

Canadian Association of Paediatric Nephrologists COVID-19 Rapid Response: Home and In-Center Dialysis Guidance

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Abdullah Alabbas¹ , Elizabeth Harvey², Amrit Kirpalani³,
Chia Wei Teoh² , Cherry Mammen⁴, Kristen Pederson⁵,
Rose Nemec², T. Keefe Davis⁶, Anna Mathew⁷,
Brendan McCormick⁸, Cheryl A. Banks⁹, Charles H. Frenette¹⁰,
David A. Clark¹¹ , Deborah Zimmerman⁸, Elena Qirjazi¹²,
Fabrice Mac-Way¹³, Hans Vorster¹⁴, John E. Antonsen¹⁵,
Joanne E. Kappel¹⁶, Jennifer M. MacRae¹² , Juliya Hemmett¹²,
Karthik K. Tennankore¹¹ , Louise M. Moist¹⁷,
Michael Copland¹⁸, Michael McCormick¹⁹, Rita S. Suri^{20,21} ,
Rajinder S. Singh¹⁶, Sara N. Davison²² , Mathieu Lemaire^{2*},
and Rahul Chanchlani^{23*}

Abstract

Purpose of the program: This article provides guidance on optimizing the management of pediatric patients with end-stage kidney disease (ESKD) who will be or are being treated with any form of home or in-center dialysis during the COVID-19 pandemic. The goals are to provide the best possible care for pediatric patients with ESKD during the pandemic and ensure the health care team's safety.

Sources of information: The core of these rapid guidelines is derived from the Canadian Society of Nephrology (CSN) consensus recommendations for adult patients recently published in the *Canadian Journal of Kidney Health and Disease (CJKD)*. We also consulted specific documents from other national and international agencies focused on pediatric kidney health. Additional information was obtained by formal review of the published academic literature relevant to pediatric home or in-center hemodialysis.

Methods: The Leadership of the Canadian Association of Paediatric Nephrologists (CAPN), which is affiliated with the CSN, solicited a team of clinicians and researchers with expertise in pediatric home and in-center dialysis. The goal was to adapt the guidelines recently adopted for Canadian adult dialysis patients for pediatric-specific settings. These included specific COVID-19-related themes that apply to dialysis in a Canadian environment, as determined by a group of senior renal leaders. Expert clinicians and nurses with deep expertise in pediatric home and in-center dialysis reviewed the revised pediatric guidelines.

Key findings: We identified 7 broad areas of home dialysis practice management that may be affected by the COVID-19 pandemic: (1) peritoneal dialysis catheter placement, (2) home dialysis training, (3) home dialysis management, (4) personal protective equipment, (5) product delivery, (6) minimizing direct health care providers and patient contact, and (7) caregivers support in the community. In addition, we identified 8 broad areas of in-center dialysis practice management that may be affected by the COVID-19 pandemic: (1) identification of patients with COVID-19, (2) hemodialysis of patients with confirmed COVID-19, (3) hemodialysis of patients not yet known to have COVID-19, (4) management of visitors to the dialysis unit, (5) handling COVID-19 testing of patients and staff, (6) safe practices during resuscitation procedures in a pandemic, (7) routine hemodialysis care, and (8) hemodialysis care under fixed dialysis resources. We make specific suggestions and recommendations for each of these areas.

Limitations: At the time when we started this work, we knew that evidence on the topic of pediatric dialysis and COVID-19 would be severely limited, and our resources were also limited. We did not, therefore, do formal systematic review or meta-analysis. We did not evaluate our specific suggestions in the clinical environment. Thus, this article's advice and recommendations are primarily expert opinions and subject to the biases associated with this level of evidence. To



expedite the publication of this work, we created a parallel review process that may not be as robust as standard arms' length peer-review processes.

Implications: We intend these recommendations to help provide the best care possible for pediatric patients prescribed in-center or home dialysis during the COVID-19 pandemic, a time of altered priorities and reduced resources.

Keywords

infectious disease, clinical practice guidelines, renal replacement therapy, pediatric nephrology

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Purpose

Children and adolescents receiving in-center hemodialysis (HD) are a unique and vulnerable population during a pandemic. The necessity for treatment at the dialysis center from 3 to 4 times weekly means they cannot remain isolated in their homes. They must regularly interact with the health care team, drivers in public transport, and other patients in the dialysis unit and hospital. Most Canadian HD units are built with few (if any) isolation rooms. Many units are too small to follow the strict minimum of 2 m distance between patients at all times in the waiting room and treatment areas.

These circumstances may increase the risk of rapid spread of COVID-19 infection. If infected, patients managed with maintenance dialysis are potentially at increased morbidity and mortality risk because of their compromised immune system. Therefore, adequate implementation of measures to prevent the spread of COVID-19 among in-center HD units is of paramount importance.

In contrast, home dialysis therapies for patients with end-stage kidney disease (ESKD) minimize the number of interactions required between patients and the health care system. This article, adapted from the rapid response adult home and

¹Division of Nephrology, Department of Pediatrics, University of Alberta, Edmonton, Canada

²Division of Nephrology, Department of Paediatrics, University of Toronto, ON, Canada

³Division of Nephrology, Department of Paediatrics, Western University, London, ON, Canada

⁴Division of Nephrology, Department of Pediatrics, The University of British Columbia, Vancouver, Canada

⁵Division of Nephrology, Department of Pediatrics, University of Manitoba, Winnipeg, Canada

⁶Division of Nephrology, Department of Medicine & Pediatrics, University of Saskatchewan, Saskatoon, Canada

⁷Division of Nephrology, Department of Medicine, McMaster University, Hamilton, ON, Canada

⁸The Ottawa Hospital, University of Ottawa, ON, Canada

⁹Prince Edward Island Provincial Renal Program, Summerside, Canada

¹⁰Division of Infectious Diseases, Infection Prevention and Control, Department of Medicine, McGill University, Montreal, QC, Canada

¹¹Division of Nephrology, Department of Medicine, Dalhousie University & Nova Scotia Health, Halifax, Canada

¹²Division of Nephrology, Department of Medicine, Alberta Health Services, University of Calgary, Canada

¹³Division of Nephrology, Department of Medicine, Hôtel-Dieu de Québec Hospital, CHU de Québec-Université Laval, Quebec City, Canada

¹⁴Ontario Renal Network, Toronto, Canada

¹⁵Hemodialysis Committee, British Columbia Renal Agency, Vancouver, Canada

¹⁶Division of Nephrology, Department of Medicine, University of Saskatchewan, Saskatoon, Canada

¹⁷Division of Nephrology, Department of Medicine, Western University, London, ON, Canada

¹⁸The University of British Columbia, Vancouver, Canada

¹⁹St. Michael's Hospital, Toronto, ON, Canada

²⁰Division of Nephrology, Department of Medicine, Research Institute, McGill University, Montreal, QC, Canada

²¹Centre de recherche du Centre hospitalier de l'Université de Montréal, QC, Canada

²²Division of Nephrology, Department of Medicine, University of Alberta, Edmonton, Canada

²³Division of Pediatric Nephrology, Department of Pediatrics, McMaster Children's Hospital, Hamilton, ON, Canada

*The last two authors are co-senior authors.

Corresponding Authors:

Mathieu Lemaire, Division of Nephrology, Department of Paediatrics, 555 University Avenue, Toronto, ON M5G 1X8, Canada.

Email: mathieu.lemaire@sickkids.ca

Rahul Chanchlani, Division of Pediatric Nephrology, Department of Pediatrics, McMaster Children's Hospital, 1280 Main Street West, Hamilton, ON L8S 4K1, Canada.

Email: chanchlr@mcmaster.ca

in-center dialysis guidelines, will provide guidance on managing children with ESKD at home or at in-center dialysis units.

While provincial and federal public health agencies provide recommendations regarding infection control practices daily, most of these recommendations, including those from the Centers for Disease Control and Prevention (CDC), provide little concrete or specific guidance on how to manage home dialysis and in-center HD units during the pandemic. Furthermore, advice from other countries is not necessarily applicable to the Canadian landscape.

The Canadian Association of Paediatric Nephrologists (CAPN) solicited a workgroup of clinicians and dialysis experts to discuss COVID-pandemic-related issues in the management of children receiving home dialysis and in-center HD. The goal was to collate concrete recommendations that can be easily translated into practice within the resource constraints of individual programs in Canada. We adapted the guidelines recently adopted for Canadian adult dialysis patients for pediatric-specific settings. These include specific COVID-19-related themes that apply to hospital-based dialysis and home dialysis in a Canadian setting, as determined by a group of senior renal leaders across the nation. Similarly, a group of clinicians and nurses, with deep expertise in pediatric dialysis, reviewed the revised pediatric guidelines. Methods and rationale for the Canadian Society of Nephrology (CSN) COVID-19 Rapid Response Program have been published.¹

Introduction

While the toll of the COVID-19 pandemic on children is orders of magnitude lower than that on adults, it is now becoming clear that some pediatric patients are severely affected, sometimes resulting in death and long-term morbidity.²⁻⁴ A novel, pediatric-specific syndrome that resembles Kawasaki disease, now named pediatric multisystem inflammatory disease, has also been described.^{5,6}

COVID-19 has affected pediatric patients who require any form of kidney replacement therapy (KRT) in various ways. A few of the issues faced by patients include unavoidable delays for nonurgent surgical procedures (eg, insertion of a central venous line or peritoneal dialysis [PD] catheter),^{7,8} unavailability of kidney transplantation⁹ (particularly living-related), or scarcity of critical reagents (eg, PD fluid).¹⁰ Also, inpatient dialysis units have been associated with outbreaks.^{11,12} Risk factors include multiple hospital visits each week, each lasting several hours, with a potential for suboptimal physical distancing from other patients, and close contact with staff required during dialysis-access manipulation. Although most of the large outbreaks reported are from adult centers,¹³ pediatric dialysis units are also not spared.¹⁴ It is essential to optimize care for Canadian dialysis patients based on lessons learned from countries severely affected earlier in the pandemic, such as China^{15,16} and Europe.¹⁷⁻¹⁹ Detailed comparisons of various approaches used worldwide will be

useful,²⁰ especially when correlation to patient outcomes is possible.

As many patients as possible should be offered one of the home dialysis methods, starting or transitioning will be essential to continue offering optimal care in a safer environment.²¹ It is important to note that pediatric home dialysis consists mainly of PD as home hemodialysis (HHD) is rarely used and not offered in most centers in Canada. Furthermore, the frequency for in-person clinic visits may be dramatically reduced in the near future because of the rapid implementation of telemedicine and the design of more flexible methods of reimbursements.²²⁻²⁴

This rapid response program guidance applies to pediatric patients requiring any form of chronic, outpatient KRT in a Canadian context during the COVID-19 pandemic. We have adapted them from the guidelines for adult patients recently published by the CSN for in-center and home dialysis.^{25,26}

Guiding Principles of Care for Patients With ESKD in the COVID-19 Era

The following principles guided our work to help ensure that ethical decisions were made:

1. **Uncertainty**—To acknowledge that clinicians and administrators are now working in a rapidly evolving environment that will require decision-making with limited resources and higher uncertainty levels than usual.
2. **Macro-allocation**—To acknowledge that the local context and local government priorities will shape decision-making. Previous, sacrosanct standards may need to be temporarily adjusted to maximize health outcomes for the most significant number of patients.
3. **Minimize net harm**—To limit the spread of SARS-CoV-2 infections and the disruption of the health care system.
4. **Reciprocity**—To protect our health care workforce from COVID-19 as an end to preserve the staffing levels needed for the delivery of care to patients who, by definition, require physical interventions.
5. **Fairness**—To ensure that patients with kidney disease continue to receive treatments regardless of their COVID-19 status and avoid outcomes that disproportionately affect those who are most vulnerable (eg, lower socioeconomic status).
6. **Proportionality**—To keep restrictions on staff and patients commensurate with the level of risk to public health.
7. **Respect for autonomy**—To continue to reflect patient values and beliefs as much as possible while acknowledging that choices may be limited in a pandemic.
8. **Fidelity**—To maintain a commitment to patients to provide necessary care, even though challenging times and when there is a risk to providers.

Table 1. Case Definitions Use for Patients Without a Confirmed COVID-19 Diagnosis.

	Symptoms +	Symptoms –
Exposure +	P1 = Probable	P3 = High Risk
Exposure –	P2 = Suspected	P4 = Low Risk

Note. Exposure is defined as travel outside of Canada, close contact with a person infected or suspected to have COVID-19, or contact with bodily fluids from a person with or suspected to have COVID-19.

Sources of Information

- Alberta Kidney Care South Regional guidelines
- American Society of Nephrology. March 2020. *Information for Screening and Management of COVID-19 in the Outpatient Dialysis Facility*. https://www.asn-online.org/g/blast/files/DIALYSIS_COVID_2019_Update_03.13.2020_FINAL.pdf
- BC Renal Agency. http://www.bcrenal.ca/resource-gallery/Documents/BCR-Covid_response_highlights_May_2020.pdf
- Expert opinions and emails (all provinces)
- International Society of Peritoneal Dialysis (ISPD). March 2020. *Strategies regarding COVID-19 in PD patients (adapted from Peking University First Hospital)*. https://ispd.org/wp-content/uploads/ISPD-PD-management-in-COVID-19_ENG.pdf
- COVID-19 rapid guideline: dialysis service delivery NICE guideline. <https://www.nice.org.uk/guidance/ng160>
- The workgroup members used Internet search engines to retrieve documents from provincial and local HD programs,²⁷⁻³² provincial public health agencies, the CDC,³³ other kidney agencies,^{15,34} and nonreviewed preprints. Finally, we searched PubMed for relevant peer-reviewed published articles using the search terms “COVID-19” AND “(dialysis OR chronic kidney disease)” specifically for articles published for children on dialysis.

Methods

In the pandemic’s context, the CSN developed the COVID-19 rapid response team by recruiting volunteers from within the CSN Board who identified other experts within the kidney community. Their home dialysis guidelines for adult patients were published in the *Canadian Journal of Kidney Health and Disease*.²⁶ Following the adult recommendations, the CAPN also aimed to develop home dialysis policies for Canadian children. The goal was to modify the existing Canadian adult home and hospital dialysis guidelines for the pediatric setting. The CAPN solicited a team of recognized experts on home and hospital dialysis. National and international kidney publications and webinars were viewed for recommendations that could apply to the Canadian

environment.^{15,19,35,36} Through informal searching, the team also reviewed the existing literature related to pediatric home and hospital dialysis and modified the adult recommendations to reflect Canadian pediatric programs’ needs.

We reproduced the guidelines of the adult home dialysis and outpatient HD working groups verbatim unless the pediatric group intended a change, in which case we highlighted this. We reproduced the adult rationales, either verbatim or in condensed form. We also added pediatric context and considerations, when available, and justified our differences from the adult guidelines. For many questions, no pediatric-specific data were available and no specific considerations were applied. We include herein the most relevant portions of the adult guidelines and highlight the CSN COVID-19 Rapid Response Team in the “Acknowledgments” section. In addition, several adult nephrologists who wrote them are co-authors in this article. The intention of this article is that it would be easy to read for pediatric nephrologists and would stand alone as a useful reference and resource.

COVID-19 Risk Levels Categorization for Dialysis Patients

We recommend that all dialysis patients be categorized based on known COVID-19 test results, symptoms, and exposure history to determine the optimal care. The case definitions listed in Table 1 will be used in this document.

Recommendations for Home Dialysis

1. PD Catheter Placement Should Continue Unabated Where Resources Permit

- 1.1 We suggest that PD catheter insertions (bedside and surgical) should be designated as an “urgent/emergent” procedure. These procedures should continue to be placed for patients who are expected to require dialysis during the COVID-19 pandemic, as recommended by the American Society of Diagnostic and Interventional Nephrology (ASDIN) and Vascular Access Society of the Americas (VASA).³⁷
- 1.2 We suggest that medical preoperative assessment to facilitate surgical placement of PD catheters be performed as per the existing local hospital policies.
- 1.3 We recommend that patients wishing to convert from in-center HD to PD for any reason, including the mitigation of risk from COVID-19, also be considered for urgent PD catheter insertion.

Rationale (from adult home dialysis guidelines). Patients with advanced chronic kidney disease (G5 not dialyzed [G5ND]) who do not have a PD catheter placed before starting dialysis will require a central venous catheter (CVC) and will need to be treated with in-center HD. Patients who start dialysis in this way (“crash starts”) have increased morbidity and mortality risk.³⁸

During the COVID-19 pandemic, patients are also more likely to use additional health care resources and more likely to have high levels of exposure to health care workers. Therefore, recommending PD as a modality in which definitive access can be placed at the outset is efficient and will reduce the number of patients requiring in-center HD. There are advantages of home dialysis as it allows children and their caregivers to self-isolate more easily and reduces the requirement to travel to dialysis centers where the risk of transmission between patients is significant.

Allowing patients to transfer from in-center HD to PD to mitigate their COVID-19 risk, or for any other reason, is valuable and reduces the resources needed for the provision of in-center HD. It is essential to recognize the risk of exposure to patients and health care workers during the initial PD training while they are in the hospital. Adequate downstream staff and support, particularly community support after training, is essential.

Pediatric context. PD is often the preferred modality for children. Acute PD is common in the pediatric population because of better hemodynamic stability and more efficient solute clearance compared with adults.^{39,40} Furthermore, acute HD is often not feasible, especially in small infants.

2. Training for Home Dialysis: PD and HHD

- 2.1 We suggest that home dialysis be preferentially offered to all patients who require chronic KRT if the family situation permits, as a means of reducing COVID-19 transmission risk to themselves, to other patients, and health care workers, by reducing contact with clinics and hospitals, compared with in-center HD.
- 2.2 We recommend, for eligible candidates, PD over HHD because of the shorter training time.
- 2.3 We suggest that dialysis programs tailor their workflows to accommodate higher volumes of patients/families trained on PD or HHD.
- 2.4 We suggest, for most children starting PD, that training for automated peritoneal dialysis (APD) such as continuous cycler peritoneal dialysis (CCPD) is preferred, unless there are compelling reasons to shift to chronic ambulatory peritoneal dialysis (CAPD).
- 2.5 We suggest that traditional training programs be modified, where feasible, to minimize the need for patients to attend the local clinic, to protect patients and health care workers.
- 2.6 We suggest training using a combination of in-person and online modules or videos if possible. However, individual learners' needs should be accounted for, and training style be modified accordingly. This hybrid approach would reduce in-person training time and maximize the number of patients trained. In addition, telemedicine is evolving which may be another venue for training.
- 2.7 We suggest creating and using a streamlined PD training curriculum, including a checklist of "essential tasks," to minimize training time.
- 2.8 We recommend continuing to train patients for HHD in centers already supporting this modality, provided trained staff are available who are not required to redeploy to meet a more compelling need. We suggest carefully selecting patients and families who are anticipated to train safely and rapidly.
- 2.9 For patients learning HHD with an existing arteriovenous fistula (AVF), we suggest that for patients who also have a CVC in situ, needle training of AVF access should be delayed to facilitate faster training in HHD.
- 2.10 We suggest that in patients with mature AVF access, any changes in therapy should be based on traditional clinical assessments. Should there be a local outbreak of COVID-19 or an urgent need to reduce hospital visits, a discussion for temporary CVC insertion to facilitate faster training in HHD should take place between providers, patients, and families to weigh the relative risks and benefits.
- 2.11 For HHD programs that support multiple platforms (conventional HD machine vs newer platforms, eg, NxStage System One, Fresenius Medical Care), we recommend that training focus should be on the platform associated with shorter learning time and fewer home renovations.
- 2.12 For HHD programs using conventional HD machines only, we suggest that attention should be directed closely to local tradespeople's availability to modify electrical and plumbing systems. We suggest that early discussions take place with local trades to reduce this barrier to independence at home. When tradespeople must go into the house, we suggest they practice physical distancing, proper hand hygiene, and wear a surgical mask; this needs to be reviewed at the time of engagement.
- 2.13 We suggest that all travel programs for patients treated with home modalities be suspended immediately and indefinitely.

Rationale (from adult home dialysis guidelines). Patients with ESKD treated with in-center HD typically must come to the dialysis unit 3 to 4 times weekly, often using a form of public transportation. This dramatically increases their risk of COVID-19 exposure. The intensive nature of the treatment requires significant health care workforce utilization that is likely to be reduced during the pandemic. Home dialysis therapies maintain social distancing, often without additional nursing support. Follow-up visits usually occur approximately every 1 to 2 months. We also suggest a combination of telehealth and in-person visits should be used as needed, especially for patients recently commenced on dialysis. We prefer PD to HHD because of the reduced training time

required to prepare the patient for independent home dialysis. We also prefer HD platforms that are easier to learn and require minimal modifications to the home over more traditional HD machines as they reduce patients' exposure to the health care team and tradespeople (ie, plumbers, electricians).

Pediatric context. APD is the main PD modality used in pediatrics because it provides more flexibility to attend school and to participate in social activity during the day, and reduces stress on caregivers during the day. In addition, APD allows easy tailoring of dialysis prescriptions, especially among infants who are often high transporters.⁴¹ Finally, CAPD is associated with a higher risk of infectious and mechanical complications compared with CCPD.⁴²

3. Home Dialysis Management

- 3.1 We suggest that patients have a minimum of 2 weeks of PD or HHD supplies and medications in case they require self-isolation or there is a disruption in the delivery of supplies. We recommend rotating these supplies to minimize wastage from expiry.
- 3.2 We recommend patients follow public health advice and stay home. Visits by family and friends should be minimized, and visits by health care workers limited to those needed to provide training or treatment.
- 3.3 We recommend that if a health care worker must go into the home, that this be used as an opportunity to bring supplies to the patient that they might otherwise have had to pick up in person at the home dialysis unit (eg, dressings, specialized tape, or thrombolytics).
- 3.4 We recommend reinforcing hand hygiene protocols with written and visual literature designed for both patients and health care workers, including procedural steps where liquid soap and water may be used in place of an alcohol-based hand sanitizer.
- 3.5 If Health Canada-approved hand sanitizer is not available, we suggest using locally produced alcohol-based hand sanitizer containing 60% to 80% ethanol or isopropyl alcohol or hand washing with liquid soap for 20 seconds.
- 3.6 We recommend ensuring that all team members, care providers, and patients have received appropriate education and supervision concerning hand hygiene and personal protective equipment (PPE), and that the home unit is adequately equipped with the necessary equipment such as soap, sinks, paper towels, and alcohol-based sanitizer that are easily accessible.

Rationale (from adult home dialysis guidelines). Patients with ESKD are at high risk of COVID-19 infection complications. For this reason, visitation by the health care team, family, and friends should be minimized. Hand hygiene protocols should be reviewed and strengthened; as many as 50% of

home adult patients are not washing their hands for dialysate exchanges within 6 months of training.⁴³ Alcohol-based hand sanitizer is more effective than handwashing with soap and water in reducing microbial flora. Therefore, it is theoretically more effective in reducing the risk of infection associated with connection procedures.⁴⁴ However, given the lack of randomized trial data to support this assertion, liquid soap and water may be used for some or all aspects of the connection procedure to extend the supply of alcohol-based hand sanitizers.

Pediatric context. We did not find any pediatric-specific data.

4. Personal Protective Equipment

- 4.1 We recommend that all home dialysis patients be provided with written or verbal information regarding the signs and symptoms of COVID-19.
- 4.2 We recommend that patients be reminded of their responsibility to report their symptoms and be reassured that any symptoms reported will not impact the ability to continue with their treatments.
- 4.3 We recommend that screening questions be answered in keeping with local policy, before a patient enters a home dialysis unit or clinic, and before staff and health care workers come into contact with the patient.

PPE for medical staff caring for possible, probable, or confirmed cases of COVID-19

- 4.4 We recommend that the patient be approached as COVID-19 positive, using appropriate PPE, following local infection prevention and control (IPAC) guidelines: At the time of writing, this would include surgical mask, visor, gown and gloves, and an N95 mask for an aerosol-generating procedure.

PPE for medical staff caring for patients with confirmed COVID-19-negative test or low-risk patients

- 4.5 PPE should be available to all staff members and used according to local practices and or national guidelines based on the nature of the contacts with the patient. For most home dialysis patients, this would include the staff wearing a surgical mask.
- 4.6 As the COVID pandemic evolves, we foresee that PPE policies may require revision for health care workers with direct patient contact regardless of COVID-19 status due to the potentially increased incidence of asymptomatic COVID-19 patients. This will need to be balanced with the availability of PPE in the local environment.

PPE for PD and HHD patients

- 4.7 We suggest that masking during routine PD exchanges done at home should continue unchanged (ie, it was

mandated before the COVID-19 pandemic, and remains a cornerstone of infection prevention during the pandemic).

- 4.8 We suggest that surgical masks or cloth masks, if a surgical mask is not available, continue to be used, for accessing CVCs, or for accessing AVF with buttonhole technique pre- and postdialysis. If masks are not available, we suggest that it is acceptable to perform these procedures without a mask.
- 4.9 We suggest that patients with respiratory symptoms use a surgical mask, or cloth mask if a surgical mask is not available. If masks are not available, we suggest that it is acceptable to perform these procedures without a mask; patients should take care not to sneeze or cough on the connection.
- 4.10 For patients who must come into the home dialysis unit or clinic for assessment, or for patients who require a health care worker to come into their home, we recommend that the patient wear a surgical mask if tolerated, anticipating that optimal strategies may change with time and circumstances.

Rationale (from adult home dialysis guidelines). Although many PD programs teach patients to use a mask when doing dialysate exchanges, ISPD 2016 guidelines state that masks are unnecessary for asymptomatic patients: This would become important were mask supplies to be limited.⁴⁵ Most HHD programs teach patients to use a mask when accessing CVCs or when needling AVF with buttonhole technique.⁴⁶ However, there are no data supporting the routine use of masks for catheter access.

In situations where mask supply is limited, the CDC endorsed maskless connections and disconnections.⁴⁷ Following the same logic, limiting the use of PPE for PD dialysate exchanges and HD connections may also be justified. It may also be acceptable to use a cloth mask in place of a surgical mask for low-risk procedures, as per recent public health policy. As the presentation of COVID-19 may be atypical in dialysis patients, we have suggested surgical mask use for patients who will be in contact with the health care team. We have also suggested surgical mask use when members of the health team must interact with home dialysis patients due to the high risk of COVID-19 complications in this population.

Pediatric context. ISPD pediatrics 2012 guidelines recommend the use of facemasks for healing PD exit site.⁴⁸ However, there is no clear recommendation for routine care. Most pediatric centers teach patients to use a mask such as when connecting and disconnecting patients from the machine. Despite the lack of supporting evidence, the consensus among pediatric PD programs is to use masks during routine care during this pandemic.

5. Ensure Delivery of Dialysis Products Is Done Safely

- 5.1 We suggest ongoing open communication with dialysis vendors and suppliers to ensure timely and safe delivery for both patients and drivers.
- 5.2 We recommend telephone prescreening of patients for COVID-19 status and COVID-19 symptoms. If positive for either, arrangements for product delivery be coordinated with the home dialysis unit.
- 5.3 We recommend that physical distancing should be maintained between patients and drivers during product delivery.
- 5.4 We recommend hand hygiene and surgical masks for drivers who must go into the home, aligned with our recommendations for health care workers.

Rationale (from adult home dialysis guidelines). Delivery of product into a patient's home requires contact between the patient, delivery driver, and product. All of the hospital infection control policies to protect patients and the health care team apply to delivery drivers.

Pediatric context. We did not find any pediatric-specific data.

6. Minimizing In-Person Contact With Health Care Providers

- 6.1 We suggest that routine follow-up and elective procedures such as assessment of peritoneal membrane characteristics through peritoneal equilibration tests (PET) and clearance studies should be delayed in almost all patients.
- 6.2 We suggest coordinating transfer set changes with any necessary in-person visits or delaying transfer set changes for up to 6 to 9 months unless there appears to be a compromise to the integrity of the transfer set. This recommendation does not apply to programs that use bleach containing agents for disinfection in which the usual 6-month protocol still applies. Patients should still visually inspect and photograph any cracks, breaks, or changes in color and report to their PD team immediately.
- 6.3 We suggest that routine AVF access flow measurements for patients treated with HHD should be delayed and that patients be educated to monitor for the onset of difficulty needling, prolonged bleeding after dialysis, or elevated arterial/venous pressures as surrogates of AVF access dysfunction and report them to the HHD team for consideration of access flow measurement or definitive investigation.
- 6.4 We suggest reducing the frequency of laboratory testing for stable patients (determined by programmatic

review). We suggest changing all PD and HHD visits to a hybrid model of in-person and telehealth (video or telephone), with the exception of patients who, in the judgment of the team, would benefit from more frequent in-person assessments.

- 6.5 We suggest that patients with new nonserious symptoms consider calling the home dialysis team for advice, rather than referring themselves directly to emergency, and that patients with severe or serious symptoms should contact 911 or attend their local emergency department as usual.
- 6.6 Patient visits should be kept to a minimum with priority given to infants and young children to closely monitor their growth, blood pressure, and physical examination more accurately. Some of these visits may be reserved for more essential issues such as peritonitis, severe exit-site infection, or training new patients. Control the number of patients per clinic session and speed up all procedures done during the clinic visit to reduce the number of patients in the waiting area so they can sit further apart.³⁶

Rationale (from adult home dialysis guidelines). When patients treated with PD or HHD must leave their home, their potential risk of COVID-19 exposure is increased. We must balance this against concerns about reducing the frequency of health care team global assessments, commonly undertaken procedures, examinations, and laboratory tests. Delaying formal kinetic studies such as PET and the other monitoring described above is unlikely to have negative health consequences in the short term. All laboratories should be following local policies that minimize the risk of COVID-19, including handwashing, PPE, and physical distancing; we considered that the risks of visiting outpatient or hospital-based laboratories for blood tests were not prohibitive, but high enough that we should minimize this risk in those who are stable. For acute medical problems, whether suspected COVID-19-related or intercurrent issues, if circumstances permit, the involvement of the home dialysis unit team may lead to more efficient use of emergency room resources, and routing of the patient to the emergency room currently best able to manage both their need for dialysis and their need for health care for the intercurrent problem.

Pediatric context. We did not find any pediatric-specific data.

7. Caregivers Support in the Community

- 7.1 We suggest training of willing family members who may have been previously unavailable to help decrease the number of visits by health care providers.
- 7.2 For programs that depend on third-party agencies such as respite nursing, we suggest open and frequent communication to verify staffing levels and services that can be realistically provided.

- 7.3 If there is no home provider or caregiver available to manage PD, the nephrology team should be contacted immediately. If possible, they may provide urgent training to an alternate caregiver, and if this is not possible, patients may require hospitalization until a trained caregiver is available.

- 7.4 We suggest that units be prepared to bring some PD patients to the home dialysis unit in case of technique, supply, or support failure and that in-center PD be considered if resources permit, and favored over the conversion to HD. In addition, efforts should be made to admit patients directly to the inpatient ward if they pass COVID-19 screening and are reported to be well, to avoid crowding the emergency department.

Rationale (from adult home dialysis guidelines). We outline some strategies designed to keep people at home in times of constrained resources, arguing that if the system is stressed to the point that insufficient health care providers are available to maintain current standards, likely trained health care workers will be a constrained resource across the system. Under these circumstances, the benefits of staying home with a dialysis prescription that might normally be considered suboptimal outweigh the risks of transfer to other modalities.

Pediatric context. We did not find any pediatric-specific data.

8. Treatment of COVID-19 for PD Patients (Modified From the Chinese Society of Paediatric Nephrology)¹⁵

We suggest that the management of COVID-19 infection is the same for PD patients as for all other patients. In addition, we recommend that patients with mild or moderate symptoms of COVID-19 can continue PD treatment as usual, with prescription change according to their general evaluation. Severe or critically severe cases requiring life support because of multiple organ dysfunction syndrome can be temporarily transferred to continuous kidney replacement therapy (CKRT). As in patients on HD, it is advisable to monitor volume balance closely and ensure dry weight targets are accurate and being obtained, so increased ultrafiltration may be needed if remaining on PD.

Recommendations for In-Center HD

1. Identification of Patients With COVID-19 in the Dialysis Unit

Screening of the dialysis patients

- 1.1 We recommend that all dialysis units implement their own formalized screening process to detect individuals infected with SARS-CoV-2.

- All patients should be screened at the entry to the dialysis unit by health care workers using a screening tool (see below)
- Patients should not be allowed to wait in the waiting room prior to screening. In situations where this is not possible, ensure a distance of more than 2 m between chairs. Floors should be labeled for line up to enter the unit to ensure physical distancing.
- Patients and caregivers should be informed of their responsibility to self-report symptoms in themselves and/or their children and be reassured that their dialysis treatments will continue.
- If there is an outbreak in the dialysis unit, infection control within the institution along with local public health officials should be consulted to determine necessary modifications to screening and testing procedures.
- We should redirect patients presenting with severe symptoms meeting admission criteria to the location for medical care. Admission criteria should follow local standards.

Testing HD patients for COVID-19

- 1.2 We suggest that all patients presenting with symptoms compatible with COVID-19 (P1 [probable] and P2 [suspected]), as defined in Table 1, be tested for SARS-CoV-2 in the HD unit.
- 1.3 We recommend that testing in the dialysis unit should only be performed after the dialysis nurses have been properly trained to do so, and an isolation room is available.
- 1.4 Nurses performing COVID-19 testing should use PPE for droplet/contact precautions as per provincial health agency guidelines. N95 masks are not required.
- 1.5 Kidney programs should advocate for expedient results, ideally within 24 hours, for patients treated with maintenance dialysis, to allow planning of future dialysis treatment location depending on COVID-19 status.
- 1.6 Chest X-ray may be performed if clinically indicated. Computed tomography (CT) scan is not required for the diagnosis of COVID-19 but may be ordered in individual cases if deemed clinically appropriate.

Call ahead

- 1.7 We recommend that all dialysis patients be advised that if they develop symptoms, they should inform the dialysis unit BEFORE their scheduled treatment.
- 1.8 All patients should be informed of the signs and symptoms of COVID-19.
- 1.9 Consider giving standardized pamphlets from the public health office if available in the patient's language.
- 1.10 Patients should be instructed to call the dialysis unit if they develop symptoms at home.

1.11 If resources allow, consider requesting a nurse or a trained ward clerk to call all HD patients at least 24 hours before their upcoming treatment to inquire about symptoms.

1.12 Patients who report symptoms should be directed to the most appropriate medical resources (eg, seek immediate medical attention, testing options [if, when, and where], adjusting the timing and location of their next dialysis treatment to permit evaluation and minimize exposure to others).

Rationale (from adult outpatient HD guidelines). In-center HD patients have a high risk of infection as they cannot remain isolated in their homes. Therefore, a rigorous screening process at the entry to the dialysis unit is needed to identify potentially infected patients and inform precaution measures to prevent transmission and protect health care workers.

The presentation of COVID-19 may be atypical in dialysis patients,⁴⁹ especially if they are immunocompromised. Nonmedical screeners at a hospital/facility entrance can be rapid and standardized. However, these individuals may not be trained to identify probable cases as accurately as health care workers who know the patients and can detect changes in status and symptoms. Temperature and oxygen saturation may aid in the identification of infected patients who do not present with typical symptoms. Patients may feel more confident and comfortable to report symptoms to health care workers if well informed of COVID-19 symptoms and assurances of continued dialysis care.

Patients who present with severe symptoms may decompensate quickly and should be directed to the emergency department or other suitable location for further assessment. Allowing patients to call ahead allows the dialysis unit staff to optimize their treatment plan to minimize the spread of infection and ensure patient safety. It also ensures that patients who are sick are identified and treated as soon as possible. Categorizing patients according to the probability of infection will inform precaution measures to safely treat patients in the most appropriate location and in the most appropriate manner, to minimize transmission to other patients, and to protect health care workers.

Pediatric context. We did not find any pediatric-specific data.

2. HD of Patients With Confirmed COVID-19

Assessment of patient stability

2.1 We recommend that all patients with COVID-19 be assessed at each treatment for suitability to be dialyzed in the dialysis unit.

2.2 All patients with COVID-19 meeting admission criteria or deemed to be otherwise unstable should be dialyzed in a location that does not put them or others at risk. These criteria include the following:

- new requirement for oxygen,
- new onset of persistent hypotension,
- new altered levels of consciousness.

Treatment location for stable patients

- 2.3 We recommend all dialysis patients with COVID-19 who are stable continue to receive their dialysis treatments in an outpatient dialysis unit.
- 2.4 We recommend that all dialysis patients with COVID-19 be separated from other patients using droplet/contact precautions during their dialysis treatments:
- Separated means dialysis in an isolation room with droplet/contact precautions. A negative pressure ventilation room is NOT required. Droplet/contact precautions means procedure mask, visor, gloves, and gown.
 - If no isolation rooms are available, cohorting COVID-19-positive patients on a separate dialysis shift may be considered, preferably during the last shift of the day to allow adequate time for disinfection.
 - If this is not possible, see section 6 below.

Transportation to the dialysis unit

- 2.5 We recommend that all dialysis patients with a confirmed COVID-19 infection be transported in a private vehicle, without other patients:
- For children, private transportation may include a private taxi, or special transportation for disabled individuals provided by provincial health agencies. The optimal method will consider the patient's financial resources, and physical and cognitive function.
 - If single-patient transportation cannot be provided, consider cohorting patients with confirmed COVID-19 in the same vehicle, provided all patients are wearing masks.
 - When in a vehicle with a patient confirmed to have COVID-19, the driver should wear a procedure mask and visor. All patients and their drivers should perform hand hygiene before and after entering vehicles.

Escort to the dialysis unit

- 2.6 We suggest that all dialysis patients with confirmed COVID-19 be escorted by security or other hospital/facility personnel from the entrance of the building to the dialysis unit:
- Patients with confirmed COVID-19 should not wait in the waiting room, whenever possible.
 - Patients with confirmed COVID-19 should not be allowed to go to other areas within the hospital or facility.

Masks and hand hygiene

- 2.7 We recommend that all dialysis patients wear a mask from the moment they leave their house until they

return home, if this is age-appropriate. This includes the following: in a transport vehicle, in the hospital or facility, and during treatment.

- 2.8 We also recommend that all dialysis patients perform hand hygiene with hand sanitizer upon entry to and exit from the dialysis unit:

- All dialysis patients with confirmed COVID-19 should be provided with an extra procedure mask at the end of each treatment to wear in the vehicle on the way to the next dialysis session.
- If the dialysis unit does not have enough masks, then the patient should wear a cloth mask.
- Hand sanitizer should be located at the entry to the dialysis unit.

Counseling on home isolation

- 2.9 We recommend that all dialysis patients be counseled on how to safely isolate themselves from others who live in their household:

- Ideally, dialysis patients and their parents should be provided with a standardized pamphlet from the provincial public health agency on how to practice home isolation, if such a pamphlet exists in their own language (eg, http://www.bccdc.ca/Health-Info-Site/Documents/StoptheSpread_COVID-19_at_home.pdf).

Discontinuation of isolation procedures

- 2.10 We recommend that the above recommendations be followed until the patient is declared negative according to provincial public health agency guidelines:

- At the current time, one such recommendation is that isolation should be continued until the patient is asymptomatic, AND a minimum of 10 days self-isolation.
- The duration of isolation may be longer than 14 days for immunocompromised patients—consultation with local infectious disease or infection control experts on a case-by-case basis is suggested.
- Given that the risk of reinfection is not known, patients who have recovered from COVID-19 should be screened as discussed in section 1 and treated by the algorithm mentioned in section 3.

Visitors/caregivers access to the dialysis unit

- 2.11 We suggest that visitors not be permitted for patients with confirmed COVID-19.

- 2.12 We suggest that only 1 caregiver should be permitted for pediatric patients with confirmed COVID-19:

- If allowed to visit,
 - **All caregivers who enter the unit should be screened.**
 - **Only asymptomatic caregivers with no known exposure to enter the unit should be permitted. If an infant (<18 months) or a toddler (18 months to 2.5 years of age) is**

infected and only has 1 caregiver, appropriate strategies should be in place for this caregiver to stay with him/her.

- **All caregivers are required to wear a mask and practice physical distancing.**
- **All caregivers should be reassured that their loved one will continue to receive the best possible and safest HD care.**
- If it is not possible to have someone accompany the child (especially the very young), the dialysis unit should make every effort to seek support from services available in their hospital.

Contact tracing for confirmed COVID-19 patients

2.13 We recommend that the local IPAC team be notified of patients with probable and confirmed COVID-19 to ensure consistent processes for contact tracing for all staff and patients, and to ensure that public health is notified if the current interim case definition is met:

- The local public health department should be notified by the local infection control team if there is a suspected outbreak in the dialysis unit.
- The interim case definition is defined nationally but reported provincially. It is available at <https://health-infobase.canada.ca/covid-19/epidemiological-summary-covid-19-cases.html#a3>

Rationale (from adult outpatient HD guidelines). Patients with severe symptomatic COVID-19 infection have a very high risk of transmitting infection to others and therefore should be dialyzed in an isolation room with airborne/droplet/contact precautions to minimize risk to nursing staff and other patients. This is not always possible in the main dialysis unit. Furthermore, unstable patients usually require intensive nursing care, which is difficult to provide in a busy outpatient unit, as every time the nurse enters the isolation room, PPE with N95 must be donned. Finally, unstable patients are at high risk of needing advanced resuscitation efforts (eg, cardiopulmonary resuscitation [CPR]), which require expeditious access to an expert resuscitation team (see section 4). For these reasons, unstable patients should ideally be dialyzed in an isolation room within the dialysis unit.

Stable patients with COVID-19 should not be admitted to hospital as it is not medically needed and to reserve inpatient resources for those who need it. Isolation of stable confirmed COVID-19 patients using droplet/contact precautions while they are in hospital or a treatment facility follows recommendations of provincial public health agencies. It is recognized that not all dialysis facilities have this capability. In this case, COVID-19-positive patients may be cohorted together on a single dialysis shift, accepting the small risk of cross-infection with a different COVID-19 strain. Finally, it is recognized that some dialysis units are already at capacity and

may not have the ability to reserve an entire shift for just a few patients with confirmed COVID-19. For such units, a protocol of dialysis under fixed dialysis resources would need to be considered (see section 6 for details).

Airborne precautions (N95 masks) are only required for patients who are undergoing aerosol-generating medical procedures (AGMP); these should NOT be done in the dialysis unit (including high flow oxygen). Please see the provincial health agency Web site for latest recommendations on what is classified as an AGMP and current recommendations for use of N95 masks.

In keeping with public health recommendations, confirmed COVID-19 patients should not circulate freely in public spaces. An escort will help adhere to this recommendation.

It is not safe for visitors to be at the bedside of a patient infected with COVID-19 during a dialysis treatment. Preventing infection transmission supersedes patient-centered care and autonomy in this case. In case of infants and toddlers where parents/caregivers are required to be present, appropriate protective gear should be worn while they are in the dialysis room as suggested by local guidelines.

Pediatric context. We did not find any pediatric-specific data.

3. HD of Patients Not Yet Known to Have COVID-19

Assessment of patient stability

- 3.1 We recommend that all patients with symptoms of COVID-19 (P1 or P2, see section 1) be assessed at each treatment for suitability to be dialyzed in the dialysis unit.
- 3.2 We suggest that any patient with probable or suspected COVID-19 and signs of respiratory deterioration during HD (such as hypoxemia or respiratory distress) has rapid assessment for transfer to the emergency room, and/or early controlled intubation by a specialized resuscitation team, as appropriate.
- 3.3 We recommend that all dialysis units review their resuscitation procedures in detail with all staff and consider consulting with the local intensive care unit (ICU) team.

Dialysis of stable patients

- 3.4 We recommend that all dialysis patients whose COVID-19 status is unknown and who are stable continue to receive their dialysis treatments in an outpatient dialysis unit.
- 3.5 We recommend that all patients whose COVID-19 status is not known (P1, P2, P3, P4) be treated according to the pathways outlined in Tables 2 and 3 (see below) that account for the prevalence of disease within the community.

Table 2. Care Pathway for Low Prevalence of COVID-19 in Community.

	P1 Symptoms + Exposure + PROBABLE	P2 Symptoms + Exposure – SUSPECTED	P3 Symptoms – Exposure + EXPOSED	P4 Symptoms – Exposure – MAY BE EXPOSED
Patient wears mask on entry, during dialysis, and in transport vehicle ^a	YES	YES	YES	NO
“Separated dialysis” ^b (isolation room)	YES	YES	IF POSSIBLE	NO
Droplet/contact PPE ^c	YES	YES	YES	NO
Test for SARS-CoV-2 ^d	YES	WHEN POSSIBLE	NO	NO
Shared transportation ^e	NO	NO	NO	YES
Wait in waiting room ^f	NO	NO	NO	YES
Wander in facility	NO	NO	NO	YES
Counsel on home isolation	YES	YES	YES	NO
Discontinue isolation procedures ^g —also see C3 for special populations	If COVID-19 negative: when symptoms resolve AND >14 days from exposure If COVID-19 positive: See Section B	If COVID-19 negative: when symptoms resolve If COVID-19 positive: See Section B	14 days from exposure	N/A
Caregiver can accompany patient	YES	YES	YES	YES
Visitors can accompany patient ^h	NO	NO	NO	NO

^aMasks for patients

When the prevalence of COVID-19 in the community is high (as determined by public health), all patients should wear masks throughout the treatment, including P4. When prevalence is low, patients who are asymptomatic with no known exposures do not need masks.

^bSeparated Dialysis (Isolation Rooms)

Ideally, P1, P2, and P3 patients should be dialyzed in separate isolation rooms. If this is not possible, maintain droplet/contact precautions by keeping >2 m distance between patients AND using a physical barrier to separate treatment stations, such as plexiglass screens, washable curtains, or disposable plastic sheets.

P1, P2, and P3 patients should NOT be cohorted together, even with patients of the same category. This is to avoid transmission from positive (but not yet confirmed) patients to those who are negative.

Negative pressure ventilation rooms are NOT required for routine dialysis. They are recommended ONLY if an aerosol-generating medical procedure (AGMP) is anticipated, such as high flow oxygen, intubation, or mechanical ventilation. For this reason, we recommend unstable patients are dialyzed in an appropriate location (see 3.1).

Cleaning of the treatment area, machines, and isolation rooms should follow provincial public health agency guidelines.

^cPPE (Personal Protective Equipment)

Health care workers who care for patients in categories P1, P2, and P3 (ie, exposed or symptomatic) require appropriate PPE for droplet/contact precautions when providing treatment or care within 2 m of the patient. This means a procedure mask, visor, gloves, and gown. Airborne precautions (N95 masks) are NOT required, except for AGMPs. Dialysis is NOT an AGMP.

For patients in category P4: Public health agencies determine whether COVID-19 is highly prevalent in the community. When this is the case, we recommend that health care workers wear a mask and visor for all patients, without changing between patients (ie, they are supplied with 1 or 2 masks for each shift and wear them continuously except for breaks).

Whether to reuse PPE and how to process PPE for reuse should follow provincial public health agency guidelines.

^dRepeat Testing for P1 and P2 Patients who Are Initially Negative

When there is a high clinical suspicion for COVID-19 and negative nasopharyngeal swab, the test may be repeated. The sensitivity of nasopharyngeal swabs for COVID-19 may be less than 100%. Whether to do more than 2 tests for a single patient should be determined on an individual basis in consultation with local infectious disease specialists.

^eTransportation

The recommendations in section 2.5 apply here, except that patients who are P1, P2, or P3 should NOT be cohorted together in the same vehicle.

^fWaiting Room

If feasible, medically stable patients can opt to wait in their car or transport vehicle and be contacted by phone when their treatment spot is ready, to avoid the waiting room.

If the patient must use the waiting room, practice distancing measures with patients separated by at least 2 m. This includes moving chairs to the required separation, or taping chairs that are not to be used, to maintain separation.

^gDiscontinuation of Isolation Procedures

Patients in categories P1 and P2 should remain isolated until they have NO symptoms AND the patient has definitively tested negative for COVID-19.

The duration of isolation may be longer than 14 days for immunocompromised patients—consultation with local infectious disease experts on a case-by-case basis is suggested.

Patients in categories P1 and P3 who have been exposed to outbreaks in a group facility (eg, long-term care facility) should be isolated until at least 14 days AFTER THE OUTBREAK IS CLEARED from their group facility.

^hVisitors/Caregivers—see section 2.11-2.12.

Special populations

3.6 We recommend that for dialysis patients who reside in a group home or are coming from another facility, the following precautions in addition to those in Table 2 or Table 3:

- A patient coming from an institution in a region with an identified outbreak should be considered as P3 (exposed) whether or not the institution itself has been identified to have an outbreak.

- P3 recommendations in Table 2 or Table 3 should continue until at least 14 days after an outbreak is cleared from a facility in the region.
- Dialysis patients coming from another dialysis facility should be categorized and treated as P3 for 14 days.

Rationale (from adult outpatient HD guidelines). Recommendations provided vary according to prevalence so that patient-centered care can be respected over principles of

minimized harm and reciprocity during periods of low prevalence prior to and after the peak of the pandemic. As prevalence increases, index of suspicion for COVID-19 infection increases in symptomatic patients even in the absence of identifiable exposure. Those who are symptomatic should ideally be treated with droplet/contact precautions as per provincial public health guidelines. Asymptomatic exposed patients may transmit infection to vulnerable populations and should wear a mask and undergo protected dialysis accordingly. As prevalence increases in the community, all people should be considered exposed irrespective of identifiable exposure.

Rationale for care pathways for P1 and P2 are the same as that for confirmed COVID-19. Care pathway for P3 is based on the risk of transmission of infection by asymptomatic or presymptomatic individuals. Thus, droplet and contact precautions should be used, when possible.

Pediatric context. We did not find any pediatric-specific data.

4. Resuscitation of HD Patients With Confirmed, Probable, or Suspected COVID-19

- 4.1 We suggest that any patient with confirmed COVID-19 and signs of respiratory deterioration during HD (such as hypoxemia or respiratory distress) has rapid assessment for transfer to the emergency room, and/or early controlled intubation by a specialized resuscitation team (protected code blue).
- 4.2 We recommend that all pediatric dialysis patients have CPR unless a “do not resuscitate” (DNR) order is clearly documented in the hospital chart.
- 4.3 We recommend that all dialysis units review their resuscitation procedures in detail with all staff, including
 - Determining whether the proper equipment is available in the dialysis unit or if the code team will bring it;
 - Ensuring that all staff are aware of the local resuscitation protocols that should be followed, including when, for whom, and how a “protected code blue” is to be used;
 - A protected code blue includes using a designated (preferably negative pressure ventilation) isolation room with a closed door that is left vacant in case of need for resuscitation. If one is not available, the team should decide on whether and how to modify the protected code blue protocol in advance with the local resuscitation/ICU team;
 - For satellite dialysis units that operate outside a hospital, with no resuscitation team within the building, decisions whether and how the protected code blue procedure will be modified

should be made with local resuscitation experts and stakeholders, including ICU physicians, paramedics, and ambulance services;

- The protected code blue protocol should contain detailed information on resuscitation location, how the patient will be moved to the designated resuscitation room (including how patients will be disconnected from dialysis machine and whether blood returned or not), PPE to be used, what type of oxygen mask is to be used, where and how the patient should be transferred after resuscitation, whether successful or unsuccessful, and decontamination procedures;
- The team may also give consideration to assigning 2 nurses during each dialysis shift as the acting code leader and assistant until the resuscitation team arrives;
- Programs should consider simulating and practice code blue scenarios in HD units.

Rationale (from adult outpatient HD guidelines). We considered the importance of respecting patient wishes, where possible, and to provide appropriate, beneficial medical interventions. However, with finite resources, it is appropriate to allocate resources (eg, ICU, ventilation) to patients most likely to survive. For the rare pediatric populations where this would apply, patients should have these forms in their home so that if they deteriorate at home, paramedics and other health care workers may be informed of the code status.

The decision to implement protected codes blue during the pandemic considers the need to protect against the risk of aerosolized transmission of the virus to other patients and health care workers and is in keeping with most provincial public health guidelines.

Pediatric context. For the unusual pediatric patient to whom this would apply, patients should have these forms readily available so that if they deteriorate at home, paramedics and other health care workers may be informed of the code status.

5. Routine HD Care

Laboratory investigations

- 5.1 We suggest reducing the frequency of routine blood work and access flow measurements for stable patients:
 - Ensure that patients receiving less frequent dialysis are included in the routine blood work schedule.
 - Consider a method to stagger laboratory investigations to distribute the work of the laboratory over different weeks and shifts (eg, alphabetically by patient’s last name).

- If possible, review blood work remotely and order appropriate changes through the electronic medical record to reduce exposure to paper charts.
- Prescriptions should be faxed or submitted electronically to the patient's pharmacy.

Physician rounds

- 5.2 We recommend that during the COVID-19 pandemic, pediatric nephrologists and their teams develop a plan to provide regular medical assessments of their dialysis patients while maintaining strict and appropriate infection control precautions.
- 5.3 Ideally, the team is multidisciplinary, including nurses, physicians and pharmacists, dietitians, social work, physiotherapy, occupational therapy, and special education specialists.
- 5.4 We suggest patients be regularly assessed for suitability to transition to home dialysis therapies:
 - Nephrologists and nurse practitioners caring for HD patients should be available for in-person assessment of patients where patient safety and care planning demands face-to-face assessment.
 - When in the HD unit patient care area, strict and appropriate IPAC procedures should be followed. These include the following:
 - Wearing mask and visor or mask and goggles while in the patient care area;
 - Maintaining a distance of at least 2 m from patients except during necessary physical examination;
 - Using droplet/contact precautions, as suggested by local guidelines, when performing necessary physical examination;
 - In certain circumstances, the nephrologist may provide care virtually by phone, video, or other telehealth strategies;
 - Other health care workers (eg, dietitians, pharmacists, social workers) should follow their local hospital guidelines. We suggest that these professionals may minimize in-person visits and provide care virtually whenever possible without reducing the quality of care provided;

Rationale (from adult outpatient HD guidance). We recognize the need to minimize the risk of infection transmission by nephrologists rounding physically in the unit on large numbers of patients. Conversely, the very small (albeit nonzero) risk of infection transmission while wearing appropriate PPE and respecting >2 m physical distance is greatly outweighed by the benefits of being physically present with the ability to properly analyze patient problems and provide more optimal medical care. Hence, physical examination of patients should be limited to those in whom it is deemed necessary.

Pediatric context. We did not find any pediatric-specific

data.

6. Dialysis Under Fixed Dialysis Resources

- 6.1 We suggest that the team should inform dialysis patients early in the pandemic that their dialysis schedules may change, but that these changes will only be temporary, and will only be undertaken if safe.
- 6.2 When there is a shortage of isolation rooms, we suggest that patients with confirmed COVID-19 be cohorted together on a separate shift.
- 6.3 When there is shortage of isolation rooms, we recommend cohorting should be avoided for
 - symptomatic patients with probable or suspected COVID-19 (P1 and P2),
 - asymptomatic exposed (P3) patients,
 - These 2 groups of patients may be managed following the options outlined below.

Options

1. Maintain at least 2 m between patients AND separate patients using (1) clear plexiglass screens, disinfected between treatments, or (2) disposable plastic sheets, which can be used to create an isolation bubble with zipper for entry and washed or changed after each treatment, or, if none of these are available, (3) cloth curtains, washed between treatments.
2. If resources and space allow, create temporary walls between the stations.
3. If resources allow, consider using some home dialysis training rooms as additional isolation rooms for patients in categories P1 and P2 who are under investigation. However, this should NOT be at the expense of reducing capacity in the home dialysis training unit because this facilitates transitioning people away from the hospital and in-center dialysis unit.
4. If resources allow, consider converting other single rooms within the facility to "dialysis ready" rooms.

Shortage of Nursing Staff With Expertise in Pediatric HD

- 6.4 We suggest identifying staff in the local regional network who have experience in dialysis, but are not currently working in the area, including retired HD staff.
- 6.5 If there remains a shortage of HD nursing staff (from illness, quarantine, or deployment to other units), we suggest several options be considered to increase dialysis capacity before reducing dialysis frequency for individual patients. These options are outlined below.
- 6.6 For patients currently receiving 4 times or more weekly HD, we recommend that a reduction of no more than 1 weekly session (and no less than 3 weekly sessions)

Table 3. Care Pathway for High Prevalence of COVID-19 in Community.

	P1 Symptoms + Exposure + PROBABLE	P2 Symptoms + Exposure – SUSPECTED	P3 Symptoms – Exposure + EXPOSED	P4 Symptoms – Exposure – MAY BE EXPOSED
Patient wears mask on entry, during dialysis, and in transport vehicles ^a	YES	YES	YES	YES
“Separated dialysis” ^b (isolation room)	YES	YES	IF POSSIBLE	NO
Droplet/contact PPE ^c	YES	YES	YES	Mask and Visor
Test for SARS-CoV-2 ^d	YES	YES	NO	NO
Shared transportation ^e	NO	NO	NO	Try to avoid
Wait in waiting room ^f	NO	NO	NO	Try to avoid
Wander in facility	NO	NO	NO	NO
Counsel on home isolation	YES	YES	YES	Only if recommended for general population
Discontinue isolation procedures ^g —also see C3 for special populations	If COVID-19 negative: when symptoms resolve AND >14 days from exposure If COVID-19 positive: See Section B	If COVID-19 negative: when symptoms resolve If COVID-19 positive: See Section B	14 days from exposure	NA
Caregivers	YES	YES	YES	YES
Visitors ^h	NO	NO	NO	NO

^aMasks for patients

When the prevalence of COVID-19 in the community is high (as determined by public health), all patients should wear masks throughout the treatment, including P4. When prevalence is low, patients who are asymptomatic with no known exposures do not need masks.

^bSeparated Dialysis (Isolation Rooms)

Ideally, P1, P2, and P3 patients should be dialyzed in separate isolation rooms. If this is not possible, maintain droplet/contact precautions by keeping >2 m distance between patients AND using a physical barrier to separate treatment stations, such as plexiglass screens, washable curtains, or disposable plastic sheets.

P1, P2, and P3 patients should NOT be cohorted together, even with patients of the same category. This is to avoid transmission from positive (but not yet confirmed) patients to those who are negative.

Negative pressure ventilation rooms are NOT required for routine dialysis. They are recommended ONLY if an aerosol-generating medical procedure (AGMP) is anticipated, such as high flow oxygen, intubation, or mechanical ventilation. For this reason, we recommend unstable patients are dialyzed in an appropriate location (see 3.1).

Cleaning of the treatment area, machines, and isolation rooms should follow provincial public health agency guidelines.

^cPPE (Personal Protective Equipment)

Health care workers who care for patients in categories P1, P2, and P3 (ie, exposed or symptomatic) require appropriate PPE for droplet/contact precautions when providing treatment or care within 2 m of the patient. This means a procedure mask, visor, gloves, and gown. Airborne precautions (N95 masks) are NOT required, except for AGMPs. Dialysis is NOT an AGMP.

For patients in category P4: Public health agencies determine whether COVID-19 is highly prevalent in the community. When this is the case, we recommend that health care workers wear a mask and visor for all patients, without changing between patients (ie, they are supplied with 1 or 2 masks for each shift and wear them continuously except for breaks).

Whether to reuse PPE and how to process PPE for reuse should follow provincial public health agency guidelines.

^dRepeat Testing for P1 and P2 Patients who Are Initially Negative

When there is a high clinical suspicion for COVID-19 and negative nasopharyngeal swab, the test may be repeated. The sensitivity of nasopharyngeal swabs for COVID-19 may be less than 100%. Whether to do more than 2 tests for a single patient should be determined on an individual basis in consultation with local infectious disease specialists.

^eTransportation

The recommendations in section 2.5 apply here, except that patients who are P1, P2, or P3 should NOT be cohorted together in the same vehicle.

^fWaiting Room

If feasible, medically stable patients can opt to wait in their car or transport vehicle and be contacted by phone when their treatment spot is ready, to avoid the waiting room.

If the patient must use the waiting room, practice distancing measures with patients separated by at least 2 m. This includes moving chairs to the required separation, or taping chairs that are not to be used, to maintain separation.

^gDiscontinuation of Isolation Procedures

Patients in categories P1 and P2 should remain isolated until they have NO symptoms AND the patient has definitively tested negative for COVID-19.

The duration of isolation may be longer than 14 days for immunocompromised patients—consultation with local infectious disease experts on a case-by-case basis is suggested.

Patients in categories P1 and P3 who have been exposed to outbreaks in a group facility (eg, long-term care facility) should be isolated until at least 14 days AFTER THE OUTBREAK IS CLEARED from their group facility.

^hVisitors/Caregivers—see section 2.11-2.12.

versus usual prescription may be considered when all other options have been exhausted; if this option is used, it should be considered to be a temporary measure that can only be used for patients who can safely tolerate it, with close monitoring of potassium, fluid gains, and adequacy parameters. See Table 4 below for details.

Options

1. Maximize use of the dialysis unit's open hours by allowing “staggered shifts” rather than 2 fixed shifts a day.
2. Consider increasing the nurse:patient ratio for chronic stable patients.

Table 4. Algorithm to Determine Dialysis Treatment Frequency Priority.

Priority levels	Parameters	Suggestions
A	Average interdialytic weight gain $>4\%$ ⁵⁰⁻⁵² during the last month OR Cannot miss based on opinion of treating physician eg, inability to tolerate small weight gains due to tenuous cardiac status, nonadherent with Kayexalate, etc	Cannot miss any treatments safely
B	2 or more predialysis K values >5.5 mEq/L during the last 3 months	Ideally should not miss any treatments If a patient must miss 1 treatment, use sodium polystyrene sulfonate 1 g/kg/dose orally; maximum dose: 15 g/dose or 1 g/kg/dose rectally; maximum dose range: 30-50 g/dose; retain at least 15 to 60 minutes daily until the next treatment, or another approved potassium binder, or a diuretic if there is residual urine output.
C	One predialysis K value > 5.5 mEq/L in the last 3 months	Can temporarily miss 1 treatment in a week, but only if necessary. Prescribe additional sodium polystyrene sulfonate 1 g/kg/dose orally; maximum dose: 15 g/dose or 1 g/kg/dose rectally; maximum dose range: 30-50 g/dose; retain at least 15 to 60 minutes daily until next treatment or another approved potassium binder, or a diuretic if there is residual urine output.
D	All others	Can temporarily miss 1 treatment in a week, if necessary. The need for sodium polystyrene sulfonate should be determined by the treating physician based on knowledge of the patient's average K, adherence, and residual kidney function.

Note. Patients should not miss 2 consecutive treatments, and if possible, no more than 2 treatments in 6 weeks.

Patients with serious dialysis access-related issues with decreased blood flows and preexisting poor adequacy or malnutrition should NOT miss any treatments.

Treating physician has the discretion to override this algorithm for individual patients.

Patients for whom hemodialysis frequency has been reduced should be reassessed clinically for uremic symptoms and electrolytes imbalance after each session.

Sodium Polystyrene Sulfonate oral route is more effective than rectal and is preferred.

3. Consideration for CKRT use to bridge over or train the staff to use equipment.
4. Open the dialysis unit on Sundays to reduce the number of nurses required during a single shift.
5. Open the dialysis unit overnight if resources allow. Be aware that this option may cause nursing fatigue, is disruptive to patients, and requires special transport arrangements.
6. Patients should not miss 2 consecutive treatments, and if possible, no more than 2 treatments in 6 weeks.
7. Patients with serious dialysis-access issues with decreased blood flows and the potential for under-dialysis, and those with recognized under-dialysis, should NOT miss any treatments.
8. Patients' potassium, weight gains, and blood volume processed should be monitored weekly to determine if their dialysis frequency should be increased back to 3 times per week.

Rationale (from adult outpatient HD guidance). Most HD facilities do not have enough isolation rooms to be able to accommodate large numbers of patients requiring droplet/

contact isolation precautions (confirmed COVID-19, probable or suspected COVID-19, asymptomatic exposed to COVID-19, non-COVID-19 infections such as *Clostridium difficile*, etc.). Ensuring protection of noninfected patients and staff is paramount and may require modifications to dialysis treatment schedules, but this should be duly balanced with the need to ensure adequate dialysis treatment for the individual patient requiring isolation.

Similarly, if a severe shortage of HD nursing staff during the pandemic (eg, from illness, quarantine, deployment to other units, or due to markedly increased numbers of patients needing acute dialysis for acute kidney injury), multiple options may need to be considered to change nursing to patient ratios, or to temporarily change dialysis schedules in order that the greatest number of patients be allowed to receive an acceptable minimum amount of dialysis.

Pediatric context. Patients for whom HD frequency has been reduced should be reassessed before and after each session to ensure that the change in dialysis prescription does not result in clinical deterioration. Anecdotally, it is challenging to achieve euvolemia in children treated with HD

and significantly elevated urea levels have been observed in some patients, both attributed to reduced dialysis frequency. Dietitian input is also crucial when making changes for these patients. Furthermore, such changes should only be made if there is an urgent need to reduce hospital visits.

Limitations

Because of limited time and resources, no attempt was made to do a formal systematic review or meta-analysis of the literature, but rather to focus on the questions posed within the Canadian pediatric nephrology community. The recommendations are based predominantly on expert opinion, and subject to the usual biases associated with this form of evidence. We have also assumed that all regions in Canada will ultimately have COVID-19 within their communities and must prepare for this eventuality. However, it is likely that the risks of COVID-19 exposure will be highly variable across the country mandating implementation of policies commensurate with risk.

Implications

These recommendations are intended to provide the best care possible during a time of reduced resources. Protection of patients, parents, and health care providers by limiting potential exposure to COVID-19 was paramount in these recommendations. As part of our knowledge translation strategy, the article will be hosted on the CAPN Web site. Members of the CAPN, Canadian Association of Nephrology Nurses and Technologists (CANNT), and the Canadian Association of Nephrology Administrators (CANA) will receive an email to this effect.

Author note

Rajinder S. Singh is now affiliated to The University of British Columbia, Vancouver, Canada.

Ethics Approval and Consent to Participate

Not applicable, this work did not involve human subjects.

Consent for Publication

All authors provided consent for publication.

Availability of Data and Materials

Not applicable, as original data were not collected for this study.

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ORCID iDs

Abdullah Alabbas  <https://orcid.org/0000-0003-2312-7541>

Chia Wei Teoh  <https://orcid.org/0000-0002-5994-0799>

David A. Clark  <https://orcid.org/0000-0003-1105-3418>

Jennifer M. MacRae  <https://orcid.org/0000-0002-4711-1440>

Karthik K. Tennankore  <https://orcid.org/0000-0002-7919-6709>

Rita S. Suri  <https://orcid.org/0000-0002-0519-3927>

Sara N. Davison  <https://orcid.org/0000-0003-4513-6449>

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