A narrative review of care for patients on maintenance kidney replacement therapy during the COVID-19 era

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Background and Objective: Coronavirus disease 2019 (COVID-19) has inflicted the whole world since the end of 2019 and may transform the provision of care of kidney replacement therapy (KRT). This narrative review aimed to summarize the impacts of COVID-19 on the continuity of KRT and the strategies healthcare facilities adopted to ensure the accessibility and continuity of the care. Management for KRT patients infected with COVID-19 was not within the scope of this review.

Methods: We searched online publications in PubMed and Sinomed before November 2020, using search terms "COVID-19", "care", and "kidney replacement therapy".

Key Content and Findings: We found that COVID-19 affected the care cascade of KRT, the choice of treatment modalities, and self-care of individuals on maintenance treatment. Healthcare providers adopted the strategies including preventing COVID-19, using telehealth in the care cascade, and patients' health education and psychosocial support.

Conclusions: We concluded that the pandemic has challenged the current provision of care and has a profound influence on the convey of renal care.

Keywords: End-stage kidney disease (ESKD); kidney replacement therapy (KRT); coronavirus disease 2019 (COVID-19); care; review

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Rationale/background

End-stage kidney disease (ESKD) is the advanced, permanent stage of chronic kidney disease, where kidney replacement therapy (KRT) including kidney transplantation, peritoneal dialysis (PD) and hemodialysis is imperative to save patients' life. ESKD has been one of the major chronic disease burdens in both resource-rich or resource-limiting settings. Worldwide, the prevalence of KRT is 159–2,584 per million population (1). It is estimated that in China 200–250 per million population developed ESKD per year (2). In 2015, China had approximately 608,000 on dialysis and 7,040 underwent kidney transplantation (3,4). Not exempted from kidney disease, children have a relatively low prevalence of KRT, with 9 per million of the age-related population (4–18 years) (5).

Coronavirus disease 2019 (COVID-19) has been an international concern of public health. By November 18, 2020, the total number of COVID-19 confirmed cases has reached over 56 million, and the pandemic has claimed more than one million deaths (6). The pandemic spread to every continent with more than 190 countries reporting positive cases. So far, it has been established that the pathogenic virus, severe acute respiratory syndrome coronavirus

2 (SARS-CoV-2), directly affects many organs, and all populations are susceptible to it (7). Furthermore, the studies demonstrated that certain populations including the elderly, people with chronic kidney disease, cardiovascular diseases, and diabetes are more vulnerable to the infection and have increased morbidities and mortalities once they developed the COVID-19 (7,8). ESKD patients, with a higher chance of comorbidities, impaired immune systems, and malnutrition, were inclined to have more severe COVID-19 and worse outcomes (7-9). Compared with the general population, most of the current studies reported that patients on KRT had the same or relatively lower incidence of COVID-19 but a higher risk of severe infection, higher ICU admission, and higher mortality (10-12). In general, children tended to be less affected and had better COVID-19 outcomes (13-15). Similar results were observed in children on KRT (16-18), where children on KRT mostly had mild manifestations and good prognoses.

With possible exposure to COVID-19, repurposing of the hospitals, shortage of healthcare staff, and suspension of delivery and public transplantation, the continuity of KRT has faced with many challenges during the COVID-19 pandemic (19). The kidney transplant programs have shrunk or been suspended across the Europe and USA during the lockdown (20,21). Patients on in-center hemodialysis faced with the increasing risk of COVID-19 exposure in hospital and during traveling. For home PD, the sustainability of the medical supplies is threatened. To sustain and optimize the care for KRT during the pandemic, original studies have been conducted and experience and consensus have been shared. It is essential to review these studies and inform the care of patients on KRT in practice and the future. We present the following article in accordance with the Narrative Review reporting checklist (available at https://pm.amegroups.com/article/view/10.21037/pm-20-101/rc).

Objectives

In this review, the challenges and care strategies for managing patients on KRT during the COVID-19 pandemic were summarized. Management for patients on KRT infected with COVID-19 was not within the scope of the discussion.

Methods

Research selection

We searched publications in PubMed and Sinomed online before November 2020 using title/abstract keywords "COVID-19", "care", and "kidney replacement therapy". The full search strategy in PubMed was ["Novel Coronavirus" OR COVID-19 OR "Coronavirus disease 2019" OR SARS-CoV-2.] AND [care or management] AND ["kidney transplant" or dialysis or hemodialysis or "peritoneal dialysis" or "kidney replacement therapy" or "renal replacement therapy"]. The inclusion criteria were as follows: (I) studies published in English and Chinese; (II) in any population including adults and pediatrics; (III) in any study type including, but not limited to, original studies, expert consensus, review, and viewpoints; (IV) in settings including outpatient care, community care, ambulatory care, home care, and inpatient care. The studies on the management of patients on KRT infected with COVID-19 were excluded. RZ and QS screened the literature and synthesized the results.

Discussion/summary

Impacts of COVID-19 pandemic on the care of KRT

The pandemic and its attendant measurements have affected KRT care access and long-term follow-ups (19). During the pandemic, the access to transplantation and hemodialysis is affected most; 71.8% of centers across the US had suspended the living-donor kidney transplantation program in March (22), and the number of waitlist deaths was 2.2 times higher in five states with the highest COVID-19 caseloads (23). Among pediatric transplantation programs, the impact was relatively less sustained with reduced access only in the early stage of the pandemic in the US (24). In other region, the postponing of regular tests was reported. A cross-sectional study found that 46 out of 107 pediatric kidney transplant recipients had difficulties in having blood tests (25). In hemodialysis centers, the decrease in weekly treatment sessions (26) and the difficulty in arteriovenous fistula (AVF) creation (27) were observed. The home PD were less affected than hemodialysis, with the main challenges of obtaining PD supply. In Zhao *et al.*'s study, around one-third of patients experienced a shortage of PD supply, especially for PD fluids and cassettes (25).

The challenges for delivering KRT in the COVID-19 era made the patients and healthcare providers inevitably reconsider the choice of treatment modality and choose home PD as their preferred treatment therapy for its lower risks of acquiring COVID-19 (28,29). Data from the UK, the US, and Canada found that patients on home PD have

2–3 times lower incidence of COVID-19 than patients on center hemodialysis (29). In a dialysis center in Italy, compared with hemodialysis patients, home PD patients have a lower rate of all-cause hospitalization (30). To implement home PD in the COVID-19 era, timely access to catheter placement was a prerequisite when routine theaters in many centers were closed. Bedside PD catheter insertion could be implemented with safety and efficacy during the pandemic (28,31). Meanwhile, it is more important to keep patients at home with safety, thus clinicians were supposed to use regular phone calls and videoconferences to remain connected with the patients. Assessment in treatment delivery, ultrafiltration volumes, weight, BP changes, catheter function, and PD-related complications were supposed to be included (28).

Besides the direct impacts on the care cascade of KRT and reconsideration of treatment modalities, the COVID-19 also had physical, mental, social, behavioral, and financial impacts on self-care of individuals on KRT as well as their families. Previous studies suggested that patients on KRT are at an increased risk of mental distress (32,33). A mixed-methods study in hemodialysis patients reported the increased isolation, loneliness, fear of being infected, increased sadness and anxiety, and altered self-esteem and autonomy. They also experienced difficulties in adjusting to the contingency plan at the dialysis unit, difficulties in managing dietary recommendations and fluid restrictions, and a decrease in physical activity (34). The possible mental distress may also cause the maladaptive behavior in transplant recipients, such as nonadherence in immunosuppressants (32).

Prevention of COVID-19 among patients on KRT

Various institutions and centers quickly responded to the crisis, integrated the preventative measurements into care routine, reported the strategies, and formed the consensus to guide the renal practice. Guidelines regarding preventing COVID-19 have been issued focusing on adults and children on KRT and have covered the hospital and ambulatory settings of KRT care (35,36), especially for management in-center hemodialysis units (37-44). These guidelines from different renal expert panels offered recommendations for COVID-19 prevention in terms of adherence to hand hygiene, wearing personal protective equipment (PPE) (37), postponing unnecessary in-person visits (35), COVID-19 screening, facility adjustments, and management of suspected or confirmed cases of COVID-19. Current experience suggested that with proper management, patients on KRT could safely have their treatment ongoing. With rapid testing, cohort isolation, proper screening, and management, the in-center hemodialysis could be implemented during the pandemic (45). In a transplant center, no case of COVID-19 occurred in over 2,000 patients on kidney transplantation with telephone, WeChat follow-up, and online education (46).

Healthcare team and patients both should be trained in use of PPE and perform the hand hygiene at the proper time (37). For patients on home dialysis and transplantations, it is recommended that non-urgent hospital visits should be rescheduled and non-essential procedures should be avoided during the pandemic (35,36). In Brazilian Society of Nephrology, non-essential procedures referred, but not limit to changing transfer set, peritoneal equilibrium test (PET) and KT/V, while urgent PD catheter placement, repositioning catheter with dysfunction, and catheter removal due to complications were considered as non-electives (35). Additionally, for home PD patients, disinfection for the home environment once daily and disinfection of drainage fluid using 500 mg/L chlorine-containing solution in regions with high COVID-19 caseload were recommended (41). Among patients on transplantation, strict adherence to staying at home, avoiding non-emergent hospital visits, keeping social distancing, and wearing PPE in public was strongly recommended (44).

Almost all the guidelines recommended establishing standard COVID-19 screening protocols for healthcare team and patients. Among healthcare team, daily temperature monitoring and symptomology monitoring should be implemented (37). For dialysis facilities, the patients were supposed to alert the facilities if they presented with suspicious symptoms; medically stable patients were suggested to wait outside prior to the screening; the screening including assessment in temperature, suspicious symptoms, and travel-occupation-contact-cluster history taking was conducted in a separate room; tests for suspected patients and all patients have been both recommended depending on the testing capacities and social resources (47). Besides, to decrease the chance of acquiring COVID-19 in hospitals, facility adjustments were recommended including the shift reorganization of medical staff, standard environment disinfection protocols, and provision of PPE. Extra limiting of the visitors in adult or pediatric hemodialysis units was mentioned (41,43).

Telehealth and point-of-care in the follow-up of patients on KRT

The most noticeable change in routine care of KRT is substantially increasing use of telehealth catalyzed by the limiting access to hemodialysis and transplantation and increasing willingness of staying at home to minimize the risk of COVID-19 infection (19,48,49). A global survey of healthcare providers found that only 14% of healthcare providers continued face-to-face consultations (19). Dialysis and transplant centers reported their experience and shared their reflections on using telehealth in the care for patients on KRT to overcome the barriers of accessing renal healthcare during the crisis. These reports showed that telehealth is promising in improving patients' satisfaction and achieving satisfying patients' outcomes as an economic and efficient way of renal care provision.

During the emergency, a variety of telehealth platforms were used to maintain the care of KRT patients. Besides, protocols and pathways were developed to standardize the process of online services and integrated into the providers' workflow (50). Platforms used in managing KRT patients vary significantly and could fall within two categories, medical specific platforms and general platforms. The former platforms usually conform to certain regulations for medical use, such as HIPPA in the US, and offer a variety of functions used in patients' online visits or management, such as online consultation, patients' self-reporting, and online prescribing. Most reported medical platforms were largely developed before the COVID-19 era, with a specific focus on one condition such as kidney transplantation or PD. The latter platforms including telephone, e-mail, messages, virtual conference or meeting applications, and social media are not solely used for medical purposes but with high accessibility and simplicity of use during the crisis. For instance, the providers from New York offered virtual visits for 108 patients with kidney transplants and triaged them remotely to decrease avoidable in-person visits (51).

These platforms combined with point-of-care initiatives including automatic PD cyclers, remote monitoring devices, and mobile phlebotomy better facilitate provider-patient communication. For transplantation, a multidisciplinary team from Thomas Jefferson University Hospital successfully converted the in-person pre-transplantation evaluation for the waitlisted into online systemic sessions on their HIPAA-compliant platform. The kidney transplant program was further supported by telemedicine of potential living donor evaluations, at-home phlebotomy, and enterprise-wide infusion centers (49). In home automatic PD patients, cyclers with embedded software enabled the dialysis team to evaluate the dialysis performance and adjust the prescriptions (29,52). In a review, automatic PD cyclers equipped with remote patient monitoring help patients gain greater independence and safety, allow better access in remote areas, faster address of problems, and increase patients' adherence to the dialysis prescription. Besides, with the use of medical devices connected to providers' portal, incremental dialysis, a soft dialysis based on the residual kidney function and symptomatology, would be more widely diffused for potential prognosis and economic benefits (52). Ronco *et al.* used the alarm alert setting in the system to identify and troubleshoot PD-related issues early and timely during the crisis in Italy (30). Along with the logistics adjustment and clinical management in their study, only two hospital admission were made while the episodes of peritonitis remained comparable to the previous months in their cohort of 130 ambulatory patients during the study period (30).

The benefits of telehealth including less medical cost and increased healthcare access were also emphasized among children on KRT and their families. Experience of telehealth use in children on KRT was reported (53). In the US, 35 of 38 pediatric centers participating in the Standardizing Care to Improve Outcomes in Pediatric ESRD (SCOPE) Collaborative conducted telehealth visits during the COVID-19 (53). In China, healthcare providers used phones and WeChat, a multi-purpose social media application, to communicate with families with children on PD and kidney transplantation (25). WeChat was actively used where families were encouraged to report symptoms and children's condition and healthcare providers offered consultations and coordinated dialysis supplies (25,50).

Despite the successful experience in using telehealth in KRT patients, some potential limits of the telehealth practice have been discussed. The benefits from extended reimbursements coverage, waiving regulation restriction, and broadening the eligible platforms for telehealth during the pandemic may be weakened. Besides, few studies are available to investigate the factors influencing of telehealth accessibility, including education background, socioeconomic status, languages, and family support on patients' outcomes. It is evident that incorporation of telehealth in renal care still needs to be backed up with more evidence and has operational issues including technique access, technique stability, data privacy, biometric

measurements accuracy, billing, insurance coverage, and regulation restrictions (53,54).

Health education and psychosocial support for patients on KRT

COVID-19 and its preventative measures have limited healthcare access and rendered psychosocial and financial distress among people (55). The negative impacts could be more severe for patients on KRT and required patients and their families to take more responsibilities, to be more active in self-care, and adopted adequate behaviors to cope with the potential challenges. To facilitate the patients' autonomy in decision making, increase the patients' involvement in KRT management, and improve the patients-reported outcomes, healthcare providers needed to have organizational mission aligned with patients goals, deliver fast and proper health education information, and understand and improve patients' emotional well-being (33,56).

Although consensuses in preventing COVID-19 among KRT patients in and out of hospital settings have been published, these measurements and knowledge need to be filtered into the patient-friendly material. The proper forms of health education are essential to make information well-received. From the patients' perspective, it is imperative to have continuous communication with dialysis or transplantation health providers (55,57). A qualitative study in Australian kidney transplantation candidates after suspension of transplant programs reported confusion from receiving conflicting information from the health care providers about the suspension and resumption of the kidney transplantation (58). It indicates that healthcare providers should convey reliable and consistent information through adequate health education. Almost all the guidelines or consensus mentioned the importance of health education of home care for patients on dialysis and with transplantation (42). The health education included susceptibility of COVID-19 and detailed preventative measures, such as wearing masks, hand hygiene, social distance, and alertness to the atypical symptoms of COVID-19 (47). Canadian Society of Nephrology also suggested that education of KRT care should be delivered with vetted informational websites and mobile applications maintained by professional organizations. Online forums could also be used for information sharing. For places with limited access to the Internet or electronic devices, health education materials could be conveyed by emails or telephones (27). A multidisciplinary team empowered young adults with chronic conditions and their families for self-management during the COVID-19 by using virtual consultations. The consultations included advance care planning, emergency preparedness, chronic care management, and coping during this time of crisis (59). This program empowering the patients to actively cope with the care challenges was promising in reducing the uncertainty of the diseases and improving the survival and quality of life of the adults.

In children, it is imperative to get the family involved and patient-family center care is valued. The data from China showed that 13% and 11% of the caregivers of pediatric KRT patients reported depressive symptoms and anxiety during the COVID-19 (25). And in this study, psychologists offered sessions over phones to these anxious and depressive parents. Other aspects of care have been mentioned, such as returning to school, advocacy for education, and special needs of chronic ill children during the COVID-19 (60).

Implications for practice and research

This review has several implications for practice and research. For practice, the patients' involvement should be valued more in the care practice where adequate health education and multidisciplinary support of psychosocial aspects of KRT patients are essential to reach better outcomes and better quality of care. Besides, developing and testing of a hybrid of remote-ambulatory care model could be done to advance renal health. More importantly, strong policy impetus is needed to overcome the system barriers such as billing and insurance issues of sustainable and high-quality care (53,54). For research, it is imperative to have more evidence supporting the use of telehealth in providing efficient, safe, and economic renal service, especially in the resource-limited settings where renal professionals or facilities are lacking or disproportionately distributed.

Summary

During the pandemic, the care cascade of KRT and individuals' self-care have been affected. To address the challenges, renal professionals formed the consensus and shared the measurements of preventing COVID-19 infection among patients on dialysis and transplants, using telehealth and point-of-care to sustain the care continuity, and providing health education and psychosocial supports to better patients' outcomes. Accompanying these challenges, COVID-19 also presents with rethinks on the possible shift

in care delivery of KRT patients.

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References

1. Leonberg-Yoo AK, Weiner DE. Epidemiology of End-Stage Renal Disease. In: Magee C, Tucker J, Singh A. editors. Core Concepts in Dialysis and Continuous Therapies. Boston: Springer; 2016:3-13.
2. Yu X, Yang X. Peritoneal dialysis in China: meeting the challenge of chronic kidney failure. Am J Kidney Dis 2015;65:147-51.
3. Wang F, Yang C, Long J, et al. Executive summary for the 2015 Annual Data Report of the China Kidney Disease Network (CK-NET). Kidney Int 2019;95:501-5.
4. Huang JF, Zhang ZJ, Guo YH, et al. Report on organ transplantation development in China (2015 ~2018) 2019.11. Available online: http://en.cma.org.cn/module/download/downfile.jsp?classid=0&filename=1641321f95524992974c11f71da149b9.pdf
5. Harambat J, van Stralen KJ, Kim JJ, et al. Epidemiology of chronic kidney disease in children. Pediatr Nephrol 2012;27:363-73.
6. Johns Hopkins Unversity. Coronavirus Resource Center 2020 [updated 2020.11.20. Available online: https://coronavirus.jhu.edu/map.html
7. Cevik M, Kuppalli K, Kindrachuk J, et al. Virology, transmission, and pathogenesis of SARS-CoV-2. BMJ 2020;371:m3862.
8. Luo L, Fu M, Li Y, et al. The potential association between common comorbidities and severity and mortality of coronavirus disease 2019: A pooled analysis. Clin Cardiol 2020;43:1478-93.
9. Hsu CM, Weiner DE. COVID-19 in Dialysis Patients: Outlasting and Outsmarting a Pandemic. Kidney Int 2020;98:1402-4.
10. Wu J, Li J, Zhu G, et al. Clinical Features of Maintenance Hemodialysis Patients with 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. Clin J Am Soc Nephrol 2020;15:1139-45.
11. Bell S, Campbell J, McDonald J, et al. COVID-19 in patients undergoing chronic kidney replacement therapy and kidney transplant recipients in Scotland: findings and experience from the Scottish renal registry. BMC Nephrol 2020;21:419.
12. Sánchez-Álvarez JE, Fontán MP, Martín CJ, et al. Status of SARS-CoV-2 infection in patients on renal replacement therapy. Report of the COVID-19 Registry of the Spanish Society of Nephrology (SEN). Nefrología (English Edition) 2020;40:272-8.
13. Dong Y, Mo X, Hu Y, et al. Epidemiology of COVID-19 Among Children in China. Pediatrics 2020;145:e20200702.
14. Götzinger F, Santiago-Garcia B, Noguera-Julian A, et al. COVID-19 in children and adolescents in Europe: a

multinational, multicentre cohort study. Lancet Child Adolesc Health 2020;4:653-61.
15. Jiang L, Tang K, Levin M, et al. COVID-19 and multisystem inflammatory syndrome in children and adolescents. Lancet Infect Dis 2020;20:e276-88.
16. Bush R, Johns F, Acharya R, et al. Mild COVID-19 in a pediatric renal transplant recipient. Am J Transplant 2020;20:2942-5.
17. Basalely A, Brathwaite K, Duong D, et al. COVID-19 in Children With Kidney Disease: A Report of 2 Cases. Kidney Med 2021;3:120-3.
18. Plumb L, Benoy-Deeney F, Casula A, et al. COVID-19 in children with chronic kidney disease: findings from the UK renal registry. Arch Dis Child 2021;106:e16.
19. Chudasama YV, Gillies CL, Zaccardi F, et al. Impact of COVID-19 on routine care for chronic diseases: A global survey of views from healthcare professionals. Diabetes Metab Syndr 2020;14:965-7.
20. Sharma V, Shaw A, Lowe M, et al. The impact of the COVID-19 pandemic on renal transplantation in the UK. Clin Med (Lond) 2020;20:e82-6.
21. Jager KJ, Kramer A, Chesnaye NC, et al. Results from the ERA-EDTA Registry indicate a high mortality due to COVID-19 in dialysis patients and kidney transplant recipients across Europe. Kidney Int 2020;98:1540-8.
22. Boyarsky BJ, Po-Yu Chiang T, Werbel WA, et al. Early impact of COVID-19 on transplant center practices and policies in the United States. Am J Transplant 2020;20:1809-18.
23. Boyarsky BJ, Werbel WA, Durand CM, et al. Early national and center-level changes to kidney transplantation in the United States during the COVID-19 epidemic. Am J Transplant 2020;20:3131-9.
24. Charnaya O, Chiang TP, Wang R, et al. Effects of COVID-19 pandemic on pediatric kidney transplant in the United States. Pediatr Nephrol 2021;36:143-51.
25. Zhao R, Zhou Q, Wang XW, et al. COVID-19 Outbreak and Management Approach for Families with Children on Long-Term Kidney Replacement Therapy. Clin J Am Soc Nephrol 2020;15:1259-66.
26. Hussein NR, M Saleem ZS, Ibrahim N, et al. The impact of COVID-19 pandemic on the care of patients with kidney diseases in Duhok City, Kurdistan Region of Iraq. Diabetes Metab Syndr 2020;14:1551-3.
27. White CA, Kappel JE, Levin A, et al. Management of Advanced Chronic Kidney Disease During the COVID-19 Pandemic: Suggestions From the Canadian Society of Nephrology COVID-19 Rapid Response Team. Can J Kidney Health Dis 2020;7:2054358120939354.
28. Wilkie M, Davies S. Peritoneal Dialysis in the time of COVID-19. Perit Dial Int 2020;40:357-8.
29. Brown EA, Perl J. Increasing Peritoneal Dialysis Use in Response to the COVID-19 Pandemic: Will It Go Viral? J Am Soc Nephrol 2020;31:1928-30.
30. Ronco C, Manani SM, Giuliani A, et al. Remote patient management of peritoneal dialysis during COVID-19 pandemic. Perit Dial Int 2020;40:363-7.
31. Chávez Valencia V, Lagunas Rangel FA, Orizaga de la Cruz C. Letter to the Editor: Safety and Efficacy of Bedside Peritoneal Dialysis Catheter Placement in the COVID-19 Era: Initial Experience at a New York City Hospital. World J Surg 2020;44:3584-5.
32. Aziz F, Jorgenson MR, Garg N, et al. The care of kidney transplant recipients during a global pandemic: Challenges and strategies for success. Transplant Rev (Orlando) 2020;34:100567.
33. Browne T, Grandinetti A. Please do not forget about us: The need for patient-centered care for people with kidney disease and are at high risk for poor COVID-19 outcomes. Am J Transplant 2020;20:3267-8.
34. Sousa H, Ribeiro O, Costa E, et al. Being on hemodialysis during the COVID-19 outbreak: A mixed-methods' study exploring the impacts on dialysis adequacy, analytical data, and patients' experiences. Semin Dial 2021;34:66-76.
35. Calice-Silva V, Cabral AS, Bucharles S, et al. Good practices recommendations from the Brazilian Society of Nephrology to Peritoneal Dialysis Services related to the new coronavirus (Covid-19) epidemic. J Bras Nefrol 2020;42:18-21.
36. International Society of Peritoneal Dialysis Standards and Guidlines Committee. Strategies regarding COVID-19 in PD patients 2020. Available online: https://ispd.org/strategies-covid19/
37. Basile C, Combe C, Pizzarelli F, et al. Recommendations for the prevention, mitigation and containment of the emerging SARS-CoV-2 (COVID-19) pandemic in haemodialysis centres. Nephrol Dial Transplant 2020;35:737-41.
38. Chen G, Zhou Y, Zhang L, et al. Core principles for infection prevention in hemodialysis centers during the COVID-19 pandemic. Infect Control Hosp Epidemiol 2020;41:865-6.
39. Eibensteiner F, Ritschl V, Ariceta G, et al. Rapid response in the COVID-19 pandemic: a Delphi study from the European Pediatric Dialysis Working Group. Pediatr Nephrol 2020;35:1669-78.

40. Expert Panel of Nephrology Branch CMA. Interim prevention and control recommendations for 2019 Novel Coronavirus Infection for blood purification center (1st Edition). Chinese Journal of Nephrology 2020;36:E002.
41. Shen Q, Wang M, Che R, et al. Consensus recommendations for the care of children receiving chronic dialysis in association with the COVID-19 epidemic. Pediatr Nephrol 2020;35:1351-7.
42. Ikizler TA, Kliger AS. Minimizing the risk of COVID-19 among patients on dialysis. Nat Rev Nephrol 2020;16:311-3.
43. Suri RS, Antonsen JE, Banks CA, et al. Management of Outpatient Hemodialysis During the COVID-19 Pandemic: Recommendations From the Canadian Society of Nephrology COVID-19 Rapid Response Team. Can J Kidney Health Dis 2020;7:2054358120938564.
44. Tavares MS, Penido M, Andrade OVB, et al. Recommendations Of The Brazilian Society Of Nephrology Regarding Pediatric Patients On Renal Replacement Therapy During The Covid-19 Pandemic. J Bras Nefrol 2020;42:32-5.
45. Cho JH, Kang SH, Park HC, et al. Hemodialysis with Cohort Isolation to Prevent Secondary Transmission during a COVID-19 Outbreak in Korea. J Am Soc Nephrol 2020;31:1398-408.
46. Fang C, Wang L, Nie M, et al. Emergency management for kidney transplantation in the epidemic period of coronavirus disease 2019. Zhong Nan Da Xue Xue Bao Yi Xue Ban 2020;45:495-500.
47. Li SY, Tang YS, Chan YJ, et al. Impact of the COVID-19 pandemic on the management of patients with end-stage renal disease. J Chin Med Assoc 2020;83:628-33.
48. Chen G, Zhou Y, Xia J, et al. When the COVID-19 pandemic changed the follow-up landscape of chronic kidney disease: a survey of real-world nephrology practice. Ren Fail 2020;42:733-9.
49. Yadav A, Caldararo K, Singh P. Optimising the use of telemedicine in a kidney transplant programme during the coronavirus disease 2019 pandemic. J Telemed Telecare 2020. doi: 10.1177/1357633X20942632.
50. Chinese Medical Doctor Association of Youth Pediatric Nephrology. Mind maps for online medical consultation and advice for children with chronic kidney disease. Chin J Evid Based Pediatr 2020;15:15-8.
51. Chang JH, Diop M, Burgos YL, et al. Telehealth in outpatient management of kidney transplant recipients during COVID-19 pandemic in New York. Clin Transplant 2020;34:e14097.
52. Borrelli S, Frattolillo V, Garofalo C, et al. Remote patient monitoring in dialysis patients: the "change of pace" for home dialysis. Recenti Progressi in Medicina 2020;111:404-10.
53. Lew SQ, Wallace EL, Srivatana V, et al. Telehealth for Home Dialysis in COVID-19 and Beyond: A Perspective From the American Society of Nephrology COVID-19 Home Dialysis Subcommittee. Am J Kidney Dis 2021;77:142-8.
54. Kear TM. An Opportunity to Advance Kidney Health Becomes a Responsibility. Nephrol Nurs J 2020;47:313-7.
55. Extance A. COVID-19 and long term conditions: what if you have cancer, diabetes, or chronic kidney disease? BMJ 2020;368:m1174.
56. Cozzolino M, Piccoli GB, Ikizler TA, et al. The COVID-19 infection in dialysis: are home-based renal replacement therapies a way to improve patient management? J Nephrol 2020;33:629-31.
57. Gedney N. Long-Term Hemodialysis during the COVID-19 Pandemic. Clin J Am Soc Nephrol 2020;15:1073-4.
58. Guha C, Tong A, Baumgart A, et al. Suspension and resumption of kidney transplant programmes during the COVID-19 pandemic: perspectives from patients, caregivers and potential living donors - a qualitative study. Transpl Int 2020;33:1481-90.
59. Langmaid L, Ratner L, Huysman C, et al. Supporting the Medically Fragile: Individualized Approach to Empowering Young Adults With Chronic Disease During the COVID-19 Pandemic. J Adolesc Health 2020;67:453-5.
60. Hamilton JL. Returning to school in the midst of the COVID-19 pandemic for children with chronic disease and special needs. J Pediatr Nurs 2021;57:85-6.

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