

Survey of US Living Kidney Donation and Transplantation Practices in the COVID-19 Era



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Introduction: The scope of the impact of the coronavirus disease 2019 (COVID-19) pandemic on living donor kidney transplantation (LDKT) practices is not well defined.

Methods: We surveyed US transplant programs to assess practices, strategies, and barriers to living LDKT during the COVID-19 pandemic. After institutional review board approval, the survey was distributed from 9 May 2020 to 30 May 2020 by e-mail and postings to professional society list-servs. Responses were stratified based on state COVID-19 cumulative incidence levels.

Results: Staff at 118 unique centers responded, representing 61% of US living donor recovery programs and 75% of LKDT volume in the pre-pandemic year. Overall, 66% reported that LDKT surgery was on hold (81% in “high” vs. 49% in “low” COVID-19 cumulative incidence states). A total of 36% reported that evaluation of new donor candidates had paused, 27% reported that evaluations were very much decreased (>0% to <25% typical), and 23% reported that evaluations were moderately decreased (25% to <50% typical). Barriers to LDKT surgery included program concerns for donor (85%) and recipient (75%) safety, patient concerns (56%), elective case restrictions (47%), and hospital administrative restrictions (48%). Programs with higher local COVID-19 cumulative incidence reported more barriers related to staff and resource diversion. Most centers continuing donor evaluations used remote strategies (video, 82%; telephone, 43%). As LDKT resumes, all programs will screen for COVID-19, although timeframe and modalities will vary. Recommendations for presurgical self-quarantine are also variable.

Conclusion: The COVID-19 pandemic has had broad impacts on LDKT practice. Ongoing research and consensus building are needed to reduce barriers, to guide optimal practices, and to support safe restoration of LDKT across centers.

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KEYWORDS: COVID-19; kidney transplantation; living kidney donation; pandemic; screening; telehealth

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The declaration of the COVID-19 pandemic in March 2020 and resulting public health emergency has had implications across the spectrum of transplantation care processes, including patient

evaluation, organ procurement and placement, surgery and early aftercare, and management of immunosuppressed recipients.^{1–3} In the United States, transplant surgery was designated as a tier 3b essential procedure by the Centers for Medicare and Medicaid Services (CMS), establishing that transplantation should *not* be uniformly postponed as “elective” during the pandemic.⁴ However, in practice, the feasibility of transplantation has depended on local COVID-19 disease burden and related resource considerations, as well as perceived medical urgency in balance with

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potential patient risks.⁵ Although programs across the United States have continued lifesaving procedures (e.g., heart and high-acuity liver transplantation), the numbers of deceased and living donor kidney transplantations (LDKTs) decreased dramatically in the early weeks of the pandemic.⁵

Compared to deceased donor kidney transplantation (DDKT), the impact of the pandemic on LDKT has been particularly striking. During the week of 24 March 2020, whereas 80% of DDKT programs were operating with restrictions, 72% of US LDKT programs reported full suspension of living donation and transplant activities. In the week ending 11 April 2020, only 11 LDKT procedures were performed in the entire United States.⁶ Living donor kidney transplantation is often considered “elective” (i.e., distinct from “essential” DDKT) and possible to safely delay. In addition, LDKT has added complexity related to both the safety of the recipient, as early reports suggested that transplant recipients faced substantially increased risk of mortality following SARS-CoV-2 infection,^{7,8} and of the living donor. The dramatic decrease in LDKT clinical activity has important health implications for transplant candidates seeking access to kidney transplantation.

As hospitals resume scheduling and performing elective surgeries, establishing conditions for safe conduct of LDKT activity has become a critical consideration in the transplant community.^{9–11} To facilitate discussions of best practices, we designed a survey to assess the impact of the COVID-19 pandemic on comprehensive elements of living donor candidate evaluation, surgery, follow-up, and education practices. Herein we report the findings based on responses at US transplant programs from 9 May 2020 to 30 May 2020. We also compared responses according to general population COVID-19 cumulative incidence by state, to assess the impact of disease burden on LDKT program practices.

MATERIALS AND METHODS

Survey Design

The survey instrument was developed by the study investigators. Key topics of study interest were identified, and survey items were developed and refined by direct discussion and e-mail between investigators. The final survey instrument comprised 34 questions (Supplementary Table S1). The survey queries information on participant role (transplantation center staff [transplantation surgeon, nephrologist, coordinator, social worker, administrator, or other]) and United Network for Organ Sharing (UNOS) Center ID. Participants were asked about their processes for donor evaluation and follow-up. They were further queried

about the impact of COVID-19 on their volume of living donor procedures in general and kidney paired donation (KPD) procedures in specific. Center LDKT volume in the year prior to pandemic declaration (March 2020) was drawn from the Scientific Registry of Transplant Recipients (SRTR).

This study was approved as Human Subject Exempt by the Saint Louis University Institutional Review Board.

Survey Administration

The target population was transplant program staff at all US LDKT programs (N = 194) active in 2020, including surgeons, nephrologists, administrators, coordinators, and social workers. Potential participants at all US kidney transplant programs were derived from the working group’s professional connections and e-mailed the survey through the Qualtrics Survey Software. Opportunity for self-elected participation through a Qualtrics link was also posted to professional society listservs (e.g., American Society of Transplantation [AST], Kidney Pancreas Community of Practice [COP], Live Donor COP, and AST Outstanding Questions in Transplantation [OQiT]). The COP postings were approved by COP leadership, and the OQiT posting was approved by the AST Education Committee. Data are analyzed from distribution between 9 May 2020 and 30 May 2020. The first page of the survey notes that the decision to proceed indicates consent to participate. Up to 2 reminders were provided for nonrespondents.

Statistical Analysis

Each program was represented only once in the analysis. For programs with multiple respondents, we selected 1 participant to represent the program using a hierarchical algorithm. First, we prioritized responses with the most complete information (i.e., fewest unanswered items). Next, we prioritized surveys submitted by transplantation surgeons, or nephrologists, over those from coordinators, social workers, administrators, or others. Finally, if any programs had more than 1 response after the above 2 steps, we retained the earliest submitted survey.

Responses to each survey question were described with either percentages and frequencies or with means and ranges, as appropriate. To obtain percentages, we divided the number of program responses (i.e., row totals) by the total number of programs who responded to the question, such that percentages reflect proportions of respondents, as per previous methods.^{12–15} For questions in which participants were asked to “select all that apply,” the denominator for calculating percentages was the number of participants responding

Table 1. Participant characteristics

Role in transplantation program (n = 118)	% (n) ^a
Transplantation surgeon	38 (45)
Transplantation nephrologist	47 (55)
Administrator	3 (4)
Coordinator	5 (6)
Other	7 (8)
UNOS region (n = 118)	% (n) ^a
1	9 (11)
2	12 (14)
3	11 (13)
4	7 (8)
5	13 (15)
6	4 (5)
7	11 (13)
8	7 (8)
9	8 (10)
10	8 (10)
11	9 (11)

UNOS, United Network for Organ Sharing.
^aIndicates the item denominator, based on number of respondents, and accounting for contingent responses.

to that question. For these questions, column totals exceed 100%.

The LDKT programs were categorized based on the COVID-19 cumulative incidence in their state using data that were published in the *New York Times* on 14 May 2020 incorporating reports by federal, state, and local county data health departments.¹⁶ States were categorized into 3 levels providing approximately equivalent number of programs in each level, as follows: “low,” <200 cases/100,000 population; “moderate,” 200 to <500 per 100,000; and “high,” ≥500 cases per 100,000. Although the sample size of programs was too small for statistical significance ($P > 0.05$ by χ^2 test), stratification by local COVID-19 cumulative incidence strata is presented to assess trends in the relationship of local disease cumulative incidence with living donor care practices.

All analyses were performed using RStudio version 1.2.5042 (RStudio Inc., Boston, MA).

RESULTS

Survey Participants

This report describes responses from US LDKT programs. We received responses from 118 unique programs (Supplementary Figure S1). Respondents represented 61% of US living donor recovery programs and 75% of LDKT volume in the year before the pandemic was declared (April 2019 to 11 March 2020). Participants were most often transplantation nephrologists (47%) or surgeons (38%) (Table 1). All UNOS regions were represented. Programs were drawn from 39 states, with 37, 39, and 42 programs located in states

Table 2. Living donor evaluation activity

Survey question	Overall	Stratified by state COVID-19 cumulative incidence		
		Low	Moderate	High
Have you continued living donor candidate evaluations during the COVID-19 pandemic? (n = 117)	% (n)	% (n)	% (n)	% (n)
Yes	56 (65)	57 (21)	46 (18)	63 (26)
No	44 (52)	43 (16)	54 (21)	37 (15)
What has been your volume of living donor candidate evaluations during the pandemic? (n = 118)	% (n)	% (n)	% (n)	% (n)
None (we have paused evaluations)	36 (43)	35 (13)	44 (17)	31 (13)
Very decreased (>0 to <25% typical)	27 (32)	27 (10)	23 (9)	31 (13)
Moderately decreased (25% to <50% typical)	23 (27)	27 (10)	13 (5)	29 (12)
Slightly decreased (50% to <80% typical)	8 (10)	8 (3)	15 (6)	2 (1)
About the same	5 (6)	3 (1)	5 (2)	7 (3)
Increased	0 (0)	0 (0)	0 (0)	0 (0)
If you have continued living donor candidate evaluations, what modalities do you use for patient interactions? Select all that apply. (n = 79)	% (n)	% (n)	% (n)	% (n)
Assessment in clinic	30 (24)	43 (10)	27 (6)	24 (8)
Telehealth: telephone-based	43 (34)	48 (11)	36 (8)	44 (15)
Telehealth: video-based	82 (65)	87 (20)	95 (21)	71 (24)
Did your center use telehealth for donor evaluation prior to the COVID-19 pandemic? (n = 118)	% (n)	% (n)	% (n)	% (n)
Yes	13 (15)	8 (3)	10 (4)	19 (8)
No	87 (103)	92 (34)	90 (35)	81 (34)
What elements of the living donor evaluation does your center use telehealth to perform? Select all that apply. (n = 89)	% (n)	% (n)	% (n)	% (n)
Medical evaluation	76 (68)	75 (21)	85 (22)	71 (25)
Surgical evaluation	37 (33)	29 (8)	42 (11)	40 (14)
Social work evaluation	79 (70)	79 (22)	77 (20)	80 (28)
ILDA evaluation	73 (65)	75 (21)	73 (19)	71 (25)
Dietician evaluation	65 (58)	71 (20)	69 (18)	57 (20)
Coordinator education	78 (69)	86 (24)	73 (19)	74 (26)
Other	12 (11)	11 (3)	15 (4)	11 (4)

COVID-19, coronavirus disease 2019; ILDA, independent living donor advocate.

ranked as “low,” “moderate,” and “high” COVID-19 cumulative incidence, respectively.

Living Donor Evaluation

Living donation evaluation was significantly reduced by the COVID-19 pandemic, with 36% of programs reporting pausing living donor candidate evaluation during the pandemic (Table 2). Among those responding programs that continued living donor evaluation, 82% used video-based evaluation and 43% used telephone-based assessment. In contrast, only 30% of programs reported using in-clinic assessment. For 87% of responding programs, telehealth reflected new technology for living donor evaluation that was driven by the COVID-19 pandemic. Centers reported using this technology predominantly for medical evaluation (76%), social work evaluation (79%), and independent living donor advocate assessments (73%).

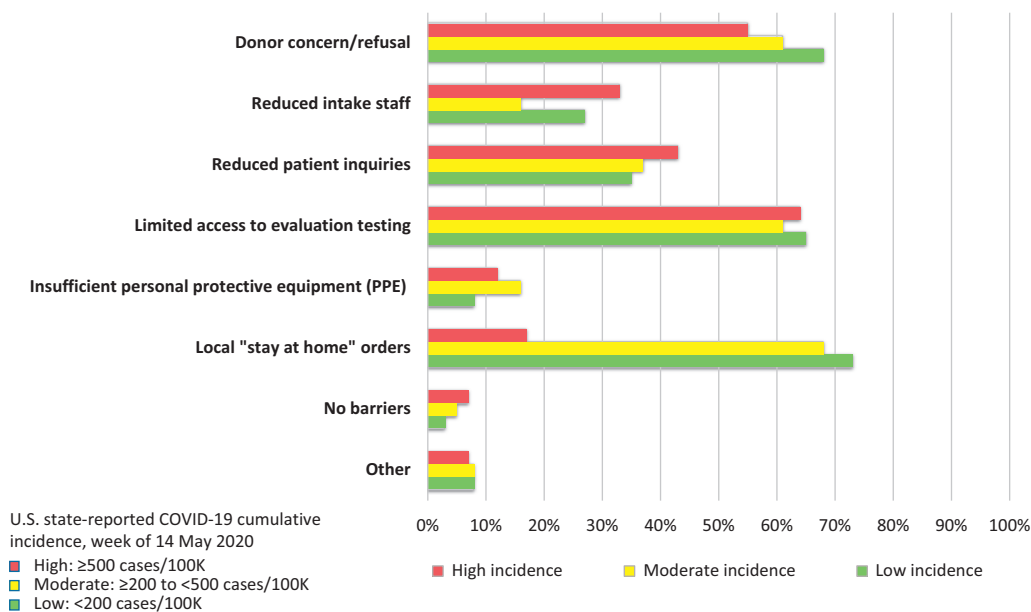


Figure 1. Barriers to living donor candidate evaluation related to the pandemic, by state coronavirus disease 2019 (COVID-19) cumulative incidence level. States were categorized into 3 levels providing approximately equivalent number of centers in each, based on cases/100,000 (14 May 2020) as: low, up to 200 cases per 100,000; moderate, 200 to <500 cases per 100,000; and high, ≥500 cases per 100,000. Although the sample size of programs was too small for statistical significance ($P > 0.05$ by χ^2 test), stratification by local COVID-19 cumulative incidence is presented to assess trends in the relationship of local disease burden with living donor care practices.

Conversely, surgical evaluation was still predominantly done in-person, with 37% reporting use of telehealth for surgical evaluation. Importantly, 83% of responding programs required at least 1 in-person pre-donation evaluation. As a result of the impact of COVID-19, 95% of programs reported a reduction in evaluation volume, with more than 90% of programs reporting at least a 50% reduction in their average volume of donor evaluations. Trends in evaluation practices appeared to be similar across levels of state COVID-19 burden.

Responding programs identified a number of key barriers to proceeding with donor evaluation and testing. Restrictions caused by local stay-at-home orders (71%) were the most common issues reported,

followed by limited access to evaluation testing (63%), donor concern/refusal (61%), and reduced donor inquiries (38%). Patterns appear to be generally similar across COVID-19 cumulative incidence groups (Figure 1).

Living Donor Evaluation Testing

Living donor programs have markedly altered their predonation testing procedures as a result of the COVID-19 pandemic (Table 3). Although the majority of responding programs continued laboratory testing (56%), of those continuing laboratory testing, many incorporated local testing in community laboratories (74%), and some are using home-based phlebotomy

Table 3. Living donor evaluation testing

Survey question	Overall	Stratified by state COVID-19 cumulative incidence		
		Low	Moderate	High
Have you continued living donor candidate lab testing during the pandemic? (n = 117)	% (n)	% (n)	% (n)	% (n)
Yes	56 (65)	65 (24)	55 (21)	48 (20)
No	44 (52)	35 (13)	45 (17)	52 (22)
If you continued living donor candidate lab testing during the pandemic, where are labs performed? Select all that apply. (n = 65)	% (n)	% (n)	% (n)	% (n)
Transplant hospital	65 (42)	73 (16)	61 (14)	60 (12)
Community lab	74 (48)	82 (18)	87 (20)	50 (10)
Home-based phlebotomy service	17 (11)	5 (1)	22 (5)	25 (5)
Have you continued other forms of living donor candidate testing during the pandemic (e.g., radiology, cardiac testing)? (n = 117)	% (n)	% (n)	% (n)	% (n)
Yes	39 (46)	46 (17)	32 (12)	40 (17)
No	61 (71)	54 (20)	68 (26)	60 (25)

COVID-19, coronavirus disease 2019; lab, laboratory; labs, laboratory tests.

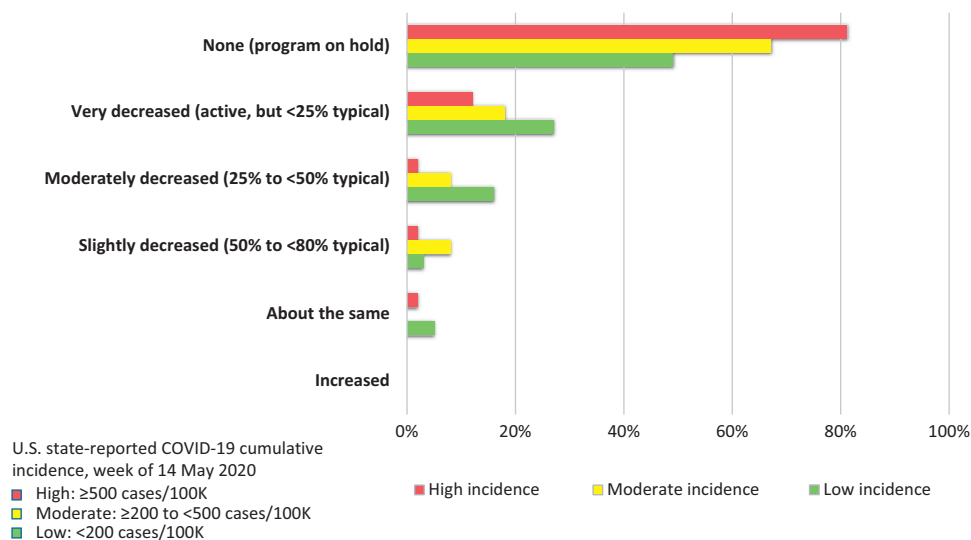


Figure 2. Volume of living donor kidney transplantation (LDKT) activity during the pandemic, by state coronavirus disease 2019 (COVID-19) cumulative incidence level.

(17%). Testing appeared to decline more in areas with high COVID-19 burden, in which 52% of responding programs reported stopping testing compared with 35% of programs in low cumulative incidence states. In contrast, 61% of responding programs reported halting other types of testing (e.g., radiology and cardiac testing), with minimal differences by local burden of COVID-19 infection.

Living Donation/Transplantation Surgery Practices and Presurgical Screening

During the pandemic, LDKT surgery has been largely curtailed (Figure 2). Volume was decreased by at least 50% of prepandemic levels at 93% of responding programs, with 66% of programs halting LDKT completely. Programs in the highest COVID-19 cumulative incidence states were more likely to have paused LDKT (81%) compared with programs in low cumulative incidence states (49%). Among the barriers cited to proceeding with LDKT, program concern for donor safety (85%), concern for recipient safety (75%), and patient reluctance (56%) were the most common reasons (Figure 3). Government restrictions on “elective” cases was cited in 60% of programs in high cumulative incidence areas and 27% of low cumulative incidence areas. The majority of programs that reported interruptions also reported plans to restart LDKT within the next month. Overall, 72% of programs elected to pause KPD programs with minimal variation by disease burden.

Disease Transmission Prevention Practices

To ensure safe practice, all programs planned to implement pre-donation testing for COVID-19 by polymerase chain reaction (PCR). In addition, 19% of

programs reported use of serum IgG testing, which varied from 16% in low cumulative incidence areas to 26% in high cumulative incidence areas (Table 4). COVID-19 testing was performed at the hospital laboratory in 93% of programs, whereas 13% reported using community laboratories and 4% a public health laboratory. Timing of testing varied by center, with 25% requiring testing within 24 hours, 48% within 48 hours, and the remainder within 72 hours of donation surgery. Program practice regarding self-quarantining prior to donation varied significantly. At 27% of responding programs, no quarantine was requested, 39% required 7 to 14 days, and the remainder required a variety of shorter lengths (Table 5). Recommendation for longer self-quarantine trended higher in high COVID-19 cumulative incidence states at 45%, compared to 32% in low cumulative incidence states. For patients who traveled to the living donor recovery center, 28% of responding programs required no additional quarantine, whereas 36% required 7 to 14 days. Notably, 8% of programs in high COVID-19 cumulative incidence states stated a preference for remote donation (i.e., organ travel, compared to patient travel for a distant donor), whereas no center in low and moderate cumulative incidence states expressed such preference. To further protect patients during hospitalization, 90% of responding programs had separate COVID-19 wards and 86% required personal protective equipment (PPE) for all staff.

With regard to variation in counseling, 44% of programs counseled donors that the risk of contracting COVID-19 is not affected by donation, 31% counseled that the risk of complications is not impacted by donation, and 57% educated donors that COVID-19 has been associated with acute kidney injury. These

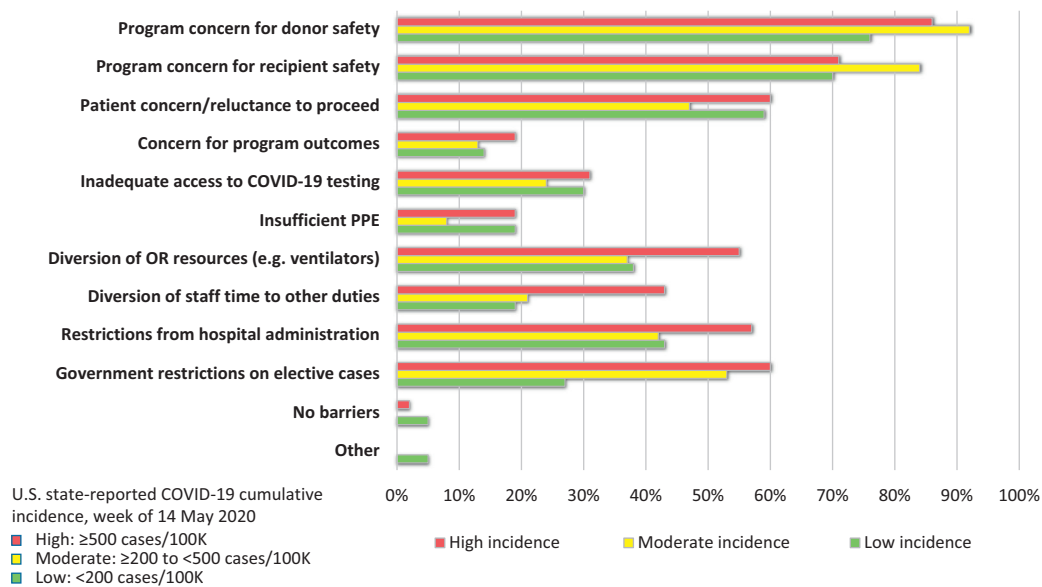


Figure 3. Barriers to living donor transplant encountered related to the pandemic, by state coronavirus disease 2019 (COVID-19) cumulative incidence level. OR, operating room.

practices appear to be similar across state cumulative incidence levels.

Living Donor Follow-Up

Safe living donation requires programs to carefully follow donors. However, operationalizing this follow-up has changed during the pandemic (Table 6). Overall, 28% of responding programs have stopped follow-up completely during the pandemic, and this frequency was similar across state COVID-19 cumulative incidence levels. A majority (52%) reported continuing follow-up without change, whereas 20% have continued follow-up without laboratory testing. Importantly, only 21% of programs that continued follow-up used in-person evaluation, whereas the majority of centers performing follow-up reported using video-based telehealth (73%) and telephone-based telehealth (66%) strategies. Among programs continuing laboratory follow-up testing for donors during the study period, 80% used community laboratories and 19% used home-based phlebotomy. The most common barriers to living donor follow-up reported were hospital restrictions on elective visits (54%) and patients’ unwillingness to come for laboratory tests (42%) and on-site visits (39%) (Figure 4). Following the COVID-19 pandemic, 93% of responding programs plan to increase the use of telehealth for donor follow-up compared to pre-pandemic levels.

DISCUSSION

In this national survey of US transplantation programs on LDKT program practices during the COVID-19

pandemic, we found evidence of marked reductions in all phases of living donor care and surgery nationwide. In high cumulative incidence areas, LDKT activity was curtailed not only in response to concerns for donor safety but also as a result of administrative restrictions and resource availability for cases perceived to be elective. These findings resonate with data from the Organ Procurement and Transplantation Network (OPTN)/United Network for Organ Sharing (UNOS) data, which documented a substantial decline in LDKT surgery during the initial pandemic,⁵ but add knowledge in terms of underlying evaluation, testing, and care processes. Although LDKT rates are slowly recovering, the practice constraints described in this survey identify potential barriers that may recur in the context of local infection resurgences.

Living donor safety is the central priority for all healthcare professionals involved in LDKT. Although national guidance from the CMS has been to continue organ transplantation as an essential procedure where local resources allow, living donation practice should be considered in light of both donor and recipient risks, and the potential to safely delay surgery. Initially, donation was reduced because of profound shortages in medically necessary supplies and high hospital occupancy in areas with significant COVID-19 disease cumulative incidence as well as patient safety concerns. As these limitations have eased, programs have begun to resume elective surgeries with appropriate safety steps. Our survey shows that 80% of programs planned to resume LDKT by early summer 2020. However, this resumption in activity has not replaced the lost transplants, as 27% fewer living

Table 4. Living donation/transplantation surgery practices and presurgical screening

Survey question	Overall	Stratified by state COVID-19 cumulative incidence		
		Low	Moderate	High
Would you approve a living donor candidate for surgery based on telehealth evaluation only, without physical exam? (n = 117)	% (n)	% (n)	% (n)	% (n)
Yes	17 (20)	16 (6)	21 (8)	14 (6)
No	83 (97)	84 (31)	79 (30)	86 (36)
When are you planning to resume normal living donor transplantation procedures? (n = 118)	% (n)	% (n)	% (n)	% (n)
Never interrupted	5 (6)	14 (5)	3 (1)	0 (0)
Within the next 2 weeks	31 (37)	24 (9)	44 (17)	26 (11)
Within the month	27 (32)	16 (6)	18 (7)	45 (19)
When the incidence of local COVID-19 cases has shown steady decline over 14 days	6 (7)	5 (2)	5 (2)	7 (3)
When recommended by professional guidelines	6 (7)	3 (1)	8 (3)	7 (3)
Program had paused, but now resumed	25 (29)	38 (14)	23 (9)	14 (6)
When you resume living donation, when will you perform COVID-19 testing in asymptomatic patients in relation to surgery? (n = 116)	% (n)	% (n)	% (n)	% (n)
Within 24 hours	25 (29)	24 (9)	29 (11)	22 (9)
Within >24 to 48 hours	48 (56)	43 (16)	47 (18)	54 (22)
Within >48 to 72 hours	27 (31)	32 (12)	24 (9)	24 (10)
Will not test asymptomatic patients	0 (0)	0 (0)	0 (0)	0 (0)
What testing modality do you use for presurgical COVID-19 testing for living donors? Select all that apply. (n = 116)	% (n)	% (n)	% (n)	% (n)
PCR, nasopharyngeal swab	99 (115)	97 (36)	100 (37)	100 (42)
PCR, other specimen	1 (1)	3 (1)	0 (0)	0 (0)
Serum IgG antibody	19 (22)	16 (6)	14 (5)	26 (11)
Serum IgM antibody	14 (16)	14 (5)	11 (4)	17 (7)
Serum antigen	2 (2)	3 (1)	0 (0)	2 (1)
Where do you send presurgical COVID-19 testing for donors and recipients? Select all that apply. (n = 114)	% (n)	% (n)	% (n)	% (n)
Hospital lab	93 (106)	89 (31)	95 (36)	95 (39)
Community lab	13 (15)	17 (6)	13 (5)	10 (4)
Public health reference lab	4 (5)	3 (1)	3 (1)	7 (3)
How has the COVID-19 pandemic impacted kidney paired donation (KPD) at your center? (n = 116)	% (n)	% (n)	% (n)	% (n)
Continue all KPD	16 (19)	17 (6)	18 (7)	14 (6)
Continue only internal KPD	6 (7)	3 (1)	8 (3)	7 (3)
Half all KPD	72 (84)	75 (27)	66 (25)	76 (32)
Center does not perform KPD	5 (6)	6 (2)	8 (3)	2 (1)

COVID-19, coronavirus disease 2019; exam, examination; KPD, kidney paired donation; lab, laboratory; PCR, polymerase chain reaction.

donor transplantations have been performed as of 11 August 2020 compared to 2019.⁵

This survey demonstrates a decline in living donor candidate evaluations due to donor/recipient safety concerns and fewer donor inquiries. Donors and recipients should be educated and reassured that their donor's safety is of paramount importance to every transplantation program. Many programs have changed their practices significantly to protect the donor during all phases of donor care, including increased use of telehealth and obtaining laboratory tests locally before and after donation to minimize SARS-CoV-2 exposure. These practices should help to alleviate the anxiety experienced by potential donors.

Asymptomatic infected patients undergoing surgical procedures in a series from Wuhan, China, experienced significantly higher morbidity and mortality rates,¹⁷

demonstrating the need to ensure that donors are not infected at the time of surgery and also have precautions taken to avoid contracting COVID-19 infection. The American Society of Transplant Surgeons (ASTS) and The American Society of Transplantation (AST) have suggested a series of steps/recommendations to ensure donor and recipient safety, including testing and self-quarantine. Both recommend proceeding with living donation for asymptomatic individuals with a negative polymerase chain reaction test close to donation surgery. All transplantation programs surveyed are in agreement with this recommendation. The role and duration of predonation quarantine practices for local and distant donors appear to require additional clarification. The ASTS strike force recommends a period of at least 7 days and preferably 2 weeks prior to donation for both donor and recipients of LDKT.¹⁰

Table 5. Disease transmission prevention practices

Survey question	Overall	Stratified by state COVID-19 cumulative incidence		
		Low	Moderate	High
How long do you ask local donors to self-quarantine prior to donation surgery? (n = 118)	% (n)	% (n)	% (n)	% (n)
No general quarantine request	27 (32)	38 (14)	18 (7)	26 (11)
>0 to 2 days	4 (5)	3 (1)	8 (3)	2 (1)
2 to 7 days	19 (23)	22 (8)	23 (9)	14 (6)
7 to 14 days	39 (46)	30 (11)	41 (16)	45 (19)
Other	10 (12)	8 (3)	10 (4)	12 (5)
If a donor has to travel to your center for surgery (i.e., residence is not local), how long will you require them to quarantine prior to surgery (in addition to negative COVID-19 testing)? (n = 113)	% (n)	% (n)	% (n)	% (n)
No quarantine with negative COVID-19 test	28 (32)	32 (12)	31 (11)	22 (9)
> 0 to 2 days	4 (4)	3 (1)	6 (2)	2 (1)
2 to 7 days	16 (18)	16 (6)	19 (7)	12 (5)
7 to 14 days	36 (41)	32 (12)	31 (11)	45 (18)
Refuse donor	3 (3)	5 (2)	3 (1)	0 (0)
Prefer remote donation surgery	3 (3)	0 (0)	0 (0)	8 (3)
Other	11 (12)	11 (4)	11 (4)	10 (4)
Would your center accept a donor who has recovered from COVID-19 infection and is PCR negative but antibody positive? (n = 108)	% (n)	% (n)	% (n)	% (n)
Yes	66 (71)	69 (22)	67 (24)	62 (25)
No	34 (37)	31 (10)	33 (12)	38 (15)
What measures does your center use to reduce risk of donor contracting COVID-19 during surgical hospitalization? Select all that apply. (n = 116)	% (n)	% (n)	% (n)	% (n)
Separate COVID-19 and non-COVID-19 wards	90 (104)	92 (34)	87 (33)	90 (37)
PPE use for patients and staff	86 (100)	92 (34)	79 (30)	88 (36)
Staff screening	58 (67)	70 (26)	53 (20)	51 (21)
Other	9 (11)	8 (3)	13 (5)	7 (3)
How do you counsel living donors about COVID-19 related risks? Select all that apply. (n = 110)	% (n)	% (n)	% (n)	% (n)
The risk of contracting COVID-19 is not impacted by donation	44 (48)	40 (14)	40 (14)	50 (20)
The risk of complications is not impacted by donation	31 (34)	26 (9)	29 (10)	38 (15)
COVID-19 has been associated with acute kidney injury	57 (63)	46 (16)	51 (18)	72 (29)
Other counseling	27 (30)	23 (8)	34 (12)	25 (10)

COVID-19, coronavirus disease 2019; PCR, polymerase chain reaction; PPE, personal protective equipment.

This time period is impossible for recipients on in-center dialysis. The Transplantation Society recommends a 2-week quarantine for donors.¹¹ The current survey shows wide variation in adoption of these recommendations, with most programs requiring no or a few days of quarantine prior to surgery. Programs generally did not require longer durations of quarantine for donors traveling a distance, who may be at higher risk for COVID infection because of travel-related contact with several individuals. Although the use of telehealth and local testing has minimized donor inconvenience, the need for up to 2 weeks of self-quarantine prior to surgery could add burden and potentially financial hardship for employed donors without work-from-home options. In response to feasibility concerns, in July 2020, the AST modified recommendations to suggest that although self-quarantine is recommended as a preventive strategy, it should not be mandatory.⁹ In our practice, although we highly recommend that the living donor candidate, recipient, and their support system self-quarantine for

7 to 14 days prior to the scheduled surgery, we consider exposure risk at a case-by-case level and review the exposure prevention plan with a multidisciplinary selection committee. We concur with the AST that living donors who travel by air to the transplantation center for surgery should be strongly encouraged to self-quarantine for 14 days prior to donation.⁹

In April 2020, the OPTN/UNOS suspended data collection and submission requirements for living donor follow-up (along with recipient follow-up and recipient malignancy forms), retroactive to 17 March 2020 and currently effective through 30 September 20.^{18,19} The purpose is to reduce patient exposure to COVID-19 driven by testing, as well as to reduce administrative burden on centers. We found that one-third of the programs suspended living donor follow-up during the survey period. Those programs that continued follow-up have used telehealth or telephone visits to minimize risk of COVID-19 exposure to the donor. The use of remote technologies should allow

Table 6. Living donor follow-up

Survey question	Overall	Stratified by state COVID-19 cumulative incidence		
		Low	Moderate	High
Have you continued living donor follow-up during the pandemic? (n = 117)	% (n)	% (n)	% (n)	% (n)
Yes: clinical and labs	52 (61)	59 (22)	42 (16)	55 (23)
Yes: clinical only, but labs deferred	20 (23)	14 (5)	24 (9)	21 (9)
No (we have paused follow-up)	28 (33)	27 (10)	34 (13)	24 (10)
If you have continued clinical living donor follow-up what modalities do you use for patient interactions? Select all that apply. (n = 90)	% (n)	% (n)	% (n)	% (n)
Assessment in clinic	21 (19)	17 (5)	19 (5)	26 (9)
Telehealth: telephone-based	66 (59)	59 (17)	74 (20)	65 (22)
Telehealth: video-based	73 (66)	69 (20)	81 (22)	71 (24)
If you continued living donor follow-up lab testing during the pandemic, where are labs performed? Select all that apply. (n = 74)	% (n)	% (n)	% (n)	% (n)
Transplant hospital	61 (45)	61 (17)	71 (15)	52 (13)
Community lab	80 (59)	89 (25)	67 (14)	80 (20)
Home-based phlebotomy service	19 (14)	18 (5)	14 (3)	24 (6)
Has your center used telehealth for living donor follow-up prior to the COVID-19 pandemic? (n = 116)	% (n)	% (n)	% (n)	% (n)
Yes	17 (20)	19 (7)	13 (5)	19 (8)
No	83 (96)	81 (29)	87 (33)	81 (34)
Do you plan to use telehealth for living donor care after the COVID-19 pandemic? (n = 115)	% (n)	% (n)	% (n)	% (n)
Yes, at higher than pre-pandemic utilization	61 (70)	68 (25)	54 (20)	61 (25)
Yes, selectively	33 (38)	24 (9)	38 (14)	37 (15)
No	6 (7)	8 (3)	8 (3)	2 (1)

COVID-19, coronavirus disease 2019; lab, laboratory; labs, laboratory tests.

programs to continue vital postdonation surveillance and to maintain best practices regardless of temporary relaxation of OPTN/UNOS reporting requirements.

With regard to variation in counseling, less than one-half of programs counseled donors that the risk of contracting COVID-19 is not affected by donation; less than one-third counseled that the risk of complications from infection is not impacted by donation; and more

than one-half (57%) educate donors about associations of COVID-19 and acute kidney injury.^{20,21} In our opinion, although status as a donor should not affect susceptibility to contracting COVID-19 in the community setting or confer an immunosuppressed state, reduced renal reserve due to surgical nephrectomy could increase susceptibility to severe acute kidney injury in the context of severe infection, because of

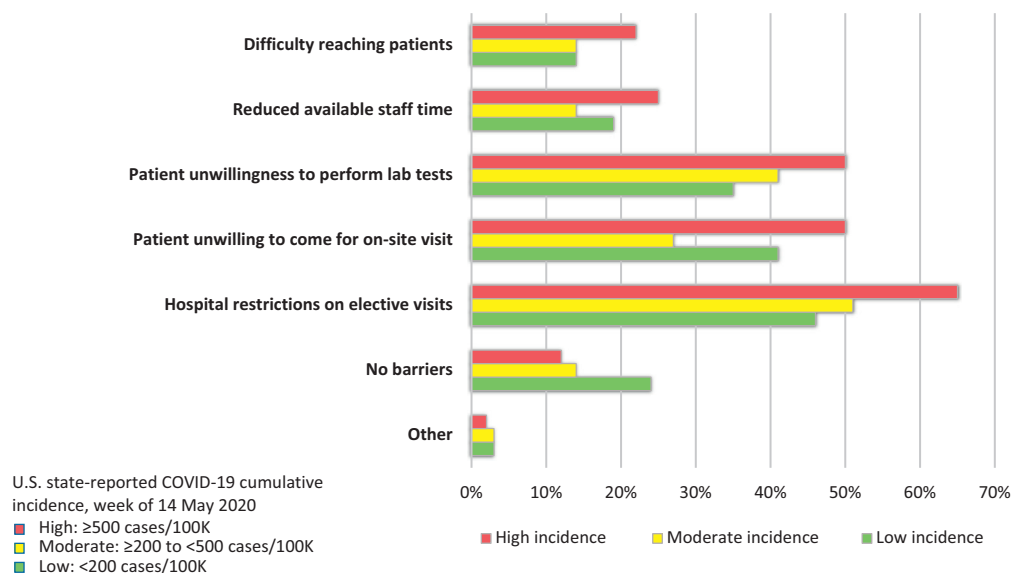


Figure 4. Barriers to living donor follow-up encountered related to the pandemic, by state coronavirus disease 2019 (COVID-19) cumulative incidence level. lab, laboratory.

lower baseline renal reserve. To date, there have been no reports in which a recent living donor has acquired COVID-19 and experienced acute kidney injury or required dialysis, although monitoring is warranted as donation and LDKT resume during the pandemic. Postdonation precautions to reduce risk of infection, such as social distancing and use of masks, and further consensus on data-driven education and counseling for living donors, are advisable until effective disease prevention strategies (e.g., vaccines) are available.

This survey suggested that the COVID-19 pandemic is likely to have long-lasting impacts on living kidney donation and LDKT practices. The CMS and insurance companies were responsive in permitting use of telehealth in new donor evaluation and even those across state lines, and transplantation programs adapted quickly in incorporating telehealth into their practices. However, most programs remain unwilling to use telehealth for the surgical evaluation and require at least 1 in-person visit prior to donation. We concur that telehealth cannot replace an in-person physical examination by at least 1 provider; furthermore, an in-person assessment may not only be a key component of surgical assessment but also of medical evaluation and psychosocial evaluation. In response to the success of telehealth platforms, most programs report a willingness to use this technology both before and after donation.⁶ Although most programs reported continuing some form of postdonation follow-up, a minority deferred laboratory follow-up. Although early postdonation complication rates are very low in general, recent data demonstrate the prognostic importance of early postdonation renal function,²² and thus overcoming pandemic-related, patient-level, and system-level barriers to donor follow-up is an important priority. Widespread telehealth should be beneficial in donor evaluation and postdonation follow-up practices, even after the pandemic, as it provides the donor with flexibility and minimizes inconveniences while maintaining safety and contact with the program. However, prospective evaluation is needed to determine whether reliance on telehealth for communication with donors affects quality of care (e.g., missed information compared to in-person evaluation across practitioners) or access to care (e.g., among donors without Internet access). Flexible options for continuing routine laboratory tests, including home phlebotomy services with certified safety and reimbursement, should be offered to help living donors to continue follow-up monitoring during the pandemic.²³

Our study extends findings from a recent survey of the impact of COVID-19 on transplantation by Boyarsky *et al.*, in which the authors included items on LDKT practices and perceptions albeit in a limited fashion.⁶ Their survey, which was primarily based on surgeon responses, was conducted the week of 26

March 2020, fairly early in the course of the pandemic, when practices and perceptions were beginning to evolve and programs may not have had a chance to define their policies and practices. In the March survey, programs reported a complete halt in 72% of LDKT activity, whereas our more recent finding of a 66% pause in LDKT program activity demonstrates the continued significant impacts of COVID-19. Our data from May also include granular details on the reasons behind such decisions after programs had time to assess their local environment. Serial surveys are also complementary in documenting the evolution of LDKT program activity as COVID-19 cumulative incidence trends significantly progressed over time.

Two-thirds of respondents, at similar levels across the 3 cumulative incidence groups, indicated their willingness to accept potential donors who have recovered from COVID-19. The presentation and outcomes of COVID-19 infection in the general population are highly variable, ranging from asymptomatic infections, to pulmonary complications, to kidney complications. The clinical implications of serological testing, including the protective effects of IgG antibody, are not defined.²⁴ The potential for viral shedding in the urine²⁵ may have implications for disease transmission through kidney donation. There is a need for research to define optimal living donation testing strategy and timing, to maintain donor and recipient safety, and inform counseling. As the pandemic evolves, there is a need to define best practices for safe KPD, and optimal logistical procedures for donors who live far from the donor recovery center.

Our study has the limitations inherent to the survey study design, such as potential for recall bias. The findings represent practices as they are reported; we cannot verify how accurately the reports represent actual practice at each LDKT program. Respondents were identified by online outreach to US transplant professionals, and not all programs are represented. However, the 61% response rate is higher than in many contemporary studies of transplantation program practices (where response rates in the vicinity of 30% are common),^{14,26,27} likely reflecting the strong community interest in the topic, and the responding centers represent 75% of LDKT volume in the period. Per prior methods,^{26–28} we applied an *a priori* methodology to select 1 representative survey per program favoring completeness and clinical role who was blinded to the responses, but results may have varied somewhat with other methodologies. These survey data reflect the opinions and experiences of the respondents at the time of completion, and, given the rapidly dynamic nature of the COVID-19 pandemic, may not be reflective of

subsequent practice. However, these data provide the most comprehensive assessment of living donor practice in the United States that is currently available, and offer a benchmark for comparing future practices as the pandemic and related guidance evolve over time. The number of transplantation programs provides limited power for statistical comparison of differences across local COVID-19 cumulative incidence levels; nonetheless, we included the trends to address a question of interest frequently raised in the community.

In conclusion, the COVID-19 pandemic has had profound impacts on all aspects of transplantation, and this impact is particularly notable for living kidney donation and LDKT. Living donation practice carries additional responsibilities for transplantation programs, given the potential risks to healthy donors undergoing a surgical procedure for the benefit of another person, and the risks of disease transmission to an immunosuppressed recipient. However, pausing LDKT may have a lasting impact on the organ supply and transplant candidate outcomes. While the pandemic continues, outcomes of donors and recipients alike must be closely monitored, especially in areas experiencing local disease resurgences. Additional study and consensus building are needed to determine whether individuals who have recovered from COVID-19 may safely donate, to define guidance for safe KPD, and to inform optimal logistical procedures for donors who live distant from the donor recovery center. Careful development of guidance and protocols to minimize risk, balanced for feasibility and practicality for donors, is vital to enabling programs to reopen safely and to continue LDKT while COVID-19 persists in our communities. As donor centers embrace the challenge of allowing LDKT to recover, efforts to develop, update, and follow best practices must be sustained throughout the pandemic to ensure that living donation and LDKT remain as safe as possible, and serve and support the best outcomes of donors and their recipients.

DISCLOSURE

All the authors declared no competing interests.

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DATA AVAILABILITY STATEMENT

Data availability is limited to aggregate summaries as reported, based on IRB requirements.

SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Table S1. Survey instrument.

Figure S1. Flowchart of representative survey response selection.

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