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TRANSPLANT INFECTIOUS DISEASE

ORIGINAL ARTICLE

Effect of age and rural residency on perceptions about SARS-CoV-2 pandemic and vaccination in kidney transplant recipients

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Abstract

Background: Transplant patients have poor outcomes in coronavirus-disease 2019 (COVID-19). The pandemic's effects on rural patients' overall care experience, attitudes to telemedicine, and vaccination are poorly understood.

Methods: We administered a cross-sectional survey to adult kidney transplant recipients in central Pennsylvania across four clinical sites between March 29, 2021 and June 2, 2021. We assessed the pandemic's impact on care access, telemedicine experience, attitudes toward preventive measures, vaccination, and variation by sociodemographic variables.

Results: Survey completion rate was 51% (303/594). Of these, 52.8% were rural residents. The most common impact was use of telemedicine (79.2%). Predominant barriers to telemedicine were lack of video devices (10.9%), perceived complexity (5.6%), and technical issues (5.3%). On a 0–10 Likert scale, the mean positive impression for telemedicine was 7.7; lower for patients with telephone-only versus video visits (7.0 vs. 8.2; $p < .001$), and age ≥60 years (7.4 vs. 8.1; $p = .01$) on univariate analyses. Time/travel savings were commonly identified (115/241, 47.7%) best parts of telemedicine and lack of personal connection (70/166, 42.2%) the worst. Only 68.9% had received any dose of COVID vaccination. The vaccinated group members were older (58.4 vs. 53.5 years; $p = .007$), and less likely rural (47.8% vs. 65.2%; $p = .005$). Common themes associated with vaccine hesitancy included concerns about safety (27/59, 46%), perceived lack of data (19/59, 32%), and distrust (17/59, 29%). At least one misconception about the vaccines or COVID-19 was quoted by 29% of vaccine-hesitant patients.

Conclusions: Among respondents, the pandemic significantly impacted healthcare experience, especially in older patients in underserved communities. COVID-19 vaccination rate was relatively low, driven by misconceptions and lack of trust.

KEYWORDS
COVID, COVID vaccine, kidney transplant, SARS-CoV-2, telemedicine, transplant, vaccine hesitancy

1 | INTRODUCTION

The SARS-CoV-2 pandemic has had devastating consequences for kidney transplant recipients. Across multiple countries, coronavirus-disease 2019 (COVID-19) has been associated with high infection rates, morbidity, and mortality among kidney transplant recipients over the past 2 years.[1] Moreover, this time period has been notorious for significant disruptions in access to healthcare. In a national survey, nearly 32% of US adults reported avoiding routine medical care during the pandemic.[2] An analysis of insurance claims through August 2020 showed that patient access and adherence to chronic medications could be adversely affected. Although this study found that there appeared to be increased adherence with tacrolimus, a manufacturer shortage of generic tacrolimus occurred during this time.[3] The patient-level impact of this disruption in healthcare and medication access remains poorly understood in transplant patients, especially in rural areas.

Although messenger RNA (mRNA)-based vaccines were found to be safe in transplant recipients, only 30%–40% develop a protective immune response after 4 weeks of receiving two doses.[4] Humoral response rates improved close to 70% after 4 weeks of receiving a third dose of the vaccine.[5] Recognizing this phenomenon, the Centers for Disease Control and Prevention (CDC) issued recommendations for administering three doses of mRNA-based vaccines to transplant recipients followed by a booster dose.[6] Unfortunately, a significant level of vaccine hesitancy has been detected in many US adults throughout the pandemic. Despite improving confidence in vaccines, younger, less educated adults in nonmetropolitan areas are less likely to express an intent to be vaccinated. This difference remains significant even among adults with underlying medical conditions.[7] The identified reasons for vaccine hesitancy included safety or efficacy concerns, lack of trust in government, and concerns about speedy vaccine development. Attitudes about COVID-19 vaccination have not been well studied in kidney transplant recipients, especially those residing in rural areas.

Using a validated survey instrument, we surveyed a predominantly rural sample of kidney transplant recipients to assess the impact of the pandemic on their healthcare and their beliefs and attitudes toward COVID-19 vaccination.

2 | MATERIALS AND METHODS

2.1 | Design, setting, and participants

We performed a cross-sectional survey of adult kidney transplant recipients in central Pennsylvania followed by the Geisinger Kidney Transplant program across four clinical sites. Patients received an invitation to participate in this survey through the patient portal linked to their electronic medical record between March 29 and April 9, 2021. Patients were initially contacted by email and follow-up phone calls were done. Patients who did not have access to their patient portal or preferred not filling out the survey over the internet were provided the option to complete the survey by telephone call. Survey responses were collected through June 2, 2021. Our research protocol was reviewed and considered exempt from review by the Geisinger Institutional Review Board (study number: 2020-1098).

2.2 | Survey instrument

Our survey included questions from the previously piloted Psychological Impact of COVID-19 survey (https://tools.niehs.nih.gov/dr2/index.cfm/resource/22587), as well as additional questions specific to telehealth and kidney transplantation that were developed by our group by developing consensus across authors from four transplant centers. A copy of the survey is included in the Supporting Information section.

2.3 | Statistical analysis

Survey results were arranged into descriptive categories, including respondent characteristics, pandemic impact on access to care, patient telemedicine experience, and patient attitudes toward COVID-19-preventive measures, including vaccination. Mean and standard deviation (SD) were calculated for responses to questions, including numerical Likert scales. Free text responses were carefully reviewed and assigned themes by one of the study investigators (GS) to better characterize themes within qualitative data. We used addresses geocoded to census tracts to classify participants' communities as rural, suburban/small town, lower density urban, and higher density urban areas. This community classification, developed by the CDC Diabetes Location, Environmental Attributes, and Disparities Network has the goal to minimize within-category variation and maximize between-category variation in urban areas surrounded by rural areas like central Pennsylvania.[8] We compared perceptions of the pandemic, telemedicine, preventive measures, and vaccination by age, community type, and telemedicine modality, using chi-square tests and unpaired *t* tests for categorical and continuous variables, respectively. All statistical analyses were performed using STATA/MP 15.1 (College Station, TX).

3 | RESULTS

A total of 594 kidney transplant recipients followed at our center were invited to participate in the survey. Out of these, 303 (51%) responded and completed the survey. A total of 224 (74%) patients finished the survey online and 79 (26%) patients were surveyed using telephone call. Respondent characteristics are aggregated in Table 1. Mean age of the respondent cohort was 57 years with SD 15, and mean time from kidney transplantation was 88 months (SD 83). Calcineurin inhibitors (84.5%) and antimetabolites (69.3%) were the most used immunosuppression agents. More than half of the patients (52.8%) lived in rural areas; 23.8% lived in suburban areas or small towns, and 20.4% lived in urban areas.

TABLE 1 Respondent characteristics: 303 respondents

Characteristic	Value
Age at survey close, years, mean (SD)	57 (15)
Concurrent organ transplants, *n*	
Liver	6
Lung	3
Pancreas	2
Stem cell	1
Time since last kidney transplant, months mean (SD)	88 (83)
Immunosuppression, *n* (%)	
Calcineurin inhibitor	256 (84.5%)
Antimetabolite	210 (69.3%)
Belatacept	50 (16.5%)
Steroid	29 (9.6%)
mTOR inhibitor	20 (6.6%)
Area of residence, *n* (%)	
Rural	160 (52.8%)
Suburban/small town	72 (23.8%)
Lower density urban	38 (12.5%)
Higher density urban	24 (7.9%)
Unknown	9 (3%)

Abbreviation: SD, standard deviation.

The perceived impact of the pandemic in summarized in Table 2. Nearly 11% patients reported problems receiving their immunosuppressants. The most common reported reason was that pharmacies did not have generic tacrolimus available (n = 31). Two patients reported that they could not receive belatacept due to infusion center closure. In most of these patients, access to immunosuppression could be restored by changing pharmacies, tacrolimus formulation, dose of prescription, or immunosuppression. Two patients reported rationing tacrolimus pills. Largely, patients (96%) did not report disruption in getting transplant-related labs drawn. Only 9% patients reported issues with transplant care access, mostly due to problems with response to calls or patient portal messages. Nine patients (3%) canceled their transplant appointments due to fear of COVID-19 exposure. Most patients (79.2%) were able to switch to telemedicine, with no difference between rural (78.8%) and non-rural participants (80.3%) (Table S1). More than 25% reported issues with telemedicine. These largely centered around lack of video devices (11%) and perceived complexity, technical, or internet problems (11%). Only seven patients (2%) expressed a strong preference for in-person visits.

Among the 240 respondents who switched to telemedicine visits, the experience is summarized in Tables 3 and S2. Roughly 1/3 of telemedicine users received visits using telephone alone (no video). The overall patient impression appeared to be positive: mean 7.7, SD 2.4, on a 0–10 Likert scale (10 = highest rating), with no difference between rural and non-rural respondents (7.8 vs. 7.8; p = 1.0). Individuals who only accessed telemedicine via telephone were less favorable to telemedicine, compared to individuals who accessed telemedicine using televideo or a combination of televideo and telephone (7.0 vs. 8.2; p = .0003). Individuals ≥60 years of age viewed telemedicine less favorably than those <60 years of age (7.4 vs. 8.1; p = .01). Nearly half of the patients stated that the best part was saving travel or time. A third of the patients cited convenience or improved access, and avoidance of COVID-19 exposure as the best part. A total of 166 of 240 telemedicine users reported some poor experiences with telemedicine. Of these, 70 perceived a lack of personal connection during the visit, 42 had technical challenges, 39 were concerned about the lack of physical examination, and 21 cited poor communication.

Attitudes of 299 kidney transplant recipients to COVID-19 preventive measures are summarized in Tables 4 and S3. Only 68.9% had received one or both doses of the COVID-19 vaccine at the time of the survey. Those who were vaccinated were older than those who were unvaccinated at the time of the survey (58.4 vs. 53.5 years; p = .007) and less likely to live in rural areas (47.8% vs. 65.2%; p = .005). Willingness to get vaccinated was also lower for those living in rural areas compared to non-rural areas (7.9 vs. 8.8; p = .02). Self-reported adherence to non-pharmaceutical measures was high overall: social distancing (mean 8.2 [SD 2.3], on 0–10 Likert scale; 10 = an extreme amount) and face mask wearing (mean 9.3 [SD 1.9], on a 0–10 Likert scale; 10 = regularly). Those who were vaccinated were more likely to also follow social distancing (8.6 vs. 7.1; p < .0001) and masking (9.6 vs. 8.6; p < .0001), compared to those who were unvaccinated. Respondents older than 60 years of age were more likely to follow social distancing (8.5 vs. 7.8; p = .003) and tended to be more likely to mask (9.5 vs. 9.1; p = .08). Many participants reported feeling isolated: often (13.2%), some of the time (46.0%), hardly ever (40.9%) with corresponding levels of distress reported (often isolated [mean distress 5.8 on 0–10 Likert scale; 10 = extremely distressed]), some of the time (mean 4.3), hardly ever (3.0). Of the 93 unvaccinated transplant patients, there was great variability in willingness to be vaccinated (median 5; interquartile interval 1–9 on 0–10 Likert scale; 10 = very willing).

A total of 59 respondents indicated their reasons for unwillingness to be vaccinated. These multi-choice responses are summarized in Figure 1 and illustrative quotes are included in Table S4. Nearly half (27 patients) were concerned about vaccine side effects. Other common themes included a perception of lack of data in transplant patients (19 patients), lack of long-term data (17 patients), not trusting vaccines (13 patients), concerns about rapid vaccine approval (9 patients), and beliefs about lack of vaccine efficacy (7 patients). Fewer number of patients indicated a political or anti-government stance (five patients), desire for another formulation (three patients), transplant physician approval (three patients), or concerns about medication allergies (three patients). Misconceptions like vaccines causing COVID-19 (three patients), or disbelief in risk from COVID-19 (two patients), were less common. Religious beliefs against vaccination were cited by only two patients. Overall, 17 of the 59 respondents (29%) cited at least 1 of 4 misconceptions: Vaccines cause COVID-19, the approval was too fast, vaccines do not prevent COVID-19, or COVID-19 fears are exaggerated. A total of 19 of 59 (32%) reported problems with trusting vaccine data, the government, political distrust, or the vaccine

TABLE 2 Impact of the pandemic on access to care among 303 respondents

Impact	*N* (%)	Details
Problems with receiving immunosuppressants	**33 (10.9%)**	
Reason		Pharmacy didn't have tacrolimus (*n* = 31) Infusion center for belatacept closed (*n* = 2)
Management		Changed pharmacies (*n* = 18) Changed pharmacy and tacrolimus formulation (*n* = 6) Changed tacrolimus formulation or dose (*n* = 5) Changed infusion center (*n* = 2) Rationed tacrolimus pills (*n* = 2)
Delayed/unable to get transplant labs	**12 (4%)**	Worried about COVID-19 exposure (*n* = 5) Lab appointments restricted (*n* = 3) Issues with transportation (*n* = 3) Lab closed due to pandemic (*n* = 1)
Issues with transplant care access	**26 (8.6%)**	Slow/inadequate response to queries (*n* = 10) Canceled appointments due to fear of COVID-19 exposure (*n* = 9) Appointments not available (*n* = 5) COVID-19 infection precluded care (*n* = 2)
Switched to telemedicine	**240 (79.2%)**	Video visit (*n* = 74) Both video and telephone visits (*n* = 87) Telephone visits (*n* = 79)
Issues with telemedicine (among those who switched)	**77 (25.4%)**	No video device available (*n* = 33) Video visit too complicated to do (*n* = 17) Internet/technical problems (*n* = 16) Prefer in-person visits (*n* = 7) Schedule conflicts/late calls (*n* = 4)

Abbreviation: COVID-19, coronavirus-disease 2019.

TABLE 3 Telemedicine experience in patients who completed telemedicine visits

Positive impression on 0–10 Likert scale: (*n* = 240)	**Mean (SD)**
All respondents	7.7 (2.4)
Had video visits only (*n* = 74)	8.3 (2.1)*
Had both video and phone visits (*n* = 87)	8.1 (2.2)*
Had phone visits only (*n* = 79)	7.0 (2.6)*
Best part of telemedicine: (*n* = 241)	***N* (%)**
No need to travel/saves time	115 (47.7%)
Convenience/improved access	82 (34%)
Avoided COVID-19 exposure	79 (32.8%)
Improved communication	27 (11.2%)
Scheduling convenience	13 (5.4%)
Worst part of telemedicine: (*n* = 166)	***N* (%)**
Lacking personal connection	70 (42.2%)
Technical challenges	42 (25.3%)
Lack of physical examination	39 (23.5%)
Poor communication	21 (12.7%)
Didn't like format/personal preference	15 (9%)

Abbreviations: COVID-19, coronavirus-disease 2019; SD, standard deviation.
*$p = .0003$ for comparison of video/both versus phone visits only.

approval process. These two beliefs overlapped in only four patients. Hence, a total of 32 respondents (54%) cited either a lack of trust or a vaccine-related misconception as their reason to not accept the vaccine.

4 | DISCUSSION

Our study adds valuable understanding of the impact of the SARS-CoV-2 pandemic, patient perceptions of care, and attitudes toward vaccination in a predominantly rural kidney transplant recipient population. This population is at high risk and under-represented in many COVID-19 studies.[9] There are unique challenges for transplant patients in this pandemic, including potential concerns about how vaccination affects kidney transplant, how to manage immunosuppression in the setting of infection, and vaccine effectiveness.

There have been a few studies examining COVID-19 outcomes in the transplant population. In a systematic review and meta-analysis of 202 such patients, immunosuppression maintenance and tacrolimus continuation were independent predictors of survival.[10] More than 1 in 10 of our survey respondents reported encountering challenges with receiving immunosuppressants. However, most were able to work with their transplant program to overcome these obstacles. Despite a predominantly rural population, less than 10% patients reported problems with laboratory access or access to their transplant team. This

TABLE 4 Attitudes toward coronavirus-disease 2019 (COVID-19) preventive measures (299 respondents)

Preventive measure	Adherence rate
Receipt of COVID vaccine, *N* (%)	
Overall	206 (68.9%)
One dose	45 (15.1%)
Both doses	161 (53.8%)
Types of vaccine received, *N* (%)	
Pfizer	87 (42.2%)
Moderna	119 (57.8%)
Social distancing over past 6 months (0–10 Likert scale), mean (SD)	
Overall	8.2 (2.3)
Vaccinated	8.6 (1.7)*
Unvaccinated	7.1 (3.0)*
Wearing face mask over past 6 months (0–10 Likert scale), mean (SD)	
Overall	9.3 (1.9)
Vaccinated	9.6 (1.3)*
Unvaccinated	8.6 (2.7)*
Willingness to get vaccinated among the 93 unvaccinated respondents (0–10 Likert scale), median (interquartile range)[a]	5 (1–9)

Abbreviation: SD, standard deviation.

[a]Median and inter-quartile range reported due to variability.

*$p < .0001$ for comparison.

demonstrates that transplant programs can effectively use communication and innovation to overcome pandemic-related challenges.[11] For instance, our transplant center has been offering telemedicine appointments to all transplant patients. Transplant coordinators and physicians have worked with regional pharmacies and labs to ensure continued access to medical testing and immunosuppressants.

Prior to this pandemic, a cross-sectional study on 1.1 million patients showed that older patients were almost 75% less likely to choose telemedicine over in-person visits.[12] Older, underserved, non-English speaking patients have continued to face barriers to telemedicine use during the pandemic.[13] Our study furthers the understanding of perceptions of telemedicine amongst transplant patients. Nearly 80% of our respondents had switched to telemedicine to receive care. However, one in four reported issues like lack of access to video, perceived complexity, and technical problems. Although the overall impressions were positive, younger patients, those with access to televideo (compared to telephone only), and those residing in higher density urban areas clearly viewed telemedicine more favorably. Potential solutions to mitigate these disparities include engaging care partners, investment in technology/internet, and use of telemedicine to supplement rather than supplant in-person visits.[14] Distribution of video-enabled tablets have previously been shown to significantly improve preference for telemedicine visits among veterans.[15] Studies examining the impact of implementation of these strategies in transplant patients and the overall population are sorely needed and may identify effective interventions to improve the accessibility and perception of telemedicine.

Positive associations with telehealth previously identified in a qualitative study of 30 CKD patients include convenience, lower cost, perceived safety, and efficiency.[13] Similar trends emerge among

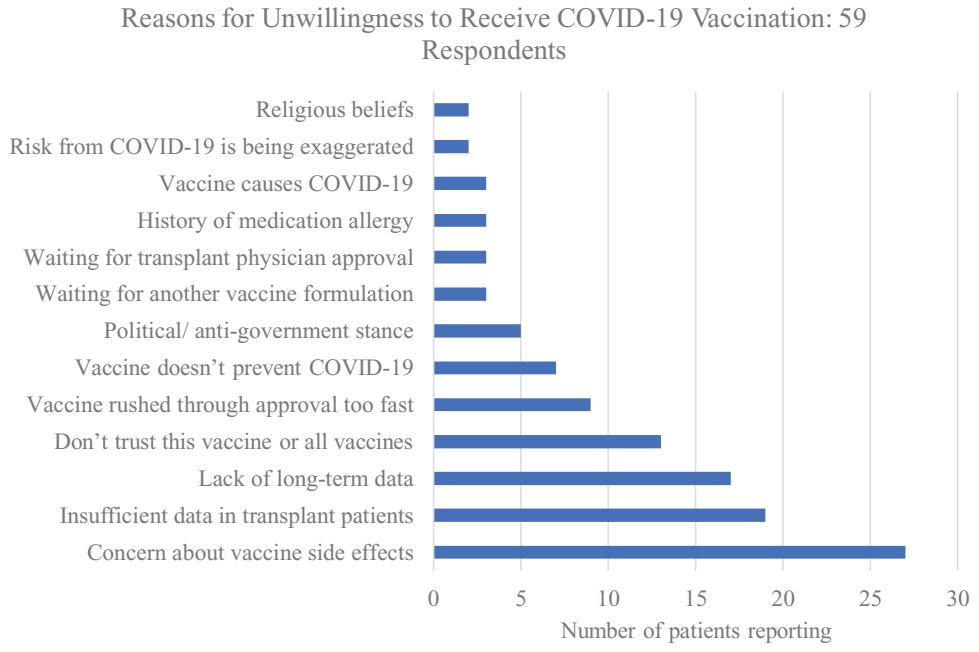

FIGURE 1 Reasons for unwillingness to receive coronavirus-disease 2019 (COVID-19) vaccination: The reasons are listed along the *y*-axis and the number of patients reporting each reason along the *x*-axis.

transplant patients in our study. Almost half of 241 respondents identified time/travel savings as the best part of telemedicine. Like the CKD patients, transplant patients also cited convenience and COVID-19 safety as positive factors. More than 1 in 10 felt that telemedicine improved healthcare communication. Major barriers to telemedicine identified were again similar to CKD patients: deficient personal connection, technical challenges, and lack of physical examination.[13] Further qualitative studies are required in transplant patients to identify components of effective communication that can then be generalized regardless of the platform of care delivery. To supplement physical examination during telemedicine interactions, mobile robotic systems were perceived to be acceptable by a national sample of 1154 respondents. Among the 41 patients who actually experienced telemedicine utilizing the robotic system in an emergency setting, 92.5% reported a satisfactory interaction and 82.5% considered it similar to an in-person interview.[16] It remains to be seen whether such systems can supplement telehealth examination and sense of personal connection outside an emergency setting.

A number of studies have shown that antibody response to vaccination is impaired in individuals with solid-organ transplants, and that a third dose of mRNA vaccines can be helpful in improving initial immunogenicity in this population.[4,5] Although this study was conducted relatively early on with respect to the release of this information, a substantial proportion of patients raised concerns about vaccination, including concerns about side effects, lack of trust in vaccines, and mention of reasons that are often cited in social media misinformation. Individuals who were unvaccinated also had less favorable opinions about social distancing and masking. These findings highlight the continued need to provide ongoing guidance and education about vaccination, non-pharmacologic preventive measures, and interpretation of latest evidence with this vulnerable population. About 5% of our respondents with vaccine hesitancy were waiting on their transplant physician recommending it, underlining the critical role transplant programs can play in this process. Physician recommendation has recently been recognized as an important determinant of COVID-19 vaccination likelihood in a CDC analysis of more than 340 000 US adults.[17]

Information on attitudes about COVID-19 is available in the general population and can be considered for extrapolation. In an online survey of nearly 2000 Canadian adults in April–May 2020, 62% perceived COVID-19 to be a serious health problem. Overall, 45.2% people felt the pandemic was stressful. Overall, 48.5% of respondents reported decreases in social health and 39.1% in mental/emotional health. Overall, 75.6% reported trusting news-based television, print, or websites.[18] Contrary to this, most respondents in the Middle East report relying on medical staff for COVID-19-related information, followed by social media.[19] Considering the major role that distrust of the government, medical personnel, and public health authorities is playing in vaccine hesitancy, there is need for further investigation into the underlying causes of these geopolitical differences in trustworthiness. A better understanding of factors underlying the distrust of public health authorities in developed countries will help in designing interventional studies to alleviate it.

Perception of a greater risk from COVID-19 has been associated with protective behavior implementation. In a nationally representative US sample of nearly 6700 people, every quartile of increase in perceived risk of infection was associated with an increase in protective behaviors.[20] Early surveys in New York City and Los Angeles showed a widespread public support of preventive measures, ranging between 75% and 90%.[21] Longitudinal assessment in an ongoing 7700 US resident panel showed evidence of decrease in adherence to 16 evidence-based COVID-19 protective measures over time.[22] Findings from our cohort align with this observation as adherence to social distancing, masking, and vaccination were relatively high for the time in which we administered the survey. Moreover, older patients and those who were vaccinated were more likely to follow social distancing and masking. Older age was identified as higher risk in COVID-19 early in the pandemic and has been well accepted by the public as a marker of increased risk.[23] The distrust associated with subsequent announcement of risk factors, mitigation efforts, and vaccination remains poorly explained.

Public misconceptions about COVID-19 are rampant, fueled by falsehoods circulating on social media. In a convenience sample of nearly 6000 US and UK adults, less than 40% believed that wearing face masks is protective. Other misconceptions included estimates of mortality risk, risk among children, and risk posed by people of East Asian ethnicity.[24] Although convenience online health surveys provide valuable information, they have methodological limitations that may muddy the picture.[25] A global survey that tried to avoid coverage bias and included respondents from 19 countries showed that only 75.4% of American respondents were interested in taking a COVID-19 vaccine even if it was proven safe and effective.[26] This leaves a significant proportion of the population unprotected and vulnerable to this pandemic. A survey of 473 Australian kidney transplant patients done slightly before ours showed that 73.1% patients planned to receive the vaccine.[27] On the other hand, a survey of 1308 solid organ transplant recipients in the United States in November 2020 showed that almost half were unwilling or unsure about the vaccine.[28] Our study, performed after more information and guidance was available about transplant patients, indicates some progress has been made. In a previously understudied rural population, nearly 70% kidney transplant recipients had received at least one vaccine. However, vaccine hesitancy still remains extensive, and our study identifies that older and rural transplant patients should be a target population to dispel myths and disinformation. Although limited rural health infrastructure and vaccine availability remain valid concerns, an analysis of 2689 counties showed that origins of vaccine hesitancy in rural areas are complex and rooted in political beliefs, educational attainment, and predominant economic activity.[29]

A few limitations constrain the generalizability of our study. Surveying kidney transplant recipients from central Pennsylvania may not be representative of the overall transplant population. However, we had a relatively high response rate of 51%, which may reflect how impactful the pandemic has been to this vulnerable population. Other COVID surveys have had much lower response rates, as low as 35% in some studies.[30] Despite this, we cannot rule out sampling error and

selection bias due to nonresponse or predominance of online versus phone responses. The potential for selection bias is somewhat mitigated by the fact that our respondents and nonrespondents were similar in terms of mean age (57 vs. 55 years; $p = .14$) and rural residency (53% vs. 52%; $p = .76$). Another limitation was that we only surveyed patients at one timepoint and did not survey a non-transplant control population. It could be argued that knowledge and behaviors of these patients may have evolved since that time. Moreover, recall bias may affect answers to behavior over the past 6 months (such as masking and social distancing). Given the complexity of rapid information flow affecting behaviors, it can be hard to deduce whether these behaviors remained consistent over this entire time period. Similarly, the phased vaccine rollout, evolving recommendations, and supply constraints may have affected public messaging and attitudes toward vaccination. Regardless, given the paucity of patient-level COVID-19 data in rural transplant recipients, we believe that this study adds significantly to our understanding of the perceptions and values of this vulnerable population. It shows that transplant patients, despite being highly engaged and exposed to healthcare professionals, are equally susceptible to misconceptions and disinformation. Our results might assist in designing further studies into analyzing public policy, perceptions, focus of communication, and encouraging vaccine uptake in rural areas, especially as the pandemic affects increasingly rural areas.[31]

In conclusion, our cross-sectional survey of predominantly rural kidney transplant recipients showed significantly perceived impact of the pandemic on access and experience of healthcare, especially in older patients in underserved communities. COVID-19 vaccination rate was relatively low for this high-risk population, driven by misconceptions and lack of trust.

AUTHOR CONTRIBUTIONS

Gurmukteshwar Singh: conceptualization, analysis, initial manuscript draft, and manuscript revision.

Bekir Tanriover: conceptualization, survey design, methodology, and manuscript revision.

Joseph DeWalle: data acquisition and statistical analysis.

Neeraj Singh: conceptualization, survey design, methodology, and manuscript revision.

Alex R. Chang: conceptualization, operationalization, statistical analysis, initial manuscript draft, manuscript revision, and supervision.

Prince M. Anand: conceptualization, funding, operationalization, manuscript revision, and supervision.

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CONFLICT OF INTEREST

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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