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.

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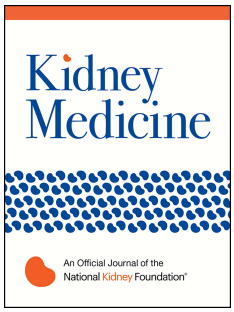

Caring for Dialysis Patients in a Time of COVID-19

Ashish Verma, M. B., B.S, Ankit B. Patel, MD, PhD, Maria Clarissa Tio, MD, Sushrut S. Waikar, MD, MPH

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Caring for Dialysis Patients in a Time of COVID-19

Ashish Verma M. B., B.S[1] Ankit B. Patel MD, PhD[1] Maria Clarissa Tio, MD[1] Sushrut S. Waikar MD, MPH[2]

Complete author and article information provided before references.

Editorial, p ●

Abstract

Coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is a pandemic and a public health emergency. The overwhelming rise in the number of cases has brought significant challenges to healthcare systems worldwide. Patients with end-stage kidney disease (ESKD) are highly vulnerable with the multiple comorbidities that make them susceptible to adverse outcomes with COVID-19. Over 2 million people worldwide receive maintenance hemodialysis (HD) at outpatient centers. Effectively preventing the spread of infection among HD centers, healthcare personnel, and patients is essential to ensure the continued delivery of dialysis to ESKD patients. This article discusses dialysis patients' care during COVID-19, addressing measures for patient and health care personnel protection and care of dialysis patients with suspected or confirmed COVID-19.

Keywords: Hemodialysis, COVID-19, Peritoneal dialysis, Outpatient dialysis units.

Coronavirus 2019 (COVID-19) is a respiratory illness that started in Wuhan, China, and has now spread to more than 150 countries, including the United States[1] . As of July 14th , the total number of confirmed COVID-19 cases has reached 13,145,302 worldwide[2]. Patients with COVID-19 infection usually present with fever (44%–98%), cough (68%–76%), myalgia (18%), and fatigue (18%)[3]. The overwhelming rise in the number of cases has challenged healthcare systems all over the world. The estimated case fatality risk for COVID-19 ranges from 0.25% to 3%,[4] with the risks higher in those with preexisting comorbid conditions—10.5% for cardiovascular disease, 7.3% for diabetes, 6.3% for chronic respiratory disease, 6.0% for hypertension, and 5.6% for cancer[55 5].

In 2016, nearly 125,000 people in the United States were initiated on kidney replacement therapy (KRT) for End-Stage Kidney Disease (ESKD), with over 726,000 on dialysis or living with a kidney transplant[6]. Dialysis patients receive KRT through various modalities including in-center hemodialysis (HD), peritoneal dialysis, and home HD. In the United States, 62.7% of ESKD patients receive HD as their KRT modality, with 98% of them receiving treatments in outpatient centers. Patients on KRT have multiple comorbidities such as diabetes, hypertension, and cardiovascular disease, which are risk factors for adverse outcomes in COVID-19. In addition, patients on KRT who are infected with SARS-CoV-2 usually present with atypical symptoms, making it a diagnostic challenge[7].The second patient who died from COVID-19 in the United States was a outpatient HD patients from the Seattle area[8, 9]. The experiences of frontline nephrologists caring for dialysis patients in Seattle and New York have been described recently[9, 10].

Scope of the problem

SARS-CoV-2 spreads from person to person through droplets expelled during coughing and sneezing[1]. Transmission through direct contact and fecal contamination can also occur[1]. Recent reports show that aerosol transmission is also possible[11]. Patients on HD are a particularly unique and vulnerable population in the COVID-19 pandemic. HD patients cannot practice social distancing as they receive HD treatments routinely at least three times a week at outpatient dialysis units. Each session requires traveling to and from the outpatient group and inevitable exposures to healthcare personnel and all the patients concurrently receiving treatment in a particular session. At any given shift, more than 20 patients can be treated. To continue providing usual care for these patients, a framework to protect patients and healthcare personnel from contracting and spreading COVID-19 needs to be in place. In response to this, the American Society of Nephrology (ASN), together with the Centers for Disease Control and Prevention (CDC), established a COVID-19 response team. This response team has laid out guidelines for all HD facilities to follow, especially in caring for patients under investigation (PUI) and patients with COVID-19. In this review, we discuss the best practices on how to care for patients with known or suspected COVID-19 in the outpatient HD setting, how to protect patients and healthcare personnel from disease exposure using personal protective equipment, and how to approach a patient on HD with confirmed COVID-19.

Measures for patient protection

Patients with COVID-19 can be asymptomatic or symptomatic 2-14 days following exposure[1]. In the setting of COVID-19, HD facilities need to provide instructions for preventative measures to include proper hygiene and handwashing techniques, coughing and sneezing etiquette, and practice of social distancing to all patients. Each patient should be instructed to inform the HD unit if they had traveled to COVID-19 endemic areas or had contact

with persons found to be positive for SARS-CoV-2. Upon arrival, patients should be screened for signs and symptoms of respiratory infections before entering the outpatient unit. In a recent perspective from Wuhan, China, HD patients were screened for viral pneumonia with computed tomography of the chest to augment the limited sensitivity and relatively slower turnaround time of SARS-CoV-2 PCR testing[12].

If possible,all patients with suspected or confirmed COVID-19 should travel in private vehicles and not via shared rides. Mandatory signs and directions should be clearly shown in the outpatient dialysis units. Educational pamphlets about CDC dialysis guidelines and COVID-19 should be kept at the front desk for patients and visitors. Patients with symptoms should wear masks while in the dialysis facility and should be seated at least 6 feet away from other patients and healthcare personnel. If available, a different seating room for patients with suspected or confirmed SARS-CoV-2 is preferred. If patients with symptoms are medically stable, they should only present to the dialysis center at the time of their shift to minimize time within the HD facility. All supplies like alcohol hand rubs, tissue paper, and masks should be available in the triage and waiting areas. Clear communication among the unit healthcare personnel, medical director, and the state health department is vital to stay updated with the evolving guidelines for COVID-19. **Figure 1** shows the algorithm for screening patients and delivery of dialysis.

Measures for healthcare personnel protection

Healthcare personnel are at the frontlines caring for HD patients with suspected or confirmed COVID-19. Protecting healthcare personnel from contracting this infection is of prime importance. While guidelines for personal protective equipment (PPE) may vary across different institutions, all healthcare personnel in outpatient HD units should wear a surgical mask for their shifts. All outpatient and inpatient HD facilities should offer non-punitive and flexible sick leave

to their employees, consistent with current public health policies that mandate ill healthcare personnel to stay home. As with dialysis patients, healthcare personnel should practice proper hand hygiene techniques. After a known exposure, healthcare personnel should inform their supervisor and should stop working if symptomatic. If asymptomatic, the next course of action would depend on the type of exposure as determined by CDC or relevant national guidelines[13]. *High-risk* exposure is defined as having prolonged close contact with COVID-19 patients with the healthcare personnel not wearing PPE with nose and mouth exposed to droplets potentially carrying the virus. *Medium-risk* exposure is defined as having prolonged close contact with COVID-19 patients while wearing a face mask while the nose and mouth were potentially exposed to material that may contain the virus. *Low-risk* exposure is defined as having brief interactions with patients with COVID-19 or prolonged close contact with patients wearing a facemask for source control while the healthcare personnel was wearing a facemask or respirator.

An healthcare personnel deemed to be high or medium risk will be instructed to self-quarantine for 14 days. An healthcare personnel considered to have had low-risk exposure can continue to work and self-monitor for symptoms, including twice-a-day temperature checks, with instructions to stop working if fever or respiratory symptoms develop. The healthcare personnel should then self-quarantine and subsequently update the dialysis facility about disease course**.** **Figure 2** illustrates an algorithm for healthcare personnel after a positive exposure. The symptoms-based strategy and test-based strategy should be used for directing discontinuation of home isolation for healthcare personnel. A person with symptoms and positive COVID-19 should discontinue home isolation after the resolution of fever without the use of fever-reducing medications, improvement in respiratory symptoms, and subsequent negative results of a molecular assay for COVID-19 from at least two consecutive nasopharyngeal swab specimens

collected ≥24 hours apart[14]. A person without symptoms and positive COVID-19 should discontinue home isolation when at least 7 days have passed since the date of their first positive COVID-19 diagnostic test and have had no subsequent illness[14].

Strategies for personal protective equipment conservation and utilization

Personal protective equipment conservation and utilization are integral parts of healthcare delivery in times of COVID-19. PPE, which includes surgical mask, eye goggles, face shield, N95 respirator mask, and isolation gown, are critical for all healthcare personnel safety. Guidance for PPE practice varies across countries and specified units within the country. Universally all guidelines have advised using surgical masks for patients and healthcare personnel. In United states, using N95 is advised for care of COVID-19 dialysis patients. Variation in PPE practice across units is dependent on the availability of resources and specific guidelines adopted by the units. All dialysis facilities should provide healthcare personnel required education and training about using PPE and proper technique of donning and doffing of the PPE. All dialysis facilities should keep an updated PPE inventory. The administration should keep track of all PPE utilization and future needs. The administration should be communicating with local, public, and federal health offices on the need for additional supplies. Standard droplet and contact precautions should be applied when caring for suspected or confirmed COVID-19 patients. Isolation gowns, N95 masks or highlevel respirator (or facemask, if respirator is not available), and eye protection should be used for direct patient care within 6 feet of COVID-19 positive patients. For procedures mostly on inpatient hemodialysis patients, where there is the risk for aerosolization, N95 respirator masks should be used with eye protection and isolation gowns. For non-direct care of patients, only a surgical mask, standard lab coat, and eye protection are required. Physician encounters for home dialysis patients should be transitioned to

telemedicine if possible, to reduce further contact and exposure. Similarly, reducing physical examination during inpatient rounds on COVID-19 patients, cohorting patients, and restricting visitors to the patient rooms are essential to minimize exposure and conserve PPE.

Dialyzing patient with COVID-19

Patients with suspected or confirmed COVID-19 should be dialyzed in a separate isolation room. Hepatitis B isolation rooms should be used first with patients with positive hepatitis B antigen and then can be used for isolation of patients with COVID-19. If the isolation room is not available, patients should dialyze during the last shift and at the end of a row or in a corner at least 6 feet away from other patients. If there is more than one suspected or confirmed COVID-19 patient at a dialysis center, all such patients should receive dialysis during the last dialysis shift. The same healthcare personnel staff should dialyze patients with suspected or confirmed COVID-19 to avoid cross-contamination and infection. In dire circumstances of HD nursing staff shortage, a fast credentialing and accreditation for nurses should be in place. All dialysis machines, dialysis stations, and chairs should be disinfected per protocol. Telemedicine should be utilized for doctors' visits when applicable.

All dialysis patients, mainly in inpatient sites, should be instructed to have strict potassium and fluid restriction to avoid the need for added treatment sessions.[15]

If there is a surge of outpatient hemodialysis patients with COVID-19, a dedicated unit for them could help minimize exposure to the uninfected HD population and associated healthcare personnel. All physicians at one particular city should be credentialed at all outpatient dialysis centers. Further, facilitating the sharing of workload during the time of the surge is essential. The dialysis staff should be trained to do diagnostic testing in the outpatient dialysis facilities. Proper technique of taking nasopharyngeal swabs should be instructed. The testing of

these patients in the outpatient dialysis center, if possible, will prevent added patient load in the emergency department at hospitals. Patients should be told and educated about practicing self-quarantine at home and family members after dialysis. Family members should also monitor them for symptoms.

For patients with COVID-19 and PUI admitted to hospitals getting inpatient HD, similar guidelines should be followed in delivering dialysis. All dialysis catheter placement procedures should be done using eye protection, isolation gowns, and N95 masks. The symptoms-based strategy and test-based strategy should be used for directing discontinuation of transmission-based isolation for the patient. For a patient with symptoms and positive COVID-19, transmission-based isolation should discontinue after the resolution of fever without fever-reducing medications and improvement in respiratory symptoms and negative results of a molecular assay for COVID-19 from at least two consecutive nasopharyngeal swab specimens collected ≥24 hours apart as test-based strategy[16]. Per non-test-based strategy transmission-based protocol, the isolation should discontinue when at least three days have passed since recovery defined as resolution of respiratory symptoms, and at least seven days have passed since symptoms first appeared[16]. Box 1 shows guidance for discontinuing home isolation for HCP and transmission-based protocol for patients.

When these patients are ready to discharge from the hospitals, appropriate planning and allocation to the outpatient dialysis unit should be done. Isolation should be maintained at home if the patient gets discharged before the removal of the transmission-based protocol. If a patient is discharged to a long-term care facility or assisted living facility before discontinuing the transmission-based protocol, it should continue at the discharge facility. If a patient is discharged to a long term care or assisted care facility following stop of transmission-based protocol and

still has symptoms, then he or she should be kept in an isolation room wearing masks all day for a total of 14 days after onset of illness or resolution of symptoms[16].

Both primary teams and nephrologists need to be aware of the importance of appropriate discharge planning for this vulnerable patient population. If discharge occurs before removing transmission-based precautions, the patient would be expected to maintain social distancing at home for the remaining time. Arrangements should be made regarding where the patient would continue outpatient dialysis sessions, usually in COVID-19 designated facilities, if available. Excellent communication with outpatient units is essential to ensure the patients' smooth transition to receiving their regular treatments upon discharge. If a patient were to be discharged to long-term care or assisted living facility, the facility must provide regular dialysis treatments. Contact precautions should be in place in the facility if the patient were to continue the remainder of transmission-based precautions. Once the precautions are lifted, but the patient remains symptomatic, the patient must be kept in an isolation room while wearing a mask for a total duration of 14 days after the onset of illness or upon the resolution of symptoms.

Clinical data

Table 1 shows the clinical outcomes data of clinical studies in hemodialysis patients with COVID-19.

Consideration for Peritoneal Dialysis and Home Hemodialysis

Peritoneal dialysis and home hemodialysis patients can also be impacted by COVID-19 though there is limited information related to this. As both of these groups of patients can complete their renal replacement therapy at home, this minimizes risks of exposure and allows them to practice social distancing. It is vital to prevent any interruptions with the delivery of supplies to those on home dialysis treatments.

KRT Initiation

Over 100,000 Americans have been initiated on KRT annually since 2002. In standard practice, preparing patients for KRT initiation requires months of lead-time, to include education on KRT modalities, frequent outpatient nephrology visits for medication titration, appointments with respective surgical subspecialties for access evaluation, necessary imaging, surgery for access creation, and ample time to allow for access to mature. As non-urgent outpatient visits are deferred, and elective surgeries and procedures are being canceled during the pandemic, it is essential to highlight that CKD Stage 5 patients nearing KRT are an extremely vulnerable group. On March 26, 2020, the Centers for Medicare and Medicaid Services announced that access creation for ESKD patients remains an essential procedure[17]. In reality, these necessary procedures may still suffer delays when resources become scarce in the setting of the pandemic. It is necessary to recognize that while resource allocation will be challenging, crash-start dialysis or unprepared dialysis is associated with poorer outcomes, higher mortality, and a significantly negative socioeconomic impact.

Effect of COVID-19 pandemic on dialysis facilities and patients

The COVID-19 pandemic has resulted in a strain on both dialysis facilities and patients. Dialysis facilities may have to arrange different dialysis shifts for patients under investigation. Dialysis facilities also must ensure staff availability to deliver dialysis to regular patients and COVID-19 patients. Transportation for patients can also be a challenge, as many patients are dependent on public transit to dialysis facilities. There is substantial psychological stress on patients and dialysis staff during this pandemic. Patients are fearful for their and other's wellbeing, especially since their care makes social distancing difficult. Dialysis staff are also

concerned about contracting the infection and being under constant responsibility to deliver dialysis to COVID-19 patients safely.

Conclusion

There is a scarcity of real-world data regarding hemodialysis patients and COVID-19. The atypical presentation and higher risks of transmission and mortality warrant specific protocols for caring dialysis patients with COVID-19. In this time of a public health emergency, it is essential to prevent transmission and use evidence-based medicine in caring for dialysis patients to avoid any interruption in their usual care.

Article Information

Authors' Full Names and Academic Degrees: Ashish Verma M. B., B.S[1] Ankit B. Patel MD, PhD[1] Maria Clarissa Tio, MD[1] Sushrut S. Waikar MD, MPH[2]
Authors' Affiliations: [1] Renal Division, Department of Medicine, Brigham and Women's Hospital, Boston, MA
[2] Renal Section, Department of Medicine, Boston University School of Medicine, Boston, MA
Address for Correspondence: Ashish Verma, M.B., B.S
Renal Division
Brigham and Women's Hospital
75TH Francis Street
Boston MA 02115
Averma8@bwh.harvard.edu
OR
Sushrut S. Waikar, MD, MPH
Renal Section
Boston University School of Medicine
650 Albany street
Boston MA 02118
swaikar@bu.edu
Support: None.
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Table 1: Clinical studies in hemodialysis patients with COVID-19.

Study	Number of HD patients	COVID-19 positive patients	Mortality rate of COVID-19 patients
UK renal registry[18]	22,431	2,414(10.7%)	625(25.8%)
Corbett RW etal[19]	1,530	300 (19.6%)	61(20.3%)
Alberici F etal[20]	643	94 (14.6%)	24(25.5%)
Fisher M etal[21]	900	114(12.6%)	32 (28.07%)
Xiong F etal[22]	7154	154 (2.2%)	41(26.6%)

Box 1. Guidance for discontinuing home isolation for HCP and transmission-based protocol for patients[14, 16].

Test based strategy*

- Resolution of fever without the use of fever-reducing medications **and**
- Improvement in respiratory symptoms (e.g., cough, shortness of breath) **and**
- Negative results of an FDA Emergency Use Authorized molecular assay for COVID-19 from at least two consecutive nasopharyngeal swab specimens collected ≥24 hours apart.

**** Test based strategy is only used for healthcare personnel, when there is adequate resources for test are available.***

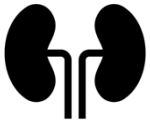
Symptoms based strategy

- At least 3 days (72 hours) have passed *since recovery* defined as resolution of fever without the use of fever-reducing medications **and** improvement in respiratory symptoms (e.g., cough, shortness of breath); **and**,
- At least 7 days have passed *since symptoms first appeared*.

Figure Legends

Figure 1: Algorithm for Screening Patients and delivery of dialysis

Figure 2: Algorithm for Healthcare Personnel Screening



Patient arrives at dialysis center for hemodialysis

Screening for symptoms
1) Fever 2) Cough 3) Shortness of breath

NO

Proceed to standard dialysis

YES

1) Provide surgical mask to patient immediately
2) Direct patient to sit in waiting room at least 6 feet away from other patients, if a different waiting room not available

Isolation room available for dialysis treatment

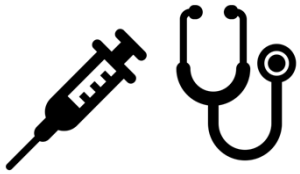
YES

NO

1) Place patient in the room
2) Make sure alcohol rub and tissue paper available in the room
3) Follow transmission-based precaution based on direct or indirect patient care
4) Proper disinfection of the dialysis chair, dialysis machine and station following dialysis

1) Place patient at end of the row or In the corner making sure 6 feet distance from other patient 2) if possible, dialyze patient in last shift

Personal Protective Equipment (PPE)
1) Direct patient care: N95 or advance level respirator, eye protection and isolation gown
2) Indirect patient care: Surgical mask, eye protection and standard lab coat
3) N95 Mask respirator for aerosolized procedure



Health care personnel working in dialysis unit known exposure to COVID-19

According to exposure, healthcare personnel will classify into high, medium and low risk exposure categories

Low risk exposure

1) Continue working per protocol.
2) Check temperature twice a day and report to dialysis in charge.
3) Stop working and put on surgical mask even after new mild symptoms of fever, cough and shortness of breath.
4) Practice self quarantine for 14 days and report diagnostic test result to the dialysis facility in charge

High or medium risk exposure

1) Put on surgical mask
2) Practice self quarantine for 14 days
3) Report diagnostic test results to the supervisor