



Preparation of hemodialysis centers in fighting against the novel coronavirus disease during the 2019–2020 epidemic: the experience in Sichuan province, China

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Background: Dialysis patients are at high risk of being infected by the novel coronavirus. This article aimed to share our experience in preparing hemodialysis centers in fighting against the COVID-19 in Sichuan province.

Methods: To control COVID-19, the Sichuan Renal Disease Quality Control Center (SRDQCC) organized a multidisciplinary team to draft and distribute documents for dialysis centers. The SRDQCC also established an online education system and a registry. A survey was used to assess the resources and the preparation of the dialysis centers. Patients with infected COVID-19 were transferred to the referral hospitals and treated with continuous renal replacement therapy (CRRT) in isolated rooms.

Results: All 21 regions in Sichuan province had designated specific referral hospitals for COVID-19. The documents drafted by the SRDQCC were distributed to all dialysis centers. A total of 313 records from the survey showed that 96% (301/313) of the dialysis centers had set up an emergency program based on the relevant documents. Only 39% (121/313) of the centers had emergency isolated room(s) for COVID-19. Also, 22% (68/313) of the centers had their patient(s) moved to other centers. The online system educated medical staff in 87% (271/313) of the centers. The online registry received 329 records. Four cases of COVID-19-infected dialysis patients were reported until March 3rd, 2020. There were no outbreaks of COVID-19 in any dialysis center in Sichuan province.

Conclusions: The experience of dialysis centers in Sichuan province in fighting against COVID-19 is worth sharing. Dialysis centers need to be prepared to cope with infectious epidemics guided by national as well as regional quality control centers or other similar organizations.

Keywords: Hemodialysis; novel coronavirus; novel coronavirus 2019 disease (COVID-19); Sichuan

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Introduction

The outbreak of COVID-19 has spread rapidly throughout the country, and more than 500 cases have been reported in Sichuan Province. COVID-19 is a highly contagious disease with high mortality (3–15%), especially in patients with comorbidities (1-4). Hospitals reduced or even closed some wards and/or outpatient departments in order to minimize transmission within hospitals. However, hemodialysis centers were not included in the hospitals' general regulations. In the Sichuan Provincial People's Hospital, which houses the Sichuan Renal Disease Quality Control Center (SRDQCC), the number of hemodialysis patients even increased by 20% in its main district due to the preparation of a backup specific referral hospital in its east district. Hemodialysis patients are at high risk of COVID-19 due to their impaired immune system, high uremic toxins, comorbidities, and relatively closed dialysis circumstances. In addition, hemodialysis patients must receive two or three treatment sessions weekly (except home-based hemodialysis, which is a minority population) in dialysis centers, significantly increasing the risk of being infected by COVID-19 in a relatively closed area and developing severe clinical consequences. The patients could also be a new contagious source to their families, caregivers, medical staff, and people who become contacted under specific circumstances, such as public traffic, malls, or hospitals.

Therefore, it is crucial that dialysis centers are prepared to cope with this epidemic even outside Wuhan, the epidemic center. Although there were reports sharing experience from dialysis centers to prevent COVID-19 outbreak, we shared the experience from the role of a provincial renal disease center to organize and initiate actions to help dialysis centers in the whole province, preparing themselves in advance to fight against the very new pandemic. Under the circumstances of the COVID-19 status worldwide nowadays and new unknown contagious pandemic we might face someday in the future, our experience should still worth sharing.

The SRDQCC carried out a series of actions to guide and assist the dialysis centers in Sichuan province to protect patients and medical staff, which included suggestions/guidelines, schemes, workflows, online educational materials, an online registry system, establishment of backup dialysis centers, and remote supports to handle hemodialysis patients suffering from COVID-19.

Methods

Development and distribution of documents for coping with COVID-19 in Sichuan Province

On January 21st, 2020, the Sichuan Provincial People's Hospital initiated actions after news about "a contagious disease" with respiratory impairment was received in mid-January. All of the medical staff received information and training about COVID-19 and the related medical protection measures. Education regarding the correct method of wearing a mask and hand hygiene was carried out for the patients and caregivers soon afterwards. A working multidisciplinary team was organized in the dialysis center to develop and/or improve the workflow scheme and perform related tasks, including medical supply, circumstance disinfection, medical staff and patient screening, backup dialysis center preparation, etc., in order to minimize the risk of the COVID-19 epidemic in the dialysis center.

Eighty-five outpatient dialysis patients were transferred in from the east branch hospital of to the main hospital dialysis center, which already had nearly 500 dialysis patients (including outpatients and inpatients). We held several expert meetings online via WeChat, and reviewed the related literature and standard operating procedures to develop a scheme to respond to the epidemic in hemodialysis centers. On January 28th, 2020, we distributed the scheme to all dialysis centers around the province. The scheme was then updated according to the evolving knowledge about COVID-19 and guidelines or suggestions from the national organizations on February 21st and March 1st, 2020.

We also shared the experience of the Sichuan Provincial People's Hospital via an online learning system, which included important documents, guidelines, suggestions, and educational materials. A COVID-19 registry system was also simultaneously established to monitor the epidemic and initiate related support as needed. Moreover, a survey was conducted to determine the current status of the centers.

Summary of the main suggestions and experience in Sichuan province

Dialysis facility

Facilities were required to establish feasible schemes and regulations according to the national and provincial

documents, and consistent with their hospitals. These included (but were not limited to) an emergency program, a screening and reporting program of COVID-19, patient information documents, and medical supply management.

The dialysis facility layout was required to assure different sections and pathways for clean and contaminated use. Disinfection of the machines, environment surfaces, and air was emphasized in ordinary treatment and under contaminated emergency circumstances. It was recommended to ensure the involvement of the hospital's infection department if needed.

A backup emergency separated dialysis room or ward was required; otherwise, the center should set up a clear, efficient, and safe pathway to transfer COVID-19 cases to a specific referral dialysis center. The SRDQCC regional quality control center was responsible for locating and coordinating the transfer with the referral hospitals.

Dialysis patients with suspected or confirmed COVID-19 were required to be reported to the SRDQCC online registry in order to prevent cross-transmission among dialysis centers.

Medical staff

The duty and responsibility of the medical staff to cope with the epidemic should be confirmed. A reasonable schedule was suggested not only to cope with emergencies, but also to protect staff and ensure adequate medical support. Online communication via WeChat or other platforms were recommended instead of live meetings.

The medical staff in dialysis centers were required to be educated about the significance, potential challenges, and knowledge of COVID-19. A training program was also required and reinforced the strict isolation, protection measures, hand hygiene, donning and doffing personal protective equipment (PPE), waste management, environmental surface cleaning, disinfection of dialysis stations, and sterilization of patient-care equipment, etc. It was also emphasized that changing gloves was not a replacement for hand hygiene. The Sichuan Provincial People's Hospital provided learning materials for the dialysis centers in the province via an online system, including short videos, pictures, slides, and documents. We also distributed free videos and hotline/network clinics for psychological support of the medical staff.

The medical staff were required to provide their travel and health information. They were also required to undergo screening for COVID-19 risks prior to returning to work in the dialysis centers. Necessary isolation was required for

staff that had potential intimate contact with COVID-19 cases, travelled from high-risk regions, or had other high-risk circumstances.

Dialysis patients and caregivers

Patients were required not to change their dialysis centers or caregivers. They were informed to minimize face-to-face contact with other people and keep their travel between dialysis centers and their houses as simple as possible. Also, they were required to provide a potential history of contact with COVID-19 and related symptoms such as fever, cough, etc.

Furthermore, they were educated about the basic knowledge of COVID-19, in order to increase their awareness while avoiding excessive worry. Free access to psychological assistance was given via network clinic or a hotline. Patients were taught self-protection measures, including wearing masks, hand hygiene, cough-etiquette, and body temperature measurement. They were required to wear a mask throughout the dialysis treatments, avoid eating or talking, and wash their hands before entering or leaving the dialysis stations.

Temperature was measured at least three times between entering and leaving dialysis centers. In the Sichuan Provincial People's Hospital, there was a three-layer concentric ring model for the patients to enter the dialysis center. The outer layer was a single-pass entrance and exit, where patients were required to measure their body temperature and provide possible contamination history. The middle layer was designed to screen, examine, diagnose, and isolate patients with fever and/or those with epidemiological history. The inner layer consisted of the wards and dialysis center. The patients had their temperature measured at the dialysis reception before entering the dialysis treatment section, as well as during and upon completion of dialysis (*Figure 1*). If a fever was confirmed, the staff would accompany the patient to the fever clinic for further screening.

Special workflow

Patients who travelled from potentially contaminated areas were required to measure and record their body temperature every day, and examinations such as whole blood cell counts, C-reactive protein, chest computed tomography, or COVID-19 nucleic acid were required according to the risk of contamination. The results were reviewed by the dialysis doctors before arranging dialysis sessions. A free online clinic about COVID-19 was provided

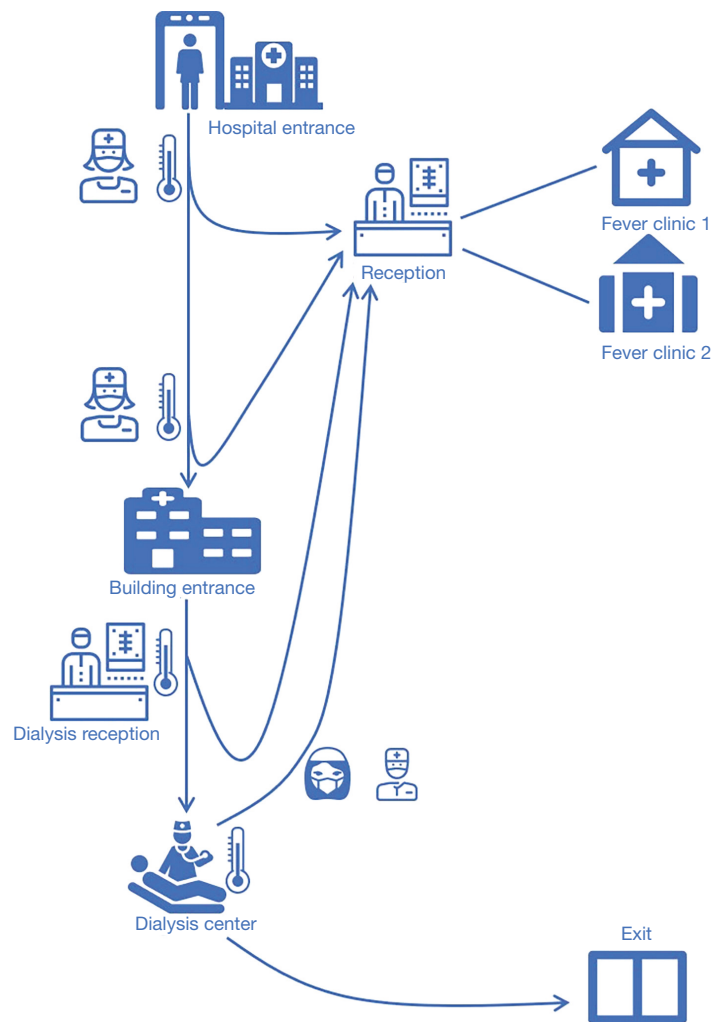


Figure 1 Screening flow chart for dialysis patients in Sichuan Provincial People's Hospital. The patients were screened upon entering the hospital, and also had their temperature measured at the dialysis reception before entering the dialysis treatment section, as well as during and upon completion of dialysis. If a fever was confirmed, staff accompanied the patient to the fever clinic for further screening. The fever clinic reception guided patients to fever clinic 1 or fever clinic 2 according to the risk of COVID-19 infection.

to the patients in Sichuan Provincial People's Hospital soon after the epidemic occurred.

A separate room for suspected COVID-19-infected dialysis patients was required. Hemodialysis or continuous renal replacement therapy (CRRT) were options for these patients. Centers that did not possess the technology or a separate room for the patient transferred patients to the nearest referral hospital that was fully equipped with the protection and isolation requirements.

For patients with a high-risk contact history but without any related symptoms, a separate section or a referral dialysis center was suggested. The SRDQCC recommended

preparing backup dialysis centers, equipment, medical supplies, and medical staff in each region of the province. However, not all centers in Sichuan could meet this criterion. Nevertheless, those centers without a backup center isolated suspected patients by time rather than space; patients were treated at the end of the treatment shift in a relatively restricted area and monitored closely. After 2 weeks of isolation, the patients could return to their normal dialysis schedule.

A strict program of transferring and isolating confirmed COVID-19-infected dialysis patients was required; the isolation of intimate contacts, including medical staff, other

patients, and caregivers etc. were also required accordingly. The air conditioning system of the center was shut down immediately upon initiation of COVID-19 controls. Also, disinfection of the environment surface, dialysis station, and other medical equipment was strictly required. The measurement of contamination was conducted prior to restarting the dialysis center.

For patients with end-stage kidney disease who might initiate dialysis in the near future, COVID-19 screening was recommended before admission to hospitals to begin dialysis treatment. Peritoneal dialysis was another option for new dialysis patients. COVID-19-infected patients were required to initiate dialysis (hemodialysis or CRRT) in referral hospitals with isolation protocols. Patients with emergency dialysis indication(s) who were unable to undergo COVID-19 screening were treated in a separated room with hemodialysis or CRRT.

Outcomes and data collection

The primary outcome was the incidence of cases as well as the outbreak of COVID-19 in hemodialysis patients in Sichuan province.

The online database for dialysis patients in Sichuan province was used to locate the patients, medical staff, and medical resources, as well as a previous survey from the SRDQCC in October 2019. The online survey was used to collect data about the preparation and management of COVID-19. COVID-19 cases were collected via the online registry, reports to the SRDQCC, as well as through the specific referral hospitals.

Statistical analysis

The data cleaning was done in Excel. The percentages of regions with referral hospital, CRRT availability among the 21 regions were calculated respectively. Percentages were also used to calculate dialysis centers with prepared emergency programs and emergency isolated rooms for COVID-19. The analysis was done with Excel of Microsoft Office 2019.

Results

According to the October 2019 survey, there were more than 392 dialysis centers, approximately 50,000 hemodialysis patients, and more than 6,000 medical staff in Sichuan province. The COVID-19 survey had 386 feedback records;

73 records were excluded for the reason of duplicate or incomplete information, 313 records were included in this analysis (*Table 1*).

There were referral hospitals for COVID-19 in all 21 regions of Sichuan except two regions (Ya'an and Panzhihua); however, CRRT was available in these two regions. The documents drafted by the SRDQCC were distributed to all dialysis centers by the 21 regional renal disease control centers. 96% (301/313) of dialysis centers established an emergency program based on the relevant documents. Only 39% (121/313) of the centers had emergency isolated rooms for COVID-19. 22% (68/313) of the centers had their patients transferred to other centers due to medical requirements (such as heart failure and dialysis access problems), and not COVID-19 isolation requirements.

The online system educated medical staff from 271 of the surveyed 313 dialysis centers. They also provided feedback of their suggestions and experience, which was helpful for improving the system.

The online registry received 329 records. There were eight reports from six centers reporting cases with a history of potential epidemiological history of COVID-19. These patients were treated by being isolated by time shifts or being treated in a relatively independent area (or both); of these patients, none were diagnosed COVID-19 finally. Six cords of suspected cases of COVID-19 were reported. They were all treated either in a referral hospital or an isolated department with CRRT in their own hospital. These suspected cases resulted in one confirmed COVID-19 case who had already been transferred to referral hospital, and five COVID-19 free cases. Three cases of COVID-19 were not reported in the system, but via email to the SRDQCC. During this epidemic, there were four cases of COVID-19-infected dialysis patients reported until March 3rd, 2020, and the data was double-checked by the referral hospitals. These four cases were all in Chengdu; they were transferred to the referral hospital and treated with CRRT in isolated rooms. One of these patients died, while the other three were in a good clinical condition.

There was no outbreak of the COVID-19 epidemic in any dialysis centers in Sichuan province.

Discussion

Dialysis patients are at high risk of infectious diseases due to their impaired immune system, high uremic toxins, comorbidities, and relatively closed dialysis circumstances.

Table 1 Survey results in dialysis centers in Sichuan province

Region of Sichuan	Survey centers	Referral hospital(s)	Referral hospital with HD center	CRRT availability	Centers with COVID-19 emergency program	HD centers with online education	HD centers with emergency isolated room(s)	HD centers with patient shift
Aba	5	Yes	Yes	Yes	3	3	4	1
Bazhong	15	Yes	Yes	Yes	15	13	4	5
Chengdu	95	Yes	Yes	Yes	92	86	38	13
Dazhou	16	Yes	Yes	Yes	15	15	3	6
Deyang	20	Yes	Yes	Yes	19	19	5	3
Ganzi	2	Yes	Yes	No	2	2	1	2
Guang'an	11	Yes	Yes	Yes	11	9	4	4
Guanyuan	6	Yes	Yes	Yes	6	5	2	0
Leshan	8	Yes	Yes	Yes	7	5	5	2
Liangshan	12	Yes	Yes	Yes	11	11	6	4
Luzhou	5	Yes	Yes	Yes	5	4	1	2
Meishan	2	Yes	Yes	Yes	2	1	1	0
Mianyang	22	Yes	Yes	Yes	22	19	12	7
Nanchong	14	Yes	Yes	Yes	13	13	6	4
Neijiang	15	Yes	Yes	Yes	14	13	5	8
Panzhihua	3	Yes	No	Yes	3	3	1	0
Suining	13	Yes	Yes	Yes	12	13	5	1
Ya'an	9	Yes	No	Yes	9	7	2	4
Yibin	25	Yes	Yes	Yes	25	17	12	2
Ziyang	12	Yes	Yes	Yes	12	12	2	0
Zigong	3	Yes	Yes	Yes	3	3	2	0
Total	313	–	–	–	301	271	121	68

HD, hemodialysis. COVID-19, novel coronavirus 2019 disease.

During the Middle East respiratory syndrome coronavirus (MERS) epidemic, nine patients in a hemodialysis unit were infected from the index case in Saudi Arabia (5). In the current epidemic, 37 of 230 hemodialysis patients and four of 33 staff COVID-19 cases were reported in one hemodialysis center in Wuhan (6). Although it is unlikely that patients on maintenance hemodialysis would be traveling to the area affected by an outbreak, they could come into contact with an undiagnosed person or a confirmed case in the family house, public traffic, or medical environments, which might put them at risk.

Preventing and controlling a highly contagious infectious disease is always a great challenge for a dialysis center

due to several difficulties at the patient, medical staff, medical supply, and equipment levels. People can restrict their activities and isolate themselves at home; however, outpatient dialysis patients must receive treatment at a dialysis center two to three times per week, especially in China where home hemodialysis is not popular. Moreover, it is unlikely that the medical staff, medical supplies, and even an emergency plan is always available when encountering such an outbreak. Our survey showed that in Sichuan Province, only 39% of the centers did not have a separate room, and approximately one third possessed the CRRT techniques and equipment. At least half of the dialysis centers responded that they might encounter a shortage of

medical supplies, especially PPE, if they were to encounter an epidemic outbreak. The lack of information about the novel COVID-19, which has infected approximately 80,000 people till now, increased the prevention and control difficulties in dialysis centers when it received public attention in January 2019.

Sichuan is a populated and high population mobile province. One non-official report showed that there were at least 20,000 people coming from Wuhan since the outbreak of COVID-19. Considerable work and efforts have been exerted by the government, disease control centers, and hospitals, etc. We agree with professor John M. Boyce that the dialysis unit should be prepared beforehand, even though we are not in the center of the epidemic area (7). There were not any guidelines available for dialysis centers, as this was the first time to face this novel virus; however, previous experience from the Korean Society of Nephrology for preventing and controlling the spread of MERS in 2015 showed that immediate actions could still be very helpful. One week after the first exposure of hemodialysis patients to a confirmed MERS case, they drafted clinical recommendations for hemodialysis facilities to follow, at a time when the first and the only confirmed case was reported in the hemodialysis unit. They released guidelines in June 2015 and amended them in November 2016 (8), and their actions successfully prevented the outbreak of MERS in the dialysis facilities.

The Sichuan Provincial People's Hospital, which houses the SRDQCC, took immediate actions to fight against COVID-19 in January, 2020, at a time when there were no cases of COVID-19 reported in the whole province. We also accepted 85 dialysis patients from our east hospital. With a strict workflow, there were no confirmed COVID-19 cases reported in our dialysis center. Our experience was shared with 87% of the survey centers via the educational system. The actions of the SRDQCC, including suggestions, guidelines, and the educational system provided a very helpful and timely support for the dialysis centers. Ninety-six percent of the dialysis centers set up feasible workflows according to their circumstances in February, 2020. Even though the equipment and isolation conditions differed between dialysis centers, they applied isolation by time schedule, by space, and both for intimate contact cases. This is not an ideal method; however, considering the absence of information, it was reasonable. As reported by Hayne Cho Park (9), three different kinds of isolation were effective in preventing secondary viral transmission.

Our survey showed that 22% of the dialysis centers

had transferred patients to other centers which could increase the difficulty in epidemic control. We established a monitoring system in order to reduce cross contamination as some patients might conceal the truth, fearing isolation, despite being informed about COVID-19, and were provided psychological support to reduce excessive worries. The system has also assisted the SRDQCC in locating COVID-19 cases and helping the regional center to coordinate the medical resources if needed.

Owing to the dedicated support from medical doctors, dialysis nurses, dialysis workers, technicians, patients and their caregivers, and the efforts of the departments from the government, disease control center, and the hospitals, four cases of COVID-19 were identified and isolated. We prevented further transmission and outbreak of COVID-19 in hemodialysis centers in the province.

This experience reminds us again to prepare in advance for similar disasters. Much work is still needed for this kind of preparation. The SRDQCC should play an even more important role in guiding, coordinating, and assisting the dialysis facilities when epidemics occur. The SRDQCC has a network in Sichuan Province, which allows for grid management by the 21 regional quality control centers. We also set up a remote consulting system in every region, which connects with more than 300 hospitals. Furthermore, we have a database for hemodialysis and have provided software for more than 300 dialysis centers (approximately 80% of the whole province). Moreover, we are designing a software to input the guidelines, standard operating procedures, workflow, and resources location information, as well as an alert function not only for COVID-19, but also for other infectious diseases. The SRDQCC suggested preparation of a backup dialysis center to treat patients at high risk of COVID-19 infection; however, not all of the regions could establish this kind of center. It is necessary to set up infrastructures to cope with similar epidemic outbreaks in the future, with the help of different organizations. In this article, we share the experience in a special setting when we had limited knowledge about COVID-19, showing the role of a provincial renal disease control center in helping dialysis centers to fight against COVID-19. Strategies with more advanced techniques and resources are available nowadays, however, most of the suggestions and workflow are still adopted currently and there was not any outbreak of COVID-19 in the province till now.

In conclusion, considering the fact that we are not in the epidemic center where dialysis centers were at greater

stress, and despite several improvements that need to be made, the experience of dialysis centers in Sichuan Province in fighting against COVID-19 might still be worth sharing. Preparing dialysis facilities with resources storage as well as advanced techniques is crucial, guided by national as well as regional quality control centers or other similar organizations.

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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References

1. Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel

- coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* 2020;395:507-13.
2. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395:497-506.
 3. Li Q, Guan X, Wu P, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *N Engl J Med* 2020;382:1199-207.
 4. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet* 2020;395:470-3.
 5. Assiri A, McGeer A, Perl TM, et al. Hospital outbreak of Middle East respiratory syndrome coronavirus. *N Engl J Med* 2013;369:407-16.
 6. Ma Y, Diao B, Lv X, et al. 2019 novel coronavirus disease in hemodialysis (HD) patients: Report from one HD center in Wuhan, China. *MedRxiv*. 2020. Available online: <https://www.medrxiv.org/content/10.1101/2020.02.24.20027201v2>
 7. Boyce JM, Hymes JL. What We Learned from Ebola: Preparing Dialysis Units for the Next Outbreak. *Clin J Am Soc Nephrol* 2018;13:669-70.
 8. Park HC, Lee YK, Lee SH, et al. Middle East respiratory syndrome clinical practice guideline for hemodialysis facilities. *Kidney Res Clin Pract* 2017;36:111-6.
 9. Park HC, Lee SH, Kim J, et al. Effect of isolation practice on the transmission of middle east respiratory syndrome coronavirus among hemodialysis patients: A 2-year prospective cohort study. *Medicine (Baltimore)* 2020;99:e18782.
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