

Risk factors and clinical outcomes of kidney transplant patients with COVID-19

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MHS Cases

1,955

3% ↓ from previous day

NYS Cases

196,146

3% ↑ from previous day

US Cases

582,594

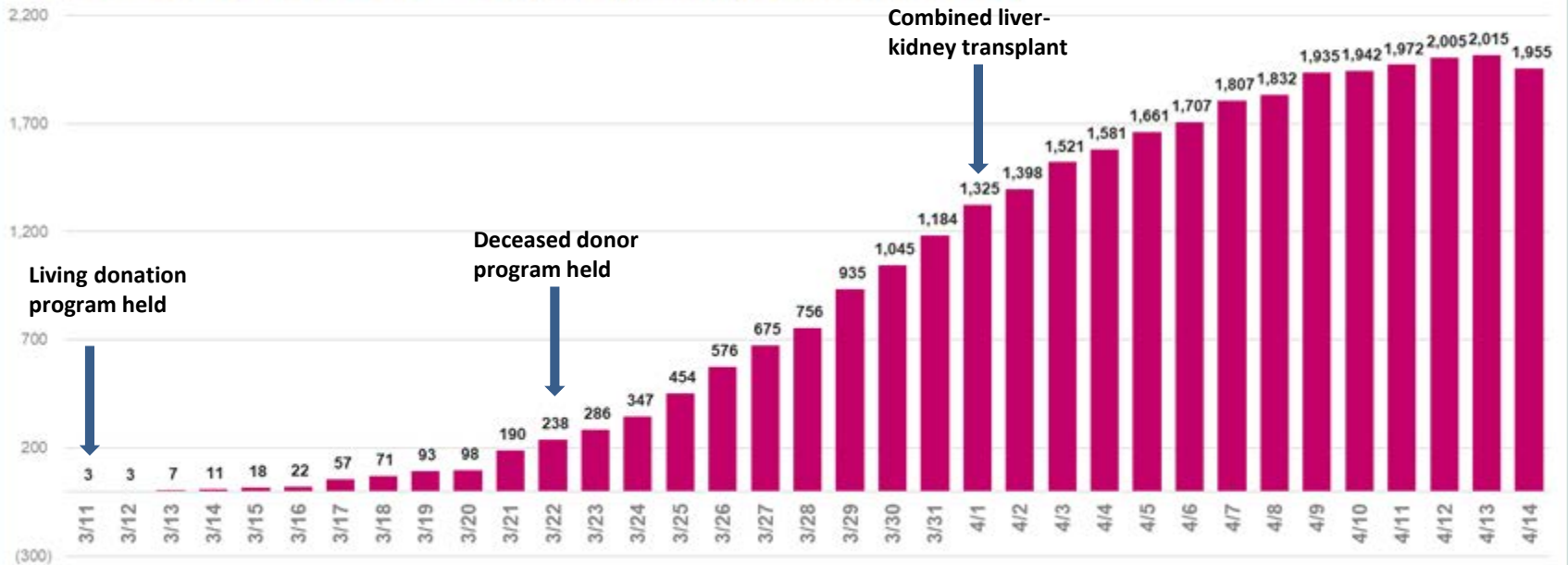
4% ↑ from previous day

Global Cases

1,934,583

4% ↑ from previous day

Total MHS COVID+ Cases (Currently Admitted as of 4/14)



CORRESPONDENCE

Covid-19 and Kidney Transplantation

	Patient Number (%) n= 36
Sex, male, n %	26 (72)
Age in years, median [range]	60 [32-77]
Race, African-American, %	14 (39)
Ethnicity, Hispanic %	15 (42)
Type of renal transplant, deceased donor, %	27 (75)
Anti-thymocyte globulin induction, %	15 (42)
Maintenance immunosuppression, %	
Tacrolimus	34 (97)
Mycophenolate 2g/day	11 (31)
Mycophenolate 1 g/day	16 (44)
Mycophenolate < 1 g/day	4 (11)
Prednisone	34 (94)
Causes of renal disease, %	
Diabetic nephropathy	19 (53)
Glomerulonephritis	8 (22)
Hypertensive nephroangiosclerosis	5 (14)
Others	3 (8)
Comorbidities, %	
Hypertension	34 (94)
Diabetes mellitus	25 (69)
Heart disease	6 (17)
Lung disease	4 (11)
Cancer	2 (6)
Smoking history, %	13 (36)
Influenza vaccination, %	21 (58)
Body mass index (median [range]) kg/m²	29.3 [21.2-43.6]
Use of Angiotensin-II Receptor Blocker, %	8 (22)
Baseline Creatinine (median [range]) mg/dL	1.4 [0.8-6.3]

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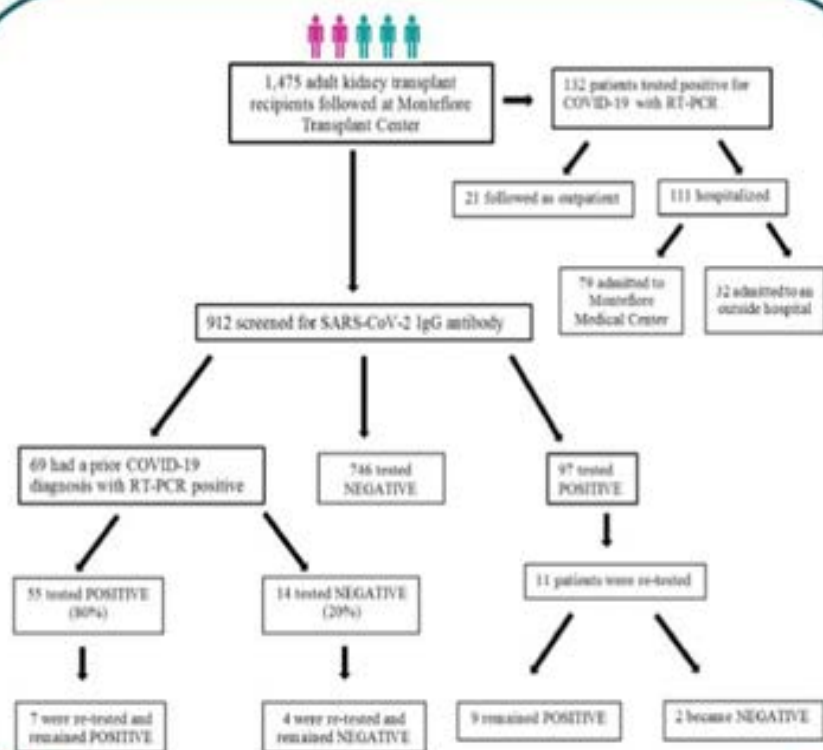
Kidney transplant recipients have increased mortality with COVID-19

- Initial mortality in our kidney transplant recipient was 28% at 3 weeks

Outcomes at a median of 21 days (range, 14–28) — no./total no. (%)	
Death	10/36 (28)
Intubation	11/28 (39)
Death after intubation	7/11 (64)
Renal replacement therapy	6/28 (21)
Remained hospitalized	12/28 (43)
Discharged from hospital	10/28 (36)

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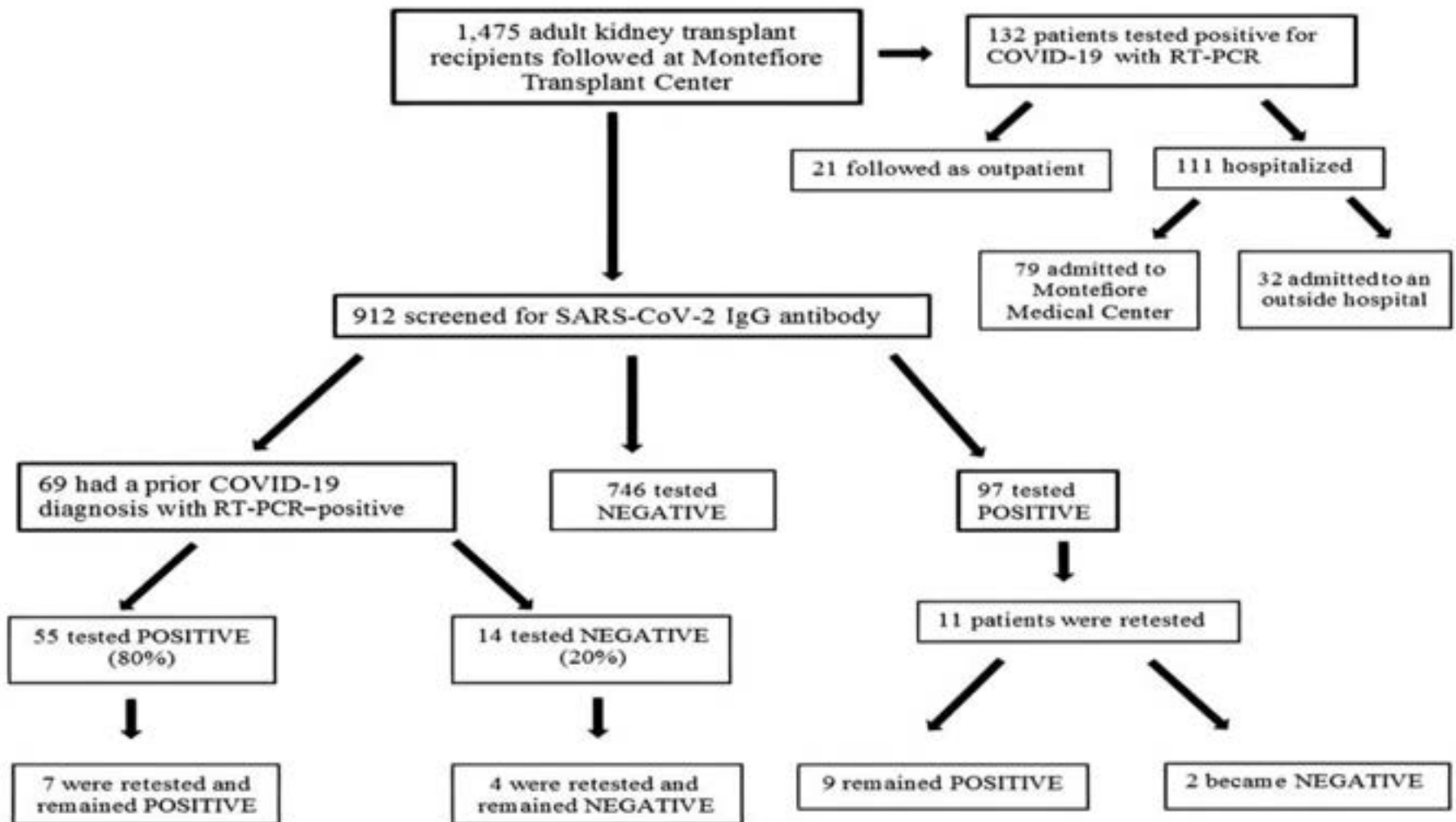
COVID-19 INFECTION IN KIDNEY TRANSPLANT RECIPIENTS AT THE EPICENTER OF PANDEMICS



The prevalence of SARS-CoV-2 infection was 23.4% in the 975 patients tested by either RT-PCR or SARS-CoV-2 IgG. Older patients and patients with higher serum creatinine levels were more likely diagnosed by RT-PCR compared to SARS-CoV-2 IgG.

Overall mortality 20.5%. Mortality in hospitalized patients 37.8%. Older age, receipt of deceased-donor transplant, lack of influenza vaccination in the previous year and higher serum IL-6 levels were associated with mortality.

CONCLUSION: 42% of kidney transplant recipients were SARS-CoV-2 IgG positive without significant symptoms and 80% of kidney patients developed an antibody response after confirmed diagnosis by RT-PCR.



SARS-CoV-2 RT-PCR positive

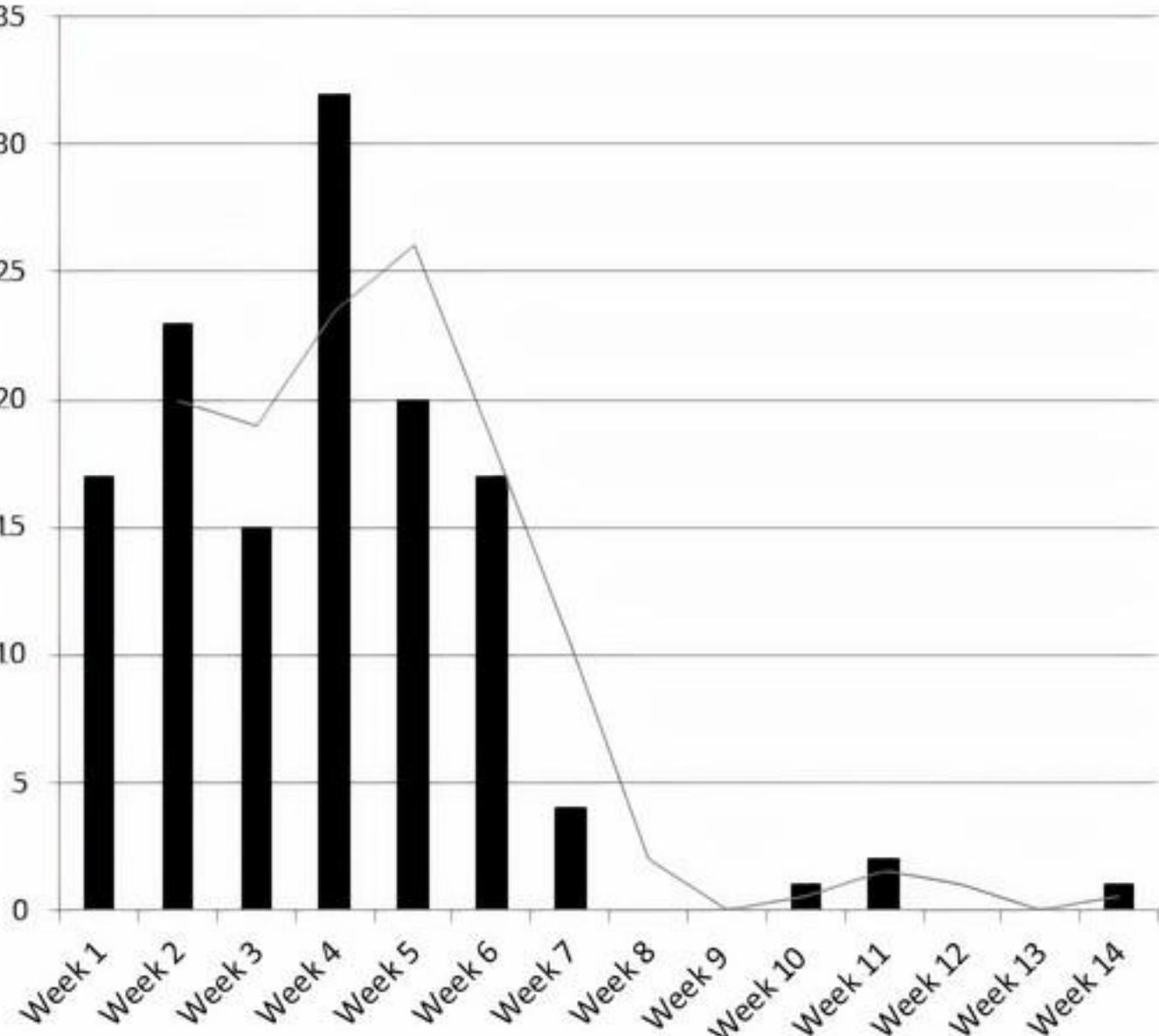





Table 1 | Clinical characteristics of patients by type of COVID-19 diagnosis and mortality

Characteristics	COVID-19 diagnosis				Mortality		
	Total patients (N = 229)	COVID-19 RT-PCR- positive (N = 132)	SARS-CoV-2 IgG antibody-positive (N = 97)	P value	Survivors (N = 182)	Nonsurvivors (N = 47)	P value
Sex				0.84			
Male	141 (62)	82 (62)	59 (61)		113 (62)	28 (60)	0.75
Female	88 (38)	50 (38)	38 (39)		69 (38)	19 (40)	
Age, yr	59 [49–68]	62.5 [51–71]	57 [46–65]	0.0024	58 [46–66]	70 [58–74]	< 0.001
Race				0.87			0.53
Hispanic	125 (55)	74 (56)	51 (53)		74 (56)	51 (53)	
African American	74 (32)	41 (31)	33 (34)		41 (31)	33 (34)	
Other	30 (13)	17 (13)	13 (13)		17 (13)	13 (13)	
Type of transplant				0.039			0.0058
Deceased donor	165 (73)	101 (77)	64 (66)		124 (69)	41 (89)	
Living donor	61 (27)	28 (21)	33 (34)		56 (31)	5 (11)	
Time after transplantation, mo	58.2 [25.4–127.6]	60.8 [20–128.5]	57.7 [28.7–124.6]	0.9	57.7 [27.3–123.7]	65.2 [16.3–134.1]	0.82
Transplantation at <6 mo	13 (7)	9 (9)	4 (4)	0.49	10 (6)	3 (6)	0.21
Transplantation at <12 mo	18 (9)	11 (11)	7 (8)	0.97	13 (7)	5 (11)	0.43
Etiology of ESRD				0.005			
Diabetes mellitus	106 (47)	72 (55)	34 (35)		73 (40)	33 (70)	0.0065
Hypertension	49 (22)	21 (16)	28 (29)		45 (25)	4 (9)	
Glomerulonephritis	52 (23)	23 (18)	29 (30)		44 (24)	8 (17)	
Polycystic kidney disease	9 (4)	2 (2)	7 (5)		8 (4)	1 (2)	
Others	12 (5)	8 (6)	4 (4)		11 (6)	1 (2)	
Body mass index, kg/m ²	28.5 [24.2–32.6]	28.7 [23.7–32.5]	28.1 [24.7–32.6]	0.76	28.3 [24.2–32.3]	29.1 [23.7–34.3]	0.66
History of smoking	81 (36)	48 (37)	33 (34)	0.68	64 (35)	17 (36)	0.92
Influenza vaccination	193 (89)	102 (86)	91 (94)	0.055	162 (93)	31 (66)	0.0015
Comorbidities							
Hypertension	224 (98)	128 (98)	96 (99)	0.47	178 (98)	46 (98)	0.83
Diabetes mellitus	140 (61)	89 (68)	51 (53)	0.019	104 (58)	36 (77)	0.016
Heart disease	49 (22)	28 (21)	21 (22)	0.96	38 (21)	11 (23)	0.72
Lung disease	16 (7)	11 (8)	5 (5)	0.34	10 (6)	6 (13)	0.083
Cancer	23 (10)	12 (9)	11 (11)	0.59	18 (10)	5 (11)	0.89
Angiotensin-converting enzyme inhibitor or angiotensin receptor blocker use	60 (26)	33 (25)	27 (28)	0.65	47 (26)	13 (28)	0.81
Statin use	143 (63)	84 (64)	59 (61)	0.61	113 (62)	30 (64)	0.86
Baseline serum creatinine, mg/dl	1.4 [1.0–1.7]	1.4 [1.1–1.8]	1.2 [1.0–1.5]	0.0048	1.3 [1.0–1.6]	1.5 [1.2–1.8]	0.032
Blood type				0.73			
A	84 (38)	47 (37)	37 (39)		64 (36)	20 (43)	0.68
B	44 (20)	28 (22)	16 (17)		35 (20)	9 (19)	
AB	6 (3)	4 (3)	2 (2)		4 (2)	2 (4)	
O	90 (40)	49 (38)	41 (43)		74 (42)	16 (34)	

Table 2 | Laboratory values and inflammatory markers on admission of the patients admitted to Montefiore Medical Center

Laboratory values and inflammatory markers on admission	Total patients (N = 79)	Survivors (N = 51)	Nonsurvivors (N = 28)	P value
Hemoglobin, g/dl	12.1 [10.6–13.2]	12.2 [10.6–13.3]	11.8 [11.1–13]	0.94
WBC count, k/ μ l	6.2 [4.4–8.0]	5.8 [4.1–7.7]	6.4 [5.4–8.1]	0.23
WBC count <4 k/ μ l	12 (15)	11 (22)	1 (4)	
Lymphocytes, k/ μ l	0.6 [0.4–0.8]	0.6 [0.4–0.8]	0.7 [0.4–0.8]	0.96
Lymphocyte count <1 k/ μ l	67 (85)	42 (82)	25 (89)	
Platelets, k/ μ l	178 [132–240]	189 [132–241]	162 [118.5–205.5]	0.22
Platelets count <150 k/ μ l	30 (38)	18 (35)	12 (43)	
CD3 cell count, cells/ μ l	319 [205–552]	390 [226.5–574]	243 [158–529]	0.12
CD3 count <706 cells/ μ l	54 (68)	33 (65)	21 (75)	
CD4 cell count, cells/ μ l	147 [88–304]	178 [117–305]	120 [74–252]	0.085
CD4 count <344 cells/ μ l	52 (66)	31 (61)	21 (75)	
CD8 cell count, cells/ μ l	126 [83–272]	147 [87.5–263]	123 [71–272]	0.4
CD8 count <104 cells/ μ l	22 (28)	13 (26)	9 (32)	
CRP, mg/dl	9.9 [4.9–16.2]	7.2 [4.6–14.8]	11.3 [5.7–18.1]	0.25
CRP >10 mg/dl	38 (48)	23 (45)	15 (54)	
Procalcitonin, ng/ml	0.3 [0.1–1.7]	0.2 [0.1–1.6]	0.4 [0.2–2.9]	0.065 
Procalcitonin >0.2 ng/ml	41 (52)	22 (43)	19 (68)	
Ferritin, ng/ml	1345 [681–2397]	1516 [713–3179]	1029 [629–1939]	0.16
Ferritin >900 ng/ml	50 (63)	35 (69)	15 (54)	
D-dimer, μ g/ml	1.7 [0.8–3.3]	1.8 [0.7–3.5]	1.7 [1.1–2.2]	0.99
D-dimer >0.5 μ g/ml	66 (84)	42 (82)	24 (86)	
D-dimer >3 μ g/ml	20 (25)	15 (29)	5 (18)	
IL-6, pg/ml	54 [25–154]	47 [26–98]	101 [22–335]	0.036 
IL-6 >60 pg/ml	32 (41)	15 (29)	17 (61)	
LDH, U/l	356 [274–414]	350 [271–406]	364 [286.5–433]	0.42
LDH >1.5 times upper limit of normal	53 (67)	33 (65)	20 (71)	
Creatine kinase, U/l	103 [56–204]	91 [55–143]	140 [68–362]	0.095
Creatine kinase >200 U/l	19 (24)	8 (16)	11 (39)	
Fibrinogen, mg/dl	605.5 [504.5–728.5]	606 [511–754]	605 [459–666]	0.46
Fibrinogen >500 mg/dl	49 (62)	33 (65)	16 (57)	
Pro-BNP, pg/ml	1785 [740–4987]	1278 [450–3234]	2380 [1152–9342]	0.031 
Pro-BNP >900 pg/ml	43 (54)	24 (47)	29 (68)	
Serum creatinine, mg/dl	2.2 [1.5–3.0]	1.9 [1.3–3.0]	2.3 [1.7–2.9]	0.33

Every 10 unit increase in serum IL-6 levels was associated with a 3.6% increase in the odds of death [OR 1.036, 95% CI 1.008-1.065, p=0.01]

Most peak inflammatory markers were higher in non-survivors

Table 3 | Peak values of laboratory values and inflammatory markers of the patients during hospitalization

Peak laboratory values and inflammatory markers	Total patients (N = 79)	Survivors (N = 51)	Nonsurvivors (N = 28)	P value
Lowest hemoglobin, g/dl	10.2 [8.2–11.9]	9.9 [8.2–11.8]	10.9 [7.9–11.9]	0.19
Lowest WBC count, k/ μ l	4.7 [3.6–6.2]	4.6 [3.0–5.9]	5.8 [4.1–6.4]	0.052
Lowest lymphocyte count, k/ μ l	0.4 [0.3–0.6]	0.5 [0.3–0.6]	0.3 [0.2–0.4]	0.021
Lowest platelet count, k/ μ l	154 [111–214]	170 [124–222]	135 [102–170]	0.045
Highest CRP, mg/dl	16.2 [10.2–27.8]	14.3 [5.9–25.6]	22.8 [17.4–31.9]	0.0032
Highest procalcitonin, ng/ml	0.6 [0.1–2.7]	0.3 [0.1–1.7]	1.9 [0.4–3.9]	0.006
Highest ferritin, ng/ml	1908 [936–4489]	2079 [1057–4489]	1568 [675.5–5493]	0.59
Highest D-dimer, μ g/ml	3.5 [1.4–8.7]	3.3 [1.0–5.2]	4.4 [2.3–16.2]	0.06
Highest IL-6, pg/ml	64 [32–208]	48 [28–98]	182 [83–498]	0.0004
Highest LDH, U/l	448 [337–683]	389 [303–578]	612 [446–868]	0.0017
Highest creatine kinase, U/l	138 [69–318]	105.5 [64.5–182.5]	194 [107–481]	0.022

COVID-19 is associated with increased morbidity in kidney transplant patients

Table 4 | Clinical outcomes of the hospitalized patients

Clinical outcomes	Total patients (N = 79)	Survivors (N = 51)	Nonsurvivors (N = 28)	P value
Intubation	28 (35)	5 (10)	23 (82)	<0.001
Acute kidney injury requiring renal replacement therapy	18 (23)	9 (18)	9 (32)	0.15
Bacteremia	7 (9)	4 (8)	3 (6)	0.67
Urinary tract infection	9 (11)	5 (10)	4 (14)	0.55
Bacterial pneumonia	4 (5)	0 (0)	4 (14)	0.014
Fungal infection	4 (5)	1 (2)	3 (11)	0.12
Cytomegalovirus viremia	12 (15)	8 (16)	4 (14)	0.87
Deep venous thrombosis	10 (13)	6 (12)	4 (14)	0.75
Cerebrovascular accident	3 (4)	1 (2)	2 (7)	0.29

Data are *n* (%) unless otherwise noted.

COVID-19 and kidney transplantation: Results from the TANGO International Transplant Consortium

- 144 hospitalized kidney transplant recipients with COVID-19 at 12 transplant centers in the US, Italy and Spain
- 65% were male with a mean age of 60 (± 12) years, 40% Hispanic and 25% African-American
- Acute kidney injury occurred in 52%
- Respiratory failure requiring intubation in 29%
- Mortality was 32% during a median follow-up period of 52 days (IQR: 16-66 days)

Variable	Univariable odds ratio (95% CI)	P value	Multivariable odds ratio (95% CI)	P value
Age	1.07 (1.03-1.11)	<.001	1.07 (1.02-1.14)	.022
≤ 60 y	1 (ref)		–	–
> 60 y	2.64 (1.27-5.77)	.012	–	–
Diarrhea	0.38 (0.17-0.87)	.017	–	–
Dyspnea	3.06 (1.34-7.7)	.011	–	–
Respiratory rate, breaths/min				
< 20	1 (ref)	–	1 (ref)	–
≥ 20	7.38 (2.68-26.18)	<.001	6.88 (1.63-41.98)	.017
Lactate dehydrogenase, U/L				
≤ 325	1 (ref)	–	1 (ref)	–
> 325	3.48 (1.62-7.83)	.002	2.74 (0.8-10.11)	.114
IL-6, ng/mL	1.01 (1-1.01)	.013	1 (1-1.01)	.04
Procalcitonin, ng/mL				
< 0.5	1 (ref)	–	–	–
≥ 0.5	3.04 (1.37-6.89)	.007	–	–
Aspartate transaminase, U/L	1.02 (1.01-1.04)	.007	–	–
eGFR	0.97 (0.95-0.99)	.002	0.96 (0.93-0.99)	.029

COVID-19 and Solid Organ Transplantation: A Review Article

Yorg Azzi, MD,¹ Rachel Bartash, MD,² Joseph Scalea, MD,³ Pablo Loarte-Campos, MD,¹ and Erver Akalin, MD, FAST, FASN¹

(*Transplantation* 2021;105: 37–55).

Article/Country	Patient number	Patient's characteristics and comorbidities	Clinical Outcomes
Lubetzky et al Cornell	54 patients	Sex: Male 38/54 (70%) Median age: 57 IQR (29-83) Race: Caucasian 17/54 (31%), Hispanic 17/54 (31%), Black 13/54 (24%), Asian 6/54 (11%), Middle Eastern 1/54 (2%) Hypertension 50/54 (90%) Diabetes mellitus 16/54 (30%) Heart disease 19/54 (35%) Lung disease 8/54 (15%)	Mortality 7/54 (13%) Hospitalized 39/54 (72%) ICU stay 11/54 (20%) AKI 21/54 (39%) Graft loss 6/54 (11%) Discharged 30/39 (77%)
Mehta et al NYU	44 patients	Sex: Male 22/34 (65%) Median age: 59 IQR (52.5-63.8) Race: Black 15/34 (44%), Hispanic 8/34 (24%), White 7/34 (21%), Asian 2/34 (7%)	Mortality 6/44 (14%) Hospitalized 34/44 (77%) ICU stay 13/34 (39%) AKI 18/34 (53%) Discharged 27/34 (79%)
Husain et al Columbia	41 patients	Sex: Male 30/41 (73%) Median age: 49 IQR (41-63) Hypertension 23/41 (56%) Diabetes mellitus: 37/41 (90%) Obesity: 12/41 (29%)	Hospitalized 13/41 (32%)
Mohan et al Columbia	15 patients	Sex: Male 10/15 (66%) Median age: 51 IQR (28-72)	Mortality 2/15 (13%) Hospitalized 15/15 (100%) Intubation 4/15 (27%) AKI 6/15 (40%) RRT 2/15 (13%) Discharged 8/15 (53%)
Nair et al Northwell	10 patients	Sex: Male 6/10 (60%) Median age: 57 IQR (47-67) Race: Caucasian 6/10 (60%), Black 4/10 (40%) Hypertension 10/10 (100%) Diabetes mellitus 8/10 (80%) Heart disease 2/10 (20%)	Mortality 3/10 (30%) Hospitalized 10/10 (100%) ICU stay 5/10 (50%) AKI 3/10 (30%) Discharged 7/10 (70%)

Article/country	Patient number	Patient's characteristics and comorbidities	Clinical outcomes	Predictors of mortality
Sanchez-Avarez et al Spain Registry of Spanish Society of nephrology ²¹	286 patients	Sex: Male 189/286 (66%) Mean age: 60 SD (\pm 13)	Mortality 53/286 (19%) Hospitalized 268/286 (94%) ICU stay 25/286 (9%)	Older age Pneumonia on imaging
Fava et al Spain Multicenter ²²	104 patients	Sex: Male 60/104 (56%) Mean age: 59.7 SD (\pm 12.48) Race: Caucasian 90/104 (87%), Hispanic 9/104 (9%), African American 4/104 (4%) Hypertension 90/104 (87%) Diabetes mellitus 32/104 (31%) Obesity 28/104 (27%) Heart disease 31/104 (30%) Lung disease 16/104 (15%)	Mortality 28/104 (27%) Hospitalized 104/104 (100%) ICU stay 24/104 (23%) AKI 47/100 (47%)	Older age ARDS on admission Elevated LDH on admission
Crespo et al Spain Multicenter ²⁷	16 patients	Sex: Male 12/16 (75%) Mean age: 73.6 SD (\pm 4.7) Race: Caucasian 14/16 (88%) Hypertension 14/16 (88%) Diabetes mellitus 8/16 (50%) Obesity 7/16 (44%) Heart disease 8/16 (50%) Lung disease 3/16 (19%) Cancer 5/16 (31%)	Mortality 8/16 (50%) Hospitalized 15/16 (94%) ICU stay 2/16 (13%) AKI 5/15 (33%)	Higher respiratory rate on admission Anemia on admission Lymphopenia on admission Higher serum creatinine, D-Dimer and C-Reactive protein on admission
Bosini et al Italy Multicenter ²⁸	53 patients	Sex: Male 42/53 (79%) Median age: 60 IQR (50–67) Hypertension 42/53 (79%) Diabetes mellitus 11/53 (21%) Heart disease 10/53 (19%)	Mortality 15/45 (33%) Hospitalized 45/53 (85%) ICU stay 10/45 (22%) AKI 15/45 (33%) RRT 3/15 (20%) Discharged 27/45 (60%)	Age >60 Dyspnea on admission
Aiberici et al Italy Single Center ²⁴	20 patients	Sex: Male 16/20 (80%) Median age: 59 IQR (51–64) Hypertension 17/20 (85%) Diabetes mellitus 3/20 (15%) Heart disease 3/20 (15%)	Mortality 5/20 (25%) Hospitalized 20/20 (100%) ICU stay 4/20 (20%) AKI 6/20 (30%) RRT 1/6 (17%) Discharged 3/20 (15%)	N/A
Collard et al France French Registry ²⁶	279 patients	Sex: Male 182/279 (65%) Median age: 61.6 IQR (50.8–69) Hypertension 201/252 (90%) Diabetes mellitus 92/223 (41%) Heart disease 81/224 (36%) Lung disease 33/223 (15%) Cancer 35/226 (16%)	Mortality at 30 d (23%) Hospitalized 243/279 (87%) ICU stay 88/243 (36%) AKI 106/243 (44%) RRT 27/243 (11%) Graft loss 9/243 (4%)	Age >60 Cardiovascular disease Dyspnea on admission
Elias et al France Multicenter ²⁹	66 patients	Sex: Male 37/66 (56%) Mean age: 56.4 SD (\pm 12.5) Race: Non-white 24/66 (36%) Hypertension 58/66 (88%) Diabetes mellitus 31/66 (47%) Obesity 20/66 (30%) Heart disease 1/66 (2%) Lung disease 13/66 (20%)	Mortality 16/66 (24%) Hospitalized 60/66 (91%) ICU stay 15/66 (22%) AKI 28/66 (42%) RRT 7/28 (25%)	N/A
Benotmane et al France Single Center ³²	49 patients	Sex: Male 37/49 (76%) Median age 62.2 IQR (52.3–67.8) Hypertension 41/49 (84%) Diabetes mellitus 23/49 (47%) Obesity 22/49 (45%) Heart disease 18/49 (37%)	Mortality 9/49 (19.5%) Hospitalized 41/49 (84%) ICU stay 14/41 (34%) AKI 31/41 (76%)	C-reactive protein >100 mg/L Interleukin-6 >65 ng/L D-dimer >960 ng/ml High-sensitivity Troponin I >30 ng/L

Mortality in Europe during first wave of the pandemic mirrored that of USA

Older age and elevated inflammatory markers were most common risk factors for mortality

Azzi et al. *Transplantation* 2021;105: 37–55

Estimating the infection-fatality risk of SARS-CoV-2 in New York City during the spring 2020 pandemic wave: a model-based analysis



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Summary

Background As the COVID-19 pandemic continues to unfold, the infection-fatality risk (ie, risk of death among all infected individuals including those with asymptomatic and mild infections) is crucial for gauging the burden of death due to COVID-19 in the coming months or years. Here, we estimate the infection-fatality risk of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in New York City, NY, USA, the first epidemic centre in the USA, where the infection-fatality risk remains unclear.

Methods In this model-based analysis, we developed a meta-population network model-inference system to estimate the underlying SARS-CoV-2 infection rate in New York City during the 2020 spring pandemic wave using available case, mortality, and mobility data. Based on these estimates, we further estimated the infection-fatality risk for all ages overall and for five age groups (<25, 25–44, 45–64, 65–74, and ≥75 years) separately, during the period March 1 to June 6, 2020 (ie, before the city began a phased reopening).

Findings During the period March 1 to June 6, 2020, 205 639 people had a laboratory-confirmed infection with SARS-CoV-2 and 21 447 confirmed and probable COVID-19-related deaths occurred among residents of New York City. We estimated an overall infection-fatality risk of 1·39% (95% credible interval 1·04–1·77) in New York City. Our estimated infection-fatality risk for the two oldest age groups (65–74 and ≥75 years) was much higher than the younger age groups, with a cumulative estimated infection-fatality risk of 0·116% (0·0729–0·148) for those aged 25–44 years and 0·939% (0·729–1·19) for those aged 45–64 years versus 4·87% (3·37–6·89) for those aged 65–74 years and 14·2% (10·2–18·1) for those aged 75 years and older. In particular, weekly infection-fatality risk was estimated to be as high as 6·72% (5·52–8·01) for those aged 65–74 years and 19·1% (14·7–21·9) for those aged 75 years and older.

Interpretation Our results are based on more complete ascertainment of COVID-19-related deaths in New York City than other places and thus probably reflect the true higher burden of death due to COVID-19 than that previously reported elsewhere. Given the high infection-fatality risk of SARS-CoV-2, governments must account for and closely monitor the infection rate and population health outcomes and enact prompt public health responses accordingly as the COVID-19 pandemic unfolds.

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Take Home Messages

Mortality is high in kidney transplant recipients with COVID-19 especially for hospitalized patients

Patients with older age and elevated inflammatory markers are associated with mortality

Older patients with additional comorbidities such as cardiovascular disease, transplantation could be deferred at the peak of pandemics