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Outcomes of Novel Coronavirus 2019 in Solid Organ Transplant Recipients: Yet Again, Race Matters

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Abstract

Background: The Coronavirus 2019 pandemic has posed a particular challenge for transplant programs across the world as little was understood regarding how the virus would affect immunocompromised hosts. In addition it was unclear if race and socioeconomic status affected hospitalization rates.

Methods: We describe a cohort of 25 solid organ transplant recipients (SOTR) within a single-center who were subsequently hospitalized for COVID-19 infection. In addition, we compared baseline characteristics of our cohort with all of our transplants from 1/2/2015 until 11/5/2020.

Results: Transplant recipients infected with COVID-19 have many comorbidities (96% with hypertension, 60% with heart failure or ischemic heart disease, and 60% with diabetes). Overall SOTR patients frequently presented with AKI (44%), frequently required ICU stay (52%), and frequently required intubation (36%). We discovered a statistically significant racial disparity in COVID-19 infection in minorities within our cohort compared to our baseline transplant recipient population.

Conclusion: Transplant recipients tended to have more atypical symptoms such as diarrhea and tolerated a stepwise reduction of immunosuppression. Solid organ transplant recipients – particularly minorities and low income patients– may benefit from additional COVID-19 precautions such as earlier access to vaccination.

Introduction

By the early spring of 2020, the United States has become the global epicenter of the coronavirus 2019 (COVID-19) pandemic [1-3]. Little was understood about how the SARS-COV-2 virus affects immunocompromised hosts, offering a significant challenge in the care of SOTRs.

The diagnosis and management of COVID-19 is quite variable throughout the US. There is a paucity of data regarding the accuracy of RT-PCR testing [4-8]. The role of antibody testing and the level of immunity conferred by these antibodies are unclear [3]. Imaging on CXR is often normal, though newer studies suggest CT may be more sensitive [9]. This has led our group to use CT chest as an integral part of ruling out COVID infection in donors and potential recipients based on our recently published algorithm [10]. As for COVID-19 specific treatment, directed therapy such as tocilizumab, hydroxychloroquine, remdesivir, steroids, and convalescent plasma have unclear benefit in transplant recipients [8-9].

At our institution we have identified a cohort of 25 solid organ transplant who were symptomatic and hospitalized for COVID-19 infection. Our aim was to describe the presentation of COVID-19, the results of our diagnostic testing and labs, the management and the outcomes of these immunocompromised post-transplant patients.

Methods

Using our electronic medical record, the solid organ transplant inpatient census was filtered to identify COVID positive transplant recipients. In total, 25 solid organ transplant recipients (18 kidney, 2 liver/kidney, 2 liver, 2 heart, and 1 lung transplant) were identified with SARS-CoV2 infection from March 19th, 2020 until July 14th, 2020 at Baylor St Luke's Medical Center in Houston, Texas. Institutional review board approval was obtained for the drafting of this manuscript under protocol H-22045 and H43113.

We then catalogued their hospitalization course to include changes in immunosuppression therapy, need for intensive care, ventilator support, additional treatment for COVID-19 including directed therapy such as tocilizumab, hydroxychloroquine, remdesivir, steroids, and convalescent plasma and report their outcomes.

We compared baseline characteristics of our COVID-19 infected cohort with the pre-pandemic transplant population by querying all transplants at our center from 1/2/2015 until 11/5/2020. In total 1643 solid organ transplants were identified. Payor status was listed in 1640 of the 1643 patietns and race/ethnicity was listed in 1633 of 1643 of patients.

Statistical analysis

Fisher exact test was used to compare patient characteristics (race/ethnicity and payor status) between the pre-pandemic cohort and our COVID positive SOTR cohort. For all comparisons p-value < 0.05 indicated statistical significance.

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Results

After diagnosis of COVID-19 by PCR, immunosuppression was either reduced or discontinued. Generally anti-proliferative medications (mycophenolate mofetil or azathioprine) were stopped in all patients. Calcineurin inhibitors or mTOR inhibitors were stopped only for severe cases (i.e. intubated or ICU patients). For the stable hospitalized patients, most of the CNi and mTORi dosages were only modestly reduced or left unchanged. Our Transplant Infectious Disease colleagues were consulted on all patients and managed COVID-19 specific therapies. Treatment modalities included convalescent plasma, hydroxychloroquine, azithromycin, tocilizumab, remdesivir, and steroids.

Kidney transplant case series (n=18):

Of the kidney transplanted patients who were hospitalized for COVID-19 infection, 100% of this cohort have hypertension, 61% have ischemic heart disease or heart failure, and 56% have diabetes. The entire cohort was on a calcineurin inhibitor, 94% were on low dose steroids, and 56% were on an anti-proliferative medication. Their characteristics are listed in Table 1.

Upon admission, patients had a median 4 days of symptoms. 61% of patients presented with fever, 56% had shortness of breath, 39% had diarrhea, 33% had malaise, and 33% had cough. Lab values were significant for elevated CRP (median of 9.9), elevated ferritin (median of 2876), and mild leukopenia (median of 6.15). 44% had AKI on presentation. Chest X-rays were consistent with viral pneumonia in 67% of patients. Non-contrast chest CT was obtained on 9 of 18 patients, all of which were consistent with SARS-CoV2 pneumonia i.e. bilateral ground glass opacities, discoid atelectasis, patchy infiltrates, and streaky opacities. Two of the CT scans that were obtained on admission revealed findings consistent with COVID-19 with a normal appearing CXR. One patient had a CT chest consistent with viral pneumonitis prior to the COVID-19 PCR resulting as positive.

Immunosuppression was weaned in all patients. Anti-proliferative medication was held in most patients except for one patient who remained on room air. Tacrolimus and cyclosporine was weaned or discontinued for most patients. 11 patients required ICU admission. 15 of 18 patients received directed therapy for COVID such as convalescent plasma, hydroxychloroquine, azithromycin, and/or tocilizumab. 6 of 18 patients required intubation and 2 patients subsequently underwent tracheostomy placement. 4 patients remained on room air. Patients received additional COVID-19 PCR testing at the discretion of the primary team, generally weekly. Three patients who converted to a negative PCR test after medical treatment tested positive at a later date. Two of the 18 patients required renal replacement therapy and intubation and eventually died from COVID-19.

Other Solid Organ Transplant Recipients (SOTR), n=7:

The remaining 7 SOTR patients consisted of 2 simultaneous liver/kidney, 2 liver, 2 heart, and 1 lung transplant recipient (Table 2). Of these patients, 86% have hypertension, 57% have heart failure or coronary artery disease, and 71% have diabetes.

Similar to the kidney cohort, 71% presented with fever, cough, and shortness of breath. However, fewer patients had GI symptoms (1 of 7).

Labs were significant for a median WBC of 7, elevated CRP of 6.72, ferritin of 412, and a fibrinogen of 500. 2 of 7 patients had an AKI on presentation. Two of the liver SOTR patients had no changes in their immunosuppression as they were only mildly symptomatic on room air or minimal oxygen via nasal cannula. MMF was stopped on all patients. CNI was reduced or stopped on the remaining patients.

Similar to the kidney SOTR, patients received convalescent plasma (4 of 7) or steroids (4 of 7) if they had respiratory distress or an oxygen requirement.

Both heart SOTR were only minimally symptomatic and were discharged in a few days. One liver SOTR had a hypoxic arrest on oxygen via nasal cannula and subsequently died with multisystem organ failure due to COVID-19.

The dual lung SOTR patient had a very aggressive course with COVID-19. She was intubated on hospital day 4, on high dose vasopressors and 100% FIO2 by hospital day 8 when she died.

Race/ethnicities and payor status of transplant patients infected with COVID-19:

Of the 25 SOTR patients infected with COVID-19 who were admitted for hospitalization, 11 were Black or African American (44%), 10 were White or Caucasian all of whom identified as Hispanic or Latino ethnicity (40%), 3 identified as "other" race (12%), and 1 was Asian (4%) (Table 3).

In terms of payor status, 16 patients had Medicare as their primary insurance, 2 patients had Medicaid as their primary insurance, and 7 patients had commercial/private coverage as their primary insurance (Table 3).

1643 patients were identified as solid organ transplant recipients at our center from 1/2/2015 until 11/5/2020. Of those patients, 39% were non-Hispanic or non-Latino White or Caucasian, 29% identified as Hispanic or Latino ethnicity, and 25% were Black or African American (Table 3). Overall, 38% of those patients had commercial providers as their primary insurance. 56% had primary Medicare coverage, and 7% had primary Medicaid coverage (Table 3).

Overall, there was a significant increase in prevalence of minorities (100%) – that being non-white race or Hispanic or Latino ethnicity -- within COVID SOTR patients compared to our pre-pandemic cohort (61%) using Fisher exact analysis ($P < 0.01$). However there was a non-significant increase in the prevalence of Medicare or Medicaid insurance to 72% from 62% pre-pandemic (p=.4074)

Discussion

The COVID-19 pandemic has significant implications for the transplant community. With the high mortality rate and its predisposition for immunosuppressed patients, our transplant population is at high risk [10-12]. The aim of this study was to compare our transplant population with the general public and to assess our diagnosis and management of COVID positive transplant recipients.

Besides immunosuppression, our cohort of patients have similar risk factors compared to the general public for contracting COVID-19 including hypertension, diabetes, cardiac disease, and obesity [1-3] albeit at a higher rate. In addition SOTR patients tended to have more atypical symptoms such as diarrhea when compared to large observational studies in China (Table 1) [13-15]. Most patients did have elevated CRP, D-Dimer, and ferritin. Future adequately powered studies are needed to see if these acute phase reactants correlate to severity of disease.

Table 1. Kidney Transplant Recipients Hospitalized for COVID-19 Infections

	Kidney Cohort	**Cumulative**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**	**K9**	**K10**	**K11**	**K12**	**K13**	**K14**	**K15**	**K16**	**K17**	**K18**
Patient Characteristics	Race		Black or African American	Black or African American	White or Caucasian	White or Caucasian	Black or African American	White or Caucasian	Black or African American	White or Caucasian	Black or African American	Black or African American	White or Caucasian	Other	Other	Black or African American	Black or African American	Black or African American	Other	White or Caucasian
	Ethnicity		Not Hispanic nor Latino	Not Hispanic nor Latino	Hispanic or Latino	Hispanic or Latino	Not Hispanic nor Latino	Hispanic or Latino	Not Hispanic nor Latino	Hispanic or Latino	Not Hispanic nor Latino	Not Hispanic nor Latino	Hispanic or Latino	Hispanic or Latino	Hispanic or Latino	Not Hispanic nor Latino	Not Hispanic nor Latino	Not Hispanic nor Latino	Hispanic or Latino	Hispanic or Latino
	Sex	11M/7F	F	F	F	F	M	M	M	M	F	M	M	M	F	M	M	M	M	F
	Age	59.5	67	61	53	74	70	61	58	67	43	57	50	49	53	68	38	61	74	58
	BMI on admit	29.86	26.61	31.64	48.4	29.86	26.63	39.31	22.32	34.54	34.5	30.41	25.1	24.05	43.42	28.8	31.02	no data	28.87	21.08
	Primary Payor status		Medicare	Medicare	Medicaid	Medicare	Medicare	Medicare	Medicare	Medicare	Commercial	Commercial	Medicare	Commercial	Medicare	Medicare	Commercial	Medicaid	Medicare	medicare
Comorbidities	Hypertension	100%	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Heart failure or ischemic heart disease	61%	Y	Y	N	Y	Y	Y	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y
	Diabetes	56%	Y	Y	N	Y	Y	Y	N	Y	Y	N	N	N	N	N	N	Y	Y	Y
Presentation	Fever	61%	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	N	Y	Y	Y	N	Y	N
	SOB	56%	N	N	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	N
	Diarrhea	39%	Y	N	N	N	Y	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	N
	Malaise	33%	Y	N	Y	N	N	Y	N	Y	N	N	N	N	N	N	N	Y	N	Y
	Cough	33%	N	Y	Y	Y	N	N	N	N	Y	Y	N	N	Y	N	N	N	N	N
	Duration of Symptoms (days)	4	3	4	4	1	7	7	4	3	2	2	4	4	7	7	14	3	7	4
Imaging Consistent with COVID?	CXR	67%	N HD0	Y HD0	N HD0	Y HD0	Y HD0	Y HD0	Y HD0	N HD0	N HD0	Y HD0	Y HD0	N HD0	Y HD0	N HD0	Y HD0	Y HD0	Y HD0	Y HD0
	CT chest	100%	Y HD3	Y HD2	Y HD4	Y HD0	No CT	No CT	No CT	Y HD0	Y HD4	no CT	no CT	Y HD0	Y HD1	no CT	no CT	Y HD1	no CT	no CT
Labs on admission	WBC	6.15	8.1	1.9	6.1	11.8	5.6	7.5	15.3	4.9	7.2	6.2	13.5	3.4	7.3	3.9	5.8	3.9	10.2	6.1
	Plt	182.5	109	128	300	239	159	139	266	142	265	179	132	186	294	85	273	175	286	199
	AST	33	45	53	24	35	19	21	53	40	22	-	74	29	-	27	59	31	54	14
	ALT	26.5	79	173	17	26	12	24	24	53	27	-	88	17	-	16	54	46	29	10
	Albumin	3.5	3.2	3.1	3.2	3.4	3.2	3.6	3.5	3.9	3.5	-	3.3	4.3	-	3.7	2.9	3.7	3.5	4.2
	Creatinine	2.265	2.26	1.44	1.14	2.27	12.48	2.6	3.39	0.92	1.14	4.42	2.78	1.14	2.33	0.96	2.25	2.81	0.89	2.59
	Creatinine Baseline	1.38	1.7	1.44	1.23	N/A	N/A	1.5	1.4	1.32	1.23	6.08	1.35	1.29	1.36	0.67	1.75	1.4	0.77	2.05
	CRP	9.885	14.64	6.03	-	27.05	14.58	5.59	16.98	9.91	2.36	4.82	14.69	4.36	13.36	-	-	8.98	-	9.86
	Troponin	0.035	0.04	-	-	0.02	0.08	0.03	0.05	0.04	0.01	0.06	0.01	-	0.01	0.01	-	0.21	0.01	0.18
	Ferritin	2876	2994	3374	325	4742	4503	496.9	7948	2758	2539	435.07	6809.63	344	96.64	-	-	5981.67	4532.01	2010.79
	D-Dimer	1.47	1.51	3.23	0.42	6.05	20	1.49	20	0.7	-	-	1.45	0.47	0.89	-	-	1.88	1.34	0.6
	Fibrinogen	574.5	-	-	-	881	-	677	-	-	382	-	-	-	677	-	472	-	-	443
Immunosuppression	CNI	100%	Y, cyclosporine	Y, tacro	Y, cyclosporine	Y, cyclosporine	Y, tacro	Y, tacro	Y, tacro	Y, tacro	Y, tacro	Y, Tacro	Y, Tacro	Y, cyclosporine	Y, cyclosporine	Y, cyclosporine	Y, tacro	Y, cyclosporine	Y, tacro	Y, tacro
	MMF	56%	N	N	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	Y
	mTORi	11%	N	N	N	N	N	N	N	N	N	N	N	N	N	Y, sirolimus	N	Y, sirolimus	N	N
	Steroids	94%	Y, pred 5	Y, pred 10	Y pred 5	N	Y, pred 5	Y, pred 5	Y, pred 10	Y, pred 5	Y, pred 5	Y, Pred 5	Y, Pred 5	Y, Pred 5	Y, Pred 5	Y, Pred 5	Y, pred 10	Y Pred 7.5	Y, pred 5	Y, Pred 5
	Change in immunosuppression	N/A	D/c cyclosporine	Reduce tacro	Reduce Cyclosporine	d/c cyclosporine	Reduce Tacro	Reduce tacro, d/c MMF	D/c tacro and MMF	reduce tacro, d/c MMF	reduce tacro, d/c MMF	Reduce tacro, d/c MMF	Reduce tacro, d/c MMF	Reduce MMF	reduce cyclosporine, d/c MMF	D/c Sirolimus	D/c MMF, reduce tacro	D/c sirolimus	Reduce tacro	D/c tacro and MMF
COVID treatment	Convalescent Plasma	67%	Y	N	N	Y	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
	Stress dose steroids	67%	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
	Tocilizumab	17%	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N
	Hydroxychloroquine	17%	Y	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Azithromycin	17%	Y	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	N
	Remdesivir	11%	N	N	Adaptive trial	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N

Outcomes	Required Dialysis	11%	Y	N	N	N/A, ESRD in transplanted kidney	N/A, ESRD in transplanted kidney	N	Y	N	N	N	N	N	N	N	N	N	N	N
	Supplemental O2		Intubation	Vapotherm	RA	Intubation	RA	Intubation, trach	Intubation	Intubation, trach	Vapotherm	NC	Intubated	RA	Vapotherm	NC	NC	RA	Intubated	Vapotherm
	ICU	61%	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	N	Y	N	N	N	Y	Y
	Death	11%	Y	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N
	Length of Stay	12	47	18	11	41	9	37	5	**57**	30	3	14	6	**13**	**13**	5	4	**8**	**6**

Table 2. Liver, Lung, Heart, and Dual Organ Transplant Recipients Hospitalized for COVID-19 Infection

		Cumulative	**Liver1**	**Liver2**	**Liver3**	**Liver4**	**Heart1**	**Heart2**	**Lung1**
Patient Characteristics	Race		Black or African American	Asian	White or Caucasian	White or Caucasian	White or Caucasian	White or Caucasian	Black or African American
	Ethnicity		Not Hispanic nor Latino	Not Hispanic nor Latino	Hispanic or Latino	Hispanic or Latino	Hispanic or Latino	Hispanic or Latino	Not Hispanic nor Latino
	Sex	4M/3F	M	M	F	M	F	M	F
	Age	63	60	73	58	77	76	63	59
	BMI on admit	31.09	32.6	23.41	30.04	27.88	32.2	31.09	36.61
	Organ		Liver	Liver	Kidney/Liver	Kidney/Liver	Heart	Heart	Lung
	Primary Payor Status		Commercial	Medicare	Commercial	Medicare	Medicare	Medicare	Commercial
Comorbidities	Hypertension	86%	Y	Y	N	Y	Y	Y	Y
	Heart failure or ischemic heart disease	57%	N	Y	N	Y	Y	Y	N
	Diabetes	71%	Y	Y	Y	Y	N	N	Y
Presentation	Fever	71%	Y	Y	Y	N	Y	N	Y
	SOB	71%	Y	N	Y	Y	Y	N	Y
	Diarrhea	14%	N	N	N	N	N	N	Y
	Malaise	29%	N	N	N	Y	N	Y	N
	Cough	71%	Y	N	Y	Y	N	Y	Y
	Duration of Symptoms (days)	4	14	1	1	4	14	7	3
Imaging consistent with COVID?	CXR	71%	Y HD0	Y HD0	Y HD0	N	Y HD0	Y HD0	N
	CT chest	100%	Y HD3	no CT	Y HD0	Y HD0	no CT	Y, HD0	no CT
Labs on Admission	WBC	7	8.7	7	4.2	7	9	4.5	4.3
	Plt	154	209	154	102	166	174	152	113
	AST	27	25	39	17	27	22	32	46
	ALT	22	16	32	33	22	19	26	20
	Albumin	3.9	3.9	4.6	4.1	3.7	3.8	4.7	3.9
	Total Bilirubin	0.6	0.7	0.3	1.5	0.8	0.6	0.5	0.3
	Creatinine	1.32	1.32	4.61	1.14	1.14	0.67	1.84	3.05
	Creatinine Baseline	1.21	1.21	2.33	1.13	1.11	0.75	1.66	1.58
	CRP	6.72	14.6	2.59	6.72	12.17	2.51	6.7	7.01
	Troponin	0.025	0	0.08	no data	0.03	0.02	0.02	0.06
	Ferritin	412.445	577	1010.41	no data	1143.16	157.47	124.58	247.89
	D-Dimer	0.91	0.91	0.98	no data	7.18	no data	0.71	0.84
	Fibrinogen	500	389	215	no data	611	no data	no data	642
Immunosuppression	CNI	86%	Y, tacro	N	Y, tacro	Y, tacro	Y, tacro	Y, tacro	Y, tacro
	MMF	29%	N	N	N	N	N	Y	Y
	mTORi	29%	N	Y, sirolimus	N	N	Y, sirolimus	N	N
	Steroids	14%	N	N	N	N	N	N	Y pred 5
	Change in immunosuppression?		no change	Decr sirolimus	No change	Decr tacro	Decr Tacro and sirolimus	D/c Tacro and D/c MMF	d/c mmf reduce tacro

COVID treatment	Convalescent plasma	57%	Y	N	N	Y	N	Y	Y
	Stress dose steroids?	57%	N	Y	N	Y	N	Y	Y
	Tocilizumab	0%	N	N	N	N	N	N	N
	Hydroxychloroquine	0%	N	N	N	N	N	N	N
	Azithromycin	14%	N	N	Y	N	N	N	N
	Remdesivir	0%	N	N	N	N	N	N	N
Outcomes	Required Dialysis?	0%	N	N	N	N	N	N	N
	Supplemental O2		Nasal cannula	Intubated	RA	NC	NC	NC	intubated
	ICU	29%	N	Y	N	N	N	N	Y
	Death	29%	N	Y	N	N	N	N	Y
	Length of Stay	4	26	1	4	5	3	4	8

Table 3. Race and Socioeconomic characteristics of solid organ transplant recipients (SOTR)

Race Characteristics:	**All SOTR from 2015-2020**	**COVID-19 positive SOTR**
White or Caucasian	1015 (62%)	10 (40%)
Black or African American	408 (25%)	11 (44%)
Other	106 (6%)	3 (12%)
Asian	76 (5%)	1 (4%)
Declined/unable to determine	22 (1%)	0
American Indian or Alaska Native	11 (1%)	0
Native Hawaiian or Other Pacific Islander	5 (0%)	0
Total:	1643	25
Ethnicity of White or Caucasian patients:		
Not Hispanic or Latino	643	0
Hispanic or Latino	372	10
Primary Payor:		
Medicaid	117 (7%)	2 (8%)
Medicare	907 (56%)	16 (64%)
Private	616 (38%)	7 (28%)
Total	1640	25

Imaging was very useful, especially non-contrast CT of the chest. Interestingly 8 of 25 patients infected with COVID-19 did not show any signs of infection on their CXR. However, all PCR confirmed patients who received CT scan revealed viral pneumonia – including three patients who had a normal CXR a few hours prior (Table 3). The potential ability for CT scan to detect COVID-19 pneumonia earlier than CXR has major implications for diagnosing persons of interest for COVID-19 and previous reports have suggested that CT can possibly alert to COVID-19 infection prior to PCR assay [9]. In fact CT chest is part of our institutional protocol to rule out COVID-19 for potential donor and recipient patients in preparation for solid organ transplantation [9-10]. Overall our data is similar to that of other studies characterizing SOT recipients with COVID-19 (AKI 25-50%, ICU stay 20-80%, ventilator support 0-39%, death 0-30%) [16-20]. In addition we hypothesized an increase in mortality in our patient population. However based on our data and propensity matched data from recent cohort studies, mortality is not significantly different. This may be attributed to the persistent immunosuppression in our population as recent studies have shown an improvement in mortality from steroid use [16]. Future studies will be required to fully delineate the role of immunosuppression in the COVID population.

We noticed that there was a large racial and ethnic disparity amongst our patients. The entire cohort consisted of minorities (non-Caucasian race or Hispanic or Latino ethnicity). This prompted our team to examine racial/ethnic characteristics of our baseline transplant population for comparison and found a significant increase in the proportion of minorities in our COVID cohort compared to the pre-pandemic transplant population. This inequality is reflected in previous studies, including one from the CDC showing a 4-5x higher hospitalization rate for COVID-19 infections in Hispanic, African-American, and for American Indian or Alaska Natives compared to Non-Hispanic White or Asian people [12]. In addition, 72% of our infected patients had Medicare or Medicaid as their primary health insurance – compared to our baseline of 62%. This increase was found to be non-significant using Fisher exact analysis, potentially reflecting an underpowered sample size.

Our cohort is from a single center, obtained from a retrospective review with a smaller sample size, which offers its own limitations. We have found solid organ transplant patients had more atypical symptoms such as diarrhea and CT imaging can be more accurate and timely in diagnosis. In regards to clinical management, a stepwise reduction of immunosuppression based on disease severity appears to be a pragmatic mode of care. Furthermore, we too have found that a significant racial disparity exists for African-American and Hispanic transplant recipients becoming infected with COVID-19. While the reasons for these disparities and their influence on health are beyond the purview of this paper the data reinforces what is patently true in the literature -- that race/ethnicity is inextricably tied to one's health outcomes in the United States [21-23]. Yet again, minorities continue to bear the brunt of chronic disease, even after they receive their transplantation.

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Conflicts of interest

We have no conflicts of interest to disclose.

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