Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Solid Organ Transplantation in the Coronavirus Disease 2019 Era: “The Great Bet” in the North Italy Transplant Program Area

Serena Maria Passamonti*, Antonino Cannavò, Valentina Trunzo, Vittoria Caporale, Ruggero Buonocore, and Tullia Maria DeFeo

Unità Operativa Complessa (UOC) Coordinamento Trapianti, Fondazione Istituto di Ricovero e Cura a Carattere Scientifico (IRCCS) Ca’ Granda, Ospedale Maggiore Policlinico, Milan, Italy

ABSTRACT

Introduction. Solid organ transplantation is challenging for waitlist patients during the coronavirus disease 2019 (COVID-19) pandemic.

Aim. This study investigates COVID-19 incidence and mortality in patients transplanted in the North Italy Transplant program (NITp) during the outbreak.

Materials and Methods. All consecutive patients transplanted from February 20 to April 3, 2020 (6 weeks), were included in our cohort and were observed for at least 4 weeks. Survival analyses were performed.

Results. In this study, 124 patients were transplanted with 12 (9.7%) hearts, 4 (3.2%) lungs, 39 (31.4%) livers, 67 (54%) kidneys, and 2 (1.6%) combined kidney-pancreas. Recipients’ mean age was 51 years (standard deviation [SD] = 16.6), and 76 of 124 (61%) were men. Five (4%) patients developed COVID-19 after a mean of 13 days (SD = 6.7), with a cumulative incidence of 4.0% (95% confidence interval [CI], 0.5-7.5). During the follow-up period, 5 of 124 (4%) recipients died; overall mortality was 4.3% (95% CI, 0.6-8.0), with only 1 patient dying of COVID-19, for a COVID-19–related mortality of 0.8% (95% CI, 0-6.0).

Conclusions. This study showed a low COVID-19 incidence and COVID-19–related mortality in patients transplanted during the COVID-19 pandemic. Further studies with a longer follow-up period are mandatory to confirm the safety of transplant procedures.

CORONAVIRUS disease 2019 (COVID-19) is a clinical condition caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and is characterized by a spectrum of symptoms varying from mild respiratory and/or gastrointestinal to interstitial pneumonia with acute respiratory distress syndrome, multiorgan failure, or death [1].

COVID-19 started in Huang, China, in December 2019 and has rapidly spread all over the world. The World Health Organization (WHO) declared a pandemic on March 11, 2020 [2]. The first case of COVID-19 in Italy was reported on February 20, 2020. To contain the rapid spread of the virus, stringent security measures were adopted. However, by April 3, 2020, data from the Italian National Institute of Health showed that 124,527 Italian people tested positive for the new SARS-CoV-2 (of which 51,535 (41%) were in Lombardy), 3994 (3.2%) were admitted to the intensive care unit (ICU), and 15,362 (12.3%) were dead from the disease. This dramatic and overwhelming situation has changed the physiognomy of our hospitals that became COVID-19 centers. COVID-19 severity seems to directly correlate with a patient’s age and comorbidities [3].

Proinflammatory cytokines may play an important role, especially in the most severe form of the disease. As a consequence, transplanted patients appear to be at particularly high risk for infection because of immunosuppressive regimens and comorbidities [4].

Transplantation is the treatment of choice for many

*Address correspondence to Dr Serena Maria Passamonti, Fondazione IRCCS Ca’ Granda, Ospedale Maggiore Policlinico, Via Francesco Sforza 35, 20122 Milan, Italy. Tel: 349 2687795. E-mail: serena.passamonti@policlinico.mi.it

© 2020 Elsevier Inc. All rights reserved.
230 Park Avenue, New York, NY 10169

Transplantation Proceedings, 52, 2631–2636 (2020) 2631
several end-stage diseases, and this scenario has inevitably impacted the management of the donation process [5]. Several case reports and series on transplanted/waiting list patients have recently been published, with different results according to different organs [6–11]. North Italy Transplant program (NITp) is a consortium of 6 regions (i.e., Lombardy, Veneto, Friuli Venezia Giulia, Liguria, Marche, and the autonomous region of Trento) that has cooperated in donor procurement and transplantation since 1974. Despite local difficulties and donors’ management, organ procurement and transplantation activities have been reduced but have continued through the COVID-19 pandemic [12]. The aim of this study was to investigate COVID-19 (donor-related or hospital-related) incidence and mortality in transplanted recipients in the NITp area in the first 6 weeks of the COVID-19 pandemic.

MATERIAL AND METHODS

Patient cohort and study design

This is a cohort study including all consecutive recipients transplanted in the NITp area from February 20 to April 3, 2020 (6 weeks). The follow-up started after transplantation through May 1, 2020 (at least 4 weeks for each patient), or until death. In case of COVID-19 onset, any symptoms of the disease were reported and registered.

### Table 1. Donors’ General Characteristics

| Donor Characteristics | Number (%) |
|-----------------------|------------|
| Total                 | 56         |
| Procurement region    |            |
| Liguria               | 1 (1.8)    |
| Lombardy              | 19 (33.9)  |
| Veneto                | 8 (14.3)   |
| Friuli                | 4 (7.1)    |
| Provincia Autonoma di Trento | 3 (5.4) |
| Marche                | 3 (5.4)    |
| Extra-NITp            | 18 (32.1)  |
| Age, years            |            |
| Mean (± SD)           | 53 (19.4)  |
| Median (minimum/maximum) | 55 (4-85) |
| Sex                   |            |
| Women                 | 27 (48.2)  |
| Men                   | 29 (51.8)  |
| Reason for hospitalization |        |
| Brain hemorrhage      | 30 (53.6)  |
| Ischemic stroke       | 3 (5.4)    |
| Postanoxic injury     | 14 (25.0)  |
| Trauma                | 9 (16.1)   |
| Risk profile          |            |
| Standard              | 38 (67.9)  |
| No-standard           | 18 (22.1)  |
| Blood group           |            |
| 0                     | 22 (39.3)  |
| A                     | 27 (48.2)  |
| B                     | 5 (8.9)    |
| AB                    | 2 (3.6)    |

Abbreviations: NITp, North Italy Transplant program; SD, standard deviation.

### Table 2. Recipients’ General Characteristics

| Recipient Characteristic | Number (%) |
|-------------------------|------------|
| Total                   | 124        |
| Sex                     |            |
| Women                   | 48 (38.7)  |
| Men                     | 76 (61.3)  |
| Age, years              |            |
| Mean (± SD)             | 51 (16.6)  |
| Median (minimum/maximum) | 55 (0-76) |
| Age, category           |            |
| 0–17                    | 9 (7.3)    |
| 18–49                   | 36 (29.0)  |
| 50–69                   | 72 (58.1)  |
| ≥ 70                    | 7 (5.6)    |
| BMI                     |            |
| Mean (± SD)             | 23.5 (4.1) |
| BMI, category           |            |
| < 18.5                  | 14 (11.3)  |
| 18.6–24.9               | 67 (54.0)  |
| 25–39.9                 | 42 (33.9)  |
| ≥ 40                    | 1 (0.8)    |
| Comorbidities, number   |            |
| 0–1                     | 21 (18.1)  |
| ≥ 2                     | 95 (81.9)  |
| Transplant region       |            |
| Liguria                 | 4 (3.2)    |
| Lombardy                | 60 (48.4)  |
| Veneto                  | 36 (29.0)  |
| Friuli                  | 19 (15.3)  |
| Marche                  | 5 (4.0)    |
| Transplanted organ      |            |
| Heart                   | 12 (9.7)   |
| Lung                    | 4 (3.2)    |
| Liver                   | 39 (31.4)  |
| Whole liver             | 35 (89.8)  |
| Left split liver        | 3 (7.7)    |
| Right split liver-kidney combined | 1 (2.5) |
| Kidney                  | 67 (54)    |
| Single kidney           | 64 (96.0)  |
| Dual kidney             | 3 (4.0)    |
| Combined kidney-pancreas | 2 (1.6)    |
| Functioning graft       |            |
| No                      | 113 (96.8) |
| Yes                     | 12 (3.2)   |
| Anti-HLA antibodies (no DSA) |        |
| Negative                | 87 (70.2)  |
| Positive                | 37 (29.8)  |
| DSA                     |            |
| Negative                | 120 (96.8) |
| Positive                | 4 (3.2)    |

Abbreviations: BMI, body mass index; DSA, donor-specific antibody; SD, standard deviation.
ICU or COVID-19–free ward (for kidney recipients) and were re-tested for COVID RNA in case of symptoms or according to local clinical and safety policy. Immunosuppressive therapies were started according to local protocols.

Pretransplant clinical, demographic, and immunological characteristics were collected, as the transplanted organ functioning. The phone call follow-up was performed by a dedicated coordinating center physician who interacted with clinicians of all transplant units and who recorded the presence, or not, of infected transplanted patients, onset timing, COVID-19 symptoms, and infection course.

Donors

Donors were classified as standard and non-standard according to the risk of potential transmission of an infective or neoplastic disease based on Centro Nazionale Trapianti guidelines. Solid organs were allocated by emergency criteria or regional rotations according to patients’ status.

At the beginning of the COVID-19 outbreak, Centro Nazionale Trapianti recommended the execution of nasopharyngeal swab or bronchoalveolar lavage as alternative in all potential donors to exclude SARS-CoV-2 infection. Subsequently, BAL become mandatory and was performed the day of procurement or within 24 hours before the recovery. In all cases, the SARS-CoV-2 real-time reverse transcription polymerase chain reaction result had to be available before the recovery procedure. In case of SARS-CoV-2 polymerase chain reaction positivity, the donor was declared at unacceptable risk and was not used [13]. General and clinical donor characteristics were collected for each donor. Organ allocation was classified as prioritized or not prioritized, according to the recipient’s status at the time of transplantation.

Outcomes

The first outcome was the cumulative incidence of COVID-19 in transplanted patients and COVID-19–related mortality. Any donors, recipients, and recipient-donors matching variables were evaluated as potential predictors of COVID-19 disease.

Statistical analyses

Continuous variables were expressed as mean values and standard deviation (SD) and compared by independent Student t test and Kruskal-Wallis test, where appropriate. Categorical variables were expressed as frequencies and percentage values and compared by χ² test.

Kaplan-Meier survival analyses were performed to assess the cumulative incidence of COVID-19 infection and the different categories of clinical manifestations and mortality.

Statistical analyses were performed within SPSS, version 23.0 (IBM Corporation, Armonk, New York, United States).

RESULTS

From February 20 to April 3, 2020, 56 donors were identified for solid organ donation. The majority of them were identified in Lombardy (19/56, 33.9%) and Veneto (8/56, 14.3%). The donors’ mean age was 53 years (SD ± 19.4), and male sex was prevalent (29/56, 51.8%). Brain hemorrhage (30 [53.6%]) and postanoxic injury (14 [25.0%]) were the main causes for hospitalization. More than a half (38/56, 68%) of patients had a standard risk profile, whereas a no-standard risk was attributed to the remaining 32% (18/56) of donors (Table 1).

Globally, 140 solid organs were transplanted in 134 recipients, of which 10 of 134 (7.5%) were transplanted at an extra-NITp transplant unit and thus were excluded from the analysis.

Overall, 124 recipients with 130 solid organs were transplanted in the NITp area (ie, 12 [9.7%] hearts, 4 [3.2%] lungs, 39 [31.4%] livers [including 3 left split-livers and 1
combined liver-kidney transplant], 67 [54%] kidneys, and 2
[1.6%] combined kidney-pancreas). Urgent list for heart,
lung, and liver transplants were 6 (50%), 0 (0), and 5 (13%)
respectively. Male sex was prevalent (76/124, 61.3%), and
the mean age at transplantation was 51 years (SD
16.6) with a body mass index of 23.5 (SD 4.1; normal value
18.5-25). Most patients presented with at least 2 or more
comorbidities. As for the procurement, the majority of
transplants were performed in Lombardy (60/124, 48.4%)
and Veneto (36/124, 29.0%) (Table 2).

After transplantation, 5 of 124 (4%) recipients developed
COVID-19 after a mean of 13 days (SD 6.7) from
transplantation, with a cumulative incidence of 4.0% (95%
confidence interval [CI], 0.5-7.5) (Fig 1). They received lung
(1 patient), liver (2 patients), and kidney (2 patients)
transplantation. All the patients were transplanted from
different donors, and no other recipient transplanted with
another organ from these 5 donors developed the infection.

One liver recipient died of respiratory distress syndrome 8
days after the onset of COVID-19 symptoms and 22 days
from transplant. The other 4 patients experienced mild
symptoms of the disease, did not change the immunosup-
pressive therapy, and were discharged from the hospital
after a few weeks. The majority of these patients were men
(4/5, 80%). They all were older than 50 years of age with 2
or more comorbidities. All patients were transplanted in
non emergency waiting list with standard-risk profile or
low-infective-risk (hepatitis B virus anticoag antigen

---

Table 3. Reported Recipients and Donors General Characteristics in Coronavirus 2019- Positive and -Negative Transplanted Recipients

| Total Recipients | COVID-19 Negative | COVID-19 Positive | P Value |
|------------------|------------------|------------------|---------|
| Donors’ reason for hospitalization, n (%) | | | .825 |
| Brain hemorrhage | 62 (52.5) | 3 (60.0) | |
| Ischemic stroke | 9 (7.6) | 0 (0) | |
| Postanoxic injury | 34 (28.8) | 1 (20) | |
| Trauma | 13 (11.0) | 1 (20) | |
| Donor sex, n (%) | | | .648 |
| Women | 59 (49.6) | 3 (60) | |
| Men | 60 (50.4) | 2 (40) | |
| Donor age, years | | | .998 |
| Mean (± SD) | 52 (18.5) | 52 (15.7) | |
| Median (minimum/maximum) | 53 (4/85) | 54 (29-66) | |
| Donor blood group, n (%) | | | .775 |
| 0 | 48 (40.3) | 2 (40) | |
| A | 60 (50.4) | 2 (40) | |
| B | 9 (7.6) | 1 (20) | |
| AB | 2 (1.7) | 0 (0) | |
| Risk profile, n (%) | | | .475 |
| Standard | 76 (65.5) | 3 (60) | |
| Non-standard | 25 (21.0) | 2 (40) | |
| Donor procurement region, n (%) | | | .854 |
| Liguria | 3 (2.5) | 0 (0) | |
| Lombardy | 48 (40.3) | 3 (60) | |
| Veneto | 15 (12.6) | 0 (0) | |
| Friuli | 11 (9.2) | 1 (20) | |
| Provincia Autonoma di Trento | 13 (10.9) | 0 (0) | |
| Marche | 7 (5.9) | 0 (0) | |
| Extra-NITp | 22 (18.5) | 1 (20) | |
| Recipient’s sex, n (%) | | | .648 |
| Women | 47 (39.5) | 1 (20) | |
| Men | 72 (60.5) | 4 (80) | |
| Recipient’s age, years | | | .115 |
| Mean (± SD) | 50 (16.7) | 62 (5.2) | |
| Median (minimum/maximum) | 53 (0/76) | 61 (55-69) | |
| Recipient’s age category, n (%) | | | .288 |
| 0-17 | 9 (7.6) | 0 (0) | |
| 18-49 | 36 (30.3) | 0 (0) | |
| 50-69 | 67 (56.3) | 5 (100) | |
| ≥ 70 | 7 (5.9) | 0 (0) | |
| BMI | | | .322 |
| Mean (± SD) | 23 (4.1) | 25 (3.9) | |
| Median (minimum/maximum) | 23 (1234) | 25 (20-29) | |
| BMI category n (%) | | | .600 |
| < 18.5 | 14 (11.8) | 0 (0) | |
| 18.6-24.9 | 65 (54.6) | 2 (40) | |
| 25-39.9 | 39 (32.8) | 3 (60) | |
| ≥ 40 | 0 (0) | 0 (0) | |
| Comorbidities number, n (%) | | | .282 |
| 0-1 | 21 (18.9) | 0 (0) | |
| ≥ 2 | 90 (81.1) | 5 (100) | |
| Transplant region, n (%) | | | .235 |
| Liguria | 4 (3.4) | 0 (0) | |
| Lombardy | 55 (46.2) | 5 (100) | |
| Veneto | 36 (30.3) | 0 (0) | |
| Friuli | 19 (16) | 0 (0) | |

Table 3. (continued)

| Total Recipients | COVID-19 Negative | COVID-19 Positive | P Value |
|------------------|------------------|------------------|---------|
| Transplanted organ, n (%) | | | .340 |
| Heart | 12 (10.1) | 0 (0) | |
| Lung | 3 (2.5) | 1 (20) | |
| Liver | 37 (31.1) | 2 (40) | |
| Kidney | 65 (54.8) | 2 (40) | |
| Single kidney | 62 (95.4) | 2 (100) | |
| Dual kidney | 3 (4.6) | 0 (0) | |
| Kidney-pancreas combined | 2 (1.7) | 0 (0) | |
| Anti-HLA antibodies (no DSA), n (%) | | | .634 |
| Negative | 84 (70.6) | 3 (60) | |
| Positive | 35 (29.4) | 2 (40) | |
| DSA, n (%) | | | .677 |
| Negative | 115 (96.6) | 5 (100) | |
| Positive | 4 (3.4) | 0 (0) | |

Abbreviations: BMI, body mass index; COVID-19, coronavirus 2019; DSA, donor-specific antibody; NITp, North Italy Transplant program; SD, standard deviation.
positivity) donors and in Lombard Transplant Units. Before transplantation, all recipients had a negative donor-recipient crossmatch, 2 of 5 (40%) had pre-formed anti-HLA antibodies, but none was a donor-specific antibody. After transplantation, 5 out of 5 were treated with steroids, 4 of 5 (80%) were treated with FK506, and none received cyclosporine, azathioprine, everolimus, or anti-interleukin 2.

No differences were found in donor and recipient characteristics comparing COVID-19 positive and -negative recipients (Table 3).

During follow-up, 5 of 124 (4.0%) recipients died, 1 of COVID-19, with an overall mortality of 4.3% (95% CI, 0.6-8.0) and a COVID-19-related mortality of 0.8% (95% CI, 0-6.0) (Fig 2).

DISCUSSION

In our study, COVID-19 had a 4.0% incidence in recipients transplanted during the pandemic, with a specific COVID-19-related mortality of 0.8%. Patients who developed COVID-19 were all more than 50 years old, transplanted in Lombardy, and were mainly men. Pretransplant immunologic status seemed to have no influence in the infection onset. Not surprisingly, 2 of 5 (40%) patients were transplanted and in the most highly affected province in Italy.

We found a lower rate of COVID-19 compared to recently published papers, where patients transplanted before the outbreak and/or on the waitlist were included [9-11]. This difference could be explained by the fact that after the “mediatic explosion” of the infection, prevention and safety measure have been implemented to avoid the wide spread of the virus. In procuring hospitals and in hospitals with Transplant Units, COVID-19 free pathways were created with the aim of reducing the possible transmission of the virus. Moreover, donors’ COVID-19 testing has been considered mandatory and all donors have been carefully studied to avoid a possible donor-related virus transmission [13]. On the other hand, compared to another study of 200 previously “COVID-19 era” pediatric recipients, we found 5 cases vs no confirmed cases. These results might be explained by the different cohorts of patients: adults and pediatric patients transplanted in any NITp transplant units compared to only pediatric recipients, all transplanted and followed in Bergamo [7].

Our data and the very low mortality rate (only 1 patient) support the safety of continuing donation and transplant process if procurement and transplant procedures follow a COVID-19-free pathway for both donors and recipients. This is reinforced by the evidence that all the patients were transplanted from different donors, and no other recipient transplanted with another organ from these 5 donors developed the infection.

In addition, general characteristics of transplanted patients developing COVID-19 did not differ from the COVID-19-positive general population [4], supporting the hypothesis that transplant, per se, seemed to not be a risk factor for the infection.

Some limitations need to be addressed. The main one is the short and variable follow-up to assess the actual incidence of post-transplant SARS-CoV-2 infection. However, all transplanted patients were followed for at least 4 weeks, and that period seems to be reasonably long enough to be confident in excluding a donor-related transmission. Because of the low incidence of COVID-19, this study does
not have enough power to find any correlation between recipient/donor characteristics and COVID-19 positivity, although this is, to our knowledge, the first study on patients transplanted in the COVID-19 era. As donation is still challenging and limited in number, we chose to include all consecutive transplanted recipients from different transplant units referred to our coordinating center. This may result in possible selection bias from different immunosuppressive therapy, treatment protocols, and monitoring, but our study was aimed to give a complete picture of real life. Data were all collected by call survey. We are confident that we have not missed any new COVID-19 diagnoses given the attention to this infection.

In conclusion, among transplanted patients in the COVID-19 era, the incidence of infection and its mortality is very low. Considering that transplant is the treatment of choice for several end-stage diseases, this infective risk may be considered acceptable because of the real benefit of transplant procedures for the health and quality of life of patients waiting for a solid organ. Further studies with a longer follow-up period are mandatory to confirm the safety of transplant procedures.

REFERENCES

[1] Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72,314 cases from the Chinese Center for Disease Control and Prevention [e-pub ahead of print]. JAMA. 2020 Feb 24. https://doi.org/10.1001/jama.2020.2648. Accessed 21 July 2020.

[2] WHO director-general’s opening remarks at the media briefing on COVID-19; 11 March 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—11-march-2020 [accessed 16.03.20].

[3] Wu C, Chen X, Cai Y, Xia J, Zhou X, Xu S, et al. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China [e-pub ahead of print]. JAMA Intern Med. https://doi.org/10.1001/jamainternmed.2020.0994. Accessed 1 June 2020.

[4] Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497–506.

[5] Michaels MG, La Hoz RM, Danziger-Isakov L, Blumberg EA, Kumar D, Green M, et al. Coronavirus disease 2019: implications of emerging infections for transplantation [e-pub ahead of print]. Am J Transplant. https://doi.org/10.1111/ajt.15832. Accessed 1 June 2020.

[6] D’Antiga L. Coronaviruses and immunosuppressed patients: the facts during the third epidemic [e-pub ahead of print]. Liver Transpl. https://doi.org/10.1002/lt.25756. Accessed 22 June 2020.

[7] Dhoori S, Rossi RE, Citterio D, Mazzafferro V. COVID-19 in long-term liver transplant patients: preliminary experience from an Italian transplant centre in Lombardy. Lancet Gastroenterol Hepatol 2020;5:532–3.

[8] Maggi U, De Carlis L, Yiu D, Colledan M, Regalia E, Rossi G, et al. The impact of the COVID-19 outbreak on liver transplantation programs in Northern Italy. Am J Transplant 2020;20:1840–8.

[9] Donato MF, Invernizzi F, Lampertico P, Rossi G. Health status of liver transplanted patients during the coronavirus outbreak in Italy: a large single center experience from Milan. Clin Gastroenterol Hepatol 2020;1854-356530538-3.

[10] Akalin E, Azzi Y, Bartash R, Seethamraju H, Parides M, Hemmige V, et al. Covid-19 and kidney transplantation. N Engl J Med 2020;382:2475–7. https://doi.org/10.1056/NEJMc2011177.

[11] Alberici F, Delbarba E, Manenti C, Economo L, Valerio F, Pola A, et al. Brescia Renal COVID Task Force. Management of patients on dialysis and with kidney transplant during SARS-COV-2 (COVID-19) pandemic in Brescia, Italy. Kidney Int Rep 2020;5:580–5.

[12] Cannavò A, Passamonti SM, Martinuzzi D, Longobardi A, Fiorattini A, Troni N, et al. The impact of COVID-19 on solid organ donation: The North Italy Transplantation program (NITp) experience [e-pub ahead of print]. Transplant Proc. https://doi.org/10.1016/j.transproceed.2020.06.025. Accessed 22 July 2020.

[13] Italian National Transplant Centre. Information for transplant programs regarding novel coronavirus. www.trapianti.salute.gov.it/trapianti/homeCnt.jsp. Accessed 8 June 2020.