

## ORIGINAL ARTICLE

# The hamletic dilemma of patients waiting for kidney transplantation during the COVID-19 pandemic: To accept or not to accept (an organ offer)?

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## Abstract

The outbreak of COVID-19 led to a reduction in the number of organ transplant interventions in most Countries. In April 2020, at the Tor Vergata University in Rome, Italy, two patients on the waiting list for kidney transplantation (KT) declined a deceased donor's kidney offer. Therefore, between April 20 and 25, 2020, we conducted a telephone survey among our 247 KT waitlist patients. Our aim was to explore: (a) the COVID-19 diffusion among them and (b) their current willingness to be transplanted in case of a kidney offer from a deceased donor. Two hundred and forty-three patients participated in a phone interview. One patient had died from COVID-19. Eighty-five (35%) KT candidates would decline any kidney offer, in most cases until the end of the COVID-19 pandemic. Upon a multivariate analysis, female gender (OR = 2.25, 95% CI = 1.26-4.03,  $P = .006$ ), high cardiovascular risk (OR = 2.33, 95% CI = 1.06-5.08,  $P = .034$ ), a waiting list time <3 years (OR = 0.375, 95% CI = 0.15-0.95,  $P = .04$ ), and the need to be transferred to another hospital for HD (OR = 2.56, 95% CI = 1.10-5.9,  $P = .03$ ) were associated with such refusal. The COVID-19 pandemic led to a fear of transplantation in a third of the KT candidates. Proactive educational webinars could be a useful tool to remove, or at least lessen, any doubts on the part of KT candidates and to avoid losing the opportunity to quit dialysis.

## KEYWORDS

COVID-19, deceased donor, kidney transplantation, SARS-CoV-2

**Abbreviations:** BAL, Bronchoalveolar Lavage; COVID-19, coronavirus disease 2019; DD, deceased donor; ESRD, end-stage renal disease; HD, hemodialysis; ICU, intensive care unit; IDDM, insulin-dependent diabetes mellitus; IQR, interquartile range; KT, kidney transplantation; OR, odds ratio; PRA, panel reactive antibodies; RRT, renal replacement therapy; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; WHO, World Health Organization.

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## 1 | INTRODUCTION

Following the initial outbreak in December 2019 in Wuhan, China, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection was declared pandemic by the World Health Organization on March 11, 2020<sup>1</sup> and, by November 11, 2020, it has already involved more than 50 million people globally.<sup>2</sup> In Italy, as of November 11, 2020, the resulting Coronavirus disease 19 (COVID-19) led to 960 373 confirmed cases and 41 750 deaths.<sup>2</sup>

The abrupt expansion of the COVID-19 pandemic in Italy had a dramatic effect on the national health system. Many hospitals, both in the North of Country, where the outbreak has been overwhelming, and in Central and South Italy, were converted to predominantly accommodate COVID-19 patients. In the attempt to contain the further spread of the disease, the national government enforced a severe lockdown from March 9 to May 18, 2020, and severe restrictive measure thereafter.<sup>3</sup>

This uncommon scenario could lead to confusion and fear in most transplantation candidates on a waiting list. Since the start of the pandemic—in the first week of April 2020—at the Transplant Center of Tor Vergata University in Rome, two patients on the renal transplant waiting list refused a kidney offer. Therefore, we investigated the point of view of all patients awaiting kidney transplantation (KT) at our Unit on the implications of the COVID-19 pandemic, as well as their willingness to receive a KT during this uncommon pandemic time. The aim of the study was to evaluate the perspective on organ transplantation of the patients listed for KT during the COVID-19 pandemic.

## 2 | MATERIALS AND METHODS

The study included all end-stage renal disease (ESRD) patients wait-listed for KT at our Transplant Center in Rome, as of April 25, 2020. The demographic and clinical features of KT candidates, retrieved from a prospectively updated national database (LURTO, www.latra.ccia.it, Matera, Italy) included age, gender, home region, comorbidities, etiology leading to ESRD, time on waiting list, Panel Reactive Antibodies (PRA) status, type and frequency of dialysis, urinary output at last follow-up, indication for primary transplant, re-transplantation or pre-emptive transplant, time since the start of dialysis, and vascular access-related problems. The presence of one or more of the following variables was considered to define patients at high cardiovascular risk: arterial hypertension (systolic blood pressure  $\geq$  140 mm Hg and diastolic blood pressure  $\geq$  90 mm Hg, or treatment with antihypertensive drugs), insulin-dependent diabetes mellitus (IDDM), obesity (body mass index  $>$  30), and previous coronary artery disease.

Between 20 and 25 April 2020, we conducted a telephone survey among all KT candidates recorded in LURTO. An informed consent was obtained before patients' participation in the study. The survey was created and administered by two transplant surgeons (TMM and GI) of the Tor Vergata University team, after a thorough

review of the literature on COVID-19.<sup>4-6</sup> The questionnaire was composed of two domains: (1) *COVID-19-specific questions* and (2) *patients' practical concerns on Renal Replacement Therapy (RRT)*. For domain (1) we asked (a) whether patients had experienced any symptoms related to the SARS-CoV-2 infection (fever, dyspnea, tiredness, dry cough, sore throat, nasal congestion/runny nose, diarrhea) since the first cases of infection in Italy (January 30, 2020); (b) whether patients had COVID-19 (Y/N) (if yes, whether they had been hospitalized and which treatment they had received, if any); and (c) if they had received a combined throat and nose SARS-CoV-2 swab testing (Y/N). For domain (2), patients were asked (a) if for any reason they had been transferred to another hospital in order to continue their hemodialysis (HD) program (Y/N); (b) if any patients had a diagnosis of COVID-19 in their local Nephrology Unit (Y/N); and (c) whether, in case of an appropriate organ offer, they would give consent to proceed with KT during the current COVID-19 pandemic (Y/N); if patients answered "No", they were asked for how long they would decline the kidney offer (with the following possible answers: "1 month", "3 months", or "up to the end of the pandemic").

### 2.1 | Statistical analysis

All data were initially recorded into an EXCEL database (Microsoft). Continuous variables were reported as medians and interquartile range (IQR); the Mann-Whitney *U* test was used for comparisons between groups. Categorical variables were reported as numbers and percentages. Comparisons were done using Fisher exact test. Variables with a *P* value  $<$ .05 were considered statistically significant and were used for a multivariate logistic regression analysis (backward conditional methods). The multivariate analysis was fitted in order to identify the characteristics of the patients who would decline the KT during the COVID-19 pandemic. The Odds Ratio (OR) and the 95% confidence interval (95% CI) were reported for significant variables. The SPSS statistical package version 23.0 was used for statistical analyses (SPSS Inc).

## 3 | RESULTS

### 3.1 | Patient demographics

On April 25, 2020, 247 patients were on the KT waiting list of our Unit. The median age of KT candidates at listing was 56 (IQR = 56-63) years and 157 (63.6%) were men. The median waiting list time was 30 (IQR = 12-51) months. The median PRA class I and II were 0 (IQR = 0-74) for both categories. The underlying kidney diseases leading to ESRD included: 87 (35.2%) glomerulonephritis, 52 (21.1%) autosomal dominant polycystic kidney disease, 41 (16.6%) unknown, 36 (14.6%) hypertensive nephropathy, 13 (5.3%) diabetic kidney disease, and 18 (7.2%) other disease. Sixty-six (26.7%) patients on the waiting list had already experienced a previous kidney graft loss (caused by chronic allograft nephropathy [*n* = 50], early vascular complications

[ $n = 6$ ], or unknown reason [ $n = 10$ ]) and were candidates to re-transplantation. One-hundred and seventy-nine (72.5%) patients had ESRD with complete anuria. Two-hundred and eleven (85.8%) patients were undergoing HD 3 days per week, while 25 (10.1%) received home-based peritoneal dialysis. Five (2.0%) listed patients were candidates to preemptive KT. In six (4.0%) patients details about the RRT were not available. One-hundred and twenty (48.6%) patients had been on dialysis for more than 5 years. Nineteen (7.7%) were enrolled in the Italian hyperimmune program (PNI 3.0), which is designed for those patients who have been on the waiting list for more than 8 years with maximum PRA > 90%.<sup>7</sup> With regard to comorbidities, 12 (4.9%) patients had a history of chronic obstructive pulmonary disease, 168 (68%) were under medical treatment for hypertension, 24 (9.7%) had IDDM, 35 (14.2%) were obese, and 28 (11.3%) had a history of cancer. Forty-eight (19%) had vascular access complications (previous arteriovenous fistula thrombosis, >3 arteriovenous fistula interventions, difficulties in accessing the fistula during HD, and permanent Palindrome™ catheter). Most patients ( $n = 210$ , 85%) reside in the same region of the transplant center (Lazio), while 37 (10.6%) were living out of the region. One-hundred and ten (44.5%) patients had already received at least one call for KT. Of these, at the time of the previous call, 70 (28.3%) were selected as a backup only, 33 (13.4%) were not transplanted because of organ unsuitability and 7 (2.8%) declined the transplantation.

## 3.2 | Survey findings

### 3.2.1 | Domain (1)

Two-hundred and forty-three (98.4%) patients participated in the telephone questionnaire. Since January 30, 2020, 64 (26.3%) patients reported one or more symptoms, such as fever ( $n = 23$ ), fatigue ( $n = 26$ ), dyspnea ( $n = 4$ ), dry cough ( $n = 14$ ), sore throat ( $n = 5$ ), nasal congestion/runny nose ( $n = 19$ ), or diarrhea ( $n = 13$ ).

Forty-five (18.5%) patients were tested for SARS-CoV-2 with nasopharyngeal swab. Of these, most were asymptomatic ( $n = 33$ , 73.3%) while 12 (26.7%) reported having had mild upper respiratory tract symptoms (ie, runny nose, nasal congestion, and dry cough).

Only one (0.4%) case of COVID-19 was recorded. The patient was a 71-year-old woman listed for retransplantation, on HD since 2006 after a previously failed KT. At the beginning of February 2020, the patient started to suffer from mild symptoms, such as nasal congestion, diarrhea, and fever. One week later, as a result of an upcoming dyspnea, she was admitted to the Emergency Unit, and then to the ICU of our hospital, where treatment with hydroxychloroquine, datunavir, ritonavir, and antibiotics was started. The patient died of COVID-19 pneumonia 26 days after admission.

### 3.2.2 | Domain (2)

Twenty-three (9.5%) KT candidates reported that COVID-19 patients were admitted to the Nephrology Unit during their dialysis

treatment. Twenty-seven (11.1%) patients reported that because of the COVID-19 pandemic they had been transferred to another local Nephrology Unit in order to continue HD.

Eighty-five (35%) KT candidates with a median waiting list time of 24 (IQR = 10-41.5) months reported that, at the time of the survey, they would have declined any kidney offer from a deceased donor. Of these, 11 (12.9%) patients stated that they would not accept a KT for the next month, 22 (25.9%) up to the next 3 months, and 52 (61.2%) until the end of the pandemic. Notably, the proportion of wait-listed patients who would decline a possible kidney offer was significantly higher among women (females = 38/86, [44.2%] vs males = 47/157 [29.9%],  $P = .033$ ), among those with a high cardiovascular risk (high cardiovascular risk = 74/193 [38%] vs no cardiovascular risk = 10/50 [20%],  $P = .013$ ) and among those listed for the first KT (first KT = 69/178 [38.8%] vs previous KT = 16/65 [24.6%],  $P = .048$ ). Additionally, patients who would decline transplantation showed a shorter time on the KT waiting list (would decline group = 24 [IQR = 10-41.5] months vs would accept group = 33 [IQR = 15.6-57.3] months,  $P = .015$ ) and had been transferred to another hospital to ensure HD since the COVID-19 pandemic (transferred = 14/27 [51.9%] vs not transferred = 69/213 [32.4%],  $P = .04$ ) (Table 1).

At multivariate analysis, female gender (OR = 2.25, 95% CI = 1.26-4.03,  $P = .006$ ), the presence of a high cardiovascular risk (OR = 2.33, 95% CI = 1.06-5.08,  $P = .034$ ), a waiting list time <3 years (OR = 0.375, 95% CI = 0.15-0.95,  $P = .04$ ), and the transfer to another hospital to continue HD (OR = 2.56, 95% CI = 1.10-5.9,  $P = .03$ ) were all independently associated with the decision to decline a possible KT offer (Table 2).

## 4 | DISCUSSION

Since the start of the COVID-19 pandemic, most national public health systems have reallocated their hospital resources giving priority to COVID-19 patients. This led to a drastic reduction in most surgical procedures, such as organ transplantation. In the United States—one of the most affected Countries, with more than 104 659 COVID-19/cases per day (update of November 10, 2020)—, living and deceased donor KT activities have been cancelled or reduced in 72% and 84% of the Units, respectively.<sup>8</sup> This is a shocking scenario, considering that in the United States 91 865 people are currently on the KT waiting list and 19 020 KTs have been performed so far (updated on latest available date, October 31, 2020).<sup>9</sup> These findings forecast a significant reduction in KT rate across the United States by the end of 2020, compared to the 23 401 KTs performed in 2019.<sup>9</sup>

In this rapidly evolving scenario, the impact of the ongoing COVID-19 pandemic on the emotional framework and the willingness of the patients awaiting KT have not yet been addressed. Surprisingly, the present survey found that 35% of the patients on our waiting list for KT would decline a possible offer of transplantation, and in most cases until the end of the ongoing pandemic. Patients willing to refuse KT were mainly women, with cardiovascular risk

**TABLE 1** Demographic and characteristics of patients on the waiting list for kidney transplantation who would accept or decline transplantation during the COVID-19 pandemic (n = 243)

Variables	Would accept the KT (n = 158, 65%)	Would decline the KT (n = 85, 35%)	$\Delta^*$	P
Age median years (IQR)	56 (47.7-62)	58 (51-65)	–	.113
Median time on waiting list (IQR)	33 (15.6-57.3)	24 (10-41.5)	–	<b>.015</b>
Gender				
Male (n = 157)	110 (70.1%)	47 (29.9%)	Female (+14.3%)	.033
Female (n = 86)	48 (55.8%)	38 (44.2%)		
PRA (median and IQR)				
Class I	0 (0-88.25)	0 (0-32)	–	.321
Class II	0 (0-64.5)	0 (0-25)	–	.267
Primary kidney disease				
Autoimmune/GN (n = 110)	77 (70%)	33 (30%)	Other (+9.1%)	.176
Other (n = 133)	81 (60.9%)	52 (39.1%)		
Diuresis				
Yes (n = 65)	39 (60%)	26 (40%)	Diuresis yes (+6.9%)	.363
No (n = 178)	119 (66.9%)	59 (33.1%)		
Previous KT				
Yes (n = 65)	49 (75.4%)	16 (24.6%)	No previous KT (+14.2%)	<b>.048</b>
No (n = 178)	109 (61.2%)	69 (38.8%)		
Previous calling for KT				
Yes (n = 109)	72 (66.1%)	37 (33.9%)	–	.788
No (n = 134)	86 (64.2%)	48 (35.8%)		
Pre-emptive KT				
Yes (n = 5)	3 (60%)	2 (40%)	Pre-emptive Y (+5.1%)	1.000
No (n = 238)	155 (65.1%)	83 (34.9%)		
Dialysis type <sup>a</sup>				
HD (n = 211)	136 (64.5%)	75 (35.5%)	HD (+7.5%)	.513
Peritoneal (n = 25)	18 (72%)	7 (28%)		
Dialysis <sup>b</sup>				
≤5 y (n = 122)	74 (60.7%)	48 (39.3%)	Years ≤ 5 (+8.5%)	.180
>5 y (n = 120)	83 (69.2%)	37 (30.8%)		
Cardiovascular risk				
Yes (n = 193)	119 (62%)	74 (38%)	Cardiovascular risk (+18%)	<b>.013</b>
No (n = 50)	40 (80%)	10 (20%)		
History of chronic pulmonary obstructive disease				
No (n = 230)	151 (65.7%)	79 (34.3%)	COPD (+15.7%)	.353
Yes (n = 12)	6 (50%)	6 (50%)		
Waiting list time				
≤3 y (n = 208)	130 (62.5%)	78 (37.5%)	≤3 y (+17.5%)	<b>.05</b>
>3 y (n = 35)	28 (80%)	7 (20%)		
Covid-19 in hemodialysis unit <sup>c</sup>				
No (n = 218)	143 (65.6%)	75 (34.4%)	Covid-19 in HD Unit (+4.7%)	.651
Yes (n = 23)	14 (60.9%)	9 (39.1%)		
Vascular access problems <sup>d</sup>				
Yes (n = 48)	29 (60.4%)	19 (39.6%)	Vascular access problems (+5.2%)	.665
No (n = 189)	124 (65.6%)	65 (34.4%)		

(Continues)

**TABLE 1** (Continued)

Variables	Would accept the KT (n = 158, 65%)	Would decline the KT (n = 85, 35%)	$\Delta^*$	P
Italian hyperimmune program 3.0 <sup>7</sup>				
Yes (n = 19)	14 (73.7%)	5 (26.3%)	Not hyperimmune (+11.7%)	.139
No (n = 224)	139 (62.0%)	85 (38.0%)		
Region				
Lazio area (n = 209)	136 (65.1%)	73 (34.9%)	—	.96
Outside (n = 34)	22 (64.7%)	12 (35.3%)		
Transferred to another hospitals for HD <sup>e</sup>				
Yes (n = 27)	13 (48.1%)	14 (51.9%)	Transferred to another hospital for HD (+19.5%)	<b>.04</b>
No (n = 213)	144 (67.6%)	69 (32.4%)		

$\Delta$ : Difference in percentage for each variable in patients who would decline the offer for Kidney Transplantation.

Bold italic values refers to significant P values ( $P < .05$ ).

<sup>a</sup> The type of dialysis for two patients was not available.

<sup>b</sup> In one patient the time since the start of dialysis was not available.

<sup>c</sup> Two patients did not answer.

<sup>d</sup> No data available for six patients.

<sup>e</sup> Three patients did not answer.

**TABLE 2** Multivariable logistic model for decision making (decline the kidney offer) in the cohort of waitlisted Kidney Transplantation patients who participated to the phone survey questionnaire (n = 243)

Variables	Beta	OR	95% CI	p-value
Gender (female)	0.081	2.25	1.26-4.03	<b>.006</b>
High cardiovascular risk (yes)	0.845	2.33	1.06-5.08	<b>.034</b>
Transferred to another hospital for HD (yes)	0.939	2.56	1.10-5.92	<b>.03</b>
Waiting list time (>3 y)	-0.981	0.37	0.15-0.95	<b>.04</b>
Constant	0.024			.967

Note: The multivariate logistic model was built on the backward conditional method; variables fit in the model were those who showed a  $P < .05$  at univariate analysis (gender, previous kidney transplantation, cardiovascular risk, transfer to another hospital for dialysis, waiting list time). The table shows the results of the last step of the backward conditional model (step 2). Bold italic values refers to significant P values ( $P < .05$ ).

factors, and were more likely to have been on the KT waiting list for less than 3 years. Furthermore, many refusers had been moved to another hospital to continue HD because of the reorganization of the health services at their usual location imposed by the COVID-19 pandemic. It is therefore understandable that the awareness of suffering from significant comorbidities, such as cardiovascular risk factors, may enhance the fear of developing a critical COVID-19 pneumonia among the population of KT candidates. It is also intuitive that patients on the KT waiting list who have been on dialysis

for a relatively shorter time are less likely to have been exposed to the myriad of physiological and psychosocial stressors so common in long-term dialyzed patients, and that they are therefore more likely to decline the KT.<sup>10</sup> Moreover, the anxiety and the stress of being transferred to other hemodialysis unit to continue their life-saving RRT may conceivably further enhance the fear related to the pandemic. On the other hand, it is less obvious why women were much more afraid about an imminent transplantation compared to men. Surely, women are twice as likely as men to suffer anxiety, stress, and depression—especially during this pandemic<sup>11</sup>—but at the same time they are usually more fearless and adherent to medical prescriptions and suggestions.<sup>12</sup>

Even though this survey includes only one Italian transplant center, we feel that during the current pandemic many KT candidates across the world avoided being hospitalized for KT for fear of getting infected with SARS-CoV-2. Even if the American Society of Transplantation created a useful webpage<sup>13</sup> for transplant candidates providing general information on COVID-19, we believe that also transplant physicians dealing directly with their wait-listed patients should clearly inform them that: (a) the dialysis units are definitely areas at high risk of SARS-CoV-2 infection; (b) patients with ESRD are more vulnerable to respiratory infections because of their underlying proinflammatory state and the concomitant functional defects in the immune cells population<sup>14,15</sup>; (c) comorbidities such as cardiovascular or chronic respiratory diseases, diabetes, and hypertension are all independent risk factors for severe COVID-19 pneumonia<sup>16</sup>; and (d) patients with ESRD may experience a less severe clinical course, or an atypical presentation of COVID-19 compared to the general population.<sup>17</sup> Furthermore, patients on HD infected with SARS-CoV-2 could remain contagious longer given the possibility of viral shedding through breath or stools.<sup>17</sup>

It should also be emphasized that there is still a wide gap between the demand for KT and the availability of suitable grafts. In 2019, the Italian Kidney Transplant Registry reported 8460 patients listed for KTs and 2137 KT being performed,<sup>18</sup> with a median waiting time of 3.2 years. Additionally, an Italian registry study reported a 25% reduction in organ procurement already at the beginning of the pandemic,<sup>19</sup> which rapidly grew up to 60% thereafter,<sup>20</sup> suggesting that the median waiting time to be transplanted would likely become much longer. Consequently, the propensity to refuse a suitable organ offer at this time means that some patients will lose a precious opportunity. This will certainly translate into a prolonged waiting list time, also in consideration that in Italy 84% of KTs are performed with organs from deceased donors.<sup>18</sup>

Based on the above consideration, we think that transplant surgeons and physicians should devote great efforts to ensure the fulfillment of the KT waiting list (viz., transplantation). Contrary to what was recently suggested by the Padua group,<sup>21</sup> we fully agree with the Italian national transplant center<sup>22</sup> that—even at the current stage of the ongoing pandemic—we should ensure transplant activities, since they are the only possible treatment for our wait-listed patients.

Certainly, organ transplantation should be performed—during this pandemic—ensuring the greatest degree of safety, both for the recipient and the medical staff.<sup>22</sup> Before transplantation, the SARS-CoV-2 infection should be investigated in donors and recipients through bronchoalveolar lavage (BAL) and combined nose-throat swab RT-PCR test, respectively. Additionally, in order to detect any missed SARS-CoV-2-infected patients and avoid an unrecognized virus spread after the KT, additional tests with BAL should be performed in the recipient during KT, or immediately after.<sup>23</sup> After transplantation, close clinical monitoring, the use of dedicated COVID-19-free ITUs and wards and pathways, and bedside radiological interventions (ultrasound, chest-X-ray, renal biopsy) are mandatory, as well as the prohibition of visitors and the constant use of personal protection devices for all graft recipients.

The management of immunosuppression (IS) after KT during the COVID-19 pandemic is currently being debated, since the natural history of SARS-CoV-2 is unknown. KT recipients under IS are generally more exposed to infection, even if some authors believe that IS—by providing a possible attenuation of the cytokine storm syndrome—may be beneficial in COVID-19.<sup>24</sup>

During this pandemic, our transplant Center received 47 kidney offers from deceased subjects. Six patients refused the transplant and the kidneys were offered to another local transplant Center; 17 were declined by the consultant renal transplant surgeon (GI) because they were not suitable for donation. Twenty-four KTs were finally performed. As per local standard protocol, IS was based on calcineurin inhibitors (tacrolimus once a day), corticosteroids, antimetabolites, and induction (basiliximab or anti-thymocyte globulin). All recipients were discharged with good renal

function and, as of November 11, 2020, one patient died because of COVID-19.

We feel that, even during this pandemic, in patients with ESRD, a continued permanence in the HD centers could be associated with greater risks of being infected by SARS-CoV-2 than the hospitalization for KT, although formal data are needed to confirm this assumption. During our telephone survey, we reassured all wait-listed patients about their individual transplant benefit and the risk of remaining on dialysis, in case of refusal. To clarify any possible misunderstanding originating from the media and the internet, we are now planning regular telemedicine conferences dedicated to KT candidates and aimed at providing them with the best available scientific and clinical evidence on the plausible impact of COVID-19 in patients on dialysis or kidney transplanted. Additionally, all candidates are informed that: (a) the Policlinico Tor Vergata has COVID-19-free dedicated areas and pathways<sup>25</sup>; (b) all medical or surgical patients who require hospitalization receive a SARS CoV-2 swab test upon admission and during their hospital stay; (c) medical and nursing staff are routinely tested; (d) the incidence of COVID-19 in our recipients who received KT during this pandemic is less than 5% [unpublished, personal data]; and (e) we also discuss the IS burden<sup>26,27</sup> and the importance of non-pharmaceutical intervention and social distancing to contain COVID-19 before and after KT.<sup>28</sup>

Furthermore, the safety, tolerability, and immunogenicity of the vaccine against COVID-19 have already been investigated in the healthy immunocompetent population<sup>29-31</sup> and seem to effectively prevent COVID-19. Surely, this victory of science could further encourage our candidates to accept transplantation once they receive an organ offer. Nevertheless, we are well aware that more specific studies on any other fragile population—such as transplanted people—are needed to confirm these excellent results.

A limitation of this study is represented by the relatively limited size of the surveyed cohort. The questionnaire was generated considering KT candidates listed in a single transplant center in the Lazio region (Central Italy) and thus may not be representative of other Italian and non-Italian patients wait-listed for KT. Therefore, we believe that these findings should be validated at national and international level, in order to gain a more comprehensive knowledge of how the risks of SARS-CoV-2 infection is perceived by KT candidates in Italy and abroad. We are aware that the COVID-19 is an evolving scenario and this “one-time” survey is only a *snapshot* of this pandemic in Italy, but we are also convinced that it could support other transplant center in other countries which are fighting the COVID-19 pandemic.

In conclusion, because of the COVID-19 pandemic, about one third of the wait-listed patients at our transplant Center have postponed their KT until the end of the pandemic. This attitude seems worrisome, since the alternative of prolonging HD treatment could even increase the risk of infection, and be associated with less favorable outcomes. Educational webinars for KT candidates could be a reliable, cost-effective, and feasible tool to provide patients and their families with the best available information

about the implications of the COVID-19 pandemic on their clinical prospects.

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## CONFLICT OF INTEREST

The authors have declared no conflict of interest.

## AUTHOR CONTRIBUTION

Study conception and design: TMM and GI; acquisition of data: GP, FR, GV and BMP; analysis and interpretation: TMM and RA; drafting of manuscript: TMM and RA; critical revision: LT; final approval: GT.

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