



Adapting Nephrology Training Curriculum in the Era of COVID-19

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Canadian Journal of Kidney Health
and Disease
Volume 8: 1–7
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DOI: 10.1177/2054358120988446
journals.sagepub.com/home/cjk



Abstract

Purpose of review: The COVID-19 pandemic has widespread implications not only for clinical practice but also for academic medicine and postgraduate training. The need to promote physical distancing and flexibility within our department has generated important revisions to the core curriculum for the Adult Nephrology Training Program in Vancouver, Canada.

Sources of information: We reviewed available educational resources and objectives to develop curricular adaptations informed by staff and trainee feedback.

Methods: Many facets of the program including clinical rotations, scholarly activities, evaluation, and wellness have been impacted, and thus revised for online delivery where possible. Trainees have personalized a learning plan based on individual goals and supplemented by a list of internet-based resources for independent review. Changes in learning objectives and methods for specific rotations have occurred and are described. Ongoing evaluation will be undertaken.

Key findings: Curriculum adaptation in the era of COVID-19 is necessary to ensure ongoing high-quality education for future nephrologists. We describe existing changes to formal training in British Columbia (BC), which will be tailored as the pandemic evolves, and anticipate them to have lasting impact on the way we structure training programs in the future. Standardization and harmonization of modified curriculum may be possible across Canada with sharing of these learnings.

Limitations: Formal evaluation of these changes in terms of knowledge acquisition and examination performance has not yet been undertaken. Next steps will include assessing and documenting the impact of this curricular transformation to further optimize scheduling, educational yield, and trainee wellness.

Keywords

COVID-19, pandemic, medical education, curriculum design, nephrology training

Received August 11, 2020. Accepted for publication December 23, 2020.

Introduction

Over the past several months, we have experienced the advent and evolution of a global pandemic, which is defined by the World Health Organization as the outbreak of a new pathogen that spreads easily from person to person across the globe, in this case, SARS-CoV-2 causing COVID-19 infection.¹ In the context of a pandemic, clinical and academic activities are disrupted as a result of the necessary focus on patient care and public health concerns, which particularly affects postgraduate training programs. Trainees are a critical part of the frontline workforce, thus re-deployment from usual rotations and changes in scheduling may defer previously organized teaching sessions.

Since considerations for personal safety are paramount, there are limitations on physician capacity in various hospital and outpatient settings, which in turn influence learning. These numerous logistical challenges complicate the usual style of

curriculum delivery. Physical distancing is an effective measure to prevent the spread of COVID-19, thus recommendations have been put forth that all nonessential group meetings be suspended.² This includes face-to-face teaching, academic rounds, and larger group sessions. Alternative learning experiences such as online or recorded lectures, virtual classrooms, and use of simulation have been proposed as methods of ensuring continued delivery of high-quality education.

There has been an early focus on training implications for medical students, due to the immediate impact of truncating

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clerkship electives and classroom learning.³ However, residents have also identified the need for restructuring programs to suit these unexpected circumstances.⁴ Given the cancellation of elective surgeries and limitations placed on procedural and surgical practice, novel curriculum adaptations have mainly come from specialties such as urology, orthopedics, and otolaryngology thus far.⁵⁻⁷ Specific to nephrology, recent literature from programs in the United States describe clinical adaptations, practical suggestions to optimize virtual medical education, and reflections on the pandemic itself.⁸⁻¹⁰ In India, efforts have been made to reinvent teaching during this time, by capitalizing on technology such as messenger applications and FOAMed (Free Open-Access Medical Education).¹¹ Many other Royal-College-accredited programs have undertaken curriculum revision during the pandemic, but we aim to document our experience as an innovative model for nephrology training in Canada.

The core nephrology curriculum in most Canadian academic centers consists of a set of learning objectives, achieved through experiential clinical exposures and formal didactic sessions. During the COVID-19 pandemic, where physical distancing has disrupted much of these prescheduled activities, we sought to develop and execute a modified curriculum for Year 1 and 2 of core training, and to consider how incoming fellows may be affected by ongoing restrictions. This has required prompt attention and collaborative efforts by all involved to ensure we continue to fully prepare future nephrologists for practice.

Methods

We conducted a review of existing objectives as outlined locally, as well as by the Royal College in the list of Entrustable Professional Activities for Nephrology.¹² A small group of fellows and staff evaluated potential resources and proposed modifications, including online content, applicable technology, and availability of our usual instructors to continue teaching via new platforms. Further discussion highlighted strategies that would promote exposure to broad clinical scenarios, enable review and feedback, ensure core concepts were conveyed, and capture the unique learning opportunities presented by the pandemic itself.

Some of the most impressive historical advancements in science and medicine have risen out of difficult circumstances. We are eager to contribute and share strategies for curriculum development to promote the ongoing innovation, creative problem-solving, and resilient leadership we have witnessed since the advent of COVID-19.

Review

We reviewed the previous objectives of specific rotations and then collaboratively developed a flexible curriculum, based on key principles which enabled each of the clinical and scholarly activities to continue in modified formats

(Table 1). These strategies were fully employed during the initial peak and can be titrated according to local caseload and hospital policies, which is crucial as many provinces enter a second wave.

Using this as a framework, each fellow created a personalized schedule to address specific learning goals by incorporating mandatory weekly meetings, teaching sessions, and clinical activities, as well as unscheduled time reserved for completion of personal academic objectives (Figure 1).

Clinical Rotations

Trainees continued with the in-patient nephrology consult service, though solid organ transplantation was on hold, so kidney transplant rotations were postponed. Community rotations were also rescheduled to ensure a sufficient group of trainees to provide service at the main hospital sites, especially given the possibility of quarantine or illness. The daily experience on consult or ward service varied with the absence of medical students and rotating residents, as well as a fluctuating hospital census. On-call shifts were maintained at the usual frequency, with measures in place to reduce potential exposures. For instance, only attending nephrologists did evening rounds in the hemodialysis unit. There has not been an official position on trainee interaction with COVID-positive patients or persons under investigation (PUIs), and accordingly, this was left to the discretion of each team. During the peak, in-hospital consulting and ward services were staffed by Nephrology fellows and faculty exclusively, given that medical students and residents had been redistributed. Therefore, our trainees minimized contact with potential cases as much as possible if they were being examined daily by the attending service. Consults in the “hot zone” were completed by chart review without direct physical examination. Now that the team has a more typical complement of learners, staff nephrologists are primarily seeing potential cases. This necessitates clear communication among all team members to reduce risk and eliminate redundancy.

Outpatient activities such as home dialysis and longitudinal fellows' clinics were transitioned to telehealth platforms such as Zoom or Doxy.me, with some visits conducted by telephone. At times when case numbers are lower, select patients are brought in for assessment, including new consults and unwell or unstable individuals. We did not arrange any simulation option for procedures, given that dialysis line insertion and removal still proceeded as usual, with adequate personal protective equipment. This has been resumed as of the new academic year. Our renal pathologists developed a virtual curriculum delivered weekly over Zoom, which provided the opportunity to discuss general nephrology and transplant cases while viewing online slides, as well as broadcasting “Biopsy Rounds” regularly via Zoom, which has continued since the onset of the pandemic with extremely positive feedback from trainees.

Table 1. Adaptations to Existing Objectives and Rotations.

Curriculum structure	Previous methods	New methods—peak periods
Clinical rotations		
• Consults	Team-based rotation with multiple learners and focus on both bedside and classroom teaching	Resident and medical student allocation variable; more fellow autonomy and staff-to-fellow teaching. Widespread efforts to minimize potential exposures.
• Hemodialysis	Rounding on daytime shifts with bloodwork review and prescription adjustment.	Where possible, one designated nephrologist to round in unit. Learning supplemented with online sessions.
• Peritoneal dialysis	In-person assessments and PD clinics.	Transition to telehealth-based clinic delivery and patient assessment on as-needed basis.
• Transplant	Donor and recipient assessments, management of short- and long-term complications for admitted in-patients as well as routine clinics.	Solid organ transplant on hold during peak period. Online sessions; further development of virtual curriculum if ongoing limited exposure to core concepts.
• Procedures	Procedural rotation and longitudinal opportunities for HD line and PD catheter insertion and removals.	Rotation on hold. Procedural exposure as able with appropriate PPE.
• Pathology	Laboratory-based rotation viewing cases alongside renal pathologist.	Rotation on hold. Supplemented with virtual slide bank, teleconferenced biopsy rounds, and online resources.
• CKD and longitudinal clinics	In-person clinics.	Primarily telehealth clinics.
Scholarly activities		
• Conferences	Travel to major academic meetings	Transitioning to virtual platforms
• Research projects	Learning the research process and completing a project.	Virtual meetings; encourage online collaboration with other sites
• Journal club	Held in person	Virtual journal club
Teaching		
• Academic half day	Afternoon small group session	Shorter lunchtime talks over Zoom
Evaluation and feedback		
• Competence by design	EPAs	Continue; supplement with virtual cases if unable to directly observe skills
Wellness		
• Resident-led events	Group gatherings for social events	Virtual session sponsored by Resident Doctors of BC with reimbursement
New objectives		
• Virtual health	Learning to adapt to online platforms for delivery of care and trainee education	
• COVID-19 specific	Participation in committees to better understand provincial and local structures	

Note. CKD = chronic kidney disease; PD = peritoneal dialysis; HD = hemodialysis; PPE = personal protective equipment; EPAs = entrustable professional activities.

We evaluated the appropriateness of resuming these rotations in their more typical format on an individual basis. For instance, fellows were rescheduled for transplant blocks once surgeries were occurring with enough frequency to provide adequate volume for achieving learning objectives. There were no formal criteria for expanding clinical service with respect to decline in provincial or local caseload, but rather these decisions were made in discussion with the program director. Currently, there is no indication that these changes will extend fellowship duration, given that graduating trainees had already completed mandatory rotations by Spring 2020, and first-year trainees had ample time left to compensate with substitutions in the schedule.

Scholarly Activities

Many major nephrology conferences have been canceled, though some are beginning to modify their schedule to an online format, such as the ERA-EDTA Virtual Congress and ASN Kidney Week. There are ongoing efforts to develop existing platforms for online lectures, which may be live-streamed or recorded for later viewing, including our Expanded Province-Wide Rounds, focusing initially on the collective response of BC Renal to COVID-19; which will continue to include all topics in nephrology.

With regard to involvement in research, trainees can be redirected to projects suitable for completion via technology-based methods, and works-in-progress should be adjusted to

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	8am – 10am: Virtual Research Meeting (Zoom) 11am: Regional COVID-19 Teleconference	9am – 12pm: Peritoneal Dialysis Clinic (Telehealth)	8am – 10am: Online renal pathology course modules 10am – 11am: Review case slides (diabetic nephropathy)	9am – 12pm: Home Hemodialysis Clinic (Telehealth)	7:30am – 9am: Virtual Province-Wide Rounds & COVID-19 update 9am – 12pm: Bloodwork review (HD Unit)
Noon	Zoom Teaching: Hemodialysis (Nephrologist)		Zoom Teaching: Pathology Cases (Renal Pathologist)	Zoom Teaching: Minimal Change Disease (Nephrologist)	
PM	1pm – 4pm: Online case-based topical reviews	1pm – 5pm: Longitudinal Fellow's Clinic (Telehealth)	1pm – 5pm: CKD Clinic (Telehealth)	1pm – 4pm: Work on systematic review	1pm – 4pm: Weekly feedback & distribute EPAs to staff
Eve	7pm – 8pm: Weekly Debrief (Zoom)	On Call		5:30pm – 7pm: Evening Journal Club (Zoom)	On Call

Figure 1. Sample schedule: outpatient week.

Note. CKD = chronic kidney disease; HD = hemodialysis.

allow for this. Research meetings, manuscript writing, peer review, critical appraisal, and other academic pursuits can be conducted remotely with ease. In an effort to promote this idea, trainees are now required to complete a case report over the course of the academic year.

We have transitioned our journal clubs to be held over Zoom as well, which allows screen-sharing presentations and facilitates audience involvement by microphone or the provided text box. The first online journal club was very successful in engaging nephrologists from across the province, whereas typically only Vancouver-based physicians and trainees would be in attendance.

Virtual Learning

Rather than the traditional weekly academic half day, we transitioned to twice weekly Zoom sessions at lunch hour, during which staff nephrologists present a topic of their choosing based on a list generated by the fellows. These presentations are partly didactic with slide presentations, though there is ample time allotted for case-based discussion around advanced management, which has been particularly helpful for topics such as glomerulonephritis and cardiorenal syndrome. Moving forward, though some aspects of clinical care have adjusted with the reduction in daily cases and the so-called “flattening” of the curve, we hope to retain elements of this teaching model considering the positive reviews from trainees. In recent months, we have adopted a virtual academic half day more similar to the pre-COVID era, though it is now conducted over Zoom.

Although this is a nephrology-focused curriculum, we have incorporated COVID-19 content in the teaching sessions and online modules, including epidemiologic principles, resource allocation (particularly for hemodialysis), crisis response, public health policy, ethics, and palliative care. Participation in meetings and teleconferences has enriched trainee understanding of operations on a program, regional, and provincial level. This has promoted a continual review of nephrology-relevant COVID-19 literature and development of a pocket guide highlighting the changes to our usual practice.

Access to technology has generally been free of issues. At home, all fellows have adequate internet access and personal computers with webcams to participate in sessions. However, the equipment at the hospital did not necessarily facilitate physical distancing, particularly when multiple trainees need to access a broadcasted session. Recently, we have upgraded the audiovisual equipment in the fellows' room to include a large flatscreen television with a tablet to provide Zoom access, and all computers in the room are now webcam-equipped.

Online learning resources are available to all trainees to supplement learning when scheduling permits, for instance during predominately outpatient-focused weeks (Table 2).

Evaluation and Feedback

We have continued with the Competence by Design evaluation model as outlined by the Royal College, though certain EPAs require more effort to complete due to the current

Table 2. Selected Online Educational Materials.

Resource	Topic	Description	Cost	Link
AST				
Transplant Curriculum	Transplant	Presentations designed by ASN and AST to cover important content for board certification.	\$400 per person	https://www.myast.org/education/transplant-nephrology-core-curriculum
GlomCon	Pathology	70+ presentations on glomerular diseases, ranging from basics to topic-specific reviews.	Free	https://glomcon.org/
Arkana Labs	Pathology	Themed quizzes, podcasts, and associated Twitter feed providing engaging educational materials.	Free	https://www.arkanalabs.com/education/
Neph Sim	General nephrology	Collection of clinical cases, image gallery, urine cytology, acid-base cases, and pathology teaching.	Free	https://nephsim.com/
NephJC	General	Twitter-based journal club that provides a forum to discuss nephrology research, guidelines, and editorials.	Free	http://www.nephjc.com/
ISN				
Online content	COVID-19	Resourced updated in real time.	Free	https://academy.theisn.org/
Webinars, courses, and modules	General	Collection of presentations and modules covering key topics.		
Pathology primers	Pathology	Virtual curriculum teaching biopsy interpretation and approach.		
Clinical cases	General	Collection of clinical vignettes for case-based learning with quizzes.		
CSN				
Online content	COVID-19	A repository for latest literature and reviews on COVID-19 (in progress)	Via CSN	https://www.csnsn.ca/covid-19-emergency-preparedness-for-healthcare-professionals
London dialysis course	Dialysis	Series of modules covering the history and evolution of dialysis, as well as adequacy and clinical pearls	Free	https://www.csnsn.ca/
ASN				
Online curricula	Dialysis, Geriatric, and onco-nephrology	Comprehensive overview of dialysis, geriatric nephrology, and onco-nephrology topics by chapter.	Free	https://www.asn-online.org/education/distancelearning/curricula/
NephSAP	General	Nephrology Self-Assessment Tool for self-study and/or board examination preparation	Via ASN	https://www.asn-online.org/nephsap/
UKidney				
Presentations	General nephrology	Collection of 200+ presentations ranging in topic from CKD, to HTN, to toxicology, and TMA.	Free	https://ukidney.com/
Tutorials	Pathology	Library of pathology tutorials.		
Articles	Literature review	Growing library of key articles, chosen as suggested reading for nephrology trainees.		
Primer	Toxicology	Review of common toxic emergencies and management.		

Note. CKD = chronic kidney disease; AST = American Society of Transplantation; ASN = American Society of Nephrology; ISN = International Society of Nephrology; CSN = Canadian Society of Nephrology; HTN = hypertension; TMA = thrombotic microangiopathy.

reality of our pandemic, especially for transplant objectives. In future, we expect that our trainees will have adequate exposure to this content as solid organ transplantation has fully resumed, but it may be helpful to supplement learning with virtual cases or simulation. This situation may also change with the advent of future waves.

Routine debriefing has become a more regular practice with important safety implications as COVID-19 policies and practices evolve. In general, trainees are experiencing increased flexibility and autonomy with some aspects of in-patient service, considering the altered schedule, virtual teaching sessions, and absence of junior trainees.

Wellness

The importance of maintaining a program's core values, promoting a sense of community, and prioritizing individual physical and mental well-being has been highlighted during this pandemic.^{13,14} The impacts of COVID-19 on junior and senior trainees are different. The expected time course remains unpredictable, which can increase trainee stress surrounding future plans. For those just starting fellowship, the consequences of disrupted training may seem overwhelming.

We have established evening Zoom meetings once weekly, providing all trainees the opportunity to socialize, discuss, and brainstorm strategies with the division head and program director. This will continue on a regular basis, though the frequency may be adjusted depending on the ease of in-person interactions as clinical work finds some semblance of a new routine. The Resident Doctors of British Columbia funded meals for a virtual "program social" during which we could connect and enjoy some sense of normalcy, despite being deployed at different hospital sites with no in-person venue for conversation.

In addition, it is important to remain cognizant of foreseeable new and potentially serious problems related to the nature of these changes, including "Zoom fatigue" and burn-out due to increased clinical workload. For this reason, we have maintained frequent informal check-ins with co-fellows during weekly meetings and have revised the call schedule numerous times according to group preference. Virtual learning offers unique advantages, considering that travel between different hospital sites is no longer required to attend academic half day and individuals can participate in lectures or teaching sessions from home, which allows for more flexible personal time throughout the week. During times when restrictions lighten, we plan to incorporate distanced in-person social events if safe and allowable.

Outcome and Future Directions

Adaptations to our usual program format were needed to enable robust trainee education. These have been made iteratively and in real time. We have synthesized them, reflected upon them and suggest using versions of this curriculum for the upcoming 6 to 12 months to enable educational goals to be met. The response to these changes were not formally quantified, though we elicited feedback regularly from both trainees and faculty during academic half day and weekly Zoom check-ins, at Residency Program Committee meetings, and informally upon introduction of new components.

A unique aspect of our local approach is significant flexibility, both in terms of individual trainee schedules and ability to adjust the curriculum in real time as constraints of the pandemic ebb and flow. This has been highlighted during informal discussion with trainees in other Canadian programs. We also anticipate that documenting our experience may enrich the collective understanding of available resources

and encourage similar knowledge-sharing from sites across the country.

Increasing contact with individual nephrologists via clinical encounters and weekly didactic sessions has been a valuable addition that we plan to maintain. The current iteration of this curriculum has garnered positive feedback from trainees and staff alike. We expect ongoing curricular transformation as the status of this pandemic evolves, particularly since future waves are expected to bring higher patient caseloads again, which in turn requires flexible modification of our educational plan.

Indeed, patient care and medical training may be forever altered by this situation, which presents a unique challenge. This is an unparalleled opportunity to transform the educational landscape by continuing the most successful new aspects of our daily routine, including ongoing use of telehealth, regular nephrologist-led case-based discussions, and trainee participation in select division meetings where appropriate. It is an exciting chance to update teaching methods and explore potential implications of these changes for the future of nephrology training. We encourage trainees to take an active role in proposing potential solutions for filling these gaps. Strong leadership, effective communication, and team-based innovation are assets now, and in the case of any future pandemics, during which today's trainees will be at the helm.

Within this framework, there is room for further evolution. For instance, clinical rotations can be rearranged to avoid missing essential experiences when COVID-19 case numbers increase. The role for expanded virtual learning can be explored, particularly for transplantation and renal pathology. Experiences which typically come later in training, such as research time and rural electives, could be rescheduled on short notice when there are lulls in the caseload. Recently, there is increasing uptake for the innovative use of technology to enhance medical education, including artificial intelligence and virtual reality.¹⁵ This could be applied to procedural training, as can simulation-based learning. Social media may also have a role, given the increasing popularity of "medical Twitter" which includes real-time COVID-19 and nephrology-related updates.

Conclusion

It is possible to develop a flexible curriculum which allows nephrology education to continue within the context of a pandemic, while limiting the physical interactions and group activities that were previously its cornerstone. Formal evaluation of these changes in terms of knowledge acquisition and examination performance has not yet been undertaken. Next steps will include assessing and documenting the impact of this curricular transformation to further optimize scheduling, educational yield, and trainee wellness. In this era of COVID-19, it is necessary to ensure ongoing high-quality education for future nephrologists. These changes to formal training in BC will be tailored as the pandemic evolves, and we anticipate them to have lasting impact on the way we structure our program in the future. Standardization and harmonization of

modified curriculum may be possible across Canada with sharing of these learnings.

Ethics Approval and Consent to Participate

No ethics approval or consent was required.

Consent for Publication

All authors consented to the publication of this manuscript.

Availability of Data and Materials

Please contact corresponding author with any requests for additional information.

Acknowledgments

The authors sincerely thank the Nephrology fellows and staff physicians at the University of British Columbia for their patience, collaborative leadership, and support during this challenging time.

Author Contributions

A.C. and A.L. conceived and drafted the manuscript. All authors contributed to the completion of the manuscript and approved the final version.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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