CANNT JOURNAL
JOURNAL ACITN

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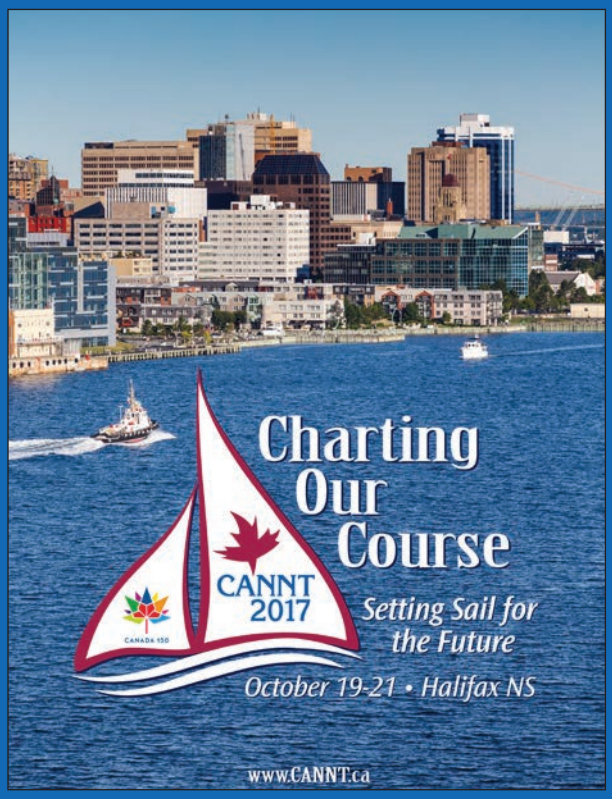

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Editor-In-Chief
Jovina Bachynski, MN, RN(EC), CNeph(C)
T: (905) 845-2571 ext 6307
Email: cannt.journal1@gmail.com

Managing Editor
Heather Coughlin, Pembroke, Ontario

Layout and Design
Sherri Keller, Pembroke, Ontario

Advertising Sales
Heather Coughlin, Pappin Communications
84 Isabella St., Unit 2, Pembroke, ON K8A 5S5
T: (613) 735-0952; F: (613) 735-7983
Email: heather@pappin.com
Rate card: www.pappin.com

JOVINA BACHYNSKI

Letter from the Editor

As we prepare to convene nationally in Halifax on October 19–21, 2017, we are very mindful of the conference theme: Charting our Course – Setting Sail for the Future. I have been in nephrology nursing for more than 20 years, and I am just as passionate about it now as I was when I started to practise in the 1990s. In charting our course throughout our years of respective practice, we have always looked at innovative ways to enrich our practice and, thus, the lives of our patients. The presentations slated for Halifax look to deliver on this front—they showcase the passion, creativity, and resourcefulness of the great minds working in nephrology practice today.

In the spirit of the above, the CANNT Journal is pleased to lead off this issue with the work by St. George, Whitlum, and Duncan on the effect of blood flow rate on hemodialysis urea clearance, which is an important clinical practice issue in hemodialysis. This highlights the paucity of definitive randomized trials in practice issues in hemodialysis—instead, there tends to be a reliance on a best practices approach. St. George et al. address the issue of whether a faster blood flow rate yields improved clearances in a randomized study. We are also pleased to publish the inspiring work by Michele Ivanouski on her team's journey to provide PD training to nurses in the community. (Of note, Michele's contribution was borne out of a poster presentation in CANNT 2015 in Vancouver for which she was the recipient of the CANNT 2015 Manuscript Award.) We round things off with our continuing education series on the role that sodium glucose cotransporter 2 inhibitors, a new class of antihyperglycemic agents in the treatment of type 2 diabetes, plays in the kidneys.

CANNT Journal is always on the lookout for budding and seasoned writers who would like to submit original research papers, relevant clinical articles, innovative quality improvement initiatives, narratives describing the nursing experience, or reviews of articles or books. I echo the message of our indefatigable president-elect (Janice MacKay) of motivating individuals—in the journal's case, I am looking to motivate and cultivate the vast talent that is out there. Perhaps this could be you this time—please do not hesitate to connect with me at **cannt.journal1@gmail.com** or in person in Halifax.

Finally, the Nephrology Healthcare Professionals Day will be held on September 20, 2017. Let us all make a concerted effort to celebrate our collective nephrology team in the way we make a difference in our daily practice and in the lives of our patients.

Jovina Bachynski
Editor, CANNT Journal

Mot de la rédactrice en chef

Alors que nous préparons notre rencontre nationale qui aura lieu à Halifax du 19 au 21 octobre 2017, nous demeurons très conscients de la thématique de cette conférence : « Tracer notre voie – cap sur l'avenir » (Charting our Course – Setting Sail for the Future). J'œuvre dans le domaine des soins infirmiers en néphrologie depuis plus de 20 ans, et j'en ressens autant de passion qu'à mes débuts dans les années 1990. En traçant notre voie au fil de nos années de pratiques respectives, nous avons sans cesse recherché des façons novatrices d'enrichir notre pratique et, par conséquent, la vie de nos patients. Les exposés prévus dans le cadre de la conférence d'Halifax s'inscrivent dans cette optique – ils mettent en lumière la passion, la créativité et l'ingéniosité des grands esprits qui œuvrent en néphrologie aujourd'hui.

C'est dans cet esprit que ce numéro du Journal de l'ACITN s'ouvre sur les travaux de St. George, Whitlum et Duncan sur l'effet du débit sanguin sur la clairance de l'urée en hémodialyse; une question importante en pratique clinique dans le domaine de l'hémodialyse. Cette recherche met en lumière le manque d'essais à répartition aléatoire fiables portant sur des questions de pratiques en hémodialyse – en effet, on tend plutôt à suivre une approche axée sur les pratiques exemplaires. Dans une étude à répartition aléatoire, St. George et ses collaborateurs se questionnent à savoir si un débit sanguin plus élevé entraîne une clairance accrue. Nous sommes également très heureux de publier le travail inspirant de Michele Ivanouski portant sur le cheminement qu'a poursuivi son équipe pour fournir une formation en dialyse péritonéale au personnel infirmier dans la communauté. Il est à noter que le travail de Michele est le résultat d'une présentation par affiches effectuée dans le cadre de la conférence de l'ACITN de 2015 à Vancouver, pour laquelle elle a reçu le prix de l'ACITN de 2015 (CANNT 2015 Manuscript Award). Nous terminons le numéro avec notre série sur la formation continue en examinant le rôle que jouent sur les reins les inhibiteurs du cotransporteur sodium-glucose de type 2, une nouvelle classe d'antihyperglycémiants dans le traitement du diabète de type 2.

Le *Journal de l'ACITN* est toujours à la recherche de nouveaux rédacteurs (novices ou chevronnés) qui souhaitent présenter des articles de recherche originaux, des articles cliniques pertinents, des rapports d'amélioration de la qualité novateurs, des récits décrivant la pratique des soins infirmiers, ou des évaluations d'articles ou de livres. Je réitère le message de notre infatigable présidente élue, Janice MacKay, sur l'importance de motiver les gens—avec cette revue, je cherche à motiver et à cultiver l'immense talent du lectorat. Et si c'était vous, cette fois? N'hésitez pas à communiquer avec moi à l'adresse **cannt.journal1@gmail.com** ou en personne à Halifax.

Enfin, la Journée des professionnels de la santé en néphrologie aura lieu le 20 septembre 2017. Mobilisons-nous pour célébrer l'équipe que constitue notre communauté de professionnels de la santé en néphrologie et les efforts que nous déployons pour améliorer notre pratique au quotidien ainsi que la vie de nos patients.

Jovina Bachynski
Rédactrice en chef,
Journal de l'ACITN

Le Journal ACITN est la publication officielle de l'Association canadienne des infirmiers/infirmières et technologues en néphrologie, a/s P.O. Box 10, 59 Millmanor Place, Delaware, ON N0L 1E0, téléphone : (519) 652-6767, télécopieur : (519) 652-5015, Courriel : cannt@cannt.ca. Publié quatre fois par année, ce journal est envoyé à tous les membres de l'Association. L'abonnement annuel est: Canada, 80 $ (+TVH), E.-U., 90 $, hors du Canada et E.-U., 115 $. Les publications antérieures, lorsque disponibles, coûtent 7,50 $ (+TVH) chacune. Les opinions émises par les auteurs dans ce journal ne sont pas nécessairement partagées par l'Association ni par le corédactrices en chef. Nous invitons les lecteurs à nous faire part de leurs opinions. Toute correspondance devra être envoyée à l'ACITN, P.O. Box 10, 59 Millmanor Place, Delaware, ON N0L 1E0.

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Le Journal ACITN accepte des articles (manuscrits) de façon continue.

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Le journal ACITN est préparé par
Pappin Communications
The Victoria Centre, 84 rue Isabella, suite 2, Pembroke, Ontario K8A 5S5.

Rédactrice en chef
Jovina Bachynski, MN, RN(EC), CNeph(C)
T: (905) 845-2571 ext 6307
Courriel : cannt.journal1@gmail.com

Éditeur
Heather Coughlin, Pembroke, Ontario

Conception et design
Sherri Keller, Pembroke, Ontario

Publicité
Heather Coughlin, Pappin Communications
84 Isabella St., Unit 2, Pembroke, ON K8A 5S5
T: (613) 735-0952; F: (613) 735-7983
Courriel : heather@pappin.com
Publicité : www.pappin.com

HEATHER DEAN

Message from the President

Engagement—it has a nice ring to it!

What motivates people to become engaged and develop effective teams?

I like to think of myself as a half-full kind of girl. When I feel myself thinking my glass is half empty, I grab a smaller glass.

We all invest a lot of time at work. Why not strive to make it the best environment we can? I found this great quote from Henry Ford. You may have heard of him—he ran a successful little car business.

"Coming together is a beginning. Keeping together is progress. Working together is success" – Henry Ford

Beginning…

There is no point forming a team unless each individual is clear about what attracts them in the first place. Once you have a group of people coming together for a common cause, formulating the team begins. Always keep in mind what brought you together in the first place and build on this connection.

Progress…

Teams that establish rules of engagement are more successful, cohesive teams. They create an environment where each individual is an important member of the team. Information exchange is fluid, up to date, and totally transparent. In a true team, everyone is in the know. Everyone is an insider!

Success…

Smile. Say "good morning". Have fun. Encourage a work/life balance. Listen to understand. Give credit when credit is due. Celebrate accomplishments. Remember to say "Thank you". Delegate, delegate—every member of the teams wants to feel like they are contributing. Compromise. Speak your mind during the meeting, *not after*. All problems must be presented with a solution. Don't be afraid to make mistakes. Don't be afraid to ask for help. Make it known you have each other's backs. Individual energy fuels other members of the team—be that spark. Mentor your new team members to succeed. Welcome new members to your team. Build on the strengths of each team member. No one says, "That is not my job"; they respond, "How can I help?" Speak positively about your team members.

"Good leaders develop ideas. Great leaders develop people. The best leaders develop new leaders." – Bobby Umar

CANNT, together we CAN!

Yours in nursing,
Heather Dean, RN, CNeph(C)

NOTICE BOARD

Canadian Nurses Association (CNA) Exam Timeline. **https://www.nurseone.ca/certification/renewing-your-certification#sthash.IDBqg5i7.dpuf**

FALL 2017

- **November 1–15, 2017**: exam period
- **January 3–November 30, 2017.** application window to renew by continuous learning
- **September 20, 2017.** Nephrology Health Care Professionals' Day
- **October 19–21, 2017.** Canadian Association Nephrology Nurses and Technologists (CANNT) 49th National Symposium 2017—Charting our Course: Setting Sail for the Future, Halifax, Nova Scotia. **www.cannt.ca**
- **October 31–November 5, 2017.** The American Society of Nephrology (ASN) 2017 Kidney Week, Morial Convention Center, New Orleans, Louisiana. **www.asn-online.org**

Le mot de la présidente

Parlons d'engagement!

Qu'est-ce qui motive les gens à s'engager et à bâtir une équipe efficace?

Je suis plutôt du type « le verre est à moitié plein ». Lorsque je me surprends à penser que le verre est à moitié vide, je prends un plus petit verre.

Nous consacrons tous une grande partie de notre temps au travail. Pourquoi alors ne pas tâcher de construire le meilleur milieu de travail possible? Je suis tombée sur cette formidable citation de Henry Ford. Vous avez sûrement entendu parler de lui : il a fondé une humble entreprise dans le secteur de l'automobile.

« Se réunir est un début; rester ensemble est un progrès; travailler ensemble est une réussite. » – Henry Ford

Un début

Il est inutile de former une équipe à moins que chacun sache exactement pourquoi il s'y trouve. Une fois qu'un groupe de personnes est réuni autour d'une cause commune, on peut alors structurer l'équipe. Gardez toujours en tête ce qui vous a réuni au départ et appuyez-vous sur cela pour bâtir votre équipe.

Un progrès

Les équipes qui établissent des règles d'engagement sont plus unies et ont plus de succès. Elles créent un environnement où chaque individu constitue un membre important de l'équipe. L'échange d'information est fluide, à jour et entièrement transparent. Dans une véritable équipe, chacun est au courant de tout. Chacun est un initié!

Une réussite

Souriez. Dites « Bonjour ». Amusez-vous. Encouragez l'équilibre travail-famille. Écoutez pour comprendre. Reconnaissez le mérite. Soulignez les réalisations. N'oubliez pas de dire « merci ». N'hésitez pas à déléguer – chaque membre de l'équipe souhaite avoir l'impression qu'il participe à part entière. Faites des compromis. Donnez votre opinion pendant la réunion, et non après. Tous les problèmes doivent être amenés avec une solution. N'ayez pas peur de faire des erreurs. N'ayez pas peur de demander de l'aide. Assurez-vous de vous soutenir les uns les autres. L'énergie de chacun alimente les autres membres de l'équipe – soyez cette étincelle. Accueillez les nouveaux membres dans votre équipe et guidez-les vers la réussite. Exploitez les forces propres à chacun. Personne ne devrait dire « Ce n'est pas mon rôle »; disons plutôt « Comment puis-je aider? ». Ayez de bons mots pour les membres de votre équipe.

« Les bons leaders forment des idées. Les excellents leaders forment des gens. Les meilleurs leaders forment de nouveaux leaders. » – Bobby Umar

ACITN : ensemble, nous faisons la différence!

Avec vous en soins infirmiers,
Heather Dean, inf., CNéph(C)

CANNT REPRESENTATIVES/ CONTACTS; REPRÉSENTANTS/ CONTACTS ACITN

CNA Liaison/Liaison pour AIIC :
Heather Dean, RN, CNeph(C)
T: 403-943-9400
CANNT.president@gmail.com

Kidney Foundation of Canada, MAC Representative/Fondation du rein—Comité de médical consultatif :
Heather Dean, RN, CNeph(C)
T: 403-943-9400
CANNT.president@gmail.com

Bursary Committee/ Comité des Bourses :
Heather Dean, RN, CNeph(C)
T: 403-943-9400
CANNT.president@gmail.com

CANNT Administrative Office/ Bureau National de l'ACITN :
PO Box 10, 59 Millmanor Place
Delaware, ON N0L 1E0
New phone: 519-652-6767
Same Toll Free: 877-720-2819
New fax: 519-652-5015
General email: cannt@cannt.ca

Contacts:
Sharon Lapointe,
Manager, Member Services
sharon@cannt.ca

Susan Mason
Manager, Website and Social Media
susan@cannt.ca

Heather Reid
National Administrator/Board
heather@cannt.ca

2017 Conference: October 19–21, 2017 Halifax, NS
Heather E. Reid, ARCT, MSc
Principal Planner & Owner
Innovative Conferences & Communications
PO Box 319, 59 Millmanor Place
Delaware, ON N0L 1E0
T: 519-652-0364
F: 519-652-5015
hreid@innovcc.ca
Website: www.innovcc.ca

Journal advertising contact/Personne contact pour la publicité du Journal :
Heather Coughlin
Pappin Communications,
84 Isabella Street, Pembroke, ON K8A 5S5
T: 613-735-0952; F: 613-735-7983
heather@pappin.com
Rate card: www.pappin.com

Your Board in Action

Serving our membership, volunteering, contributing to something important to me, forging professional relationships, promoting our mission and vision, stepping outside my comfort zone, learning something new… these are some of the reasons that I volunteered to be part of the Canadian Association of Nephrology Nurses and Technologists (CANNT).

My goal is to motivate all of my peers in becoming active members in their association. Not an easy task. Starting small, even engaging one renal professional to take up the torch and become more involved, is a huge victory for me. I rationalize to myself that if I just keep moving forward then soon all renal nurses and technologists will be an active part of the Canadian Association of Nephrology Nurses and Technologists (CANNT).

In my years as the Western VP, I have come to realize that it is going to take a coordinated effort to engage new renal professionals to become part of CANNT and to build a national community to promote the best renal care across Canada. We, as your Board, continue to work on a strategic plan to meet the needs of our members and provide value to you. It takes some commitment, creativity, collaboration, and an enormous amount of courage. In all my years of being involved in this professional association, we have not found the change that is needed to bring us all together. The challenge is multi-factorial. We, as renal professionals, have so many competing resources to seek out, become involved in, reference, and promote. There are our local institutional or work committees, policies, educational opportunities, and resources. Then most of us have provincial initiatives to standardize renal care and support renal professionals through collaborative networks.

Your Board of Directors (BOD) is working behind the scenes to re-direct the use of resources, business processes, budget allocations, or other modes of operation that will significantly reshape our association. Exciting times are on the horizon.

MEMBERSHIP

We currently have a membership of 474 renal professionals. Increasing our membership and providing value in your membership is the key to our organization.

Whether you are interested in strengthening your renal network, furthering your knowledge or maybe just in need of networking opportunities, professional organizations can be a great option for you. In addition to providing information about your chosen field, professional organizations can enhance your personal and professional development, and provide endless networking opportunities.

CANNT membership provides you with access to our members-only section of the website. This area provides many resources at your fingertips. These resources such as the Vascular Access Guidelines and Standards of Nursing and Technical Practice are readily available to our members for use in enhancing their knowledge and supporting their professional practice. Our seasonal peer-reviewed journal is touted as both an educational and informational resource for nephrology professionals across the nation. Becoming a part of this professional organization offers opportunities to apply for CANNT bursaries and grants, and funding for CNA certification and re-certification in nephrology. We also recognize our professionals nationally with our yearly awards nominations.

COMMUNICATIONS

The CANNT website (www.CANNT.ca)
Twitter: (@CANNT1)
Facebook

We connect at our monthly meetings to identify the best way to communicate on a national basis in a timely, consistent fashion. Please continue to share your ideas with us and let us know how to connect with you. Use CANNT to communicate professional information, news, events, or important dates through our multimedia communication strategies and bi-monthly email updates.

ANNUAL CONFERENCE

CANNT 2017 is themed "Charting Our Course – Setting Sail for the Future", and your conference committee members are working hard to create an innovative and exciting program to meet the needs of nephrology professionals for novice to advanced practice. Looking forward to seeing you in Halifax on October 19–21, 2017.

FINANCES

As a "not-for-profit" professional association, our objective is to provide value to our members that stays within our mission and vision. In an effort to keep upright and steady, we are consistently seeking out growth and development opportunities to assist in maintaining the viability of the association. We remain fiscally responsible in governing our costs to function as your BOD. We have realized that now is the time to venture into change to enable growth and sustainability for the organization. Stay tuned!

Janice MacKay
CANNT 2016–2018
President-Elect/Treasurer

Votre conseil d'administration en action

Être au service de nos membres, faire du bénévolat, apporter ma contribution à quelque chose qui m'est cher, bâtir des relations professionnelles, promouvoir notre mission et notre vision, sortir de ma zone de confort, apprendre quelque chose de nouveau… voilà quelques-unes des raisons pour lesquelles j'ai choisi de faire partie de l'Association canadienne des infirmières et infirmiers et des technologues de néphrologie (ACITN).

J'aspire à motiver mes pairs à devenir des membres actifs de leur association. Ce n'est pas une mince tâche. Il faut commencer à petite échelle; inspirer un seul professionnel de la santé en néphrologie à reprendre le flambeau et à participer davantage représente pour moi une immense réussite. Je me dis qu'il suffit de continuer d'aller de l'avant et qu'un jour, tout le personnel infirmier et les technologues en néphrologie joueront un rôle actif au sein de l'ACITN.

Au fil de mes années en tant que vice-présidente de l'ouest du Canada, j'ai compris qu'un effort concerté serait nécessaire pour inspirer les professionnels de la santé en néphrologie à devenir membre de l'ACITN et à bâtir une communauté nationale visant à promouvoir les meilleurs soins en néphrologie à l'échelle du pays. En tant que membres de votre conseil, nous continuons à mettre au point un plan stratégique pour répondre aux besoins de nos membres et pour vous offrir de la valeur. Il faut de la détermination, de la créativité, de la collaboration et une immense dose de courage. Au cours de toutes mes années au cœur de cette association professionnelle, nous n'avons toujours pas trouvé l'élément de changement qui réussirait à nous réunir. Ce défi repose sur plusieurs facteurs. En tant que professionnels en néphrologie, nous avons énormément de ressources concurrentes à trouver et à promouvoir, et auxquelles participer ou nous rapporter. À l'échelle locale, il y a nos comités institutionnels ou professionnels, les politiques, les occasions de formation et les ressources. Ensuite, la plupart d'entre nous ont des initiatives provinciales visant à normaliser les soins en néphrologie et à soutenir les professionnels du domaine au moyen de réseaux de collaboration.

Votre conseil d'administration travaille en coulisses pour réorienter l'utilisation des ressources, les processus opérationnels, les allocations budgétaires, ou tout autre mode de fonctionnement pouvant réorganiser notre association de façon significative. Des changements excitants se pointent à l'horizon.

ADHÉSION

Nos membres comptent actuellement 474 professionnels de la santé en néphrologie. Accroître nos effectifs et s'assurer que l'adhésion offre de la valeur à nos membres est essentiel pour notre organisation.

Que vous cherchiez à renforcer votre réseau en néphrologie ou à approfondir vos connaissances, ou que vous soyez simplement à la recherche d'occasions de réseautage, les organisations professionnelles peuvent s'avérer des plus utiles. En plus de fournir des renseignements sur votre domaine de prédilection, les organisations professionnelles vous permettent d'améliorer votre perfectionnement personnel et professionnel, et vous offrent d'innombrables possibilités de réseautage.

L'adhésion à l'ACITN vous permet d'accéder à une section du site Web réservée aux membres. Cette section met de nombreuses ressources à votre disposition. Ces ressources, par exemple les lignes directrices relatives à l'accès vasculaire ainsi que les normes de pratique infirmière et technologique en néphrologie, sont facilement accessibles à nos membres qui souhaitent approfondir leurs connaissances et perfectionner leur pratique professionnelle. Notre revue périodique évaluée par les pairs est considérée comme une ressource éducative autant qu'informative pour les professionnels en néphrologie partout au Canada. En devenant membre de cette organisation professionnelle, vous aurez la possibilité de demander des bourses et des subventions de l'ACITN et d'accéder à un soutien financier pour la certification infirmière en néphrologie de l'AIIC ou le renouvellement de la certification. Nous reconnaissons également l'excellence de nos professionnels, au moyen d'un programme de reconnaissance annuel.

COMMUNICATIONS

Le site Web de l'ACITN (www.CANNT.ca)
Twitter: @CANNT1
Facebook

Lors de nos réunions mensuelles, nous faisons le point sur la meilleure façon de communiquer régulièrement et en temps opportun avec nos membres à l'échelle nationale. Continuez à nous faire part de vos idées et indiquez-nous quelle est la meilleure manière de communiquer avec vous. Vous pouvez recourir à l'ACITN pour transmettre des renseignements de nature professionnelle, des nouvelles, des événements ou des dates importantes par nos stratégies multimédias de communication et nos bulletins bimestriels par courriel.

CONFÉRENCE ANNUELLE

En 2017, le thème de la conférence de l'ACITN est « Tracer notre voie – cap sur l'avenir » (Charting our Course – Setting Sail for the Future). Votre comité organisateur travaille fort pour créer une programmation novatrice et captivante susceptible de répondre aux besoins des professionnels en néphrologie, quel que soit leur niveau d'expertise. Nous espérons vous voir à Halifax du 19 au 21 octobre 2017.

FINANCES

En tant qu'association professionnelle à but non lucratif, notre objectif est d'offrir une valeur ajoutée à nos membres conformément à notre mission et à notre vision. Dans le but d'assurer la pérennité et la stabilité de nos services, nous recherchons constamment des occasions de croissance et de développement propres à assurer la viabilité de l'association. En tant que conseil d'administration, nous demeurons responsables de la gouvernance de nos coûts sur le plan financier. Nous sommes d'avis que le temps est venu de nous aventurer sur de nouvelles avenues pour permettre la croissance et la durabilité de l'organisation. Demeurez à l'affût pour la suite!

Janice MacKay
ACITN, 2016–2018
Présidente élue et trésorière

Community visiting nurses training plan: Home dialysis support

By Michele Ivanouski, RN, CNeph(C)

ABSTRACT

From October 2014 to January 2015, the Peritoneal Dialysis Unit (PDU) at London Health Science Centre (LHSC) had a scarcity of peritoneal dialysis- (PD) trained community visiting nurses working for nursing agencies provided by the Community Care Access Centres (CCAC) in several remote geographical areas serviced by the program. These nurses have become an extension of the PDU by communicating concerns and questions to the PDU staff while providing PD support for patients at home. By October 2014, one town had only two trained nurses to support the launch of an "avalanche" of newly trained patients and their varying degrees of need. To tackle this shortage, the PDU trialed offering community visiting nurse training in the nurses' respective hometowns over a four-month period. The response was excellent with large numbers of nurses being trained during this period. This initiative yielded additional and surprising benefits to patients and their families, and nursing agencies, as well as the LHSC PDU.

BENEFITS OF PERITONEAL DIALYSIS

Peritoneal dialysis (PD) has been an excellent renal replacement therapy (RRT) choice for many years. The medical benefits include: less exposure to hospital-acquired infections, maintenance of residual renal function, fewer symptoms related to fluid shifting (e.g., less intradialytic and postdialytic muscle cramps and hypotension), and lower mortality rates when compared to hemodialysis (HD) (Perl et al., 2011; Termorshuizen et al., 2003). Patients report benefits ranging from a more liberalized diet and less fluid restriction to more free time for family activities and ease of travel.

REQUIREMENTS FOR SUPPORT

Historically, the PD patient inclusion criteria have been very selective, and support for home care was restrictive. The previous weight limit (i.e., over 130 kg), ability and/or mobility limitations, and a history of previous abdominal surgery excluded many from being considered for PD. The Provincial Peritoneal Dialysis Coordinating Committee gives two absolute medical contraindications to PD: (1) "documented loss of peritoneal membrane function or extensive abdominal adhesions that limit dialysate flow"; and (2) "uncorrectable mechanical defects that prevent effective PD or increase the risk of infection" (e.g., surgically irreparable hernia). Morbid obesity became a relative medical contraindication (Peritoneal Dialysis Coordinating Committee, 2006a, p. 19). Some patients weighing over the weight limit have tried PD and dialyzed for some time before being transplanted or switching to hemodialysis.

Home care support was limited to short-term care with a "teach and leave" approach, i.e., providing one to two daily nursing visits for a short-stay client within a 60-day period (Provincial PD Coordinating Committee, 2006b and 2006c). These earlier restrictions, along with the lack of evidence-based selection criteria in PD units, excluded those requiring long-term care needs in their homes (Hutchinson & Courthold, 2011; Keating, Walsh, Ribic, & Brimble, 2014). As a result, in-centre hemodialysis (HD) became their only choice. Less mobile, chronically well patients travelled to their HD units in all weather conditions and followed a more restrictive dietary and fluid regimen. Some of the most adherent HD patients endured post-treatment symptoms, especially cardiac and hypotensive patients, and then braved travelling home feeling unwell. The advancement in selection criteria and expanded home care support created growth in PD numbers. By October 2014, more patients were choosing to live with the benefits of PD (Perl et al., 2011). Along with this growth came two practice changes at London Health Science Centre (LHSC) that caused increased demand on home visiting nurse support: (1) The implementation of twice-weekly, at-home pre-training flushes to maintain catheter patency; and (2) the LHSC urgent-start PD program that allows patients to start automated PD (with deferral of manual PD training) within three weeks of catheter insertion (Alkatheeri, Blake, Gray, & Jain, 2016). Due to the attraction of PD in the more remote areas of the LHSC catchment area, the PD unit (PDU) staff identified two geographical areas with severe shortage of trained nurses.

TRADITIONAL TRAINING

Historically, two full days of training were offered to community nurses at the LHSC PDU. One PD nurse would be assigned to train three to seven community visiting nurses. Upon completion, each nurse would receive a certificate of competency allowing the nurse to practise this new skill. There were frequent cancellations or no-shows for the classes; sometimes classes would only

ABOUT THE AUTHOR

Michele Ivanouski, RN, CNeph(C), Multi-Care Kidney Clinic, London Health Science Centre, London, Ontario

Address for correspondence: Michele Ivanouski, Multi-Care Kidney Clinic, London Health Science Centre, Westmount Shopping Centre, 785 Wonderland Road South, London, ON N6K 1M6

Email: ***michele.ivanouski@lhsc.on.ca***

comprise two students. On two occasions, a whole class did not show. Delving into the reasons behind the frequent absences was enlightening. Community visiting nurses expressed their helplessness in finding a coworker to care for their assigned patients while they underwent the two-day training at LHSC. If coverage could not be found, these dedicated professionals would not leave their patients, hence, the empty PD classes. In response to this deficiency, some community visiting nurses would provide their colleagues with basic rudimentary knowledge of PD without formal training to combat the shortage at the "front line". The work was technically done, but safety was compromised (Provincial Peritoneal Dialysis Coordinating Committee, 2006d).

NEW PLAN

The LHSC PDU staff offered to come to the visiting nurses' communities. Seven case managers from the Community Care Access Centre (CCAC) provided the PDU with contacts for the nursing agencies they regularly used for the LHSC PD patients in their areas. The initial focus was placed on the areas with the least number of PD-trained community visiting nurses. Dates were offered, and the managers selected the nurses for training, concentrating on areas with the greatest deficiencies. The nursing agency manager arranged a suitable venue in their town for training; locations included agency offices, local hospital board rooms, and even a converted train station. Once PD trainee numbers were confirmed, the PDU staff made arrangements for delivery of Dianeal solutions and cyclers through Baxter. Ancillary PD supplies, training manuals, and the training video were brought by the PD staff. Evaluations were requested after each completed training session. During the trial period of October 2014 to January 2015, LHSC hosted four two-day training sessions. Each class averaged nine students with a total of 32 graduates. One month post training a fictional case study was sent electronically to the newly trained alumni for follow-up learning. The PD staff discovered that this opened up and maintained the flow of communication with the newly PD-trained community visiting nurses.

IMPACT

After this trial, the LHSC PD patients had trained community visiting nurses in every geographical area reaching the most remote areas. The urgent-start patients (i.e., patients who start PD within three weeks of catheter insertion) had trained staff to monitor their progress in the early stage. The PDU had a sufficient pool of excellent skilled staff to call upon. Community visiting nurses were better able to cover their workload. The community nurse trainees arranged to see their home patients before class, after class, or even during the lunch break on their training dates. These community visiting nurses recognize the benefit of learning PD from LHSC PDU staff and insist on learning from the experts.

Following the trial, the LHSC PDU had a roster of trained community visiting nurses to call upon for their increased numbers and urgent-start patients. A closer connection was felt between the LHSC PDU and community visiting nurses. In addition, poor attendance was reversed, community visiting nurses were anxious to join classes, and PD nurse hours were used more effectively during the four months. When compared to four months of training in London from October 2013 to January 2014, the PD nurse was able to train more nurses in their day during the trial period from October 2014 to January 2015.

RESULTS

During LHSC training one year prior, nine PD nurse work days were needed to train 17 community visiting nurses, whereas, in the nurses' home towns, seven PD nurse work days were needed to train 32 community visiting nurses (Figure 1). Approximately 1.89 community visiting nurses were trained for each day spent in the LHSC training program; in contrast, each day spent *outside* of the London training program and in the community yielded 4.64 PD-trained community visiting nurses. Some comments from evaluations after the community held classes included: "Thank you for coming to us" and "I am anxious to put my new knowledge to work".

Figure 1: PD Nurse Work Days/Number of Trained Visiting Nurses

CONCLUSION

Taking PD training to nurses in the community has benefitted all parties. The patients receive consistent, safe instructions, as community visiting nurses use the same education tools and information as the LHSC PDU staff. This has led to patients feeling confident that they made a safe choice by opting for PD as their definitive RRT. The community visiting nurses found that having classes closer to home gave them the freedom to organize their work schedules. Agency staff witnessed the portability of PD in their workplace. The LHSC PDU was able to arrange for home support more easily when needed. The PDU staff made efficient use of their work hours by having full classes. This experience highlights how successful home dialysis decreases the financial burden on our strapped healthcare system. Above all, it underscores the importance of maintaining the quality of life for patients undergoing PD at home, as well as for their families.

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Examining the effect of blood flow rate on hemodialysis urea clearance

By Keira St. George, BN, BA, RN(C), Lynda Whitlum, BSN, RN, and John Duncan, MD, MSc, BSc (Hons), FRCP(C)

ABSTRACT

The National Kidney Foundation Dialysis Outcomes Quality Initiative (NKF KDOQI) 2015 guidelines identify urea clearance as the primary measure of hemodialysis adequacy, and note that a blood flow rate (Qb) of less than 300 mL/min provides insufficient clearance. There are no guidelines as to the optimal blood flow rate greater than 300 mL/min. Scant research exists on how clearance differs according to blood flow rate. Some suggest that a higher blood flow rate could negatively impact the health of arteriovenous fistulae (AVF). The authors hypothesized that clearance would meet or exceed KDOQI minimum guidelines of Kt/V 1.2 and URR (urea reduction ratio) 65%, whether dialyzing at Qb 320 mL/min or Qb 380 mL/min. Using a randomized, crossover design, data were collected from 24 patients with AVF dialyzing at a single centre over four weeks. Results showed that both Qb 320 mL/min and Qb 380 mL/min have Kt/V and URR averages above the minimally adequate doses, although the latter had an 11% higher Kt/V. This study establishes the need and importance of larger and longer studies examining clearance, Qb, and fistula health.

Key words: dialysis, blood flow, clearance rate, dialysis adequacy, dialysis clearance, flow adequacy, flow rate, hemodialysis, Qb

INTRODUCTION

Dialysis adequacy reflects the efficacy of hemodialysis (HD) treatment and directly correlates with mortality in patients with chronic kidney disease (Borzou et al., 2009; Flythe, Curhan, & Brunelli, 2013; National Kidney Foundation, 2006; Williams, Jensen, Gillum & Nabut, 2007). The National Kidney Foundation Kidney Disease Quality Outcomes Initiative (NKF KDOQI) identifies urea clearance as a primary measure of dialysis adequacy (NKF, 2015). Clearance is expressed as the calculation of Kt/V—where *K* is dialyzer urea clearance in millimetres per minute, integrated over the entire dialysis treatment; *t* is time in minutes from the beginning to the end of a dialysis treatment; and *V* is the volume of distribution of urea in millimetres (NKF, 2006)—and/or urea reduction ratio (URR), both of which measure the amount of urea cleared from the body during a single HD treatment. KDOQI (NKF, 2006) guidelines also identify that a blood flow rate (Qb) of less than 300 mL/min does not provide sufficient clearance. However, there are no such guidelines as to blood flow rates above 300 mL/min. The authors hypothesized that HD clearance would meet or exceed national urea clearance minimum guidelines of Kt/V 1.2 and URR 65% whether dialyzing with a blood flow rate of 320 mL/min or 380 mL/min in patients with an arteriovenous fistula (AVF) dialyzing four hours, three times weekly over a four-week period.

In Canada, the majority of prescribed blood flow rates range from 320 mL/min to 380 mL/min (Dialysis Outcomes and Practice Patterns Study, 2013); yet little research exists on how clearance differs according to blood flow rates in that range. This knowledge gap is significant because it has been suggested that a faster blood flow rate may have a negative impact on the AVF, which may contribute to fistula complications such as venous pseudoaneurysm (Radmili et al., 2012), hemolysis (Twardowski, Haynie, & Moore, 1999), turbulence and stenosis (Agar, 2014a), and potentially grave consequences for the patient undergoing hemodialysis (Agar, 2014b). Furthermore, research suggests that little difference in patient outcomes exists when dialysis clearance targets are exceeded (Eknoyan et al., 2002; Kemp, Parnham, & Thomson, 2001). Therefore, using a faster blood flow rate to achieve higher clearance values may be unnecessary and potentially harmful.

Determining the impact of blood flow rates on urea clearance is essential for clinicians to enact evidence-informed practice and protect patients from harm. If there is a limit to the Kt/V wherein patient outcomes cease to improve, risking fistula health for higher clearance values may be unwarranted. Although it is only a proposition that fistula health may be damaged by higher blood flow rates, if hemodialysis clearance is adequate with a slower blood flow rate, then clinical equipoise indicates that further research is required to discern whether any harm, and specifically what harm, may come to an AVF when dialyzing with a faster blood flow rate, and for what benefit of any clearance differences.

ABOUT THE AUTHORS

Keira St. George, BN, BA, RN(C), Clinical Educator, Vancouver Coastal Health, Vancouver, BC

Lynda Whitlum, BSN, RN, Richmond Community Dialysis Unit, Providence Health Care, Richmond, BC

John Duncan, MD, MSc, BSc (Hons), FRCP(C), Clinical Associate Professor, Vancouver General Hospital, University of British Columbia, Vancouver, BC

Address correspondence to: Keira St. George, Tel: (604) 319-0606; email: ***keirastgeorge@gmail.com***

LITERATURE REVIEW

A literature search on the effect of blood flow rate on dialysis clearance, dialysis adequacy contributors, and the implications of dialysis adequacy on patient morbidity and mortality was conducted using a computerized search of peer-reviewed research studies, opinion articles, and literature reviews within the health and medicine databases of ProQuest. A second literature search was also conducted using the Canadian Agency for Drugs and Technologies in Health search aids. A combination of the following key words was used: dialysis, blood flow, clearance rate, dialysis adequacy, dialysis clearance, flow adequacy, flow rate, hemodialysis, and Qb. Both searches revealed a gap in literature on the effect of blood flow rate on dialysis clearance.

It is believed that a dearth of literature on this topic exists because nephrology is a small specialty with little—and, in fact, declining—research (Al-Awqati, 2012; Bryan, Ibrahim, Zent, & Fischer, 2014; Strippoli, Craig, & Schena, 2004). In addition, as Bryan et al. (2014) mention, nephrology is a complex field highly related to other disciplines (e.g., urology, cardiology) that already dominate research towards which research funding is more likely to be directed. Furthermore, dialysis adequacy is a multifaceted issue that is potentially confounded by many variables, and the cultural change to encourage interventions and accept the dynamic role of practice-related interventions that Strippoli et al. (2004) called for has likely not yet taken place.

Due to the lack of recent research, one must be mindful of the possibility that changes in renal practice may bring into question the current applicability of previous findings. Nevertheless, because of the miniscule body of research, older studies must be considered, as they are the only body of evidence on this topic. This includes studies by Collins et al. (1992) and Hassell et al. (2001), which examined the effects of a faster blood flow rate on vascular access complications with contradictory findings, and by Borzou et al. (2009), which corroborated Hassell et al.'s (2001) findings by showing that a faster blood flow rate increases Kt/V. None of these studies, though, directly compared two commonly used blood flow rates using the same sample. With respect to the magnitude of Kt/V, Kemp et al.'s (2001) and Eknoyan et al.'s (2002) research reviews determined that Kt/V greater than the KDOQI target is only beneficial up to a certain point, and that even this has not consistently shown improvements in patient morbidity and mortality.

METHOD

Design

This randomized control experimental study with a crossover design involved the independent variable of blood flow rate (Qb), measured in mL/min, and the dependent variable of dialysis clearance, measured by Kt/V and URR. Participants were assigned to one of two groups by random selection of names from an envelope: group A (Qb 320 mL/min) or group B (Qb 380 mL/min). A low blood flow rate that is above 300 mL/min was selected so as not to jeopardize patients' HD due to being at or below the recommended minimum blood flow rate; and a high blood flow rate of 380 mL/min was selected as this is around the mean used in Canada (DOPPS, 2013). Each study period consisted of two weeks (six hemodialysis sessions, 24 hours of dialysis) at each Qb. Because urea clearance is immediate, six treatments at each Qb will reflect accurate data on Kt/V and URR. Although carryover effects are not of concern to this study, as participants routinely dialyze three times per week, wherein urea levels naturally rise between routine treatments, a washout phase of one week between study periods was used, as is recommended for an effective crossover design (Wellek & Blettner, 2012).

Sample

The target and sample population are patients with end-stage renal disease dialyzing with an AVF at the Vancouver Community Dialysis Unit. Statistical power—the measure of the likelihood that the sample results will have statistical significance in the larger population—was conducted by scientists at the Centre for Health Evaluation and Outcome Sciences (CHEOS). This calculation determined that in order to ensure that Kt/V of 1.2 and URR of 65% could be estimated with a confidence interval of 95%, a minimum sample size of 34 participants was required, with an additional 10% to account for attrition. Because randomization occurred with the study period assignment, purposive sampling was used to select participants from the accessible pool of 60 patients, according to the following inclusion criteria:

- Dialyzing for greater than six months—to ensure access patency, viability, and stability;
- Undergoing thrice weekly, four-hour hemodialysis sessions—for uniform dialysis duration;
- Dialyzing with an AVF, either brachiocephalic or radiocephalic; no central venous catheters, arteriovenous grafts, or femoral AVFs—due to differences in access flows and vessel quality;
- Dialyzing with 15-gauge needles—as organization policy restricts greater flow rates with smaller needle gauge;
- Dialyzing with a dialysate flow rate (Qd) of 500 mL/min—to reduce the possibility of clearance being attributable to differences in Qd;
- Maintaining transonic vascular access flows of greater than 600 mL/min in the preceding six months per KDOQI (NKF, 2006) minimum blood flow rate guidelines—to ensure access patency;
- Not being part of any other research study that would interfere with dialysis treatment.

Informed consent was obtained from 26 participants. One participant withdrew from the study after two treatments for undisclosed reasons, and another withdrew due to hospital admission. Data from 24 patients were collected and used.

Data collection

Routine nursing documentation per HD unit protocol provided the following data for each patient during each treatment according to their treatment run log: hourly Qb,

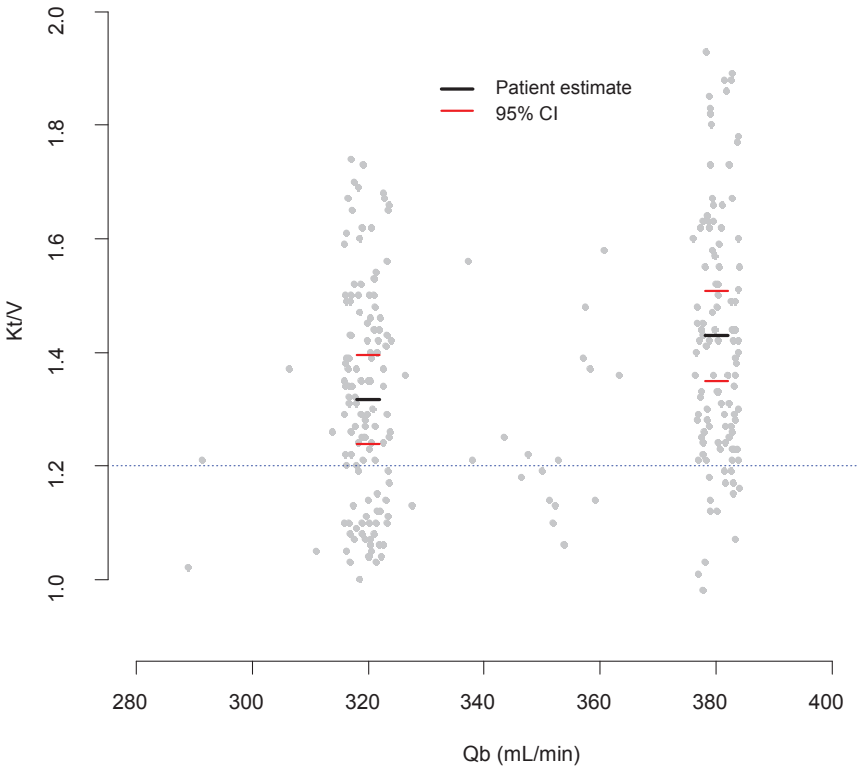

Figure 1. Observed and Estimated Mean Kt/V at 320 and 380 mL/min Blood Flow Rates

Qb=hemodialysis blood flow rate in mL/min; **grey dots**=all Kt/V observations; **dotted blue line**=minimally adequate Kt/V dose per KDOQI. Point and 95% CI estimates were derived from linear mixed regression.

pre- and post-dialysis blood pressure, weight gain, target fluid loss, dialysate flow rate, needle gauge, cannulation site and any cannulation difficulties, hourly and cumulative Kt/V, intradialytic complications, and dialysis duration. URR, which is routinely drawn every six weeks, was drawn weekly at every third treatment during the study. Standard URR bloodwork collection protocol was followed: Pre- and post-dialysis blood specimens were collected and sent, along with the corresponding requisitions, for analysis and calculation off-site at LifeLabs according to routine protocol. A research account was opened with LifeLabs, and all research requisitions and blood collections were coded to the research study. Once weekly, the co-investigators photocopied participants' treatment run logs along with the urea lab report, and input the data into a pre-determined Excel spreadsheet.

ETHICAL CONSIDERATIONS

Ethical approval was obtained from the University of British Columbia Providence Health Care Research Ethics Board (H14-01931). Participants were approached on co-investigators' non-work time, and were provided with introductory study information. Those interested in participating provided informed consent. For non-English-speaking participants, informed consent was provided in collaboration with Provincial Language Services, the interpreting service used by Providence Health Care. Patients' right to decline to participate was respected; declination would not prejudice future nursing or medical care. There were no known or anticipated harms in this study; however, if at any time a participant's psychological or physiological wellbeing appeared to be jeopardized, the participant would be withdrawn from the study. All patient identifiers were removed from data sheets, and participants were assigned a number. Participant coding sheets were kept in a locked cabinet within the dialysis unit, separate from the locked cabinet containing data collection sheets. All electronic data were stored in password-protected files in a USB flash drive.

DATA ANALYSIS

Robust data analysis was conducted by scientists at CHEOS that was tolerant of any missing data and/or discrepancies. Outcome variables of Kt/V, URR, and post-HD systolic and diastolic blood pressures were used. The main independent variable was blood flow rate (Qb) at two levels: 320 mL/min and 380 mL/min. Covariates included treatment order, measurement over time, and target fluid loss. Kt/V values for each blood flow rate were described and summarized using scatter plots (Figures 1 & 2), and means and standard deviations (Tables 3 & 4). To determine whether the two different blood flow rates could produce clinically acceptable levels of the outcome, the mean (point-estimate) outcome values and their associated 95%

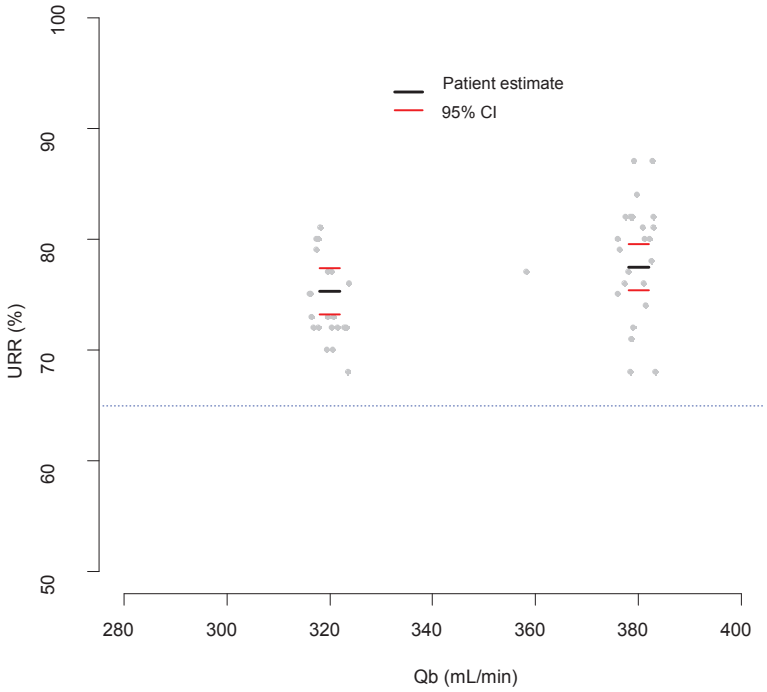

Figure 2. Observed and Estimated Mean URR at 320 and 380 mL/min Blood Flow Rates

URR=urea reduction ratio in percent; **Qb**=hemodialysis blood flow rate in mL/min; **grey dots**=all URR observations; **dotted blue line**=minimally adequate URR per KDOQI. Point and 95% CI estimates were derived from linear mixed regression.

Table 1: Descriptive Statistics

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
final ktv	264	1.35	.21	.98	1.93
Qb	288	347.29	29.44	290	380
URR	94	76.19	4.93	64	87
idwg	288	2.00	1.29	-2.1	13
tfl	288	2.32	.76	.19	4.4
postsbp	270	65.61	11.17	25	95
postdia	270	123.98	20.79	81	184

(Qb=hemodialysis blood flow rate in mL/min; URR=urea reduction ratio; idwg=interdialytic weight gain in kilograms; tfl=target fluid loss, mean litres of ultrafiltration targeted per hemodialysis session; postsbp=post hemodialysis diastolic blood pressure; postdia=post hemodialysis diastolic blood pressure)

confidence intervals (CI) for each blood flow rate were estimated using linear mixed effects regression. Blood flow rate, time (measurements 1 to 6), and treatment sequence (0, initial measurement; 1, final measurement) were entered as fixed factors, and participant identification was entered as random effects to account for repeated measurements obtained from the same participants. Additional analyses were also conducted to determine whether target fluid loss is a potential confounder for the effect of blood flow rate on Kt/V and URR. Point and interval estimates that exceeded clinical standards were interpreted as an indication that minimum standards were achieved.

Table 2: Correlational Matrix of Hemodialysis Clearance and Blood Pressure at Different Blood Flow Rates

	tfl	idwg	Qb	finalktv	URR	postsbp	postdia
tfl	1.00						
idwg	0.73	1.00					
	0.0						
Qb	0.08	0.05	1.00				
	0.14	0.41					
finalktv	-0.30	-0.20	0.26	1.00			
	0.00	0.00	0.00				
URR	0.02	-0.02	0.21	0.73	1.00		
	0.83	0.86	0.05	0.0			
postsbp	-0.15	-0.12	0.07	0.08	-0.080	1.00	
	0.02	0.05	0.25	0.22	0.47		
postdia	-0.22	-0.19	0.08	0.03	-0.24	0.62	1.0
	0.00	0.00	0.18	0.61	0.02	0.00	

(tfl=target fluid loss in litres; idwg=interdialytic weight gain in kilograms; postsbp=post hemodialysis systolic blood pressure; postdia=post hemodialysis diastolic blood pressure; URR=urea reduction ratio; Qb=hemodialysis blood flow rate in mL/Min)

Table 3: Estimated Means and Differences of Dialysis Clearance at Different Blood Flow Rates (Unadjusted for Target Fluid Loss)

	Estimated Means (95% CI)		
	380 mL/min	320 mL/min	Difference
Kt/V	1.43 (1.35, 1.51)	1.32 (1.24, 1.4)	0.11 (0.1, 0.13*)
URR	77.49 (75.38, 79.61)	75.31 (73.22, 77.39)	2.19 (1.57, 2.8)
Post-HD systolic BP	126.94 (119.07, 134.81)	124.57 (116.87, 132.26)	2.37 (-0.67, 5.41)
Post-HD diastolic BP	66.71 (62.59, 70.82)	65.68 (61.7, 69.67)	1.02 (-0.86, 2.9)

(URR=urea reduction ratio in percent)
**95% Confidence Interval: 0.1, 0.13; statistically significant at p<0.05*

RESULTS

Results support the hypothesis that each blood flow rate yields Kt/V and URR means at or above minimally adequate dose guidelines of Kt/V 1.2 and URR 65%, as displayed in Figures 1 and 2. These figures also show that patient estimate and confidence intervals for both Kt/V and URR at each blood flow rate are also at or above the minimally adequate dose thresholds. Descriptive statistics in Table 1 show a mean Qb of 347 mL/min for all 288 observations, with standard deviation (SD) of 29.44 mL/min. Of all 94 observations, the mean URR is 76.19, with SD of 4.93. The mean final Kt/V is 1.35 with 0.21 SD for all 264 observations. As Table 2 displays, there is a positive correlation with Qb and Kt/V, as well as with Qb and URR. Table 2 also shows a negative correlation between post-diastolic blood pressure and a higher URR. Target fluid loss and weight gain have a correlational coefficient of 0.73, which is statistically significant at 0.00 ($p<0.0001$). Target fluid loss and URR are not correlated, as $r=0.02$ ($p>0.05$). The *unadjusted* means and differences displayed in Table 3 reveal that Qb 380 mL/min has a slightly higher average Kt/V (1.43) than Qb 320 mL/min (1.32), with a difference in mean URR between each blood flow rate at 2.19. The *adjusted* means and differences displayed in Table 4 also show that Qb 380 mL/min has a higher mean Kt/V (1.39) than Qb 320 mL/min (1.28), with a difference in mean URR between each blood flow rate at 2.39.

Table 4: Estimated Means and Differences of Dialysis Clearance at Different Blood Flow Rates (Adjusted for Target Fluid Loss)

	Estimated Means (95% CI)		
	380 mL/min	320 mL/min	Difference
Kt/V	1.39 (1.3, 1.48)	1.28 (1.19, 1.37)	0.11 (0.1, 0.12*)
URR	79.23 (76.36, 82.11)	76.85 (74.13, 79.56)	2.39 (1.74, 3.03)
Post-HD systolic BP	129.08 (117.58, 140.58)	126.59 (115.54, 137.64)	2.48 (-0.59, 5.56)
Post-HD diastolic BP	68.47 (61.94, 75)	67.35 (61.11, 73.59)	1.12 (-0.78, 3.02)

(URR=urea reduction ratio in percent)
**95% Confidence Interval: 0.1, 0.12; statistically significant at p<0.05*

DISCUSSION

Hemodialysis clearance is a primary measure of dialysis adequacy, and clearance varies with blood flow rate. To date, there is limited evidence to delineate an optimal blood flow rate that optimizes clearance whilst minimizing any negative impact on arteriovenous fistulae. Results from this study confirm the hypothesis that both blood flow rates (Qb 320 mL/min and Qb 380 mL/min) would meet KDOQI guidelines for minimally adequate hemodialysis dose. Interestingly, only the faster blood flow rate met both the URR and Kt/V KDOQI *target* values of Kt/V 1.4 and URR 70%; the slower blood flow rate met only the URR target—even when adjusted for participant weight gain/target fluid loss (Table 4), which may reflect variability in a relatively small sample size, and warrants further study. If confirmed, such a difference may indicate that there may be some clearance benefit to dialyzing at the faster blood flow rate, although there is no clinical evidence to date that indicates any benefit to exceeding current Kt/V targets. Given the paucity of evidence, these results suggest there may be clinical benefit to identifying the blood flow rate that consistently meets clearance targets in larger studies across multiple dialysis centres. Without strong evidence for how a faster blood flow rate may impact fistula health, and with notable evidence supporting the importance of urea clearance, practitioners can only assume that there is greater long-term clinical benefit to patients dialyzing at a faster blood flow rate. Future studies that examine the impact of a faster blood flow rate on fistula health—in terms of reducing trauma, extending life, and reducing interventions—are necessary if one is to appropriately weigh the benefit versus risk of a faster blood flow rate. This study establishes the feasibility of a larger study of this kind and the safety in further exploring the blood flow rate, as it relates to fistula health.

The adjusted values for target fluid loss (Table 4), which result in a slightly lower Kt/V, but a higher URR, is to be expected given Kt/V factors in the amount of urea removed with excess fluid, whereas URR does not. This is important to note because this adjustment for urea removal without ultrafiltration of fluid lowers the mean Kt/V, which is considered the primary measure of adequacy. The correlation between Qb and both URR and Kt/V is statistically significant ($p<0.05$), i.e., URR and Kt/V increase when Qb increases.

It is questionable whether the 11% difference between the mean Kt/V at different blood flow rates in this study is clinically significant. It is difficult to state what impact 11% less urea clearance may have on patients in relation to their morbidity and mortality. When one considers that 11% is half the difference between minimally adequate dose (1.2) and target dose (1.4), clinical significance is certainly plausible. Again, this finding indicates that future larger studies on blood flow rate, as it relates to Kt/V, are clinically important, as well as what clinical benefit is demonstrated when achieving the target dose versus the minimally adequate dose, and what negative impact higher blood flow rates may have if there are statistically and/or clinically significant differences with respect to clearance.

One incidental finding is that a higher URR is associated with a lower post-diastolic blood pressure. This may be related to a higher URR being associated with higher weight gain, and the resulting consequence of fluid loss on blood pressure. This may be of no clinical significance. However, it may be worth examining in future research given the regular occurrence of post-hemodialysis hypotension—particularly when anecdotal evidence from the clinic site indicates that patients frequently end dialysis treatments early due to low blood pressure, which can consequently impact their ability to achieve appropriate fluid loss and toxin clearance. Additionally, although this study was not long enough to determine any negative consequences on fistula health, a lower post-diastolic blood pressure may be interpreted as a signal of such, in that lower blood pressure may lead to increased blood clotting.

CONCLUSION

This study sought to determine whether KDOQI minimum guidelines for adequate dialysis dose (Kt/V 1.2 and URR 65%) would be met by both a slower blood flow rate (Qb 320 mL/min) and a faster blood flow rate (Qb 380 mL/min). Results support the hypothesis that each blood flow rate yields Kt/V and URR means at or above the minimally adequate dose guidelines.

This study's findings are valuable to the nephrology community, as they provide insight into blood flow rates and related clearance values. There is currently a literature gap on the difference in clearance when the blood flow rate is greater than 300 mL/min. These results may help nephrology practitioners determine whether to dialyze patients at a faster blood flow rate to improve clearance targets. This study also provides a foundation for future study on blood flow rate and fistula health, and provides evidence that future large studies on blood flow rate, clearance, and fistula health are safe to conduct. As these findings indicate, further research is necessary, as it may help clarify which blood flow rate is best able to maximize the hemodialysis benefit whilst reducing patient harm.

STUDY LIMITATIONS

The authors acknowledge that the location of the fistula (right or left), the participants' cumulative length of time on dialysis, and the participants' dialyzer type are not referenced in the data. These factors may have some clinical relevance to the data collected. The authors also acknowledge that with only 24 participants, the study did not meet the power calculation of 34 required participants in order to achieve a confidence interval of 95%. This may have affected the reliability in relation to the population mean.

ACKNOWLEDGMENTS

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CONTACT HOUR: 2.0 HRS

Sodium glucose cotransporter 2 (SGLT2) inhibitors—Their role in the kidneys

By Brittani Prete, BSP, and Marisa Battistella, PharmD, ACPR

LEARNING OBJECTIVES

1. Describe the mechanism of action of sodium-glucose cotransporter 2 inhibitors – canagliflozin, dapagliflozin and empagliflozin.
2. Discuss the possible renoprotective benefits of SGLT2 inhibitors in patients with type 2 diabetes mellitus.

BACKGROUND

Diabetes is one of the most common chronic diseases worldwide and is among the leading causes of kidney failure (World Health Organization [WHO], 2016). Diabetic nephropathy will affect up to half of diabetics in their lifetime (McFarlane, Gilbert, MacCallum, & Senior, 2013). It is estimated that 3.4 million Canadians are currently living with diabetes with the majority classified as type 2 (Diabetes Canada, 2017a, 2017b). Type 2 diabetes mellitus is characterized by resistance to the action of insulin, impaired insulin secretion, or both (Diabetes Canada, 2017b). Pharmacological management is continuing to evolve, with more than 30 different antihyperglycemic agents available for use in type 2 diabetes mellitus. Metformin is generally the first pharmacological agent of choice, and additional agents are added based on patient characteristics such as cardiovascular disease, risk of hypoglycemia, weight concerns, and other comorbidities (Arnason & Mansell, 2017). It becomes challenging to choose antihyperglycemic medications when patients also have renal insufficiency since many are renally excreted and, thus, the risk of adverse of events increases. The sodium-glucose cotransporter 2 (SGLT2) inhibitors—canagliflozin, dapgliflozin and empagliflozin—are new agents approved for treatment of type 2 diabetes mellitus in Canada, and are considered in addition to metformin (Arnason & Mansell, 2017). This article will discuss emerging evidence on the use of SGLT2 inhibitors in patients with renal impairment.

ABOUT THE AUTHORS

Brittani Prete, BSP, Primary Care Pharmacy Resident, University Health Network, Toronto, ON;

Marisa Battistella, PharmD, ACPR, Clinician Scientist, Assistant Professor, Leslie Dan Faculty of Pharmacy, University of Toronto, Pharmacy Clinician Scientist, Clinical Pharmacist – Nephrology, University Health Network, Toronto, ON

Address for correspondence: *Marisa Battistella, University Health Network, 200 Elizabeth Street, EB 214, Toronto, ON M5G 2C4*

Email: ***marisa.battistella@uhn.ca***

MECHANISM OF ACTION

The SGLT2 transporter is the main site for glucose reabsorption in the proximal renal tubules (DeFronzo, Davidson & Del Prato (2012). The expression and activity of SGLT2 are increased in individuals with diabetes, leading to additional glucose reabsorption and consistently elevated blood sugars (Wanner, 2017). Inhibition of SGLT2 decreases reabsorption of filtered glucose from the tubular lumen and lowers the threshold for glucose by approximately 30 to 50% (DeFronzo et al., 2012; Wanner, 2017). This results in increased urinary excretion of glucose, thereby lowering plasma glucose concentrations (DeFronzo et al., 2012). SGLT2 inhibitors improve glycemic control and decrease hemoglobin A1C by 0.7–1% (Canadian Diabetes Association, 2016). Given that SGLT2 inhibitors work in the kidneys, their efficacy is dependent on renal function and, therefore, the glucose-lowering effects may be reduced or absent in patients who have moderate or severe renal impairment, respectively (Wanner, 2017). The mechanism of action of SGLT2 inhibitors is independent of insulin, which negates any potential risks for hypoglycemia (Wanner, 2017). SGLT2 inhibitors also cause natriuresis (urinary excretion of sodium) and weight loss, and are associated with an antihypertensive effect through sodium cotransport (Wanner, 2017).

RENOPROTECTIVE EFFECTS

As seen in Table 1, SGLT2 inhibitor use is generally restricted in patients with stages 3 to 5 of chronic kidney disease (CKD). This is reflective of decreases in the blood glucose lowering effects in patients with increasing renal impairment (i.e., as estimated glomerular filtration rate

Table 1: Dosing of SGLT2 Inhibitors

	Canagliflozin (Invokana®)	Dapagliflozin (Forxiga®)	Empagliflozin (Jardiance®)
Usual dose	100 – 300 mg once daily	5 – 10 mg once daily	10 – 25 mg once daily
eGFR ≥ 60 ml/min (stage 2 CKD)	No dose adjustment necessary	No dose adjustment necessary	No dose adjustment necessary
eGFR 45 – 60 ml/min (stage 3A CKD)	Should not be initiated. Adjust to or maintain at 100 mg once daily if taking and eGFR declines.	Discontinue – use is contraindicated	Should not be initiated. Close monitoring of renal function is recommended.
eGFR 30 – 44 ml/min (stage 3B CKD)	Discontinue – use is contraindicated	Use is contraindicated	Discontinue – use is contraindicated
eGFR 15 – 30 ml/min (stage 4 CKD)	Use is contraindicated	Use is contraindicated	Use is contraindicated
eGFR <15 (end-stage renal disease, dialysis)	Use is contraindicated	Use is contraindicated	Use is contraindicated

Adapted from the product monographs of Invokana®, Forxiga®, Jardiance®

[eGFR] declines) (Wanner, 2017). Contrary to current dosing guidelines, emerging evidence suggests potential renoprotective effects in patients with eGFR ≥ 30 ml/min (Wanner et al., 2016; Neal et al., 2017).

Empagliflozin (Jaridance®)

Empagliflozin was the first SGLT2 inhibitor to demonstrate reduction in both macrovascular (e.g., cardiovascular death, myocardial infarction, and stroke) and microvascular (e.g., retinopathy and nephropathy) outcomes in patients with type 2 diabetes mellitus at high risk for cardiovascular events (Fitchett et al., 2016). An analysis of renally-impaired patients (creatinine clearance [CrCl] < 60ml/min) from this major trial showed a lower risk of progression of diabetic kidney disease and lower rates of renal events such as macroalbumaria, doubling serum creatinine, and initiation of renal-replacement therapy (Wanner et al., 2016). The adverse events reported in patients with impaired renal function were comparable to that in the general study population (Wanner et al., 2016). A discussion around adverse events with SGLT2 inhibitors is outlined in the succeeding section.

Canagliflozin (Invokana®)

Recently published studies now suggest a potential class effect with regards to the cardiovascular and renal outcomes with SGLT2 inhibitors. In a renal endpoints trial of patients at high cardiovascular risk, progression of albuminuria and the renal composite outcome (composed of sustained reduction in eGFR, the need for renal replacement therapy, or death from any cause) occurred less frequently in patients taking canagliflozin (Neal et al., 2017). The renal effects data with canagliflozin are comparable to what was seen with empagliflozin (Tucker, 2017). One notable difference is the increased risk of lower limb amputation in patients taking canagliflozin (Neal et al., 2017; Tucker, 2017).

Dapagliflozin (Forxiga®)

The dapagliflozin renal function data are less robust than with the other SGLT2 inhibitors described previously, likely limited by a small sample size. In patients with type 2 diabetes mellitus, CKD stage 3, and increased albuminaria, dapagliflozin was associated with reductions in albuminuria and delay of worsening renal function (Fioretto, Stefansson, Johnsson, Cain, & Sjöström, 2016). The analysis did not show an increase in serious renal adverse events with dapagliflozin (Fioretto et al., 2016).

It is important to note that renal events in the studies mentioned above were categorized as secondary and/or exploratory outcomes. The analyses were not sufficiently powered to detect statistically significant difference in the pre-specified renal outcomes.

POSSIBLE RENOPROTECTIVE MECHANISMS

The potential mechanisms for renal effects are likely to be multifactorial (Wanner, 2017). SGLT2 inhibitors are thought to exert pleiotropic effects—that is, they may produce renoprotective benefits through several possible mechanisms, with renal hemodynamic effects playing a key role. Because glucose and sodium are co-transported in the proximal tubules, inhibition of SGLT2 also decreases sodium reabsorption (Wanner, 2017). The macula densa cells sense the increase in sodium in the nephron, which reduces renal blood flow and glomerular hyperfiltration (Wanner, 2017). This manifests as reductions in albuminuria and stabilization of eGFR (Wanner, 2017). Other effects such as improved glycemic control; increase in glucagon levels; decrease in serum uric acid levels; activation of hypoxia-inducible factor 1 and subsequent erythropoiesis; reductions in vascular stiffness, vascular resistance, blood pressure and body weight; natriuresis;

and the effect on systemic and renal neurohormonal systems may also contribute to improvements in progression of renal disease (Neal et al., 2017; Wanner, 2017; Wanner et al., 2016).

ADVERSE EVENTS

The most common adverse effects of SGLT2 inhibitors are increased risk of genitourinary tract infections, hyperkalemia, and reduced intravascular volume resulting in hypotension (Arnason & Mansell, 2017). The risk of these adverse reactions increases with worsening renal function (Wanner, 2017). In studies involving patients with renal impairment, adverse events were more commonly reported in SGLT2 inhibitors compared to standard treatment (Wanner et al., 2016; Neal et al., 2017). Therefore, careful monitoring for renal function and volume status should be undertaken to minimize potential risks (Arnason & Mansell, 2017). There have also been reports of acute kidney injury, euglycemic diabetic ketoacidosis, increased risk of lower extremity amputations, and bone fractures with SGLT2 inhibitors (DeSantis, 2017).

SUMMARY

SGLT2 inhibitors are a new class of antihyperglycemic agents indicated for the treatment of type 2 diabetes mellitus. They decrease blood glucose concentrations by increasing urinary excretion of glucose. Empagliflozin and canagliflozin have been shown to have beneficial effects on preservation of renal function in patients with diabetic kidney disease who are at risk for cardiovascular events. Future findings from ongoing renal outcome trials will confirm if the renoprotective benefits are a class effect. Possible mechanisms for improvement in renal function include direct renovascular and hemodynamic effects. Monitoring of renal function may improve glucose-lowering efficacy and reduce the risk of adverse events in patients with increasing renal impairment.

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CONTINUING EDUCATION STUDY QUESTIONS

CONTACT HOUR: 2.0 HRS

Sodium glucose cotransporter 2 (SGLT2) inhibitors—Their role in the kidneys

By Brittani Prete, BSP, and Marisa Battistella, PharmD, ACPR

1. How many people in Canada are currently living with diabetes?
   a) 11 million
   b) 3.4 million
   c) 1.2 million
   d) 6 million

2. Canagliflozin, dapagliflozin and empagliflozin inhibit which transporter?
   a) Sodium glucose cotransporter 1
   b) Sodium glucose cotransporter 2
   c) Sodium glucose antiport
   d) Sodium ion channels

3. Which of the following regarding mechanisms of action of SGLT2 inhibitors is FALSE?
   a) Main site of action is in the proximal renal tubules
   b) Decreases reabsorption of sodium and glucose
   c) Lowers the renal threshold for glucose
   d) Decreases insulin resistance

4. Which of the following is NOT a contraindication for SLGT2 inhibitor use in patients with chronic kidney disease?
   a) CrCl > 60 ml/min
   b) CrCl > 45 ml/min
   c) CrCl > 30 ml/min
   d) Dialysis

5. A patient with an eGFR of 48 ml/min is currently taking empagliflozin 25 mg daily. The patient asks if this medicine is okay to take given his worsening renal function. What is the appropriate management strategy for empagliflozin in this case?
   a) Decrease to 10 mg daily
   b) Continue on 25 mg daily and monitor renal function
   c) Hold empagliflozin until his eGFR returns to > 60 ml/min
   d) Discontinue empagliflozin

6. Which agent had a pivotal trial that showed cardiovascular and renal outcomes with SGLT2 inhibitors?
   a) Canagliflozin
   b) Dapagliflozin
   c) Empagliflozin
   d) Gliflozin

7. What is the main postulated mechanism for renoprotective benefits with SGLT2 inhibitors?
   a) Improved glycemic control
   b) Reduction in hemoglobin A1C
   c) Erythropoiesis
   d) Hemodynamic effects

8. Which of the following is NOT a possible mechanism of renoprotection with SGLT2 inhibitors?
   a) Natriuresis
   b) Decrease in uric acid levels
   c) Glycolysis
   d) Improved glycemic control

9. Which of the following is NOT an adverse effect of SLGT2 inhibitors?
   a) Hypoglycemia
   b) Urinary tract infections
   c) Hypotension
   d) Hyperkalemia

10. Which of the following is true in the analysis of renally-impaired patients taking empagliflozin?
    a) Slower progression of renal disease
    b) Increased rates of renal events
    c) Doubling of serum creatinine
    d) Increase in serious adverse effects

CONTINUING EDUCATION STUDY ANSWER FORM

CE: 2.0 HRS CONTINUING EDUCATION

Sodium glucose cotransporter 2 (SGLT2) inhibitors—Their role in the kidneys

Volume 27, Number 3

By Brittani Prete, BSP, and Marisa Battistella, PharmD, ACPR

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❏ Teaching
❏ Research
❏ Other (Specify)

_____

Work environment
❏ Acute Care
❏ Self-Care Unit
❏ Independent Health Care
❏ Private Sector

Highest level of education

Nursing	*Non-Nursing*
❏ Diploma	❏ Diploma
❏ Baccalaureate	❏ Baccalaureate
❏ Master's	❏ Master's
❏ Doctorate	❏ Doctorate

I am at present studying toward

Nursing	*Non-Nursing*
❏ Specialty Certificate	❏ Specialty Certificate
❏ Baccalaureate	❏ Baccalaureate
❏ Master's	❏ Master's
❏ Doctorate	❏ Doctorate

Primary area of practice
Choose one
❏ Adults
❏ Combined Adult/Pediatrics
❏ Pediatrics
❏ Other

Select all that apply
❏ Full-Care Hemo
❏ Self-Care Hemo
❏ Home/Independent Hemo
❏ In-Patient Nephrology
❏ In-Patient Peritoneal Dialysis
❏ In-Patient Transplantation
❏ Home/Independent PD
❏ Out-Patient Transplantation
❏ Clinical Educator
❏ Academic Educator
❏ Corporate Education
❏ Vascular/Body Access
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❏ Corporate Sales

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CANNT National Office,
PO Box 10, 59 Millmanor Place,
Delaware, ON N0L 1E0

@CANNT1

SHARON LAPOINTE
Membership Coordinator
sharon@cannt.ca

SUSAN MASON
Website and Social Media
susan@cannt.ca

HEATHER REID
National Administrator
heather@cannt.ca

Guidelines for authors

The Canadian Association of Nephrology Nurses and Technologists (CANNT) Journal invites letters to the editor and original manuscripts for publication in its quarterly journal. We are pleased to accept submissions in either official language—English or French.

Which topics are appropriate for letters to the editor?
We welcome letters to the editor concerning recently published manuscripts, association activities, or other matters you think may be of interest to the CANNT membership.

What types of manuscripts are suitable for publication?
We prefer manuscripts that present new clinical information or address issues of special interest to nephrology nurses and technologists. In particular, we are looking for:

- Original research papers
- Relevant clinical articles
- Innovative quality improvement reports
- Narratives that describe the nursing experience
- Interdisciplinary practice questions and answers
- Reviews of current articles, books and videotapes
- Continuing education articles.

How should the manuscript be prepared?
Form: The manuscript should be typed double-spaced, one-inch margins should be used throughout, and the pages should be numbered consecutively in the upper right-hand corner. More formal research or clinical articles should be between five and 15 pages. Less formal narratives, question and answer columns, or reviews should be fewer than five pages.

Style: The style of the manuscript should be based on the **Publication Manual of the American Psychological Association (APA),** Sixth Edition (2009), available from most college bookstores.

Title page: The title page should contain the manuscript title, each author's name (including full first name), professional qualifications [e.g., RN, BScN, CNeph(C)], position, place of employment, address, telephone, fax numbers and email address. The preferred address for correspondence should be indicated.

Abstract: On a separate page, formal research or clinical articles should have an abstract of 100 to 150 words. The abstract should summarize the main points in the manuscript.

Text: Proper names should be spelled out the first time they are used with the abbreviation following in brackets, for example, the Canadian Association of Nephrology Nurses and Technologists (CANNT). Generic drug names should be used. Measurements are to be in Standards International (SI) units. References should be cited in the text using APA format. A reference list containing the full citation of all references used in the manuscript must follow the text.

Tables/Figures: Manuscripts should only include those tables or figures that serve to clarify details. Authors using previously published tables and figures must include written permission from the original publisher. Such permission must be attached to the submitted manuscript.

How should the manuscript be submitted?
Email your manuscript to: **cannt.journal1@gmail.com** or **cannt.journal2@gmail.com**
Include a covering letter with contact information for the primary author and a one-sentence biographical sketch (credentials, current job title and location) for each author.

How are manuscripts selected for the CANNT Journal?
Each manuscript will be acknowledged following receipt. Research and clinical articles are sent out to two members of the **CANNT Journal** manuscript review panel to be reviewed in a double-blind review process. All manuscripts may be returned for revision and resubmission. Those manuscripts accepted for publication are subject to copy editing; however, the author will have an opportunity to approve editorial changes to the manuscript. The criteria for acceptance for all articles include originality of ideas, timeliness of the topic, quality of the material, and appeal to the readership. Authors should note that manuscripts will be considered for publication on the condition that they are submitted solely to the **CANNT Journal.** Upon acceptance of submitted material, the author(s) transfer copyright ownership to CANNT. Material may not be reproduced without written permission of CANNT. Statements and opinions contained within the work remain the responsibility of the author(s). The editor reserves the right to accept or reject manuscripts.

Checklist for authors

✓ Cover letter
✓ Article
- Title page to include the following:
  - title of article
  - each author's name (including full first name)
  - professional qualifications
  - position
  - place of employment
  - author to whom correspondence is to be sent, including address, phone, fax number, and email address
- Text of article, with abstract if applicable, **double-spaced, pages numbered**
- References (on a separate sheet)
- Tables (one per page)
- Illustrations (one per page)
- Letters of permission to reproduce previously published material.

Lignes directrices à l'intention des auteurs

Le Journal de l'Association canadienne des infirmières et infirmiers et des technologues de néphrologie (ACITN) vous invite à faire parvenir articles, textes et manuscrits originaux pour publication dans son journal trimestriel. Nous sommes heureux d'accepter vos documents soumis dans l'une ou l'autre des langues officielles, anglais ou français.

Quels sont les sujets d'article appropriés ?
Nous acceptons les articles portant sur des manuscrits récemment publiés, des activités de l'Association ou tout sujet d'intérêt pour les membres de l'ACITN.

Quels types de manuscrits conviennent à la publication ?
Nous préférons des manuscrits qui présentent de nouveaux renseignements cliniques ou qui traitent des enjeux propres aux champs d'intérêt des infirmières et infirmiers et des technologues en néphrologie. Nous recherchons plus particulièrement :

- Exposés de recherche originaux
- Articles cliniques pertinents
- Rapports sur des approches innovatrices en matière d'amélioration de la qualité
- Textes narratifs relatant une expérience de pratique infirmière ou technologique
- Textes sous forme de questions et de réponses sur la pratique interdisciplinaire
- Revues d'articles courants, de livres et films
- Articles en éducation continue.

Comment les manuscrits doivent-ils être présentés ?
Forme : Le manuscrit doit être présenté à double interligne avec une marge de 1 po et une numérotation consécutive des pages dans le coin supérieur droit de la page. Les articles plus formels de recherche ou d'études cliniques doivent compter de 5 à 15 pages. Les articles moins formels, tels que textes narratifs, questions-réponses ou revues, doivent compter moins de 5 pages.
Style : Le style du manuscrit doit être conforme au manuel de publication de l'Association américaine de psychologie (AAP), 6e édition (2009), offert dans la plupart des librairies universitaires.
Page titre : La page titre doit inclure le titre du manuscrit ainsi que les renseignements suivants : nom de chacun des auteurs (incluant prénoms au complet), titres professionnels (c.-à-d., inf., B.Sc. Inf., CNéph[C]), titre du poste occupé, nom de l'employeur, adresse, numéros de téléphone et de télécopieur et adresse courriel. L'adresse privilégiée de correspondance doit aussi être indiquée.
Résumé : Sur une page distincte, les articles formels de recherche ou d'études cliniques doivent être accompagnés d'un résumé de 100 à 150 mots, reprenant brièvement les principaux points du manuscrit.
Texte : Les sigles, abréviations ou acronymes doivent être écrits au long la première fois qu'ils apparaissent dans le texte, suivis de l'abréviation entre parenthèses; p. ex., Association canadienne des infirmières et infirmiers et des technologues de néphrologie (ACITN). Les noms génériques des médicaments doivent être employés. Les unités de mesure doivent être indiquées selon le Système international d'unités (SI). Les références doivent être citées dans le texte en utilisant le format de l'AAP. Une liste de références comprenant la bibliographie complète de toutes les références utilisées doit suivre le texte.

Tableaux/Figures : Les manuscrits ne doivent inclure que les tableaux et figures (incluant schémas, illustrations, croquis, etc.) visant à clarifier certains détails. Les auteurs qui utilisent des tableaux et des figures qui ont déjà fait l'objet d'une publication doivent fournir l'autorisation écrite de l'éditeur d'origine et la joindre au manuscrit soumis.

De quelle manière doit-on soumettre les manuscrits ?
Veuillez envoyer par courriel votre manuscrit à :
cannt.journal1@gmail.com ou **cannt.journal2@gmail.com**
Veuillez inclure une lettre de présentation en précisant les coordonnées de l'auteur principal ainsi qu'une notice biographique d'une phrase (incluant titres de compétences, titre du poste actuel et lieu de travail) pour chaque auteur.

Quel est le processus de sélection des manuscrits pour publication dans le Journal de l'ACITN ?
À la réception de chaque manuscrit, un accusé de réception est envoyé. Les articles de recherche et d'études cliniques sont envoyés à deux membres du comité de révision du **Journal de l'ACITN** afin d'être révisés suivant un processus à double insu. Tous les articles peuvent être retournés aux auteurs pour révision et nouvelle soumission par la suite. Les manuscrits acceptés pour publication peuvent subir des changements éditoriaux; toutefois, les auteurs pourront approuver ces changements. Les critères d'acceptation pour tous les manuscrits comprennent l'originalité des idées, l'actualité du sujet, la qualité du matériel et l'attrait des lecteurs.

Les auteurs doivent prendre note que les manuscrits seront considérés pour publication à la condition qu'ils ne soient soumis qu'au **Journal de l'ACITN.** Sur acceptation du matériel soumis, les auteurs transfèrent leur droit d'auteur à l'ACITN. Aucune reproduction n'est permise sans l'autorisation écrite du **Journal de l'ACITN.** Les déclarations et opinions émises par les auteurs dans leurs articles, textes ou manuscrits demeurent leur responsabilité. La rédactrice en chef se réserve le droit d'accepter ou de refuser tout manuscrit.

Aide-mémoire à l'intention des auteurs
✓ Lettre de présentation
✓ Article
- Page titre incluant les renseignements suivants :
  - Titre de l'article
  - Nom de chaque auteur (incluant prénoms au complet)
  - Titres de compétences
  - Titre du poste actuel
  - Nom et adresse de l'employeur
  - Nom de l'auteur à qui la correspondance doit être envoyée (incluant adresse, numéros de téléphone et de télécopieur et adresse courriel)
- Texte de l'article avec résumé, s'il y a lieu à **double interligne et pages numérotées**
- Références (sur une feuille distincte)
- Tableaux (un par page)
- Figures (une par page)
- Lettre d'autorisation pour tout matériel ayant déjà fait l'objet d'une publication

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