CANADIAN ASSOCIATION OF PEDIATRIC NEPHROLOGISTS COVID-19 RAPID RESPONSE TEAM
HOME and IN-CENTER DIALYSIS RECOMMENDATIONS

Home Dialysis Workgroup Members:

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On behalf of the CAPN COVID-19 RRT

ABSTRACT:

Purpose of program:
This paper provides guidance on how to best manage 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. It is adapted from the recently published rapid guidelines for adult patients with ESKD sponsored by the Canadian Society of Nephrology (CSN).

Sources of information
The core of these rapid guidelines is derived from the CSN consensus recommendations for adult patients that were recently published in the Canadian Journal of Kidney Health and Disease (CJKHD). We have also consulted specific documents from other national and international agencies focused on pediatric kidney health. Additional information was gleaned from formal review of the published academic literature relevant to pediatric hemodialysis.

Methods
The leadership of the Canadian Association of Pediatric 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 patients for pediatric-specific settings. These included specific COVID-19-related themes that are relevant to dialysis in a Canadian setting, as determined by a group of senior renal leaders. The revised pediatric guidelines were reviewed by a group of senior clinicians with deep expertise in pediatric home and in-center dialysis.

Key findings
We identified 7 broad areas of home and in-center 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 provider and patient contact, and 7) assisted peritoneal dialysis in the community. We make specific suggestions and recommendations for each of these areas.

Limitations
The suggestions and recommendations in this paper are expert opinions, and subject to the biases associated with this level of evidence. To expedite the publication of this work, a parallel review process was created that is not as robust as standard arms' length peer-review processes.

Implications
These recommendations are intended to provide the best care possible for pediatric patients who are prescribed home dialysis during the COVID-19 pandemic, a time of altered priorities and reduced resources.

Purpose of the Program:

Coronavirus disease 2019 (COVID-19) has had a profound impact on the kidney community. Children and adolescents with kidney disease are at increased risk for complications from COVID-19 because of their compromised immune system, and also from a change in the usual level of support that they receive from their kidney health care providers and other community services in managing their chronic disease.

Kidney programs across the country are developing policies in this rapidly changing environment. The Canadian Association of Pediatric Nephrology (CAPN) is in a unique position to collate guidance documents from the kidney community in an effort to provide the best possible care to the largest number of children with kidney disease while we ensure the safety of the health care team and uphold ethical principles.

In general, home dialysis therapies for patients with end stage kidney disease minimize the number of interactions required between patients and the health care system. This paper, which is adapted from the rapid response adult home and in-center dialysis guidelines, will provide guidance on how to best manage children with end stage kidney disease who will be or are being treated with home and in-center dialysis.

Introduction

While the toll of the COVID-19 pandemic on children is orders of magnitude lower than that of adults, it is now becoming clear that a subset of pediatric patients are also severely affected, sometimes resulting in fatalities.[1–3] A novel, pediatric-specific syndrome that resembles Kawasaki disease, now dubbed pediatric multisystem inflammatory disease, has also been described recently.[4,5]

The care of pediatric patients who require a form of renal replacement therapy has been impacted in a variety of ways by COVID-19. A few of the issues faced by patients include unavoidable delays for non-urgent surgical procedures (e.g. insertion of a central venous line or peritoneal dialysis catheter)[6,7], unavailability of kidney transplantation[8] (particularly living-related), or scarcity of critical reagents (e.g., peritoneal dialysis fluid[9]).

In addition, in-patient dialysis units have proven to be a potent source for nosocomial SARS-Cov-2 transmission between patients and clinical staff. Factors favoring this process include multiple visits per week, each lasting 3-4 hours, with suboptimal physical distancing from other patients, and close contact with staff required during dialysis access manipulation. While most of the large outbreaks reported are from adult centres[10], pediatric dialysis units are also not spared.[11] It is important to optimize care for Canadian patients based on lessons learned by clinicians from countries severely affected earlier in the pandemic, such as China[12,13], and Europe.[14–16] Detailed comparisons of the various approaches used around the world will be useful[17], especially when correlation to patient outcomes is possible.

Commencing, or transitioning, as many patients as possible on to one of the home dialysis methods will be important to continue offering optimal care in a safer environment. In fact, the need 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.[18–20]

These rapid guidelines have been devised for pediatric patients requiring any form of chronic, outpatient renal replacement therapy in a Canadian context during the COVID-19 pandemic. They have been adapted from the guidelines for adult patients recently proposed by the CSN for in-center and home dialysis.

Guiding Principles of Care for Patients with End-Stage Kidney Disease (ESKD) in the COVID-19 Era:

The following principles guided our work to help ensure that decisions are ethically supported:

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

Methods

In the context of the pandemic, the CSN developed the COVID-19 rapid response team (RRT) by recruiting volunteers from within the CSN Board who identified other experts within the kidney community. The guidelines by the rapid response team for adult home dialysis were published in the Canadian Journal of Kidney Health and Disease.[21] Following the adult recommendations, the Canadian Association of Pediatric Nephrologists (CAPN) also aimed to develop policies related to home dialysis for Canadian children. The goal was to modify the existing Canadian adult home dialysis guidelines for the pediatric setting. The CAPN solicited a team of experts recognized in the field of home dialysis. Various national and international kidney literature and webinars were viewed for recommendations that could be applied to the Canadian environment.[12,16,22,23] This team also reviewed the existing literature related to pediatric home dialysis, and modified the adult recommendations to reflect the need of Canadian pediatric programs.

1. COVID-19 risk levels categorization for Dialysis Patients

- We recommend that all dialysis patients be categorized based on known SARS-CoV-2 test results, symptoms, and exposure history to determine the optimal care pathway.
- The case definitions listed in **Table 1** will be used in this document.

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

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.

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2. Recommendations for home dialysis

2.1 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.*
- BC Renal Agency
- Expert opinions and emails (all provinces)
- International Society of Peritoneal Dialysis. 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

2.2 Treatment of COVID-19 for PD patients (modified from the Chinese recommendations [23])

- We suggest that the management of COVID-19 infection is the same for PD patients as for all other patients

- We recommend that patients with mild or moderate symptoms of COVID-19 can continue PD treatment as usual, with prescription adjustment according to their general evaluation. Severe or critically severe cases requiring life support due to multiple organ dysfunction syndrome can be temporarily transferred to automated peritoneal dialysis or bedside continuous kidney replacement therapy (CKRT), also called as continuous renal replacement therapy (CRRT). As in patients on hemodialysis, it is advisable to keep patients 'dry', so increased ultrafiltration may be needed if remaining on PD
- In regions where prevalence of Covid-19 is high, drained dialysate from infected PD patients can be disinfected by adding 500mg/L chlorine-containing solution for 1hr before pouring into the toilet. It is important to emphasize the need to prevent accidental splash or aerosolization of fluid when disposing of drained dialysate. This step is important since there is recent evidence that peritoneal dialysis effluent from COVID-19 patients contains live viruses.[24]

Limitations:

Because of limited time and resources, no attempt was made to do a systematic review 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 healthcare providers by limiting potential exposure to COVID-19 was paramount in these recommendations. As part of our knowledge translation strategy, the manuscript will be hosted on the CAPN website and MedRxiv. 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.

2.3 Peritoneal dialysis (PD) catheter placement should continue unabated where resources permit.

- We suggest that peritoneal dialysis (PD) catheter insertions (bedside and surgical) be designated as "urgent/emergent" procedures and continue to be placed for patients who are expected to require dialysis during the COVID19 pandemic (eGFR < 12 mL/min/1.73m^2 and declining), as recommended by the American Society of Diagnostic and Interventional Nephrology and Vascular Access Society of the Americas.
- We recommend each program maintain and update a list of patients who have completed all PD pre-insertion assessment tasks (including an evaluation for the most appropriate catheter insertion method), and use this list to support the need for ongoing PD access procedures.
- We suggest that medical pre-operative assessment to facilitate surgical placement of PD catheters be performed as per the existing local hospital policies

- 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

Patients with advanced chronic kidney disease (G5 not dialysed [G5ND]) who do not have a peritoneal dialysis catheter placed in advance of starting dialysis will require a central venous catheter and will need to be treated with in-center hemodialysis (HD). Patients who start dialysis in this way (crash starts) have increased risk of morbidity and mortality..[25]

During the COVID-19 pandemic, they are also more likely to use additional health care resources and more likely to have high levels of exposure to health care workers. 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. Moreover, there are advantages of home dialysis since 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 personal COVID-19 risk, or for any other reason, is valuable in itself, and reduces the resources needed for provision of in-center HD. Although, it is important 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.

2.4 Training for home dialysis: generalities

- We suggest that home dialysis be preferentially offered to all patients who require chronic kidney replacement therapy if the family situation permits, as a means of reducing COVID-19 transmission risk to themselves, to other patients, and to health care workers, by reducing contact with clinics and hospitals, compared with in-center HD.
- We recommend, for eligible candidates, PD over HHD because of the shorter training time.
- We suggest that units tailor their workflows to accommodate higher volumes of patients/families trained on PD or HHD.

Peritoneal dialysis training:

- We suggest, for most patients starting PD, that training for continuous cycler peritoneal dialysis (CCPD) is preferred over chronic ambulatory peritoneal dialysis (CAPD) t providers.
- 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. We suggest training using a combination of in-person and online modules or videos. However, individual learners' needs should be accounted for and training style to be modified accordingly. This hybrid approach would reduce in-person training time and maximize the number of patients trained.
- We suggest creating and using a streamlined CAPD training curriculum, including a check list of ‘essential tasks,’ to minimize training time. We suggest that patients already treated with CAPD not be retrained for continuous cycler peritoneal dialysis (CCPD) training during the pandemic, unless there are compelling indications.

- We suggest management of volume status with fluid and salt restriction, combined with high-dose diuretics in patients with residual kidney function.

Home hemodialysis training

- We recommend continuing to train patients for HHD, provided trained staff are available who are not required to redeploy to meet a more-compelling need. We suggest selecting patients who are anticipated to be able to train safely and rapidly.
- We suggest that for patients with a central venous catheter (CVC) *in situ*, needle training of arteriovenous access be delayed to facilitate faster training in HHD.
- We suggest that , in rare circumstances, for children with mature arteriovenous access and no CVC, needle training should proceed as usual. If this is anticipated to become, or becomes, time consuming such that discharge home will be delayed, we suggest placing a CVC to facilitate faster training in HHD.
- For HHD programs that support multiple platforms (conventional HD machine versus newer platforms, e.g., NxStage System One, Fresenius Medical Care), we recommend that training focus should be on the platform that is associated with shorter learning time and fewer home renovations.
- For HHD programs using conventional HD machines only, we suggest that attention is directed closely to the availability of local tradespeople to effect electrical and plumbing modifications, and we suggest early engagement with local trades to reduce this barrier to independence at home. When trades must go into the home, we suggest that they practice physical distancing, proper hand hygiene and wear a surgical mask; this needs to be reviewed at the time of engagement.
- We suggest that all travel programs for patients treated with home modalities be suspended immediately and indefinitely.

Rationale

Patients with end stage kidney disease treated with in-centre HD typically must come to the dialysis unit 3-7 times weekly, often using some form of public transportation. This greatly 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 1-2 months. We also suggest a combination of telehealth and in-person visits should be used as needed, especially for patients recently commenced on PD.

PD is preferred to HHD because of the reduced training time required to prepare the patient for independent home dialysis. HD platforms that are easier to learn and require minimal modifications to the home are also preferred over more traditional HD machines as they reduce exposure of patients to the health care team and tradespeople (i.e., plumbers, electricians).

2.5 Home dialysis management

- We suggest that patients have a minimum of two weeks of PD or HHD supplies and medications, in case they require self-isolation, or there is a disruption in delivery of supplies. We recommend rotating these supplies to minimize wastage from expiry.
- We recommend that patients follow public health advice and stay home, that visits by family and friends should be minimized, and visits by health care workers limited to those needed to provide training or treatment.
- 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 (e.g., dressings, specialized tape, or thrombolytics).
- We recommend reinforcing hand hygiene protocols with both written and visual literature for both patients and health care workers, including procedural steps where liquid soap and water may be used in place of alcohol-based hand sanitizer.
- If Health-Canada approved hand sanitizer is not available, we suggest:
    - using locally-produced alcohol-based hand sanitizer containing 60-80% ethanol or isopropyl alcohol,
    - handwashing with liquid soap for 20 seconds.
- We recommend ensuring that all team members, care providers and patients have received appropriate education and supervision with regards to 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

Patients with end stage kidney disease are high risk for complications from COVID-19 infection. 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 patients are not washing their hands for dialysate exchanges within 6-months of training.[26] Alcohol-based hand sanitizer is more effective than handwashing with soap and water in reducing microbial flora, and therefore theoretically more effective in reducing the risk of infection associated with connection procedures.[27] 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 sanitizer.

2.6 Home environment management[12]

We suggest the following strategies for home PD patients in those areas where the prevalence of Covid-19 has been deemed high (>xxx%)

- Air out the room in which PD is being conducted by opening windows and doors as deemed feasible at least twice a day for 30 min each time. When connecting the PD catheter to the dialysis tubing to conduct an exchange, it is necessary to close the window and/or any air conditioner vents to avoid convective air flow.

- The floor of the PD treatment room should be swept and cleansed before the PD treatment is conducted once daily, followed by ultraviolet disinfection (≥ 1.5 W/m^3) of the room's air, if ultraviolet equipment is available at home. The ultraviolet disinfection period should be no less than 30 min each time. The ultraviolet lamp should be kept clean and wiped with 75% alcohol once a week.
- Before and after each manual PD exchange, the procedure table should be wiped with a 75% alcohol wet cloth. If using an automated PD (APD) machine, a 75% alcohol wet cloth should be used to wipe the APD machine before and after each treatment.

2.7 Personal protective equipment (PPE)

- We recommend that all home dialysis patients be provided with written or verbal information regarding the signs and symptoms of COVID-19.
- 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.
- 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.

2.7.1 PPE for medical staff caring for possible, probable or confirmed cases of COVID19

- 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 any aerosol generating procedure

2.7.2 PPE for medical staff caring for patients with confirmed COVID19-negative test or low risk patients

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

2.7.3 PPE for PD and HHD patients

- We suggest that masks are not needed in routine PD exchanges, and that it is acceptable to instruct asymptomatic patients not to use masks. Masks are only required during connecting the PD catheter to the machine and during the dressing changes.
- 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 arteriovenous fistulas with buttonhole technique pre and post dialysis; if masks are not available, we suggest that it is acceptable to perform these procedures without a mask.
- 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.
- For patients who must come into the home dialysis unit 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

Although many PD programs teach patients to use a mask when doing dialysate exchanges, ISPD 2016 guidelines state that masks are not necessary in asymptomatic patients: this would become important were mask supplies to be limited.[28] Most HHD programs teach patients to use a mask when accessing central venous catheters or when needling arteriovenous fistula with buttonhole technique.[29] However, data supporting use of routine masks for catheter access are lacking: in situations where mask supply is limited, the Center for Disease Control endorses a strategy in which masks are not used for connection or disconnection.

Limiting the use of PPE for PD dialysate exchanges and HD connections may extend the supply, so that masks can be used to prevent the transmission of COVID-19 between patients and the health care team. 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.

2.8 Ensure delivery of a product is conducted in a safe manner

- We suggest ongoing open communication with dialysis vendors and suppliers to ensure timely and safe delivery for both patients and drivers.
- We recommend telephone pre-screening 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.
- We recommend physical distancing be maintained between patients and drivers during product delivery.

- We recommend hand hygiene and surgical masks for drivers who must go into the home, aligned with our recommendations for health care workers.

Rationale

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.

2.9 Minimizing in-person contact with health care providers

- We suggest that routine follow-up and elective procedures such as assessment of peritoneal membrane characteristics and clearances should be delayed in almost all patients.
- We suggest coordinating transfer set changes with any necessary in-person visits or delaying transfer set changes for up to 6-9 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), and that patients should visually inspect and photograph any cracks, breaks or changes in colour, and report to their PD team immediately.
- We suggest that routine arteriovenous access flow measurements for patients treated with HHD should be delayed, and that patients be educated to monitor for onset of difficulty needling, prolonged bleeding after dialysis, or elevated arterial/venous pressures as surrogates of arteriovenous access dysfunction, and report them to the HHD team for consideration of access flow measurement or definitive investigation.
- We suggest keeping the frequency of laboratory testing for stable PD patients (determined by programmatic review) monthly. 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 an in-person assessment.
- We suggest that patients with new non-serious 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
- Patient visits should be kept to a minimum with priority given to infants and young children to monitor their growth etc. Some of these visits may be for 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.[23]

Rationale

When patients treated with PD or HHD must leave their home, their potential risk of COVID-19 exposure is increased. This must be balanced against concerns about reducing the frequency of health care team global assessments, commonly undertaken procedures, examinations and laboratory tests.

Delaying formal kinetic studies 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 risk of COVID-19 including handwashing, PPE and physical distancing; we considered that the risks of visiting them for blood tests was not prohibitive, but high enough that this risk should be minimized 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.

2.10 Assisted PD coverage in the community

- We suggest that assisted PD coverage continue to be offered to patients already in the program to reduce conversion to in-center hemodialysis and prevent visits to the hospital.
- We suggest training of willing family members who may have been previously unavailable to provide assistance to decrease the number of visits by health care providers.
- For programs that are dependent on third party agencies, we suggest open and frequent communication to verify staffing levels and services that can be realistically provided
- We recommend that the above suggestions with respect to screening (pre-visit phone calls), hand hygiene and PPE be followed as they would for hospital staff: visiting health care workers should call and confirm that there are no new respiratory symptoms or exposures, before entering the home.
- If the hospital healthcare workforce responsible for assisted PD becomes overwhelmed secondary to reductions in staff numbers, we suggest the following strategies: 1) Liaising with home and community care providers to discuss utilizing their staff to help facilitate assisted PD (will require rapid training of care providers) 2) Actively reach out to family members for rapid training if this has not already been done 3) Consider alternate day PD in some cases with the following patient stratification based on prescription and residual kidney function (RKF) as follows:
    - nocturnal intermittent peritoneal dialysis (NIPD) and good RKF (>3mL/min), consider alternate day cycling (consider 16 hour cycling on alternating days)
    - NIPD and poor RKF (estimated <3 ml/min), consider alternate day cycling (consider 18 hour cycling on alternating days)
    - CCPD and poor RKF (estimated <3 ml/min) significant risk of complication with alternate day cycling (only as last resort, consider 18 hours on alternating days)
    - we suggest 2 weeks as the initial period, followed by reassessment of the patients clinical condition and the resources available.
- 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 intermittent peritoneal dialysis (IPD) be considered if resources permit, and favored over conversion to HD.

Rationale

We outline some strategies designed to keep people dialyzing at home in times of resource constraint, 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, and that 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.

3. Recommendations for in-center hemodialysis

Purpose

Children and adolescents receiving in-center hemodialysis are a unique and vulnerable population during a pandemic. The necessity for treatment at the dialysis center from three to seven times weekly means they cannot remain isolated in their homes. They must interact regularly with drivers in public transport, nurses, and members of the health care team. Most Canadian hemodialysis units are built with limited (if any) isolation rooms, and many units are too small to strictly observe the minimum 2m distance between patients at all times in the waiting room and treatment areas. These circumstances pose the perfect environment for the rapid spread of COVID-19 infection. If infected, patients managed with maintenance dialysis have a high risk of death because of their compromised immune system.Adequate implementation of measures to prevent the spread of COVID-19 among in-center hemodialysis units is therefore of paramount importance.

While provincial and federal public health agencies provide recommendations with respect to infection control practices on a daily basis, most of these recommendations, including those from the Centers of Disease Control, provide minimal concrete and specific guidance on how to manage in-centre hemodialysis units during the pandemic. Further, advice from other countries is not necessarily applicable to the Canadian landscape.

The Canadian Association of Pediatric Nephrologists (CAPN) which is affiliated with the Canadian Society of Nephrology solicited a workgroup of clinicians and experts in the field of dialysis to discuss key issues in the management of children receiving in-center hemodialysis during the COVID-19 pandemic, in order to collate concrete recommendations that can be easily translated into practice within the resource constraints of individual programs in Canada. The goal was to adapt the guidelines recently adopted for Canadian adult patients for pediatric-specific settings. These include specific COVID-19-related themes that are relevant to hospital-based dialysis in a Canadian setting, as determined by a group of senior renal leaders. The revised pediatric guidelines were reviewed by a group of senior clinicians with deep expertise in pediatric dialysis.

Sources of information

The workgroup members used internet search engines to retrieve documents from provincial and local hemodialysis programs; provincial public health agencies; the Centres for Disease Control and Prevention, other kidney agencies; as well as non-reviewed pre-prints. 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.

3.1 Identification of Patients With COVID-19 In The Dialysis Unit

3.1.1 Screening of the dialysis patients

- 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 with appropriate knowledge using a screening tool. See below.
  - Whenever possible, 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 > 2 m between chairs.
  - Patients and care-givers 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, local public health officials should be consulted to determine necessary modifications to screening and testing procedures.
  - Patients presenting with severe symptoms meeting admission criteria should be redirected to the appropriate location for medical care. Admission criteria should follow local standards.

3.1.2 Testing hemodialysis patients for COVID-19

- We suggest that all patients presenting with symptoms compatible with COVID-19 (P1 (probable) and P2 (suspected), as defined in section 1) be tested for SARS-CoV-2 in the hemodialysis unit.
- We recommend that testing in the dialysis unit should only be performed in the dialysis unit after the dialysis nurses have been properly trained to do so, and an isolation room is available.
  - Nurses performing COVID-19 testing should use PPE for droplet/contact precautions as per provincial health agency guidelines. N95 masks are not required.
  - 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.
  - Chest X-ray may be performed if clinically indicated. CT scan is not required for diagnosis of COVID-19 but may be ordered in individual cases if deemed clinically appropriate.

3.1.3 Call ahead

- We recommend that all dialysis patients be advised that if they develop symptoms, they should inform the dialysis unit BEFORE their scheduled treatment.
    - All patients should be informed of the signs and symptoms of COVID-19.
    - Consider giving standardized pamphlets from the public health office, if available in the patient's language.
    - Patients should be instructed to call the dialysis unit if they develop symptoms at home.
    - If resources allow, consider requesting a nurse to call all HD patients a few hours before their upcoming treatment to inquire about symptoms.
    - Patients who report symptoms should be directed to the most appropriate medical resources (e.g., seek immediate medical attention, testing options (if, when, and where), adjusting the timing and location of their next dialysis treatment to permit appropriate evaluation and minimize exposing others).

Rationale for screening

In center Hemodialysis patients have a high risk of infection as they are unable to remain isolated in their homes. Some may also reside in community living settings such as shelters where the prevalence of COVID-19 may be high due to outbreaks. Therefore, a rigorous screening process at 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, especially if they are immunocompromised. Non-medical 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 general 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 best plan their treatment in order to minimize 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 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.

Rationale for testing

Swabbing for COVID-19 is rapid and may be easily performed by trained nurses. Ideally, it should be done in the hemodialysis unit rather than sending patients to another facility in order to reduce the risk of exposing other people and ensure the swab is performed most expeditiously. There are significant differences between swabbing test kit availability and practices across provinces and different regions in Canada. As such, the above recommendations should be discussed with local Infection Prevention and Control authorities and adjusted as needed.

3.2 Resuscitation of hemodialysis patients with confirmed, probable or suspected COVID-19

3.2.1 Resuscitation of confirmed, probable or suspected COVID-19 patients

- We suggest that any patient with confirmed COVID-19 and signs of respiratory deterioration during hemodialysis (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), as appropriate.
- We suggest that unstable patients may require urgent resuscitation therefore the dialysis treatment should ideally be performed in a negative pressure ventilation room with rapid access to a specialized resuscitation team. This may require transfer to another facility, emergency room, or intensive care unit (ICU), as appropriate.
- We recommend that all dialysis patients have a level of intervention (code status) clearly documented in the dialysis AND hospital chart.
- 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 it will be brought by the code team
  - 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, decisions on whether and how to modify the protected code blue protocol should be made in advance with the local resuscitation / intensive care unit team.
  - For satellite dialysis units that operate outside a hospital, with no resuscitation team within the building, decisions as to whether and how the protected code blue procedure will be modified should be made in conjunction with local resuscitation experts and stakeholders, including intensive care unit physicians, paramedics, and ambulance services.
  - The protected code blue protocol should contain detailed information on: PPE to be used, what type oxygen mask is to be used, whether an automated external defibrillator (AED) should be used, whether chest compressions should wait until after intubation,

where and how the patient should be transferred after resuscitation, whether successful or unsuccessful, and decontamination procedures.
- Consideration may also be given to assigning two nurses during each dialysis shift as the acting code leader and assistant until the resuscitation team arrives.

Rationale

The importance of respecting patient wishes, where possible, and to provide appropriate, beneficial medical interventions were considered. However, with finite resources, it is appropriate to allocate resources (e.g., ICU, ventilation) to patients most likely to survive. For the rare pediatric population 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 code 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.

3.3 Hemodialysis of patients with confirmed COVID-19

3.3.1 Assessment of Stability

- We recommend that all patients with COVID-19 be assessed at each treatment for suitability to be dialyzed in the dialysis unit.
- 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:
  - new requirement for oxygen
  - new onset of persistent hypotension
  - new altered level of consciousness

3.3.2 Treatment Location for Stable Patients

- We recommend all dialysis patients with COVID-19 who are stable continue to receive their dialysis treatments in an outpatient dialysis unit.
- 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 room is available, cohorting COVID-19+ 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 sections 3.6 and 3.7

3.3.3 Transportation to the dialysis unit

- We recommend that all dialysis patients with confirmed COVID-19 be transported in a private vehicle without other patients.
  - Private transportation may include driving oneself, 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 the driver, should perform hand-hygiene before and after entering vehicles

3.3.4 Escort to the Dialysis Unit

- 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. If they must wait, they must wear a mask and maintain >2 m distance from others.
  - Patients with confirmed COVID-19 should not be allowed to go to other areas within the hospital or facility.

3.3.5 Masks and Hand Hygiene

- 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: in a transport vehicle, in the hospital or facility, and during treatment. 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.

3.3.6 Counselling on Home Isolation

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

3.3.7 Discontinuation of Isolation Procedures

- We recommend that the above recommendations be followed until the patient can be declared negative according to provincial public health agency guidelines.
  a. At the current time, one such recommendation is that isolation should be continued until the patient is asymptomatic, AND a minimum of 14 days, AND until the patient has 2 negative tests separated by at least 24 hours ("recovery"). This recommendation may change depending on the local availability of tests.
  b. 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.
  c. Given that the risk of re-infection is not known, patients who have recovered from COVID-19 should be screened as discussed in section 3.1 and treated by the algorithm mentioned in section 3.4

3.3.8 Visitors to the dialysis unit

- We suggest that only one visitor should be permitted for pediatric patients with confirmed COVID-19
- If allowed to visit,
  - All visitors who enter the unit should be screened with the screening questionnaire.
  - Only asymptomatic visitors with no known exposure should be permitted to enter the unit. In the event that an infant (<18 months) and a toddler (18 months to 2.5 years of age) have been infected and have only one caregiver, appropriate strategies should be in place to this caregiver stay with them
  - All visitors should be required to wear a mask and practice physical distancing.
  - All visitors should be provided with reassurance that their loved one will continue to receive the best possible and safest hemodialysis 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.

3.3.9 Contact tracing for confirmed COVID-19 patients

- We recommend that the local infection prevention and control 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://bit.ly/canada-covid19-case-definition

Rationale

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. Further, 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 (egg. CPR), which require expeditious access to an expert resuscitation team (see section 3.2). For these reasons, unstable patients should ideally not be dialyzed in the main outpatient dialysis unit.

Stable patients with COVID-19 should not be admitted to hospital as it is not medically needed and in order 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 sections 3.6 and 3.7 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 website for latest recommendations on what is classified as an AGMP.

In keeping with public health recommendations, confirmed COVID-19 patients should not circulate freely in public spaces. An escort will help adherence to this recommendation, especially for those who have cognitive deficits or misunderstand the recommendations.

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 gear should be worn while they are in the dialysis room as suggested by local guidelines.

3.4 Hemodialysis Of Patients Not Yet Known To Have COVID-19

3.4.1 Assessment of Stability

- 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.

- We suggest that any patient with probable, or suspected COVID-19 and signs of respiratory deterioration during hemodialysis (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.
- We recommend that all dialysis units review their resuscitation procedures in detail with all staff and consider consulting with the local ICU team.

3.4.2 Dialysis of Stable Patients

- 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.
- We recommend that all patients whose COVID-19 status is not known (P1, P2, P3, P4) be treated according to the pathways outlined in Table 2 (see below) that account for the prevalence of disease within the community.

3.4.3 Dialysis of Stable Patients from At-Risk Populations

- We recommend that for dialysis patients who a) reside in a shelter or b) are coming from another facility, the following precautions in addition to those in Table 2 (see below).
    - 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 should continue until at least 14 days AFTER OUTBREAKS HAVE CLEARED from facilities in the region.
    - Patients from different at-risk facilities such as group homes and chronic care facilities should NOT be cohorted together unless full droplet/contact precautions can be respected (see below), as this practice increases the risk of spread between these care facilities
    - Dialysis patients coming from another dialysis facility should be categorized and treated as P3 for 14 days.

Table 2: Care pathways for communities with low or high prevalence of COVID-19

Proposed measures or actions	Low or high prevalence		Low prevalence		High prevalence
	P1 Symptoms + Exposure + PROBABLE	**P2 Symptoms + Exposure – SUSPECTED**	**P3 Symptoms – Exposure + EXPOSED**	**P4 Symptoms – Exposure – MAY BE EXPOSED**	**P4 Symptoms – Exposure – MAY BE EXPOSED**
Patient wears mask on entry, during dialysis, and in transport vehicles[a]	YES	YES	YES	Yes	YES
"Separated dialysis"[b] (isolation room)	YES	YES	IF POSSIBLE	NO	NO
Droplet/contact PPE[c]	YES	YES	YES	NO	Mask and Visor
Test for SARS-CoV-2[d]	YES	WHEN POSSIBLE	NO	NO	NO
Shared transportation[e]	NO	NO	NO	YES	Try to avoid
Wait in waiting room[f]	NO	NO	NO	OK	Try to avoid
Wander in facility	NO	NO	NO	OK	NO
Counsel on home isolation	YES	YES	YES	NO	Only if recommended for general population

Discontinue isolation procedures[g] – see also section 3.4.3 for specific at-risk populations	*If COVID-19 negative:* when symptoms resolve AND >14 days from exposure *If COVID-19 positive:* See section 3.3	*If COVID-19 negative:* when symptoms resolve *If COVID-19 positive:* see section 3.3	14 days from exposure	n/a	n/a
Visitors[h]	NO	NO	One	One for low prevalence NO for high	NO

Notes

a. Masks 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. At the time of writing this document, all persons (age-appropriate) are supposed to wear masks in public places if physical distancing is not possible.

b. Separated 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. For details, see sections 3.6 and 3.7.
- 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 section 3.4.1).
- Cleaning of the treatment area, machines, and isolation rooms should follow provincial public health agency guidelines.

c. PPE (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 2m of the patient. This means: 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 (i.e., no exposure, asymptomatic): Public health agencies determine whether COVID-19 is highly prevalent in the community. When this is the care, we recommend that healthcare workers wear a mask and visor for all patients, without changing between patients (i.e., they are supplied with one or two 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.

d. Repeat 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 swab 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.

e. Transportation

- The recommendations in section 3.3
- Recommendations in section 3.3.3 apply here, except that patients who are P1, P2, or P3 should NOT be cohorted together in the same vehicle.

f. Waiting Room

- If feasible, medically stable patients can opt to wait in their car or transport vehicle and be contacted by cell 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.

g. Discontinuation 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 (e.g., long-term care facility) should be isolated until at least 14 days AFTER THE OUTBREAK IS CLEARED from their group facility.

h. Visitors

- We suggest that during periods of high prevalence of COVID-19 as determined by the local public health agency, visitors not be permitted in the dialysis unit, unless the visitor is needed to facilitate the dialysis treatment AND the patient is P3 or P4. However, it is important to note that if a child has been tested positive, it is likely that the parent/caregiver of that child is exposed as well. In these circumstances, it is critical to protect the dialysis staff from the parent to avoid getting exposed.

Rationale

Recommendations provided vary according to prevalence in order 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 pre-symptomatic individuals. Thus, droplet and contact precautions should be used, when possible.

3.5 Routine hemodialysis care

3.5.1 Laboratory investigations

- We suggest reducing the frequency of routine blood work and access flow measurements for stable patients.
    - It is suggested that routine blood work should be done at the same frequency as decided by the dialysis program
    - Ensure that patients receiving less frequent dialysis are included in the routine blood work schedule.
    - Consider a method to stagger bloodwork to distribute the work of the laboratory over different weeks and shifts (e.g., 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.

3.5.2 Physician rounds

- We recommend that during the COVID-19 pandemic, nephrologists and their teams develop a plan to provide regular medical assessments of their dialysis patients, while maintaining strict and appropriate infection control precautions.
- We suggest patients be regularly assessed for suitability to transition to home dialysis therapies.
    - Nephrologists and nurse practitioners caring for hemodialysis patients should be available for in-person assessment of patients where patient safety and care planning demands face-to-face assessment.
    - When in the hemodialysis unit patient care area, strict and appropriate infection prevention and control procedures should be followed. These include:
        - 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, and from staff.
        - 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.

Rationale

The need to minimize the risk of infection transmission by nephrologists rounding physically in the unit on large numbers of patients was recognized. 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 physical presence in being able to detect patient problems and provide more optimal medical care. Hence, physical examination of patients should be limited to those in whom it is deemed absolutely necessary.

3.6 Strategies to Deal with Anticipated Limited Resource

- We suggest that dialysis patients be informed 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.
- When there is a shortage of isolation rooms, we suggest that patients with confirmed COVID-19 be cohorted together, on a separate shift.
- When there is shortage of isolation rooms, we recommend that cohorting should be avoided for:
    - symptomatic patients with probable or suspected COVID-19 (P1 and P2)
    - asymptomatic exposed (P3) patients
    - These two groups of patients may be managed following the options outlined below.

3.6.1 Management options

- Maintain at least 2 m between patients AND separate patients using: i) clear plexiglass screens, disinfected between treatments; or ii) 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, iii) cloth curtains, washed between treatments.
- If resources and space allow, create temporary walls between the stations.
- 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. If resources allow, consider converting other single rooms within the facility to “dialysis ready” rooms.

Rationale

The majority of hemodialysis 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 C. difficile, etc). Ensuring protection of non-infected 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.

3.7 Shortage of nursing staff with expertise in pediatric hemodialysis

- We suggest identifying staff in the local regional network who have experience in dialysis, but are not currently working in the area, including retired hemodialysis staff.
- If there remains a shortage of hemodialysis 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.
- For patients currently receiving 4-7 times weekly hemodialysis, we recommend that a reduction of no more than one weekly session (and no less than 3 weekly sessions) vs. 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 Tables 3 and 4 below for details.

3.7.1 Helpful pointers

- Maximize use of the dialysis unit's open hours by allowing "staggered shifts" rather than 2 fixed shifts a day.
- Open the dialysis unit on Sundays to reduce the number of nurses required during a single shift.
- 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.
- Patients should not miss two consecutive treatments, and if possible, no more than two treatments in 6 wks.
- Patients with serious dialysis-access issues with decreased blood flows and the potential for underdialysis, and those with recognized underdialysis, should NOT miss any treatments.
- Patients' potassium, weight gains, and blood volume processed should be monitored weekly to determine if their dialysis frequency should be increased back to three times per week.

Table 3: Algorithm To Determine Dialysis Treatment Frequency Priority

Priority levels	Parameters	Suggestions
A	**Average interdialytic weight gain > 2 kg during the last month** **OR** **Cannot miss based on opinion of treating physician** e.g. inability to tolerate small weight gains due to tenuous cardiac status, non-adherent with Kayexalate, etc.	**Cannot miss any treatments safely**

B	**2 or more K values >5.5 mEq/L during the last 3 months**	**Ideally should not miss any treatments** If must miss one treatment, use Kayexalate 0.5-1 g/kg (max. 30 g) daily until next treatment, or another approved potassium-binder.
C	One K value >5.5 mEq/L in the last 3 months	Can temporarily miss one treatment in a week, but only if absolutely necessary. Prescribe additional Kayexalate 1 g/kg/d until next treatment.
D	All others	Can temporarily miss one treatment in a week if absolutely necessary The need for Kayexalate should be determined by the treating physician based on knowledge of the patient's average K, adherence, and residual kidney function

Table 4: CRITERIA for initiating and maintaining a reduced frequency of WEEKLY HEMODIALYSIS treatment[16,30]

- Adequate KRU of >3 ml/min/1.73m^2 (requires prior 24-hour urine collection available). KRU = residual urea clearance[1]
- Adequate residual urine output >600 ml/day
- Fluid gain <2.5kg between two consecutive HD treatments, or <5% of the ideal dry weight
- No clinically significant fluid overload
- Suitable body size relative to residual kidney function and not in hypercatabolic state
- K <5.5 mEq/L
- Good nutritional status
- Infrequent hospitalization and easily manageable comorbid conditions including cardiovascular or pulmonary symptoms

Rationale

If a severe shortage of hemodialysis 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.

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