higher than, pre-pandemic levels (Figure COV 40). Neither the number of heart offers (Figure COV 41) nor the rate of offer acceptance (Figure COV 42) showed notable differences after the onset of the pandemic compared with before. Mortality rates on the heart transplant waiting list showed peaks that corresponded to waves of the pandemic, though these rates did not differ substantially from rates seen in some months prior to the pandemic (Figure COV 43). All-cause graft failure rates among adult heart transplant recipients rose during winter 2020, although they had been closer to pre-pandemic levels during the first two waves of the pandemic (Figure COV 44).

Considered by OPO DSA, the difference in risk-adjusted hazard ratios for heart waiting list mortality before and after the pandemic began ranged from 0.97 to 1.06 (Figure COV 45). The difference in risk-adjusted heart transplant rate before and after COVID-19 emerged ranged from 0.69 to 1.46 (Figure COV 46), and the difference in risk-adjusted graft failure rate before and after the onset of COVID-19 ranged from 0.95 to 1.05 (Figure COV 47).

7 Lung

Prevalent lung transplant listings declined during the pandemic (Figure COV 48). Similar to other organs, new listings in the first month of the pandemic declined but recovered after the second month, though generally stayed lower than pre-pandemic levels until early 2021 (Figure COV 49). The decreases in prevalent lung listings may be a result of lower lung listings given COVID-19's impact on respiratory system or of increasing rates of lung transplant during the pandemic relative to before (Figure COV 50). While lung transplants fell in

the first months of the pandemic, they rose and stayed above pre-pandemic levels by the third month.

Lung offers dropped in the first month after the pandemic began (Figure COV 51); while they rebounded some, they remain lower than pre-pandemic levels. Offer acceptance rates were slightly higher after the pandemic than before (Figure COV 52).

Mortality rates on the lung transplant waiting list were not noticeably different during the pandemic from before, although mortality rates were higher during waves of the pandemic (Figure COV 53). All- cause graft failure rates, similarly, stayed near pre-pandemic levels until they rose noticeably in winter 2020 (Figure COV 54).

Considered by OPO DSA, the difference in risk-adjusted hazard ratios for lung waiting list mortality in the year after the onset of COVID-19 relative to the year before ranged from 0.93 to 1.09 (Figure COV 55). The difference in risk-adjusted lung transplant rate from before to after the pandemic began ranged from 0.43 to 2.20 (Figure COV 56), and the difference in risk-adjusted graft failure rate from before to after ranged from 0.92 to 1.09 (Figure COV 57).

8 Deceased Donation

Eligible death referral rates dropped initially but returned to pre-pandemic levels between the first and second wave, decreasing again in winter 2020 (Figure COV 58).

9 Discussion

Early in the pandemic, lack of availability of universal testing impaired the ability of OPOs to adequately inform transplant centers of the COVID-19 status of potential donors, leading to decreases in transplant rates. However, after the early months, rates of transplant generally rose to pre-pandemic levels. For most organs, in fact, deceased donor transplants in 2020 outpaced those of previous years, although living donor transplants appeared to lag, particularly due to almost complete shutdowns of living donor transplant in the first months. Overall, solid organ transplantation appears to be a fairly pandemic-resilient field.

Increased waiting list mortality and graft failure rates corresponding with the pandemic waves were particularly stark among kidney candidates and recipients, although they were also noticeable among many other organs. It is not possible to attribute these increases directly to COVID-19 deaths or delayed for-cause medical care; however, given the correlation with the waves of COVID-19, transplant centers should be aware that either or both of these mechanisms may be operating among their patients.

10 References

- ¹ Miller J, Wey A, Musgrave D, et al. Mortality among solid organ wait-list candidates during COVID-19 in the United States. *Am J Transplant.* 2021;(November 2020):1-7. doi:10.1111/ajt.16550
- ² Boyarsky BJ, Werbel WA, Durand CM, et al. Early national and center-level changes to kidney transplantation in the United States during the COVID-19 epidemic. *Am J Transplant.* 2020;20(11):3131-3139. doi:10.1111/ajt.16167
- ³ Cholankeril G, Podboy A, Alshuwaykh OS, et al. Early impact of COVID-19 on solid organ transplantation in the United States. *Transplantation.* 2020;104(11):2221-2224. doi:10.1097/TP.0000000000003391
- ⁴ Khairallah P, Aggarwal N, Awan AA, et al. The impact of COVID-19 on kidney transplantation and the kidney transplant recipient - one year into the pandemic. *Transpl Int.* Published online 2021:1-10. doi:10.1111/tri.13840

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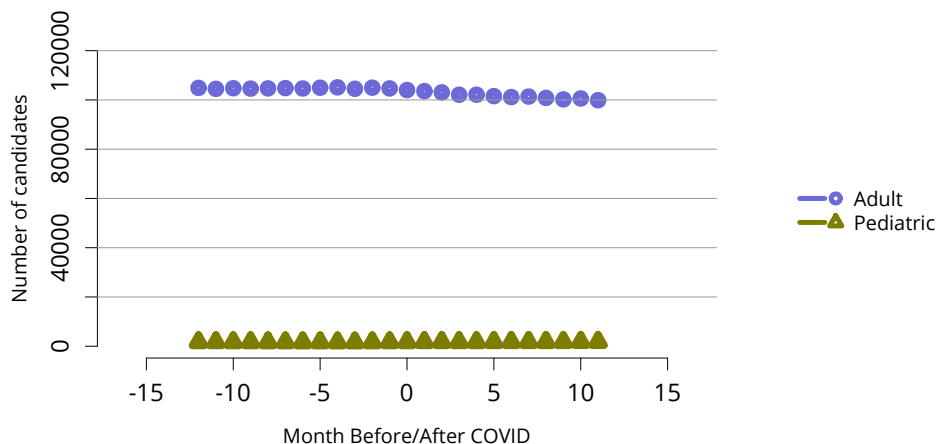


Figure COV 1. Number of prevalent kidney candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Candidates listed at multiple centers are counted once per listing. Includes active and inactive candidates on the list any time during the month.

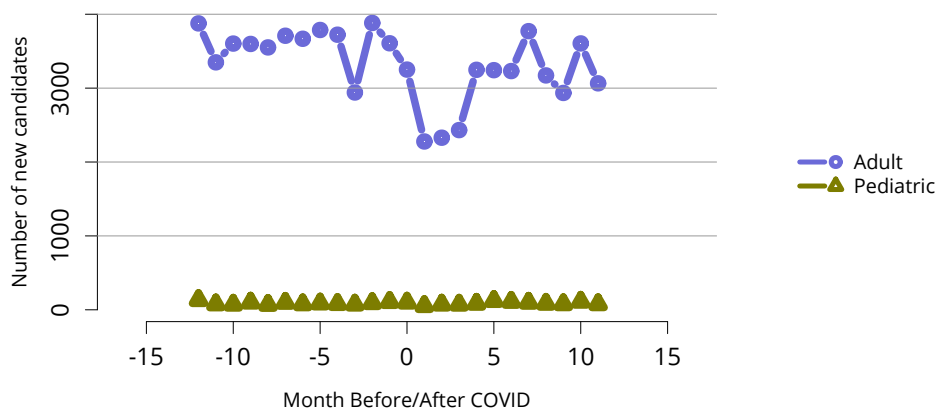


Figure COV 2. Number of new kidney candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. A new candidate is one who first joined the list during the given month, without having been listed in a previous month.

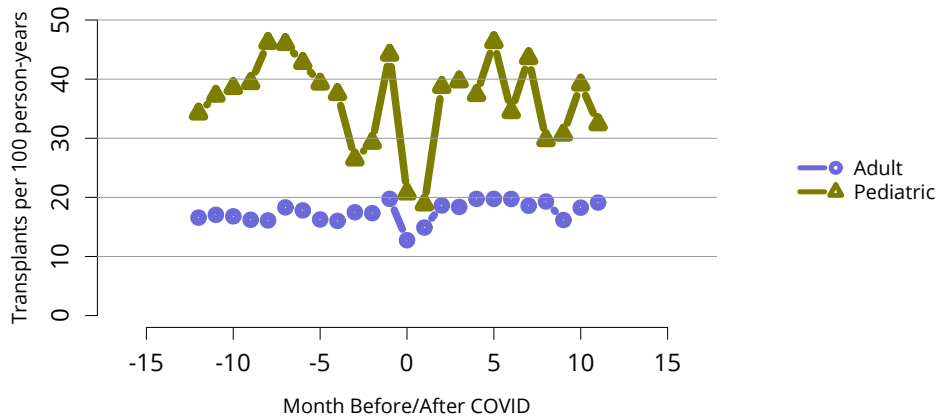


Figure COV 3. Deceased donor kidney transplant rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting in a given month. Individual listings are counted separately.

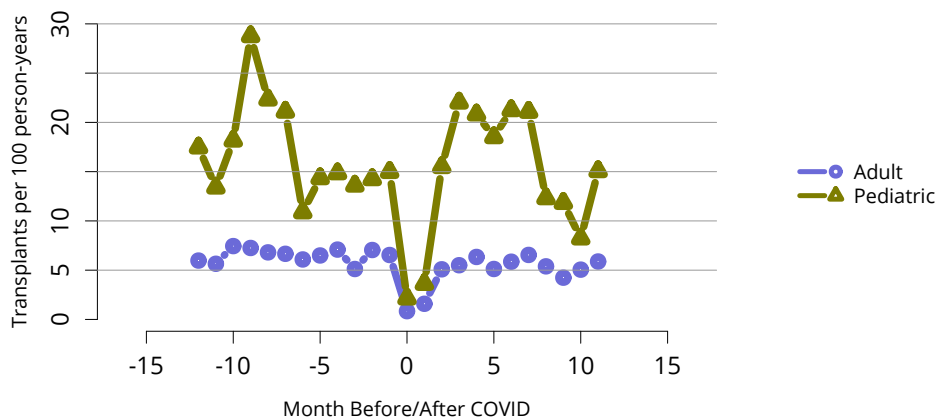


Figure COV 4. Living donor kidney transplant rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Transplant rates are computed as the number of living donor transplants per 100 patient-years of waiting in a given month. Individual listings are counted separately.

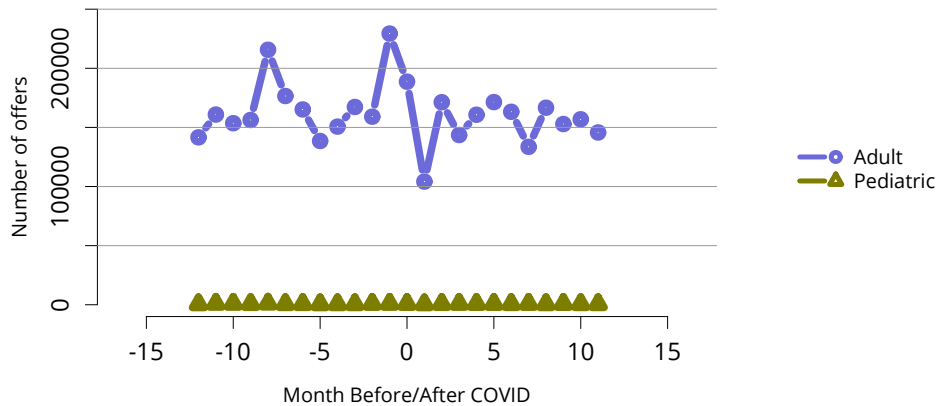


Figure COV 5. Number of kidney offers. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

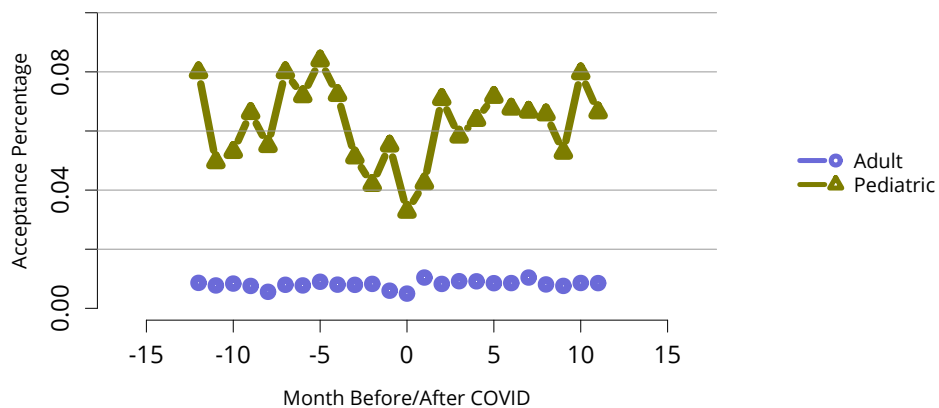


Figure COV 6. Kidney offer acceptance rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

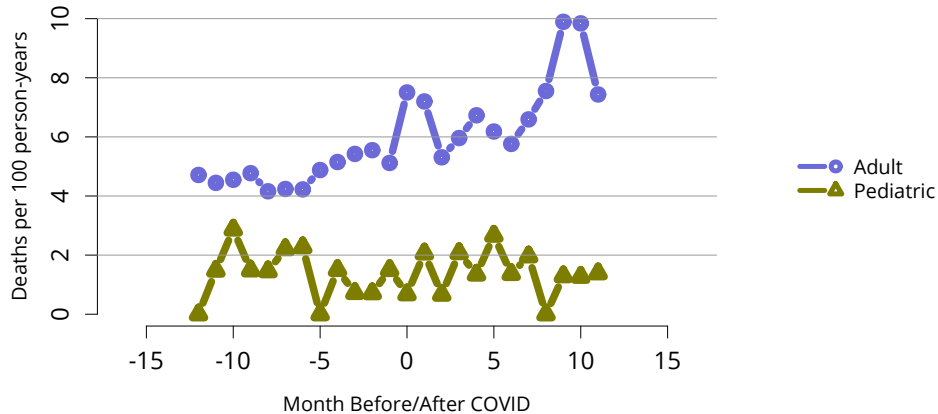


Figure COV 7. Kidney waiting list mortality rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

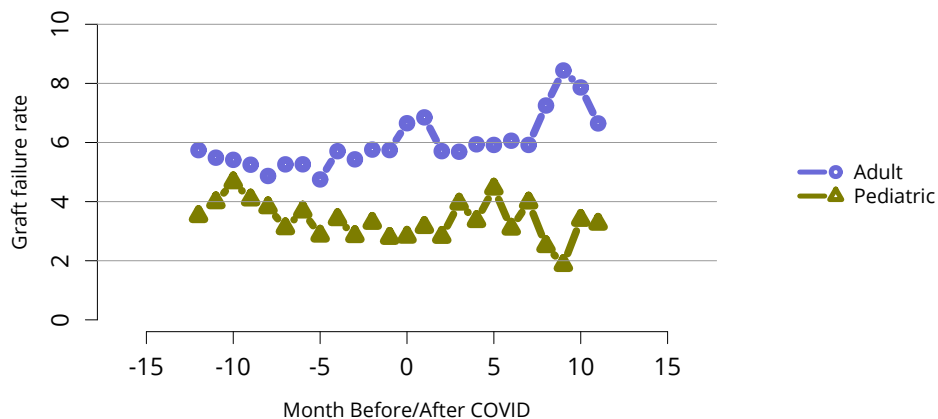


Figure COV 8. Kidney all-cause graft failure. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

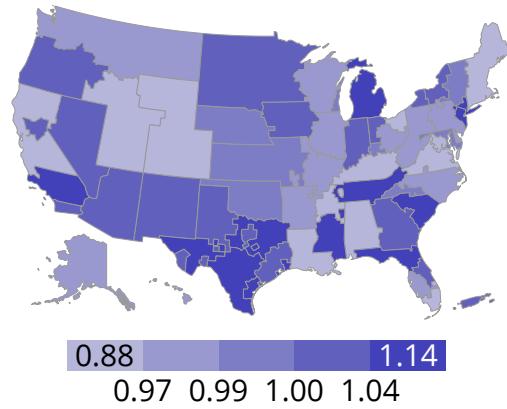


Figure COV 9. Difference in risk adjusted kidney waiting list mortality hazard ratio before to after COVID-19 by OPO. Waiting list mortality hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

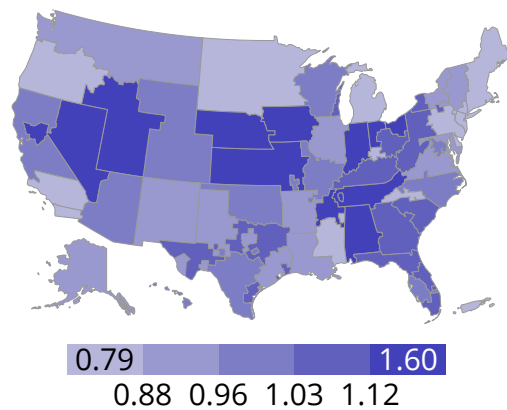


Figure COV 10. Difference in risk adjusted kidney transplant rate before to after COVID-19 by OPO. Transplant rate ratio is the difference in the OPO’s rate ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Individual listings are counted separately.

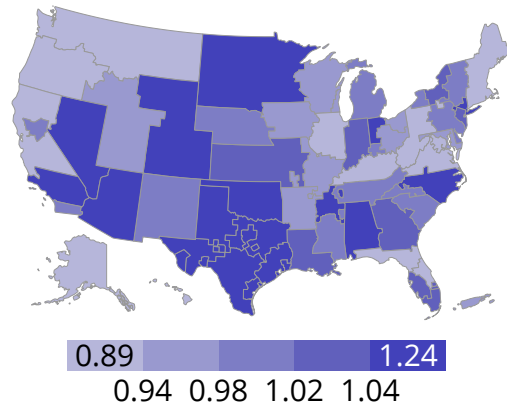


Figure COV 11. Difference in risk adjusted kidney all-cause graft failure hazard ratio before to after COVID-19 by OPO. Graft failure hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic.

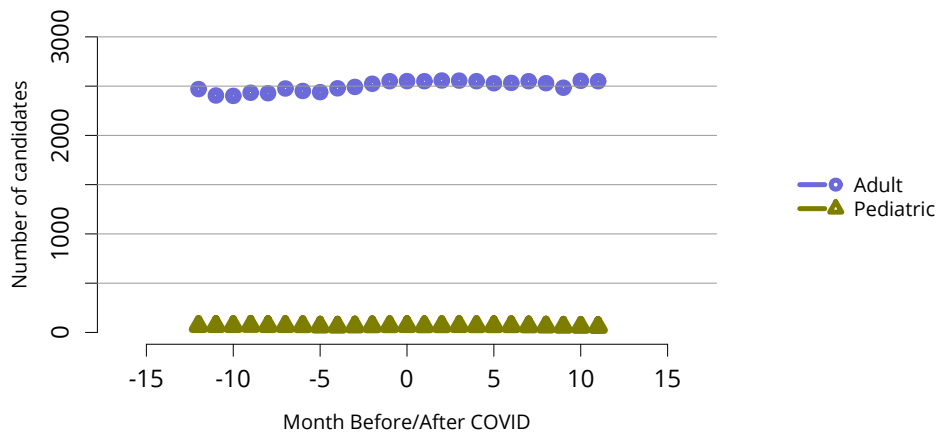


Figure COV 12. Number of prevalent pancreas candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Candidates listed at multiple centers are counted once per listing. Includes active and inactive candidates on the list any time during the month.

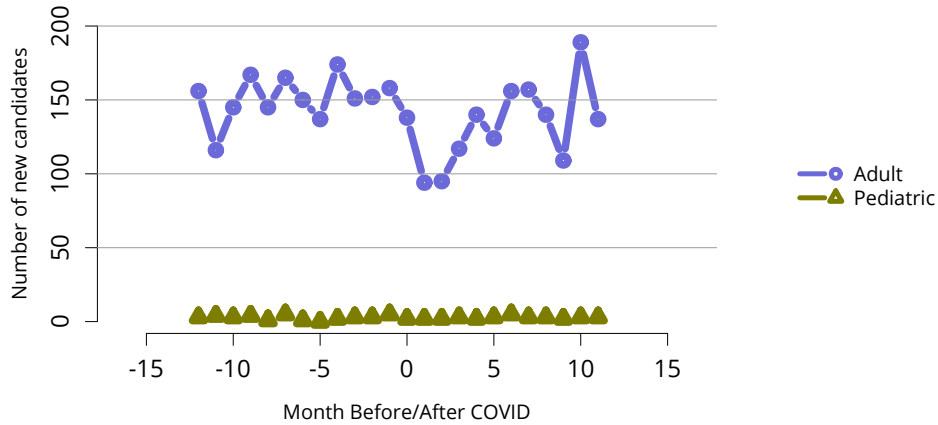


Figure COV 13. Number of new pancreas candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. A new candidate is one who first joined the list during the given month, without having been listed in a previous month.

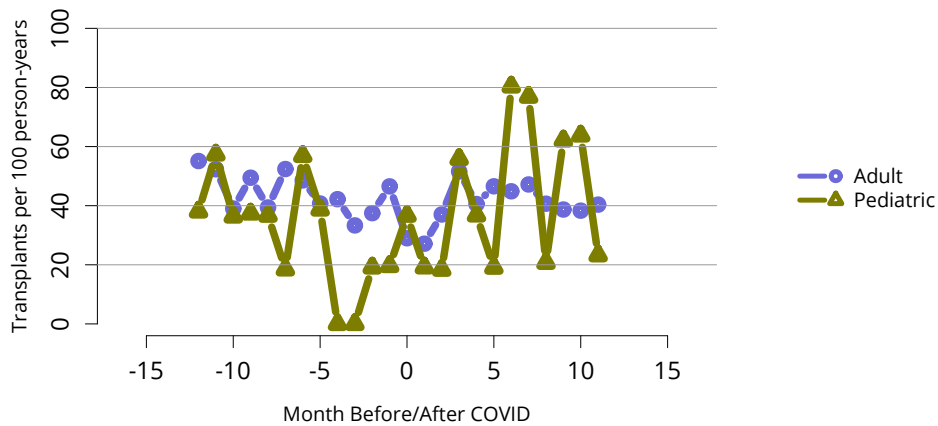


Figure COV 14. Deceased donor pancreas transplant rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting in a given month. Individual listings are counted separately.

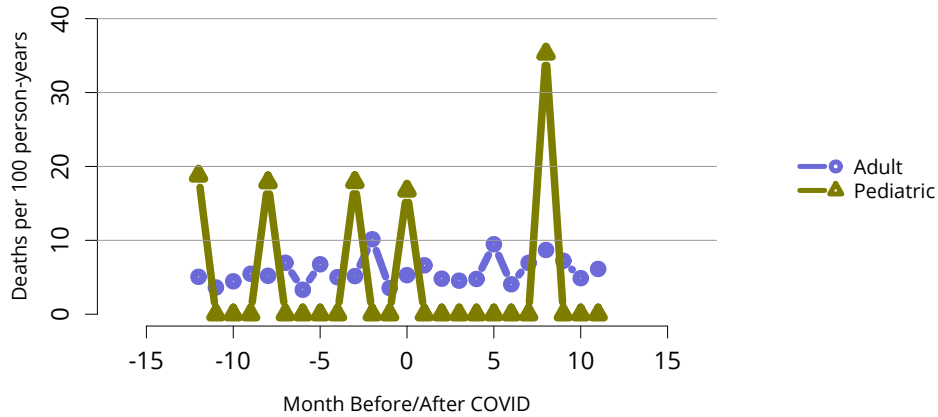


Figure COV 15. Pancreas waiting list mortality rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

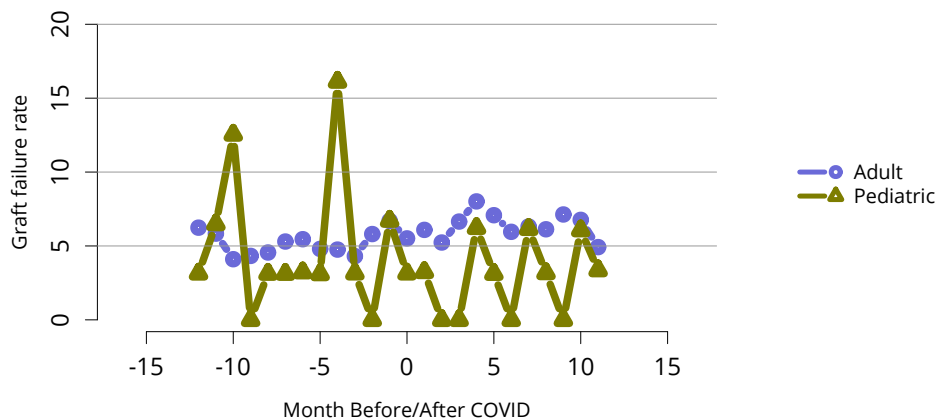


Figure COV 16. Pancreas all-cause graft failure. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

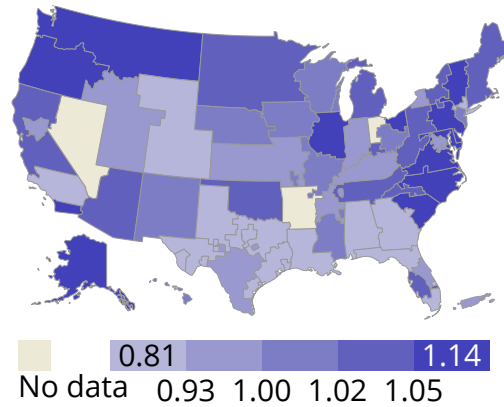


Figure COV 17. Difference in risk adjusted pancreas waiting list mortality hazard ratio before to after COVID-19 by OPO. Waiting list mortality hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

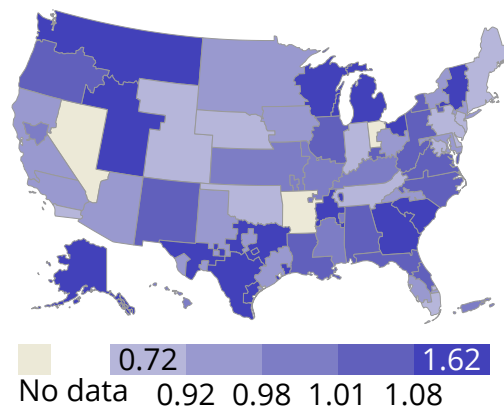


Figure COV 18. Difference in risk adjusted pancreas transplant rate before to after COVID-19 by OPO. Transplant rate ratio is the difference in the OPO’s rate ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Individual listings are counted separately.

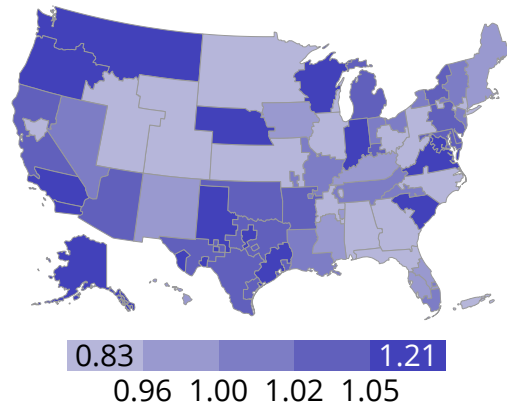


Figure COV 19. Difference in risk adjusted pancreas all-cause graft failure hazard ratio before to after COVID-19 by OPO. Graft failure hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic.

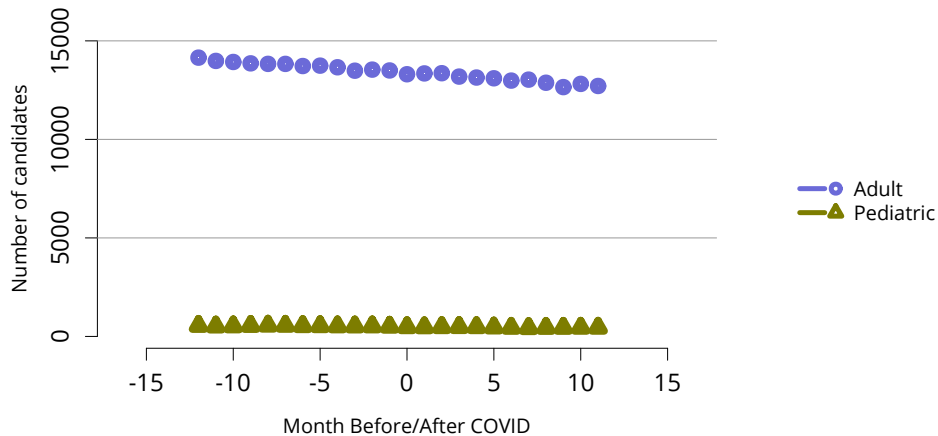


Figure COV 20. Number of prevalent liver candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Candidates listed at multiple centers are counted once per listing. Includes active and inactive candidates on the list any time during the month.

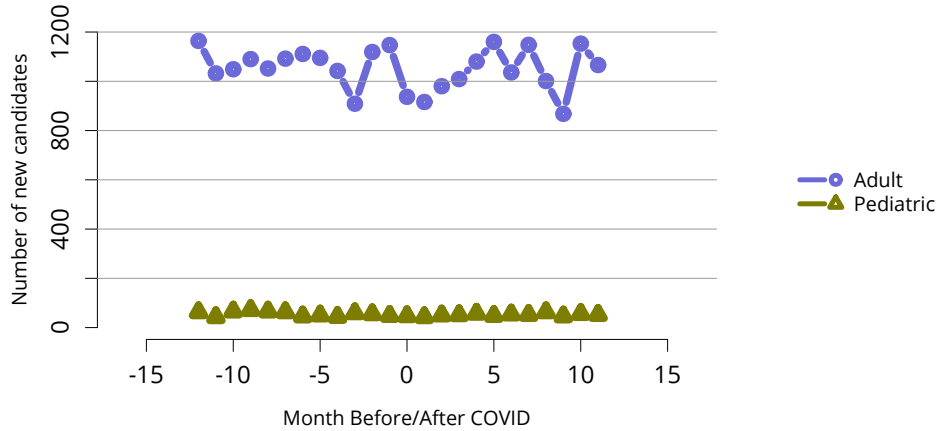


Figure COV 21. Number of new liver candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. A new candidate is one who first joined the list during the given month, without having been listed in a previous month.

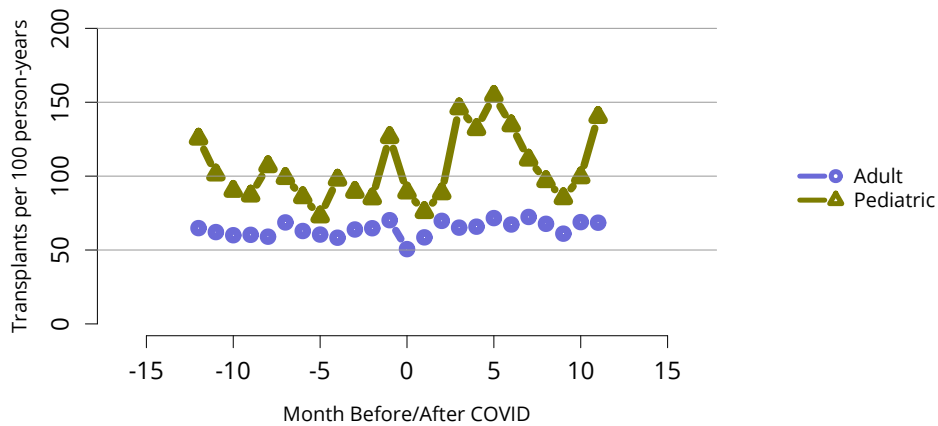


Figure COV 22. Deceased donor liver transplant rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting in a given month. Individual listings are counted separately.

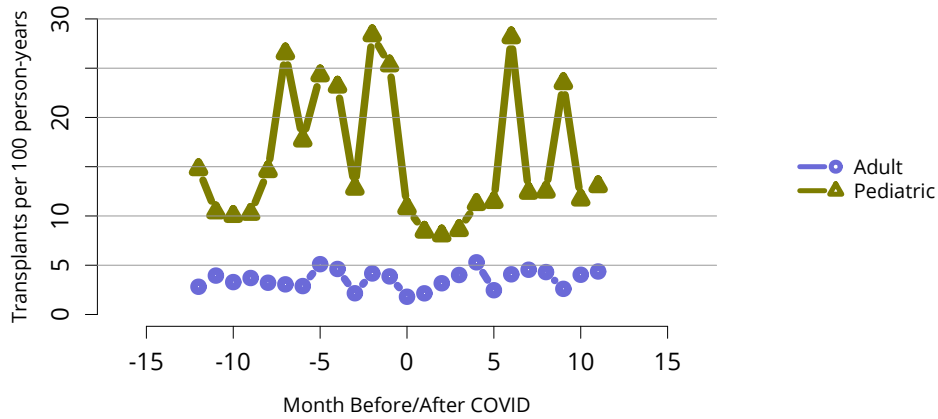


Figure COV 23. Living donor liver transplant rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Transplant rates are computed as the number of living donor transplants per 100 patient-years of waiting in a given month. Individual listings are counted separately.

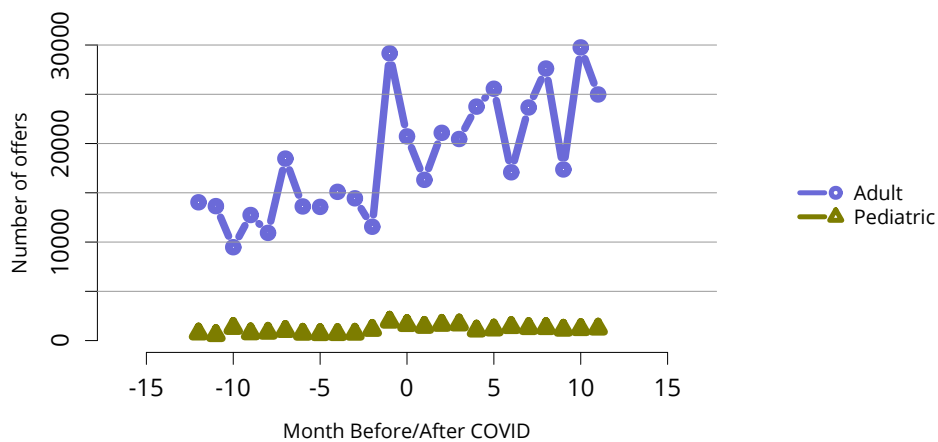


Figure COV 24. Number of liver offers. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

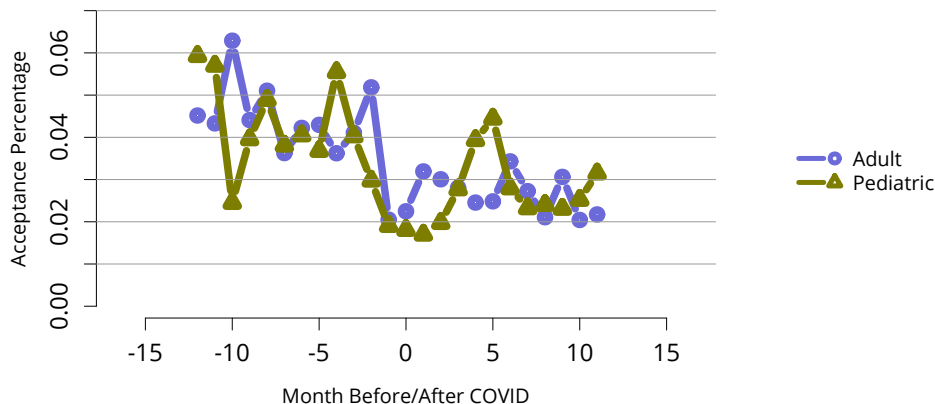


Figure COV 25. Liver offer acceptance rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

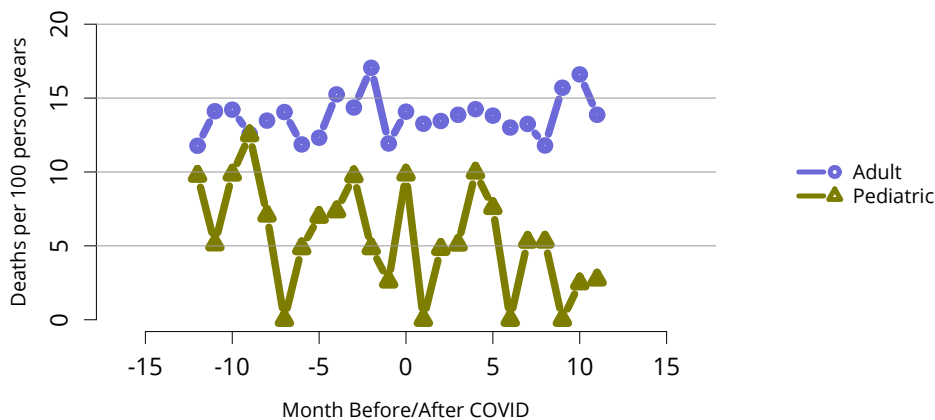


Figure COV 26. Liver waiting list mortality rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

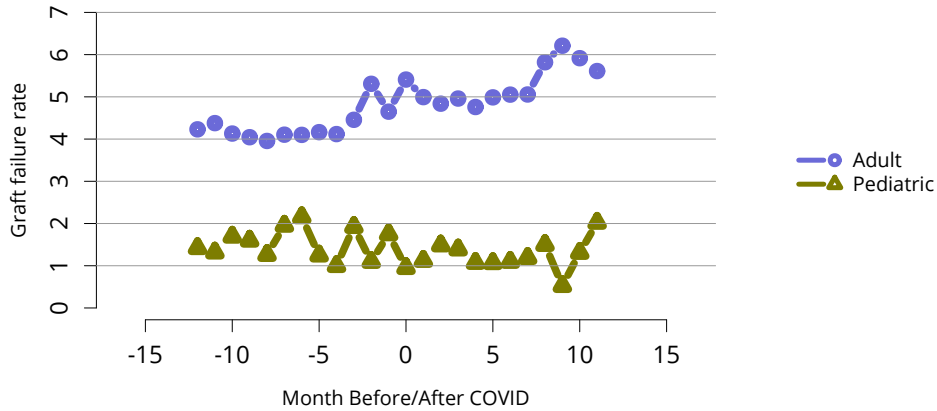


Figure COV 27. Liver all-cause graft failure. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

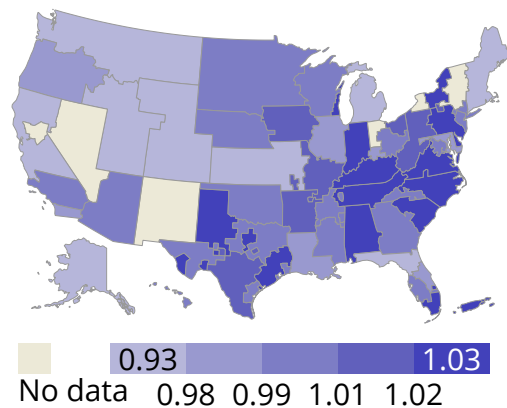


Figure COV 28. Difference in risk adjusted liver waiting list mortality hazard ratio before to after COVID-19 by OPO. Waiting list mortality hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

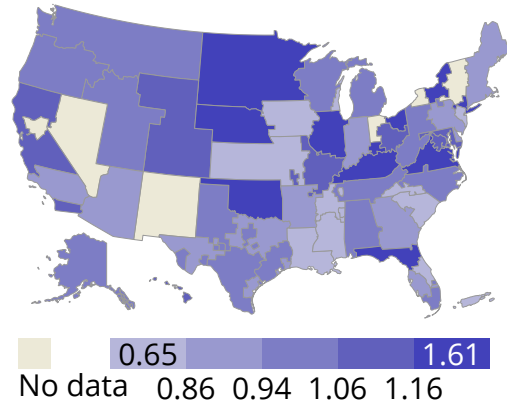


Figure COV 29. Difference in risk adjusted liver transplant rate before to after COVID-19 by OPO. Transplant rate ratio is the difference in the OPO’s rate ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Individual listings are counted separately.

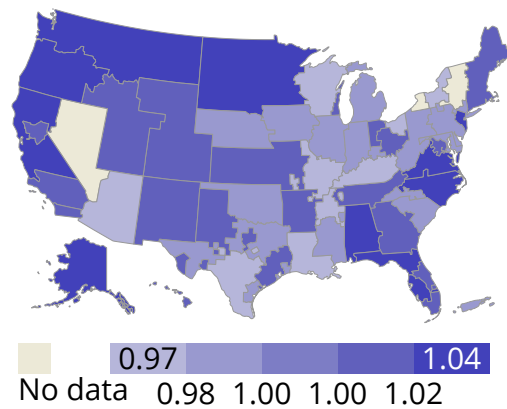


Figure COV 30. Difference in risk adjusted liver all-cause graft failure hazard ratio before to after COVID-19 by OPO. Graft failure hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic.

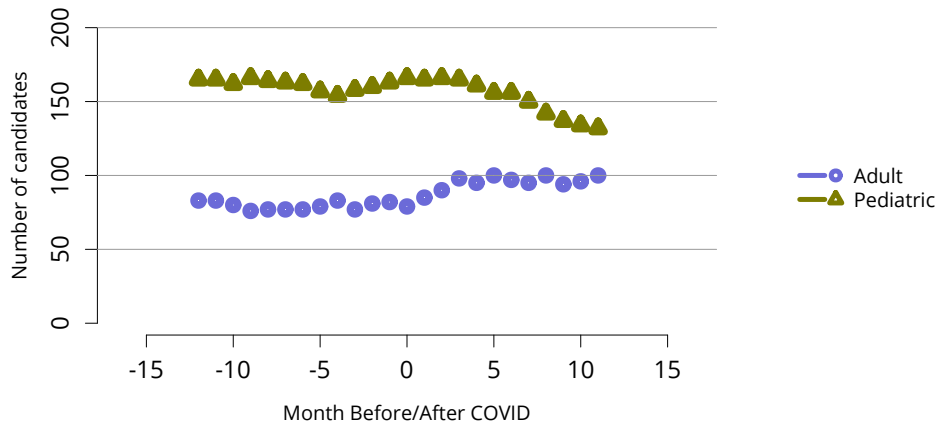


Figure COV 31. Number of prevalent intestine candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Candidates listed at multiple centers are counted once per listing. Includes active and inactive candidates on the list any time during the month.

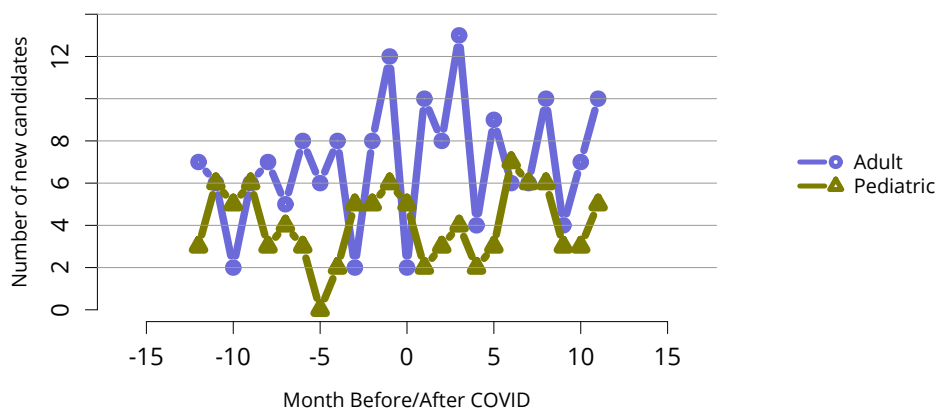


Figure COV 32. Number of new intestine candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. A new candidate is one who first joined the list during the given month, without having been listed in a previous month.

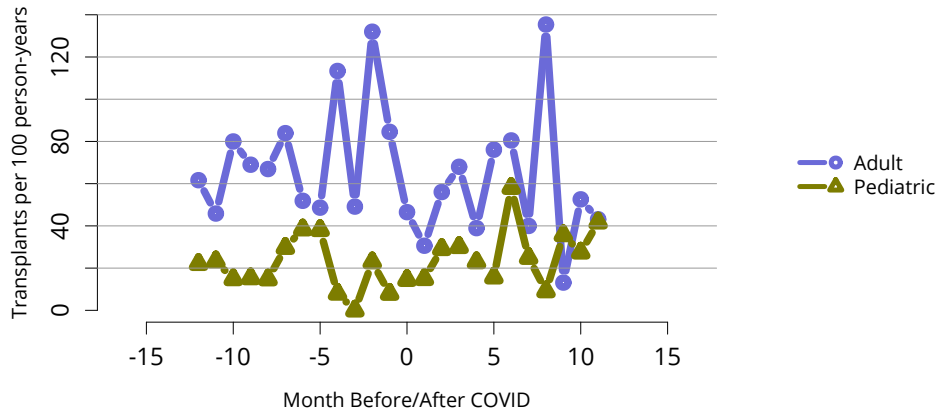


Figure COV 33. Deceased donor intestine transplant rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting in a given month. Individual listings are counted separately.

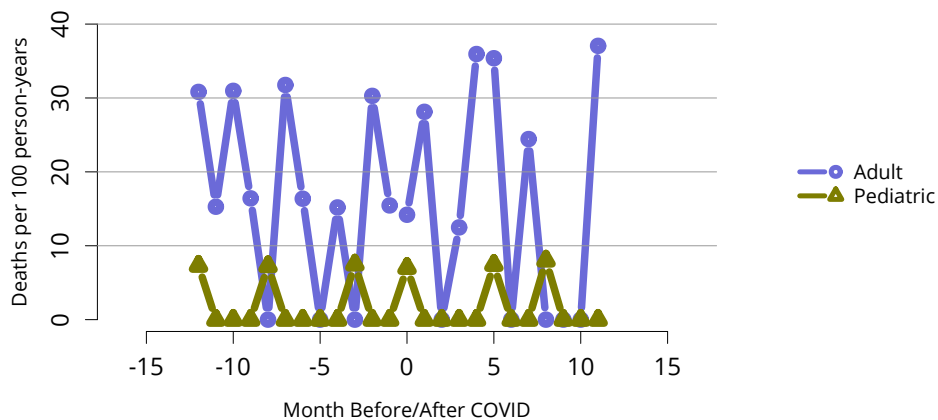


Figure COV 34. Intestine waiting list mortality rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

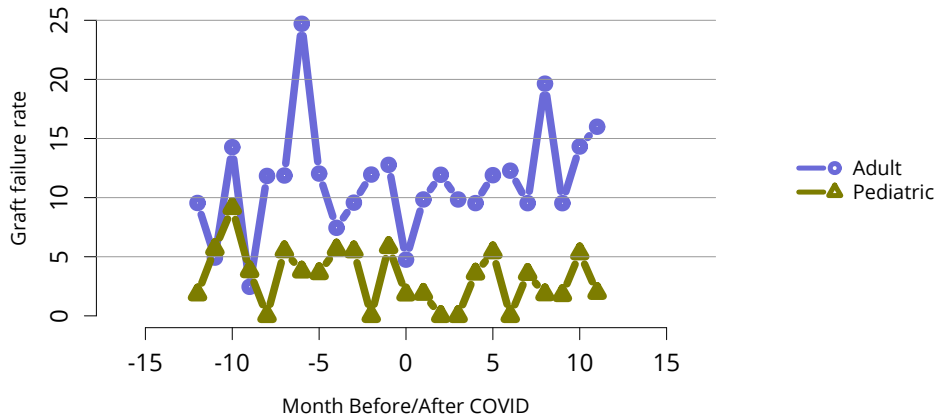


Figure COV 35. Intestine all-cause graft failure. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

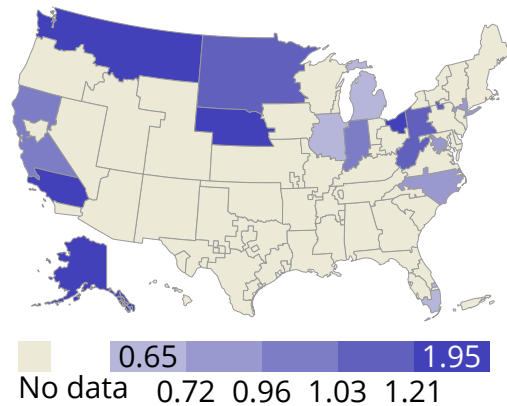


Figure COV 36. Difference in risk adjusted intestine transplant rate before to after COVID-19 by OPO. Transplant rate ratio is the difference in the OPO’s rate ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Individual listings are counted separately.

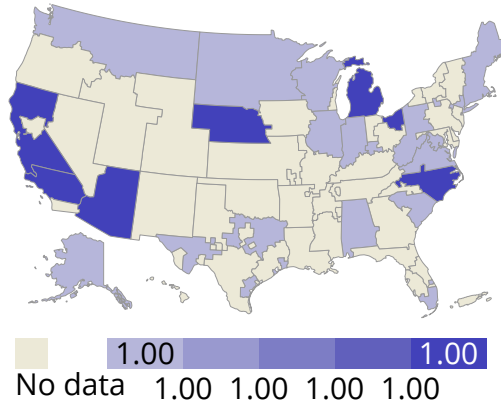


Figure COV 37. Difference in risk adjusted intestine all-cause graft failure hazard ratio before to after COVID-19 by OPO. Graft failure hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic.

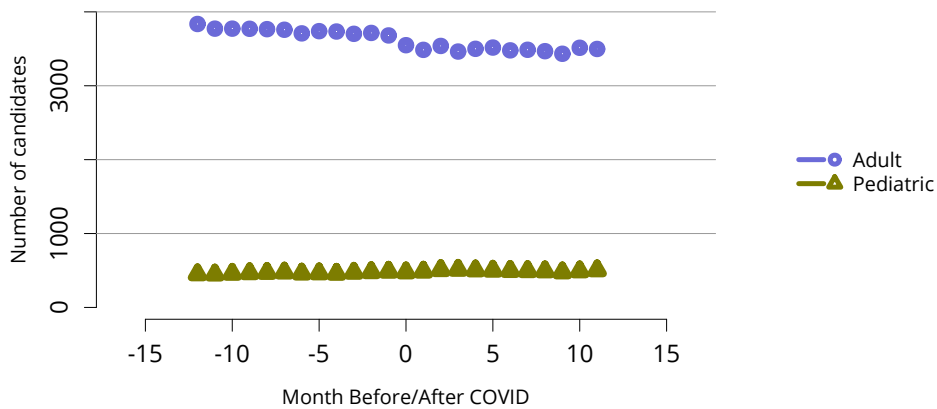


Figure COV 38. Number of prevalent heart candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Candidates listed at multiple centers are counted once per listing. Includes active and inactive candidates on the list any time during the month.

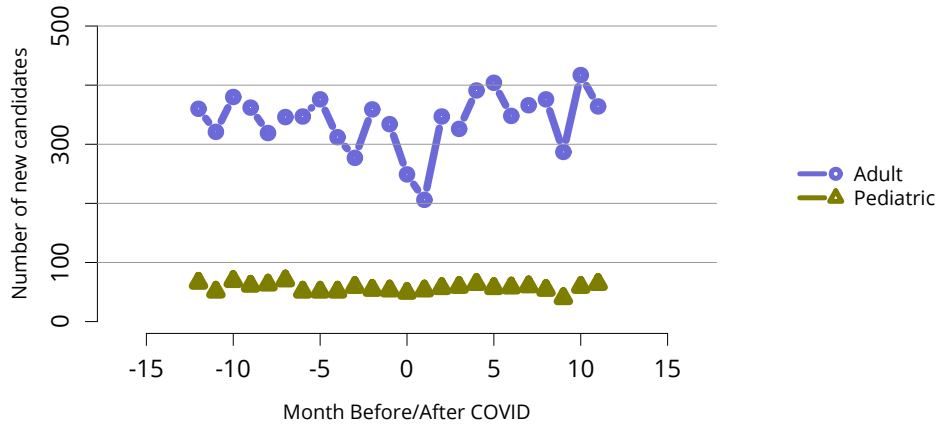


Figure COV 39. Number of new heart candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. A new candidate is one who first joined the list during the given month, without having been listed in a previous month.

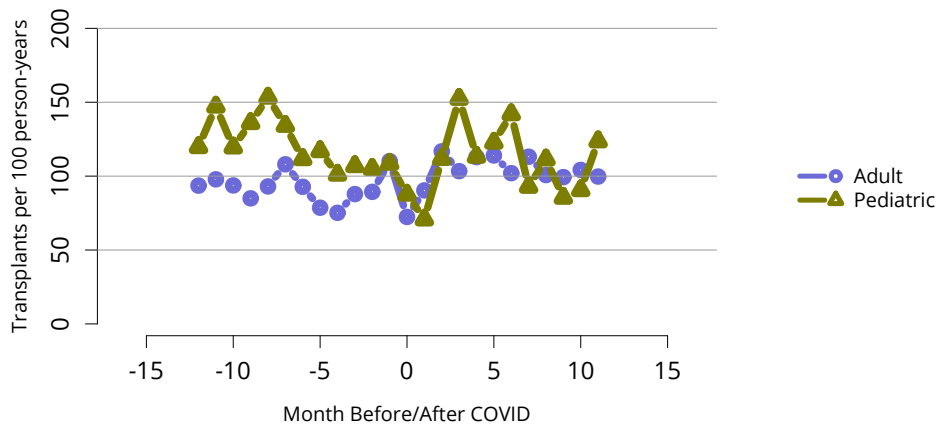


Figure COV 40. Deceased donor heart transplant rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting in a given month. Individual listings are counted separately.

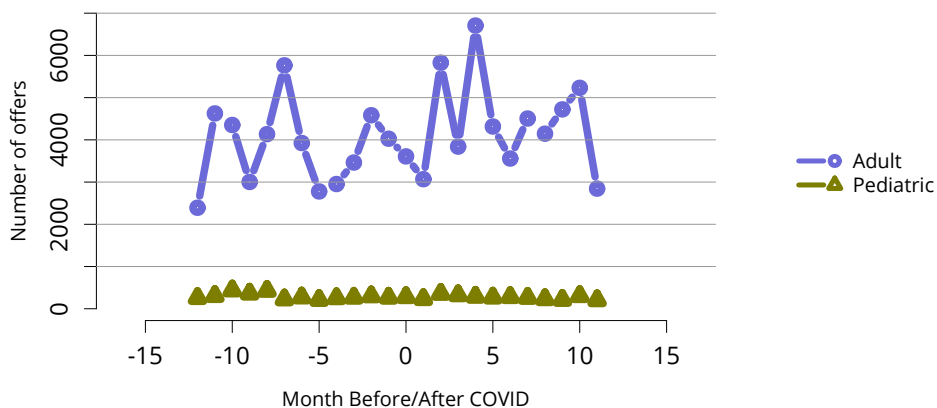


Figure COV 41. Number of heart offers. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

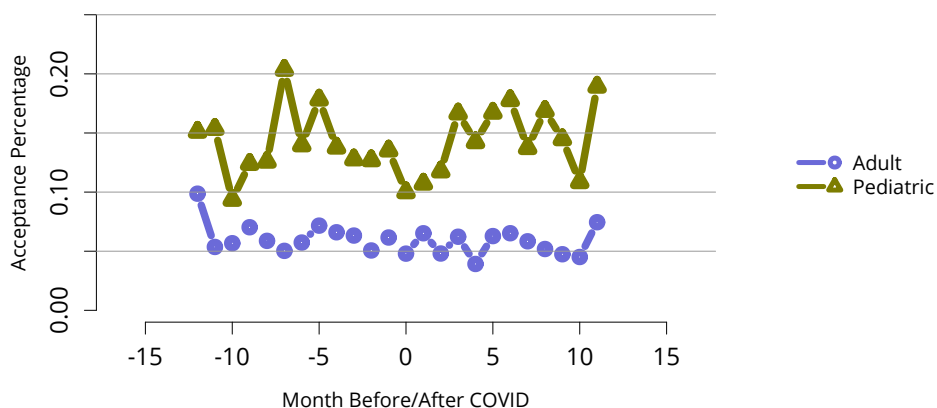


Figure COV 42. Heart offer acceptance rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

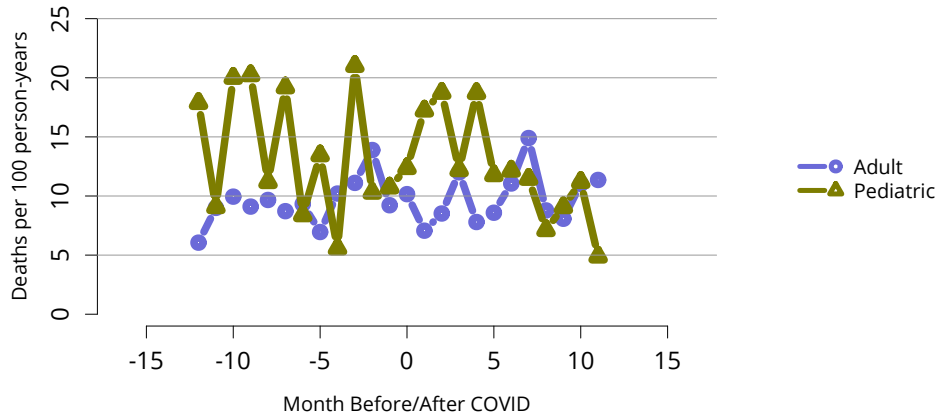


Figure COV 43. Heart waiting list mortality rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

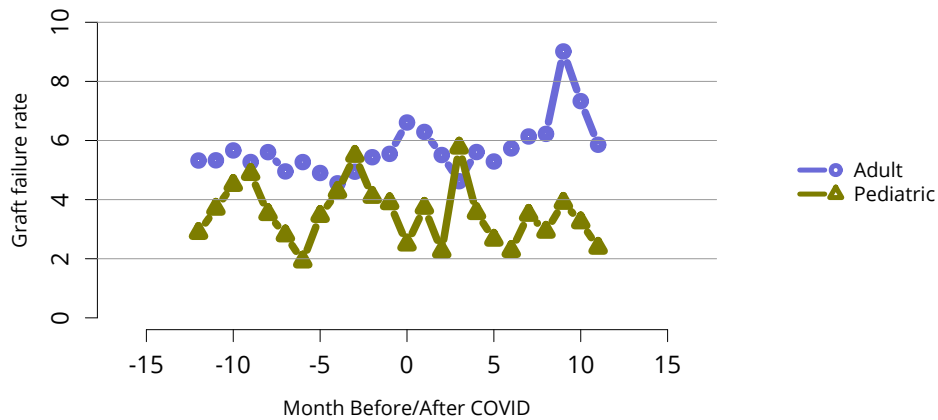


Figure COV 44. Heart all-cause graft failure. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

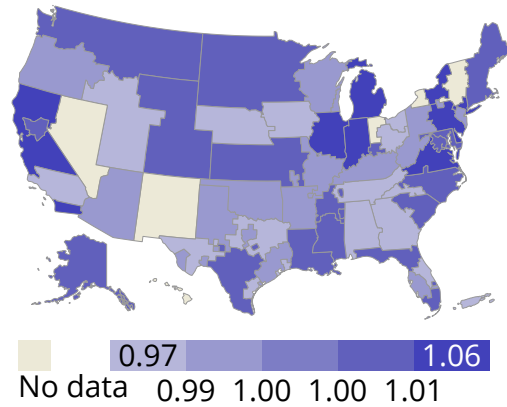


Figure COV 45. Difference in risk adjusted heart waiting list mortality hazard ratio before to after COVID-19 by OPO. Waiting list mortality hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

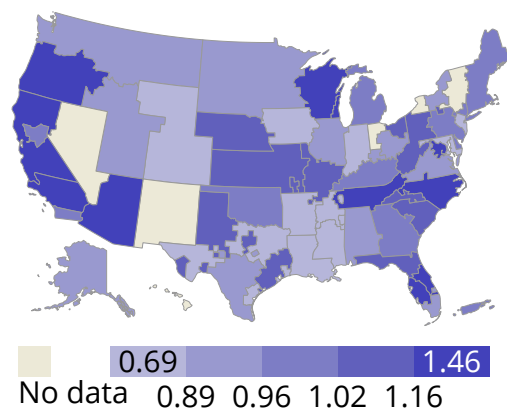


Figure COV 46. Difference in risk adjusted heart transplant rate before to after COVID-19 by OPO. Transplant rate ratio is the difference in the OPO’s rate ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Individual listings are counted separately.

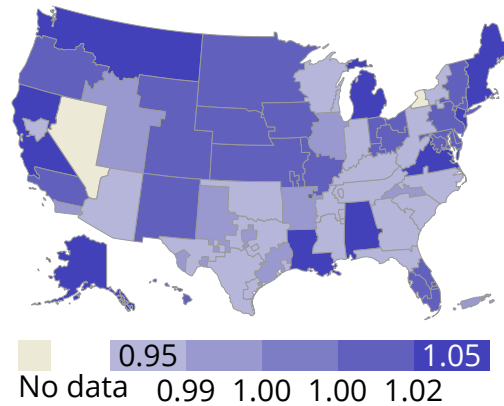


Figure COV 47. Difference in risk adjusted heart all-cause graft failure hazard ratio before to after COVID-19 by OPO. Graft failure hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic.

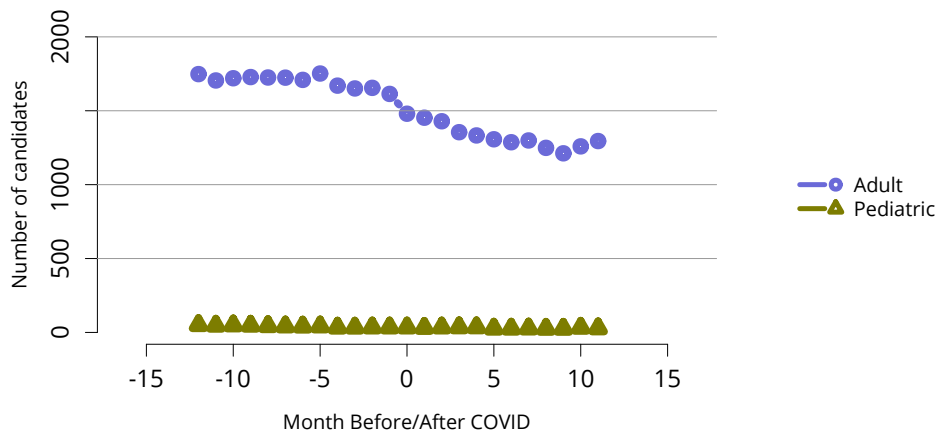


Figure COV 48. Number of prevalent lung candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Candidates listed at multiple centers are counted once per listing. Includes active and inactive candidates on the list any time during the month.

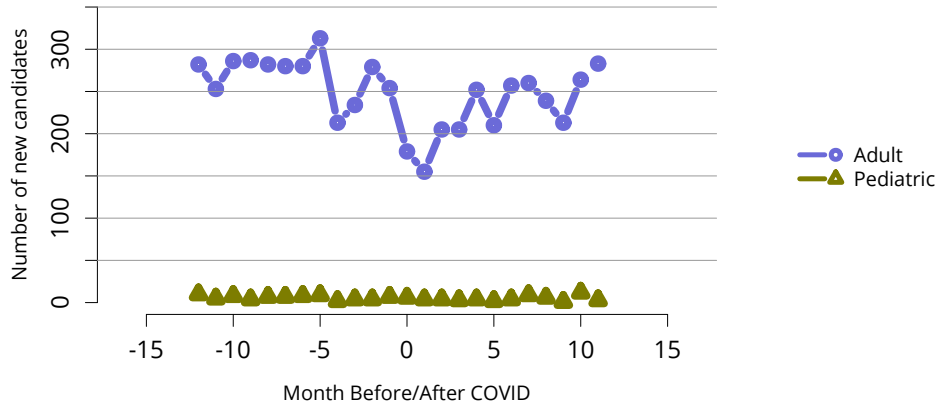


Figure COV 49. Number of new lung candidates. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. A new candidate is one who first joined the list during the given month, without having been listed in a previous month.

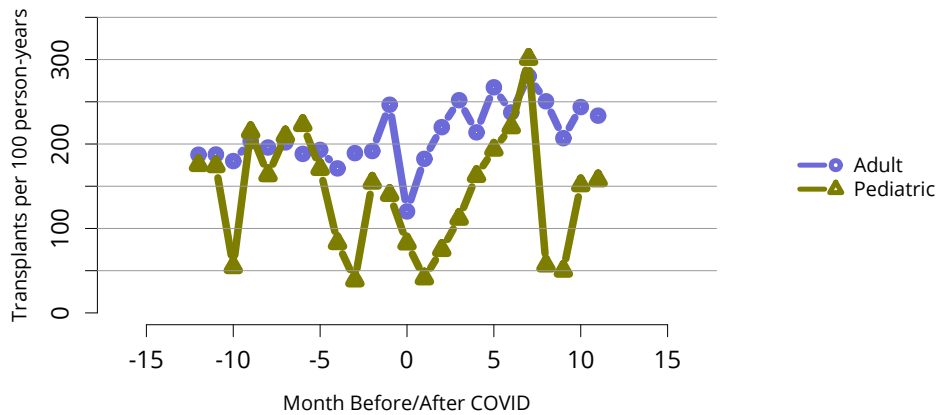


Figure COV 50. Deceased donor lung transplant rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting in a given month. Individual listings are counted separately.

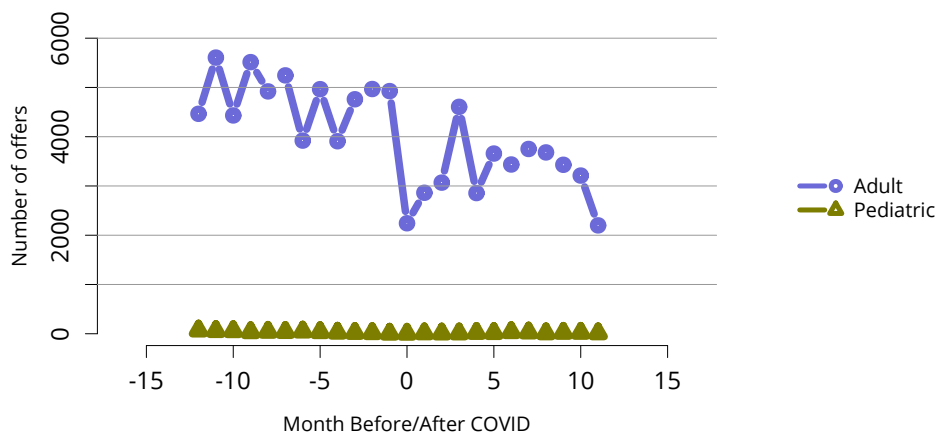


Figure COV 51. Number of lung offers. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

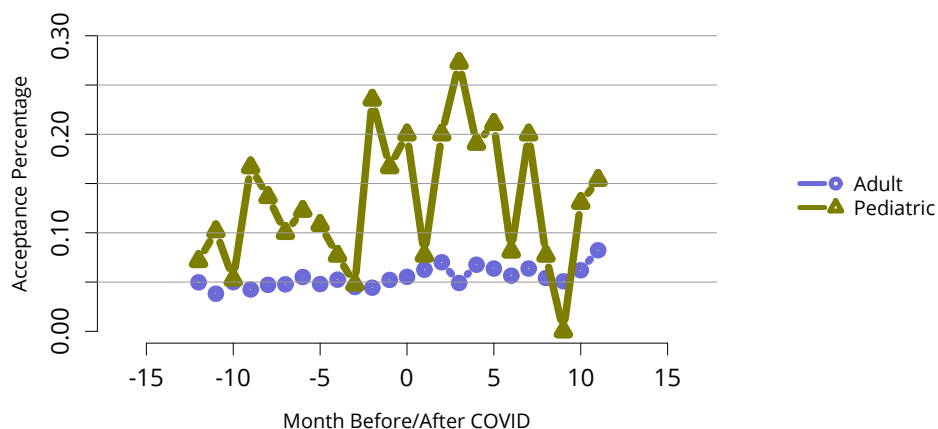


Figure COV 52. Lung offer acceptance rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

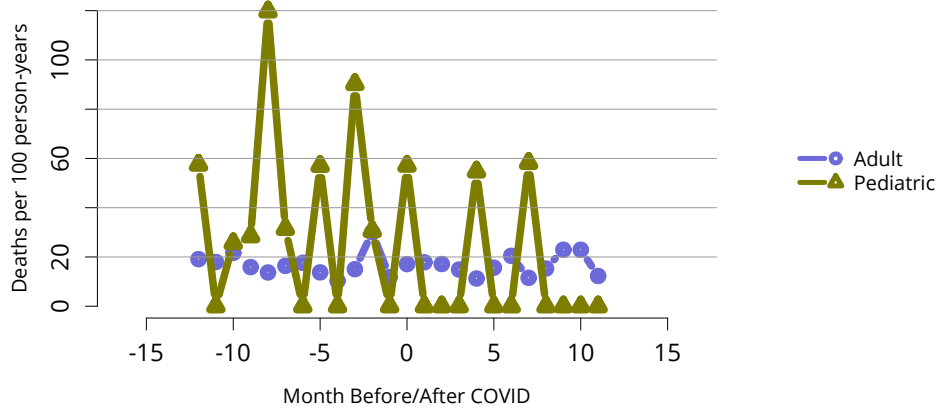


Figure COV 53. Lung waiting list mortality rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

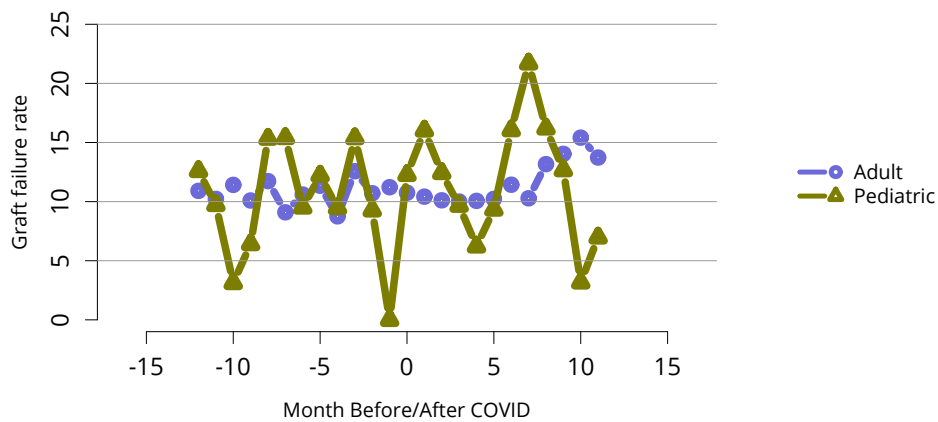


Figure COV 54. Lung all-cause graft failure. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.

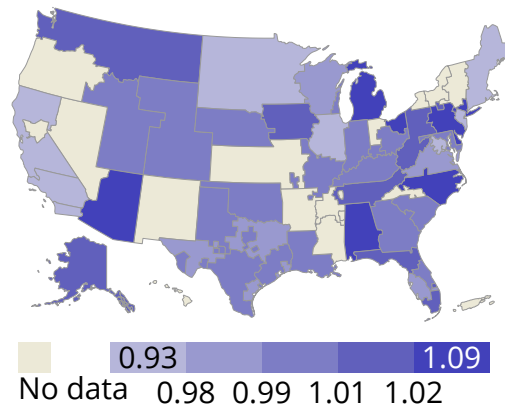


Figure COV 55. Difference in risk adjusted lung waiting list mortality hazard ratio before to after COVID-19 by OPO. Waiting list mortality hazard ratio is the difference in the OPO’s hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

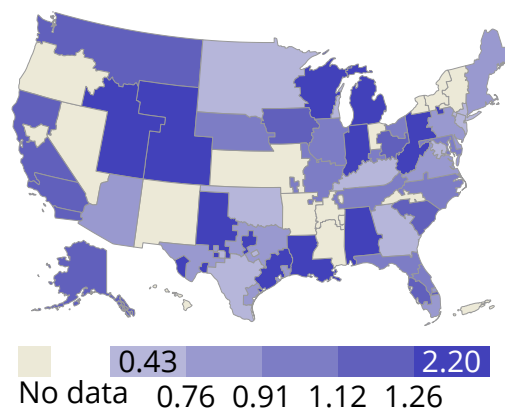


Figure COV 56. Difference in risk adjusted lung transplant rate before to after COVID-19 by OPO. Transplant rate ratio is the difference in the OPO’s rate ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic. Individual listings are counted separately.

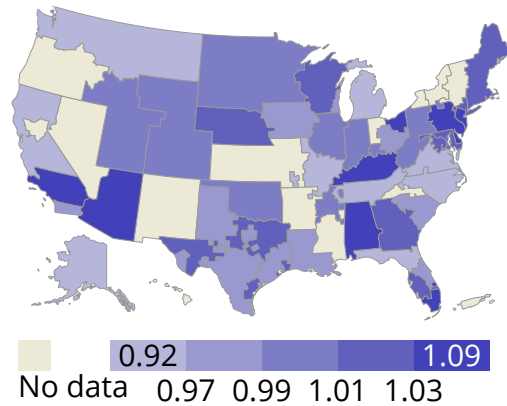


Figure COV 57. Difference in risk adjusted lung all-cause graft failure hazard ratio before to after COVID-19 by OPO. Graft failure hazard ratio is the difference in the OPO's hazard ratio compared to the nation as a whole in the 12 months after the onset of the COVID-19 pandemic as compared to the 12 months before the onset of the pandemic.

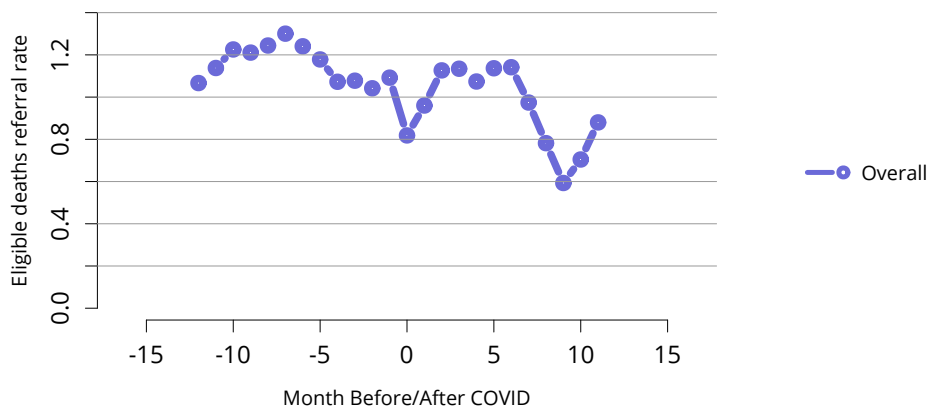


Figure COV 58. Eligible deaths referral rate. Month 0 begins March 13, 2020, the date of declaration of the National Emergency.