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Rural Physicians
OF CANADA

RURAL SURGICAL SKILLS UPDATE CONFERENCE

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EDITORIALS / ÉDITORIAUX

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THE OCCASIONAL

CASE REPORT

LEARNERS' CORNER

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Electronic medical records: Transitions

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The world is changing. You are probably practising next to a computer, and then it changes. Yes, an incremental change within a version, is no problem. However, if you change groups, or even within a group, external or internal forces will lead to changes, in which programmes you are using and how. The new rural medical resident becomes an expert at changing systems as each rotation may start with the challenge of learning how to use new informatics.

Such a recent change at our rural hospital has led me to think how fortunate we can be in rural settings when dealing with change management. It has never been pleasant to change, but a supportive environment is essential. One of the advantages of rural is that dealing with occasional stuff that we are not experts in is a strength of the rural generalist physician. Frankly, it is easier to do these transitions rurally where people, as an abstract concept, do not really exist and instead, you have interaction with a collection of persons.

You must have some buy-in. Even if it is a decision imposed from the city, starting the day with wanting to make the best of it is a place you want to be.

Then you need the support. You need physical support (many more computers and paraphernalia) and they need to be there before you need them. This is hard to do at a hospital. Space needs to be allocated and walls moved, desks installed with phone and Internet connections. Management needs to realise that the transition will fail if this does not happen on time.

Let us not forget that you need training on the new software. I grant that most training ahead of time will be insufficient as you will be looking at an interface without the context of real-life tasks and workflow. This brings up the training at the school of hard knocks.

What worked with us is a small cadre of volunteer helpers. You can call them 'super users', but the concept is understood. They are nothing more special than people whose presence is entirely to support you. These are your peers who may have received a few hours more training in the test environment and help you muddle through right then and there. Needless to say, you also need a real 'super user' consultant or two to pull in when two heads and some clicking are not getting anywhere.

That is it for a successful transition.

Pity on those who are in the city.

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Le Monde Change

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Le monde change. Vous exercez probablement à côté d'un ordinateur, et soudainement une nouvelle version arrive. Il est vrai qu'un changement progressif d'une version pose rarement un problème. Cependant, si vous changez de groupe, ou même au sein d'un groupe, des forces externes ou internes conduiront à des changements dans les programmes que vous utilisez et dans la manière dont vous les utilisez. Le nouveau résident en médecine rurale devient un expert en matière de changement de système, car chaque rotation peut commencer par le défi d'apprendre à utiliser de nouvelles technologies de l'information.

n changement très récent dans notre hôpital rural m'a amené à réfléchir à la chance que nous avons en milieu rural en matière de gestion du changement. Même si un changement n'est jamais très agréable, un environnement favorable reste essentiel. L'un des avantages du milieu rural est que le médecin généraliste rural peut s'occuper de choses occasionnelles dans lesquelles il n'est pas expert. Franchement, il est plus facile d'effectuer ces transitions en milieu rural où les gens, en tant que concept abstrait, n'existent pas vraiment et où l'on interagit plutôt avec un ensemble de personnes.

Vous devez obtenir l'adhésion de certaines personnes. Même s'il s'agit d'une décision imposée par la ville, il faut commencer la journée en voulant en tirer le meilleur parti.

Ensuite, il faut du soutien. Vous avez besoin de supports physiques; beaucoup plus d'ordinateurs et d'accessoires qui doivent arriver avant que vous n'en ayez besoin. C'est difficile à réaliser dans un hôpital. Il faut allouer de l'espace, casser quelques murs, installer des bureaux avec des connexions téléphoniques et Internet, sans oublier que la direction doit comprendre que la transition échouera si ces mesures ne sont pas prises à temps.

N'oublions pas que vous avez besoin d'une formation pour mieux comprendre ce nouveau logiciel. J'admets que la plupart des formations préalables seront insuffisantes, car vous regarderez une interface sans le contexte des tâches et des flux de travail de la vie réelle.

Ce qui a fonctionné chez nous, c'est un petit groupe d'assistants bénévoles. Vous pouvez les appeler des " super utilisateurs ", mais le concept est clair. Ils ne sont rien de plus que des personnes dont la présence est entièrement destinée à vous soutenir. Ce sont vos pairs qui ont peut-être reçu quelques heures de formation supplémentaires dans l'environnement de test et qui vous aident à vous débrouiller à ce moment-là. Il va sans dire que vous avez également besoin d'un ou deux consultants « super utilisateurs » pour vous aider lorsque deux cerveaux et quelques clics ne suffisent pas à faire avancer les choses.

Voilà pour une transition réussie.

Malheureux sont celles et ceux qui sont en ville.

Rejuvenated

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I have returned rejuvenated from our annual Rural and Remote Medicine Conference in Edmonton in April. I attended my first conference as a resident in 2006 and I have not missed one since (except for the one we all missed in 2020). Over the last 18 conferences, I have seen the organization grow in scope and impact on rural medicine. I was overjoyed to hear we hosted our largest conference ever this year with over 1100 registrants from across our country and beyond. My clinic partner Dr. Jared Van Bussel and my friend Dr. Kyle Sue-Milne hosted this fantastic gathering which always feels like coming home. I give full credit to our COO, Jennifer Barr, and all the SRPC staff on the amazing work as always.

Advocating for rural generalism has never been more needed. The number of rural Canadians without a physician is unacceptable. Rural emergency room closures have become more and more commonplace. Rural obstetrics is sadly on the decline; many rural women are being ignored by health and training systems and denied the opportunity to deliver in their home communities. The challenges are indeed great, and I believe that the SRPC is well-positioned to make a significant impact in healing what ails rural healthcare.

There is hope on the horizon. In Alberta, work is underway to establish two new distributed medical campuses in the hopes of training more rural generalists. Across the country, four other new medical schools (SFU, UPEI, TMU, and York) are beginning to take shape, all with a particular focus on primary care. This is where we need your help. These new institutions will need preceptors, curriculum experts, and clinical leaders to make these dreams a reality. I know our plates are more than full, especially after the COVID-19 pandemic, but our voices need to be heard at these tables.

Your voice also needs to be heard by the SRPC. If you are not a member, please consider joining. If your colleagues are not members, remind them of the great work we have done towards national licensure, supporting hundreds of physicians through the National Advanced Skills Training Program, and our relentless advocacy that led the CFPC to cease the implementation of the third-year in family medicine residency training.

I cannot thank Dr. Sarah Lesperance enough for her tireless work as President for the past 2 years and the sage council I have already received from her in her new role as Past President. Watching Sarah grow our organization to new heights-all while dedicating herself to her patients and family-has been inspirational. I am honoured to represent the organization in my new role as President and look forward to connecting with you all.

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Message du président

Rajeuni

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Je suis revenu réénergisé de notre conférence annuelle sur la médecine en milieu rural et éloigné, qui s'est tenue à Edmonton en avril. J'ai assisté à ma première conférence en tant que résident en 2006 et je n'en ai pas manqué une depuis (à l'exception de celle que nous avons tous manquée en 2020). Au cours des 18 dernières conférences, j'ai vu l'organisation prendre de l'ampleur et avoir un impact sur la médecine rurale. J'ai été ravi d'apprendre que nous avions organisé cette année notre plus grande conférence avec plus de 1 100 participants venus de tout le pays et d'ailleurs. Mon partenaire clinique, le Dr Jared Van Bussel, et mon ami, le Dr Kyle Sue-Milne, ont organisé ce fantastique rassemblement qui donne toujours l'impression d'être dans un endroit très accueillant. Je tiens à remercier notre directrice des opérations, Jennifer Barr, ainsi que l'ensemble du personnel de la SMRC pour le travail remarquable qu'ils ont accompli.

La défense du généralisme rural n'a jamais été aussi nécessaire. Le nombre de Canadiennes et Canadiens vivant en milieu rural sans médecin est inacceptable. Les fermetures de salles d'urgence en milieu rural sont de plus en plus fréquentes. L'obstétrique rurale est malheureusement en déclin. De nombreuses femmes rurales sont ignorées par les systèmes de santé et de formation et SE voient refuser la possibilité d'accoucher dans leur communauté d'origine. Les défis sont en effet considérables et je pense que la SMRC est bien placée pour avoir un impact significatif sur la manière de corriger les soins de santé en milieu rural.

Une lueur d'espoir pointe à l'horizon. En Alberta, des travaux sont en cours pour établir deux nouveaux campus médicaux répartis afin de former davantage de généralistes ruraux. À travers le pays, quatre autres nouvelles écoles de médecine (SFU, UPEI, TMU et York) commencent à prendre forme, toutes avec un accent particulier sur les soins primaires. C'est là que nous avons besoin de votre aide. Ces nouvelles institutions auront besoin de précepteurs, d'experts en programmes d'études et de chefs de file cliniques pour faire de ces rêves une réalité. Je sais que nous sommes de plus en plus surchargés par le travail, surtout après la pandémie de COVID19, mais nos voix doivent être entendues.

Votre voix doit également être entendue par la SMRC. Si vous n'êtes pas membre, pensez à adhérer. Si vos collègues ne sont pas membres, rappelez-leur l'excellent travail que nous avons accompli en vue de l'obtention d'une licence nationale en soutenant des centaines de médecins par le biais du Programme national de formation et compétences avancées pour la pratique rurale, ainsi que notre plaidoyer incessant qui a conduit le CMFC à mettre fin à la mise en œuvre de la troisième année dans la formation des résidents en médecine familiale.

Je ne saurais trop remercier la Dre Sarah Lesperance pour son travail inlassable en tant que présidente au cours des deux dernières années et pour les sages conseils qu'elle m'a déjà prodigués dans son nouveau rôle de présidente sortante. Voir Sarah faire progresser notre organisation vers de nouveaux sommets-tout en SE consacrant à ses patients et à sa famille-a été une source d'inspiration. Je suis honorée de représenter l'organisation dans mon nouveau rôle de président et j'ai hâte d'entrer en contact avec vous tous.

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ORIGINAL ARTICLE

The rural CPR outreach project: Medical students teach bystander CPR to secondary school students

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This article has been peer reviewed.

Abstract

Introduction: Prompt bystander cardiopulmonary resuscitation (CPR) can double the chance of cardiac arrest survival. Rural and remote communities experience longer emergency service wait times and have lower rates of bystander-CPR compared to their urban counterparts. Our study addresses this disparity.

Methods: We designed a 1.5-h free hands-only CPR course tailored to secondary school students in rural and remote communities taught by medical students. We evaluated our course using pre-test and post-test surveys.

Results: We taught over 300 secondary students in 5 days. Less than one-third of students had previously taken a CPR course. We found that brief CPR instruction taught by medical students was effective in both improving students' knowledge of CPR (t[528] = –26, $P < 0.01$) and perceived comfort in performing CPR (t[548] = –12, $P < 0.01$).

Conclusion: CPR courses taught by medical students are effective, low cost, and may help address regional health care disparities. Teaching CPR to rural/remote communities may have secondary benefits such as promoting health care careers to rural youth. We encourage other health professional programmes to consider engaging students in CPR outreach projects.

Keywords: Cardiopulmonary resuscitation, medical student, remote, rural, secondary school, youth

Résumé

Introduction: Une réanimation cardio-pulmonaire rapide peut doubler les chances de survie en cas d'arrêt cardiaque. Les communautés rurales et éloignées connaissent des temps d'attente plus longs dans les services d'urgence et ont des taux plus faibles de RCP par rapport à leurs homologues urbains. Notre étude porte sur cette disparité.

Méthodes: Nous avons conçu un cours de RCP pratique et gratuit d'une heure et demie, adapté aux élèves du secondaire des communautés rurales et isolées et dispensé par des étudiants en médecine. Nous avons évalué notre cours à l'aide d'enquêtes pré-test et post-test.

Résultats: En 5 jours, nous avons enseigné à plus de 300 élèves du secondaire. Moins d'un tiers des élèves avaient déjà suivi un cours de RCP. Nous avons constaté qu'une brève formation à la RCP dispensée par des étudiants en médecine était efficace pour améliorer les connaissances des élèves en matière de RCP (t[528] =

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–26, $P < 0,01$) et la perception de leur aisance à pratiquer la RCP (t[548] = –12, $P < 0,01$).
Conclusion: Les cours de RCP dispensés par les étudiants en médecine sont efficaces, peu coûteux et peuvent contribuer à lutter contre les disparités régionales en matière de soins de santé. L'enseignement de la RCP aux communautés rurales/éloignées peut avoir des avantages secondaires tels que la promotion des carrières dans le domaine de la santé auprès des jeunes ruraux. Nous encourageons d'autres programmes professionnels de santé à envisager d'engager leurs étudiants dans des projets de sensibilisation à la RCP.

Mots-clés: École secondaire, éloigné, étudiant en médecine, jeune, réanimation cardio-pulmonaire, rural

INTRODUCTION

An estimated 40,000 out-of-hospital cardiac arrests (OHCAs) occur each year in Canada and fewer than 10% of patients who receive care from emergency services survive.[1] Prompt bystander cardiopulmonary resuscitation (CPR) can double the chance of survival,[2] yet bystander delivery of CPR is estimated to be lower than 40%.[3] In British Columbia (BC), the highest rates of OHCA occur in the most rural and remote regions of the province. Compared to the Vancouver Coastal Health region, the incidence rates of OHCA are increased by 30% and 40% in the Vancouver Island and the Northern Health regions, respectively.[4] Moreover, rural and remote regions often experience longer delays for emergency services[5,6] and have the lowest rate of bystander-CPR training compared to other regions.[7] This creates a paucity of bystander-CPR skills in areas that would benefit the most. This disparity is likely to worsen with climate change as extreme temperatures are associated with increased OHCA.[8]

The current Heart and Stroke Policy Guidelines call upon Provincial/Territorial Governments to implement mandatory CPR training for all school-aged children; however, most provinces/territories have yet to implement such curricula.[3,9] In BC, one component of Grade 10 Physical and Health Education curriculum is the 'basic principles for responding to emergencies' (which includes: 'following safety guidelines, having an emergency response plan and knowing how to get help'); however, CPR is not currently a requirement before graduation.[10]

Despite the lack of established programmes that train school-aged children in CPR, numerous studies have shown that youth are adequate providers of CPR.[11] CPR training has been shown to not only improve students' CPR skills and willingness to help in an emergency but also increases their confidence, self-esteem and sense of community.[11] Moreover, children are known to be catalysts for change in their community and may disseminate the CPR skills they have learned.[11] Finally, in addition to the World Health Organization[12] and American Heart Organization,[13] recent high school graduates themselves support mandatory CPR training in schools.[14] Meta-analysis of school CPR programmes found that brief training can be effective and that hands-on practice is superior to other forms of CPR instruction.[15]

Medical students have previously been documented to successfully teach CPR to secondary school students.[16,17] However, we are the first programme to focus on training students in rural and remote settings to our knowledge.

METHODS

Programme design

We created the 'Rural CPR Outreach Programme' (RCOP), a basic CPR skills programme specific to rural and remote secondary school students (grades 8–12) in B.C. Four medical students acted as CPR instructors teaching a pilot course and then a 4-day outreach programme on Northern Vancouver Island. As part of the University of British Columbia (UBC) Medical Undergraduate Curriculum, medical students are required to participate in a research or community outreach project, thus allowing medical students to use their time teaching CPR as course credit. In addition, medical students are required to maintain Basic Life Support (BLS) certification, and some medical student CPR instructors are certified Heart and Stroke BLS instructors trained through the peer-led BLS training programme.[18]

The planning phase of this project was completed by the lead medical student instructor

over a 3-month period. A small amount of time was allocated (15–30 min per week) to contact schools through e-mail and assess their interest in participating in the RCOP programme. Contacts typically included high-school principals, who then directed the instructors towards relevant teachers and classes. Interested teachers had their students participate as a mandatory, non-incentivised part of their daily classroom curriculum with the option for students to opt out of the teaching. The initial pilot was done with a physical education class, and subsequent classes included grade 8–12 science classes (biology, chemistry and anatomy) and physical/outdoor education classes. Coordination was required to provide interested schools with dates and times that aligned with the medical student instructors allocated research block and to ensure no conflict with travel requirements.

CPR mannequins and automated external defibrillators (AEDs) were borrowed from the Victoria Centre for Interprofessional Clinical Simulation Learning, Heart and Stroke Foundation and St. John's Ambulance. After completing a pilot project of our course in Sooke, BC, we ran a 4-day outreach programme in the rural Northern Vancouver Island communities of Port Hardy, Port McNeill and Campbell River which took place in April 2022. To mitigate the costs of accommodations associated with this project, a small bursary of $1,000 was obtained from the Rural Health Services Research Network of BC. This funding is specifically allocated for students participating in research projects that involve rural and remote health. This covered the costs of fuel and nightly accommodations over the 4-day teaching period.

Curriculum design

We designed a 1.5-h long CPR course designed to have 2 medical student instructors teach 20–25 secondary school students. It consisted of three parts: an oral slide presentation, hands-on practice with mannequins and AED trainers and a team-based simulation.

The slide presentation reviewed the indications for CPR and the 4 steps of CPR, as outlined by the Heart and Stroke Hands-Only Bystander CPR guidelines.[19] Instructors then demonstrated CPR compressions and AED administration. Our presentation included community-specific information (e.g. outlining the location of AEDs in each community) and incorporated popular music and video clips related to CPR to engage students.

Students were then instructed to split up into groups of 4–5 students for hands-on practice. Each class was allocated 5 CPR mannequins and 5 AED trainers. Two of the 5 mannequins allowed students to receive real-time quantitative feedback regarding their compressions. Instructors circulated throughout the room providing feedback and assistance. Time permitting the course concluded with a team-based simulation. Three student volunteers were given a basic scenario where they worked together to call 911, provide CPR and retrieve and use an AED.

Given the current opioid epidemic in North America, we also included a brief discussion regarding opioid overdose and naloxone kits during the presentation. We reviewed the indications to use a naloxone kit and briefly discussed how to use a kit and where to access one in the community. No hands-on naloxone training was provided to students.

Surveys and programme evaluation

Pre-test and post-test surveys were used to assess the efficacy of our course and were administered either on paper or online through Qualtrics software. The multiple-choice pre-test survey consisted of four questions assessing students' knowledge of CPR, one question regarding students' perceived comfort level providing hands-only CPR and one question assessing students' previous exposure to CPR training. The information required to answer the CPR knowledge questions was then taught as part of the RCOP course, but the answers to the questions were never explicitly stated. After completion of the RCOP course, the post-test surveys were then administered. The post-test survey was identical to the pre-test survey with the omission of the previous exposure to CPR training. The survey questions were based on the AHA CPR in Schools Questionnaire.[20] Students were given approximately 5 min before and after the course to complete each survey.

Statistical analysis of survey responses was performed using Microsoft Excel. Two-sample

t-tests assuming unequal variances were performed to compare the pre-test and post-test answers for specific survey questions. The mean average of specific questions (cumulative CPR knowledge) was also compared using two-sample t-tests assuming unequal variances.

RESULTS

After completing a pilot project of our course in Sooke, BC, we ran a 4-day outreach programme in the rural Northern Vancouver Island communities of Port Hardy, Port McNeill and Campbell River which took place in April 2022 [Table 1].

Four medical students with an interest in emergency medicine (2 with experience in paramedicine and 2 in BLS) taught the CPR courses.

Over 5 days (1-day pilot course and 4-day outreach projects), 17 CPR courses were completed with 307 high school students in attendance. Of the students instructed, 72% of students (n = 221/307) reported that they had never taken a CPR course. Five mannequins for every 20–25 students were found to be effective.

RCOP significantly improved students' CPR knowledge test scores and self-reported perceived comfort performing CPR [Table 2]. Cumulative test scores improved from 46.4% pre-test to 90.3% post-test ($P < 0.01$). In addition, the self-reported comfort level of performing CPR increased from 41.7% pre-test to 86.3% post-test ($P < 0.01$). Of the 599 question responses collected, 57 question responses (1.9%) were marked incorrect because they were left unanswered, or more than one multiple-choice answer was selected.

Table 1: Number of students and classes taught in each location

Community	*N*	Classes taught
Sooke	50	2
Campbell River	164	8
Port McNeill	33	3
Port Hardy	60	4
Total	307	17

n is based on the number of pre-test surveys received. A small number of students chose not to participate in the survey but still participated in the course

Table 2: Pre-test versus post-test scores††

	Pre-test mean (*n*=307)	Post-test mean (*n*=292)	*P*†
Question			
CPR steps	57.0	80.1	<0.01
CPR rate	21.2	93.8	<0.01
CPR depth	57.3	93.5	<0.01
AED function	50.5	93.8	<0.01
Cumulative score	46.4	90.3	<0.01
Perceived comfort	41.7	86.3	<0.01

†Two sample *t*-test assuming unequal variances with significance value P=0.05, ††43 pre-test and 14 post-test questions were marked incorrect because the questions were left blank or multiple answers were selected. AED: Automated external defibrillator, CPR: Cardiopulmonary resuscitation

DISCUSSION

This article describes a unique model of CPR instruction in BC which may be replicated in other health professional schools (e.g. nursing and allied health). We propose a model of CPR instruction that is cost-effective and benefits both medical students and rural/remote communities. Medical students are effective CPR instructors and many schools have dedicated curricular time for community projects. Training equipment, such as mannequins and AED trainers, is often owned by medical schools and may be loaned from community organisations. Although we found a small number of mannequins effective (5 mannequins per 20–25 students), other low-cost, self-constructed, alternatives have been proposed.[21] The only funding required for our programme was for the transport of medical students between rural/remote communities.

In addition to exposing medical students to rural and remote communities, involvement as a CPR instructor fosters skills specific to the physician CANMEDs roles.[22] As an instructor, medical students gain skills in communication, collaboration, advocacy and leadership. Moreover, teaching CPR has been found to be a superior method to improve medical students' own CPR skills, as compared to taking a BLS course alone or shadowing emergency medical services.[17]

We hypothesise that a secondary benefit of our programme is exposing rural/remote secondary students to health care careers. Given the current shortage of rural physicians, emphasis has been placed on recruiting students from rural/remote communities. Numerous studies have shown that rural physicians are more likely to come from a rural background as opposed to their urban counterparts and that Canadian students from rural areas are more likely to indicate they plan

to practise in rural communities.[23] During our outreach course, it was common for instructors to answer many questions regarding post-secondary education, paramedicine and medical school. Although the benefit of this exposure was not directly assessed in our programme, it has been shown in other studies that targeting health care exposure programmes to rural communities often increases rural youth's positive perception and interest in careers in health care.[24] To begin to assess this benefit, future studies could include an assessment of secondary students' occupational direction or choice of post-secondary training before and after the RCOP course, and in the years following the RCOP session.

Although most likely representative, the secondary students taught in this study were from a limited region of B.C. The four medical student instructors had an interest in emergency medicine (two had experience in paramedicine and two in BLS Instruction). In addition, the pre-test–post-test methodology was limited to assessing students' factual knowledge of CPR and hands-on CPR performance was not evaluated. Finally, retention of CPR skills is a documented challenge when teaching CPR to school children.[25] Our study did not measure retention of CPR skills and we are unable to comment on how our course would translate to future scenarios where CPR is required. A future study has been planned to measure the skill retention of participants. We aim to do this by offering repeat annual RCOP sessions to interested schools, with an option for past participants to opt-in to an assessment of CPR skill retention before taking a refresher course. However, not all students taught in the initial sessions will be able to be assessed for skill retention, as some students will graduate before subsequent sessions can be taught.

CONCLUSION

We propose a low-cost method of teaching CPR that benefits both rural and remote communities and medical students. CPR courses taught by medical students are effective and can help address regional health care disparities. Additional secondary benefits of medical student-led CPR outreach programmes may include promoting health care careers to rural youth and improving medical students' own proficiency in providing CPR.[17] We encourage leaders of other health professional programmes to consider engaging their students in CPR outreach projects.

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Conflicts of interest: There are no conflicts of interest.

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ORIGINAL ARTICLE

COVID-19 in a rural intensive care unit in Northern British Columbia: Descriptive analysis of outcomes and demands on rural resources

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Abstract

Introduction: This descriptive study reviews clinical outcomes of individuals admitted to a northern Canadian, rural intensive care unit (ICU) with severe COVID-19. It reports our site-specific data that is part of an ongoing global effort to gather data and guide therapy; the aims of this study were to describe participants admitted to our ICU with COVID-19 and illuminate challenges faced by rural and remote centres.

Methods: This retrospective study examined data from participants admitted to the ICU with COVID-19 pneumonia between 24th November 2020 and 28th February 2022. Using data from electronic and hardcopy health records, data were obtained according to standardised forms developed for the Short Period Incidence Study of Severe Acute Respiratory Infection.

Results: Eighty-five adult participants were admitted to our ICU with COVID-19. The median age of participants was 57 years old (range: 23–83 years); 49.4% were males and 50.6% were females. Of our cohort, 58.9% required mechanical ventilation at some point during their stay and the median duration of stay in our ICU was 5 days (range: 1–36 days). Amongst individuals included, 25.9% were discharged alive from our hospital on their index admission, 57.6% were transferred to another facility and 16.5% died in our facility.

Conclusion: COVID-19 significantly strained our local ICU resources, necessitating high numbers of patient transfers. However, despite limited resources, patients at our site received contemporary guideline-based care for COVID-19 pneumonia. Future pandemic and surge capacity planning must ensure that rural and remote communities receive adequate additional resources to meet the anticipated needs of their local populations.

Keywords: Cohort study, COVID-19, critical care, patient transfer, remote, rural health

Résumé

Introduction: Cette étude descriptive examine les résultats cliniques des personnes admises dans une unité de soins intensifs rurale du nord du Canada avec une

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COVID-19 sévère. Elle rapporte des données spécifiques à notre site qui font partie d'un effort global en cours pour rassembler des données et guider la thérapie. Les objectifs de cette étude étaient de décrire les participants admis dans notre unité de soins intensifs avec la COVID-19 et d'éclairer les défis auxquels sont confrontés les centres ruraux et éloignés.

Méthodes: Cette étude rétrospective a examiné les données des participants admis à l'unité de soins intensifs pour une pneumonie due à la COIVD-19 entre le 24 novembre 2020 et le 28 février 2022. Les données ont été obtenues à partir de dossiers médicaux électroniques et papier, selon des formulaires standardisés développés pour l'étude d'incidence à court terme des infections respiratoires aiguës sévères (SPRINT-SARI).

Résultats: 85 participants adultes ont été admis dans notre unité de soins intensifs avec la COVID-19. L'âge médian des participants était de 57 ans (intervalle: 23-83 ans); 49,4% étaient des hommes et 50,6% des femmes. Dans notre cohorte, 58,9% ont eu besoin d'une ventilation mécanique à un moment ou à un autre de leur séjour et la durée médiane du séjour dans notre unité de soins intensifs était de 5 jours (intervalle: 1-36 jours). Parmi les personnes incluses, 25,9% sont sorties vivantes de notre hôpital lors de leur admission initiale, 57,6% ont été transférées dans un autre établissement et 16,5% sont décédées dans notre établissement.

Conclusion: La COVID-19 a mis à rude épreuve les ressources de notre unité locale de soins intensifs, nécessitant un grand nombre de transferts de patients. Cependant, malgré des ressources limitées, les patients de notre site ont reçu des soins fondés sur des lignes directrices contemporaines pour la pneumonie due à la COVID-19. À l'avenir, la planification de la pandémie et de la capacité de pointe doit garantir que les communautés rurales et éloignées reçoivent des ressources supplémentaires adéquates pour répondre aux besoins anticipés de leurs populations locales.

Mots-clés: Étude de cohorte, COVID-19, soins intensifs, régions éloignées, santé rurale, transfert de patients

INTRODUCTION

The rural and remote, northern Canadian healthcare landscape in Canada, is affected by significant challenges including limited geographical accessibility of tertiary centres, poor coordination between health services and staffing shortages.[1-3] Health risks such as chronic health conditions including diabetes mellitus, heart disease, excess weight and chronic obstructive pulmonary disease are found at higher rates in people living in rural and remote regions.[4,5] The risk of disease and avoidable mortality increases further in rural and remote settings.[6]

In British Columbia, the rural and remote population is culturally diverse. The 2016 census found that greater than 50% of the Indigenous population of British Columbia resides in rural and small population areas.[7] Ensuring high-quality care for all, including people suffering from COVID-19 is part of health equity. By participating in the short-period incidence study of severe acute respiratory infection (SPRINT-SARI) data collection at this site, we aimed to increase rural representation in global data and examine access to and quality of healthcare in one region in rural British Columbia.

As data emerged during the COVID-19 pandemic, it was quickly noted that it was having particularly devastating impacts on certain populations. The higher prevalence of many chronic medical conditions increased the risk of severe COVID-19 in rural and remote settings.[8,9] Racialised communities were being disproportionately impacted by COVID-19 through both morbidity and mortality.[10,11] There is a lack of data describing the population of critically ill patients with COVID-19 in rural and remote Canada and this study aimed to address this knowledge gap.

METHODS

Study design and setting

This study took place in a rural intensive care unit (ICU) in Terrace, Northwestern British Columbia (unceded territory of the Tsimshian people). The 4-bed ICU served a geographic area of approximately 225,000 km^2 and a catchment of approximately 80,000 residents.[12] This ICU was funded for two critical care nurses rotating every 12 h and respiratory therapist coverage from 0700 to 1900 7 days per week. There were two resident general internists and three general internists from Southern British Columbia who provided critical care services on a rotating basis. The ICU was supported by physiotherapy services which were shared with the rest of the hospital. The

unit included one negative pressure room with antechamber and another with negative pressure capabilities; this capacity existed before the start of the COVID-19 pandemic.

Short-period incidence study of severe acute respiratory infection

We used the standardised data collection tools from SPRINT-SARI, a global collaboration of standardised research tools for COVID-19, to describe characteristics, comorbidities, outcomes and treatments provided to patients with COVID-19 in one rural ICU in northern Canada.

SPRINT-SARI is a multicentre, observational cohort study of individuals admitted to participating hospitals and ICUs with severe respiratory illnesses, including COVID-19 pneumonia.[13] It was developed in partnership with the International Severe Acute Respiratory and Emerging Infection Consortium and the World Health Organization to facilitate health research collaboration and accelerate the understanding of COVID-19 as part of the public health response to the pandemic.[13] Data were collected and managed using Research Electronic Data Capture (REDCap) tools hosted at the University of Oxford.[14,15] Early data from the national SPRINT-SARI cohort included 811 individuals from 32 hospitals with a median age of 64 (61.0% male) years and the mortality rate was 26.2%.[16]

Data sources

Data sources included health authority electronic medical records and paper charts held in health records. Retrospective chart reviews were conducted by a medical student and a nurse. Data were fully anonymised and de-identified.

Participants

This study included adult patients with a confirmed case of COVID-19, admitted to the ICU with respiratory symptoms. Data were collected for each participant on the day of admission to the hospital, day of admission to the ICU and day of discharge or transfer, according to a standardised case report form.[15] Participants excluded from this analysis included 3 paediatric cases, 5 adult cases who were readmitted with late complications after a recent ICU admission for COVID-19 pneumonia and adult cases where COVID-19 was detected incidentally without clinical signs of COVID-19 pneumonia as deemed by the clinical staff.

Statistical analysis

Descriptive statistics were used to summarise aggregated site-level data on individuals admitted to the ICU. Categorical variables were summarised in proportions and continuous variables as means with standard deviations. Analyses were performed by the analysis software embedded within the REDCap secure online research database software.

Ethics approval

This study was approved by the harmonised Research Ethics Boards for the University of British Columbia, the University of Northern British Columbia and Northern Health (REB file number: H15-02374).

RESULTS

A total of 85 participants who were admitted to the ICU with COVID-19 pneumonia between 24 November 2020, and 22 February 2022, were included in the final analysis. The median age of participants was 57 years old (range: 23–83 years); 42 (49.4%) were males and 43 (50.6%) were females. In our study population, the most common comorbidities included excess weight, hypertension and diabetes mellitus [Figure 1].

Treatment

Of the 85 participants, 50 (59.0%) required mechanical ventilation at some point during their stay. The median duration of stay was 5 days (range: 1–36 days). Non-invasive ventilation was required for 11 participants (13.0%) and high-flow nasal cannulas were used for 56 participants (66.0%), although participants may have also received high-flow nasal cannula before admission to the ICU which was not captured in this data set. To assist with ventilation, prone positioning was implemented for 48 (56.5%) of cases.

Nearly 50% (41, 48.2%) of participants required inotropic/vasopressor support. Immunomodulatory therapies were provided to 57.6% of participants (amongst these, 73.5%

received an interleukin-6 inhibitor) and 91.2% received corticosteroids. Anticoagulation, either in prophylactic or treatment doses, was provided to 82 (96.5%) participants. Treatments are summarised further in Table 1.

Complications

Complications are reported in Table 2. The most common cardiac complications in our study population were cardiac arrhythmias (14.1%) and cardiac arrest (9.4%). Other common complications included liver dysfunction (27.1%), acute kidney injury (25.9%), hyperglycaemia (22.4%), anaemia (16.5%), pulmonary embolism (15.3%) and bacteraemia (12.9%).

Outcomes

Table 3 summarises the outcomes of participants by intubation status and transfer status.

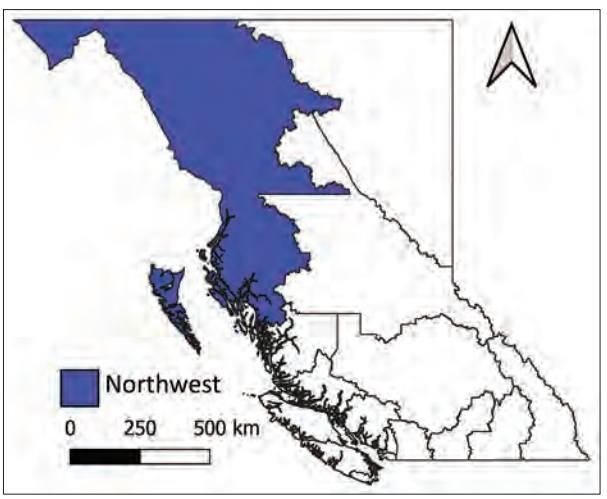

Figure 1: Prevalence of most common pre-existing comorbidities in participants admitted to our intensive care unit with COVID-19 in comparison with national data*.[16] *National data from short period incidence study of severe acute respiratory infection cohort before our data was included.

DISCUSSION

Our site's participation in this study highlights unique considerations of the impact of COVID-19 on critical care resources in rural communities.[17] Our data add an important rural and remote contribution to this dataset and increase the generalisability of the evidence generated.

Overall, the mortality in our cohort was 40.0% and the mortality rate amongst mechanically ventilated participants was 48.0%. Early analysis of other Canadian sites participating in SPRINT-SARI data collection showed a mortality rate of 31.2% amongst mechanically ventilated COVID-19 participants[16] and subsequent data estimate mortality for mechanically ventilated COVID-19 patients in Canada is 28%.[18]

Our higher mortality rate may also in part reflect the higher prevalence of comorbidities. Hypertension, diabetes and chronic cardiac disease were reported as the most prevalent presenting comorbidities of patients admitted to ICUs with COVID-19 pneumonia across Canada and worldwide [Figure 2].[16-19] Our study population had higher rates of diabetes and excess weight compared to other Canadian populations with COVID-19 [Figure 1] and reflects known geographic trends in chronic disease prevalence in rural, remote and Northern Canada.[5,6,9,16] This may have contributed to poorer COVID-19 outcomes and also highlights the importance of improving prevention, diagnosis and management of chronic disease in these regions. Our higher mortality may also reflect the limited healthcare resources in our region, distance patients must travel to receive care and mistrust in healthcare stemming from experiences of systemic racism.[20] These factors contributed to later presentation to care, delays in pre-hospital transfer, lower thresholds for capacity to be overwhelmed and delays in receiving tertiary-level

Table 1: Treatments provided to participants by ventilation status

Treatment	Intubated (*n*=50), *n* (%)	Non-intubated (*n*=35), *n* (%)	Total (*n*=85), *n* (%)
Antiviral or COVID-19 targeted treatment*	34 (68.0)	15 (42.9)	49 (57.6)
Interleukin-6 inhibitor	24 (48.0)	12 (34.3)	36 (42.4)
COVID-19 targeted agent not otherwise specified	10 (20.0)	3 (8.6)	13 (15.3)
Antibiotics	48 (96.0)	30 (85.7)	78 (91.8)
Corticosteroid	49 (98.0)	29 (82.9)	78 (91.8)
Anticoagulation	49 (98.0)	29 (82.9)	82 (96.5)
Prone positioning	33 (66.0)	15 (42.9)	48 (56.5)

*e.g. Immunomodulatory therapy such as tocilizumab and baricitinib

Table 2: Complications experienced by intubated and non-intubated participants			
Complication	Intubated (*n*=50), *n* (%)	Non-intubated (*n*=35), *n* (%)	Total (*n*=85), *n* (%)
Viral pneumonia/pneumonitis	46 (92.0)	29 (82.9)	72 (84.6)
Acute respiratory distress	42 (84.0)	7 (20.0)	49 (57.6)
Liver dysfunction	17 (34.0)	6 (17.1)	23 (27.1)
Acute renal injury/acute renal failure	14 (28.0)	6 (17.1)	22 (25.9)
Bacterial pneumonia	18 (36.0)	3 (8.6)	21 (24.7)
Hyperglycaemia	12 (24.0)	7 (20.0)	19 (22.4)
Anaemia	10 (20.0)	4 (11.4)	14 (16.5)
Pulmonary embolism	9 (18.0)	4 (11.4)	13 (15.3)
Cardiac arrhythmias	8 (16.0)	4 (11.4)	12 (14.1)
Bacteraemia	8 (16.0)	3 (8.6)	11 (12.9)
Cardiac arrest	4 (8.0)	4 (11.4)	8 (9.4)
Cardiac ischaemia	3 (6.0)	2 (5.7)	5 (5.9)
Myocarditis/pericarditis	2 (4.0)	2 (5.7)	4 (4.7)
Coagulation disorder/DIC	1 (2.0)	3 (8.6)	4 (4.7)
Myocardial infarction	2 (4.0)	1 (2.9)	3 (3.5)
Pleural effusion	2 (4.0)	1 (2.9)	3 (3.5)
Gastrointestinal haemorrhage	2 (4.0)	1 (2.9)	3 (3.5)
Congestive heart failure	0	2 (5.7)	2 (2.4)
Pancreatitis	1 (2.0)	1 (2.9)	2 (2.4)
Cardiomyopathy	0	1 (2.9)	1 (1.2)
Cryptogenic organising pneumonia	0	1 (2.8)	1 (1.2)
Endocarditis	1 (2.0)	0	1 (1.2)
Stroke/cerebrovascular haemorrhage	1 (2.0)	0	1 (1.2)
Deep vein thrombosis	1 (2.0)	0	1 (1.2)
Rhabdomyolysis/myositis	1 (2.0)	0	1 (1.2)

DIC: Disseminated intravascular coagulation

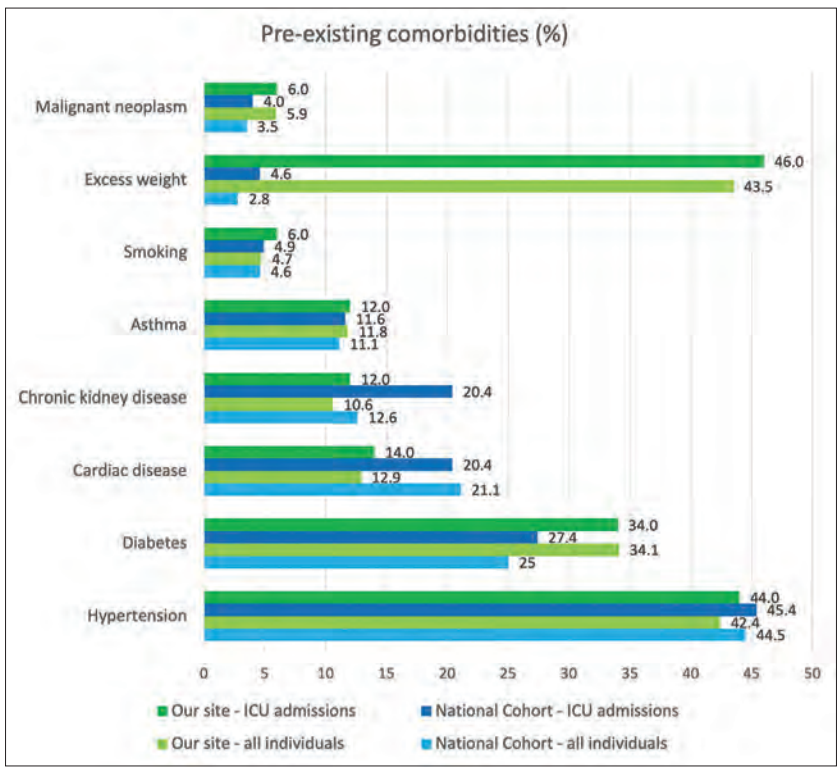

Figure 2: Prevalence of most-common pre-existing comorbidities in participants admitted to our ICU with COVID-19 in comparison with national data.

Table 3: Outcomes of participants by transfer status and intubation status

All individuals (*n*=85)			
	Non-intubated (*n*=35), *n* (%)	Intubated (*n*=50), *n* (%)	All (*n*=85), *n* (%)
Transfer to another facility	8 (22.9)	41 (82.0)	49 (57.6)
Died in our facility	9 (25.7)	5 (10.0)	14 (16.5)
Discharged alive from our facility	18 (51.4)	4 (8.0)	22 (25.9)
Ongoing hospitalisation†	0	1 (2.0)	1 (1.2)
Transfer to another facility for a higher level of care	4 (11.4)	36 (72.0)	41 (47.1)
Lateral transfer/repatriation	4 (11.4)	5 (10.0)	9 (10.6)
Died after transfer to another facility*	1 (2.9)	19 (38.0)	20 (23.5)
Total mortality	10 (28.6)	24 (48.0)	34 (40.0)
Individuals transferred to another facility (*n*=49)			
	Non-intubated (*n*=8), *n* (%)	Intubated (*n*=41), *n* (%)	All (*n*=49), *n* (%)
Higher level of care transfer	4 (50.0)	36 (87.8)	40 (81.6)
Lateral transfer/repatriation	4 (50.0)	5 (12.2)	9 (18.4)
Died*	1 (12.5)	19 (46.3)	20 (40.8)
Discharged alive	7 (87.5)	21 (51.2)	28 (57.1)
Ongoing hospitalisation†	0	1 (2.4)	1 (2.0)

*Outcome based on data that includes a review of outcomes after transfer to another facility, where available, †Outcome based on participant status at the close of study (28 February 2022)

care when indicated. In addition, early access to evidence-based therapies is particularly important for remote and rural communities that are especially vulnerable to the impacts of emerging pathogens. Further research and advocacy are needed to ensure that rural, remote and northern communities have appropriate access to critical care services.

Standardised care guidelines are often developed with an urban-centric focus and thus are difficult to implement in their entirety in rural and remote settings.[9] Our data demonstrate that despite the known disparities in rural healthcare and high-risk populations in northern and rural areas, high-quality care and evidence-based treatments can be made available to patients admitted to a rural ICU.[9,17,21] These included immunomodulatory therapy such as tocilizumab, corticosteroids and anticoagulation. Of note, only 57.6% of individuals in our study received immunomodulatory therapy; this led to a detailed review of the 42.4% of cases that did not receive immunomodulatory therapy. It was found that they were either admitted before these agents became available in our region, or clear contraindications existed in all cases except one which may have been admitted during a period of drug shortage. To further support ventilation, prone positioning was provided to 56.5% of all participants including 66.0% of mechanically ventilated participants.

Challenges

Our study draws attention to some challenges faced by one rural ICU during this demanding time. Some unique considerations for our rural setting include the low number of ICU beds, severe nurse staffing shortages, dependency on visiting nurses and non-ICU or mechanical ventilation-trained nurses.[4] In addition, limited access to members of the interprofessional team such as laboratory technicians, radiology technicians, respiratory therapists, physiotherapists and housekeeping services also contributed to the impact of the COVID-19 pandemic on our site. Known resource limitations specific to this site before the pandemic were accentuated during this time of crisis and compounded the strain in the acute care setting. An example of this was the site's ability to prone patients. Before the COVID-19 pandemic, our centre had very minimal experience proning patients and rapid development of protocols and training was needed to enable the proning of mechanically ventilated patients. Proning would commonly occur during daytime hours only, avoiding overnight proning as our site did not have respiratory therapist coverage overnight. A second example is that during some periods, we did not have access to night or weekend imaging due to technician shortages. Equitable access to

care also necessitates ensuring that ICUs in rural and remote regions are appropriately resourced to provide care during surge periods in respiratory pandemics.

The increased demand for transport systems, either for access to higher levels of care or lateral transfers for resource reasons, is also highlighted through our results. Although our patient transfer rates were high, transfers to a higher level of care accounted for 47.1% of outcomes, which means that our small rural ICU was able to provide local care for 52.9% of individuals admitted to the ICU with COVID-19 pneumonia without requiring transfer to a higher level of care. Most transfers of mechanically ventilated patients occurred as a result of exceeding local capacity to care for additional mechanically ventilated patients due to the sheer volume of cases. Earlier in the pandemic we did provide care from intubation through to extubation for patients, but as the volumes increased, we did not have sufficient staffing or physical space to meet the incoming demand. Most transfers of patients who were not mechanically ventilated or who had been liberated from mechanical ventilation were repatriated to their smaller home communities. Decisions to transfer patients were made based on multiple factors including local capacity, anticipated future health needs and transport requirements. Regional and provincial systems were established to triage patients and find accepting facilities.

For participants that did require a transfer, this meant removing critically ill people from their support systems and placing them several hundreds of kilometres away from their homes, often in an unfamiliar urban centre. This often requires the patient and family to self-fund their return trip to their community, adding considerable costs to families who have recently endured a major health crisis. Family members have important roles in care during illness including decision-making, personal care and patient safety, and this involvement is compromised in patients who are transferred far from their home communities.[22] This isolation was compounded by visiting restrictions that were aimed to reduce the transmission of COVID-19 and mitigate the demand for ICUs.[22] We found that 20 (23.5%) participants from our cohort died after a transfer, often far removed from their families, loved ones and territory. Patient and family physical and psychological outcomes relating to patient transfers that take patients far from their home communities require more research and attention.

Limitations

This study has several limitations. Our data reflect only the second and third waves as we did not have a significant first wave. Other authors have found higher mortality of COVID-19 patients admitted to the ICU in the second and third waves, so the later arrival of COVID-19 in our communities may have skewed the data.[23]

Our ICU admission days and days on mechanical ventilation are not necessarily representative of the total length of stay or days on ventilation for these patients due to the high transfer rates; our cohort was small in comparison to other urban hospitals participating in SPRINT-SARI data collection and only basic data collection was completed due to limited research capacity at the site. High-quality data on vaccine administration were not available, so analyses by vaccination status were not possible. In addition, limited local and institutional research infrastructure led to long delays from study initiation to completion. Finally, due to capacity issues, we were only able to collect data on individuals admitted to the ICU. Due to the very limited number of ICU beds, many patients who may have been in a critical care setting in some hospitals (e.g., individuals on high flow nasal cannula with high FiO2 requirements) were not included in our cohort and this may have led to a higher proportion of mechanically ventilated participants in our cohort.

CONCLUSION

Our data demonstrate that despite the known disparities in rural healthcare in northern, Canadian rural areas, such as geographical isolation, increased chronic disease burden and limited human resources in clinical settings, high-quality care and evidence-based treatments were made readily available to patients who were admitted to this ICU with COVID-19 pneumonia.[9] The increased demand for transport resources for access to higher levels of care or to offload due to staffing shortages is an important consideration for rural centres. When planning for emerging health crises, guidelines and

policies must be developed in consultation with rural and remote communities. Failure to do so leaves these communities increasingly vulnerable and amplifies geographic health inequities.

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ORIGINAL ARTICLE

'I'm on the coast and I'm on methadone': A qualitative study examining access to opioid agonist treatment in rural and coastal British Columbia

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Abstract

Introduction: Despite rural regions being disproportionately impacted by the toxic drug supply, little is known about the contextual factors influencing access to opioid agonist treatment (OAT) specific to rural residents. The present study examines these factors in a rural and coastal setting in British Columbia, Canada.

Methods: The qualitative methods were used to examine the barriers and facilitators to OAT access. Between July and October 2021, semi-structured interviews were conducted with people who use drugs who reside in a rural and coastal community. Thematic analysis was used to identify emergent themes and subthemes. Results were corroborated by the research team and a local community advisory board.

Results: Twenty-seven (n = 27) participants described both limiting and facilitating factors that influenced OAT accessibility. Access was less challenging when participants' OAT dispensing pharmacy was in close proximity, had extended hours of operation, or when pharmacies provided delivery services. Barriers to OAT access identified by participants included the high cost of transportation, residing or working in remote communities and few local OAT prescribers. A variety of treatment motivations and goals that impacted OAT satisfaction are also highlighted.

Conclusion: This study demonstrates that patient satisfaction with OAT service access in a rural and coastal setting is multi-factorial and geographic proximity alone does not fully explain OAT accessibility issues in these settings. Accessibility to OAT may be improved through delivery services, expanded OAT prescribing authorisation beyond physician-only regulations, health authorities covering transportation costs and continual assurance that prescribing practices meet individuals' goals.

Keywords: Accessibility of health services, Canada, opioid agonist treatment, opioid use disorder, patient satisfaction, rural and remote health

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Résumé

Introduction: Bien que les régions rurales soient touchées de manière disproportionnée par l'approvisionnement en drogues toxiques, on sait peu de choses sur les facteurs contextuels qui influencent l'accès au traitement par agoniste opioïde (TAO) spécifique aux résidents ruraux. La présente étude examine ces facteurs dans un contexte rural et côtier en Colombie-Britannique, au Canada.

Méthodes: Des méthodes qualitatives ont été utilisées pour examiner les obstacles et les facilitateurs de l'accès aux TAO. Entre juillet et octobre 2021, des entretiens semi-structurés ont été menés avec des personnes qui consomment des drogues résidant dans une communauté rurale et côtière. L'analyse thématique a été utilisée pour identifier les thèmes et sous-thèmes émergents. Les résultats ont été corroborés par l'équipe de recherche et un comité consultatif communautaire local.

Résultats: Vingt-sept (n = 27) participants ont décrit les facteurs limitants et facilitants qui ont influé sur l'accessibilité au TAO. L'accès était moins difficile lorsque la pharmacie du TAO des participants était proche, avait des heures d'ouverture prolongées ou lorsque les pharmacies offraient des services de livraison. Parmi les obstacles à l'accès au TAO mentionnés par les participants, il y avait le coût élevé du transport, le fait de résider ou de travailler dans des collectivités éloignées et la rareté des prescripteurs locaux du TAO. Les participants ont également fait état de divers objectifs et motivations liés au traitement qui ont eu une incidence sur la satisfaction à l'égard du TAO.

Conclusion: Cette étude démontre que la satisfaction des patients à l'égard de l'accès aux services du TAO en milieu rural et côtier est multifactorielle et que la proximité géographique n'explique pas à elle seule les problèmes d'accessibilité au TAO dans ces milieux. Cette accessibilité peut être améliorée par des services de livraison, l'élargissement de l'autorisation de prescrire un TAO au-delà des règlements réservés aux médecins, la prise en charge des coûts de transport par les autorités sanitaires et l'assurance continue que les pratiques de prescription répondent aux objectifs des individus.

Mots-clés: Santé en milieu rural et éloigné, traitement par agonistes opioïdes, troubles liés à la consommation d'opioïdes, accessibilité des services de santé, satisfaction des patients, Canada

INTRODUCTION

Opioid use disorder (OUD) disproportionately impacts rural and coastal populations.[1-3] In British Columbia, rural and coastal regions experience the highest rates of toxic drug deaths from the contamination of the unregulated drug supply with contaminants such as fentanyl and benzodiazepines.[4] Rurality has contextual factors contributing to disproportionate harms amongst people who use drugs (PWUDs) when compared to urban communities,[4,5] including lack of access to evidence-based, first line OUD therapy (i.e., opioid agonist treatment [OAT]) and novel approaches such as prescribed safer supply (PSS; i.e., short-acting opioids such as hydromorphone prescribed to address overdose risk from the toxic drug supply).[1,6-8] Low availability of specialty substance-use clinics, prescriber discomfort managing OUD, and general healthcare provider shortages contribute to reduced accessibility of OAT in rural and remote settings.[9] However, OAT accessibility is not simply determined by the geographic density of OAT prescribers; rather, OAT site dispensation proximity and service delivery approaches in rural and remote communities also play a critical role in OAT retention.[10]

When characterizing Canadian geography, population size alone does not fully describe the isolation experience of many rural, remote and coastal communities that are only accessible by airplane or ferry. There is increasing recognition that rurality is a major social determinant of health, which is magnified for PWUDs who experience other social risk factors: for example, poverty, chronic disease, unstable housing and fluctuating economic opportunities.[7,11] Rural and remote communities have fewer specialty health services, leading to less service utilisation by people who require them.[12] Moreover, these communities lack the resources to collect data on prevalence rates of specific conditions, which would inform funding allocation for needed services.[13] This is apparent in BC as there is poor coordination of funds between health authorities and local service agencies. Combined, these factors contribute to poorer health outcomes, particularly amongst populations who experience marginalisation, such as PWUD with OUD.[2] As such, access to

treatments such as OAT is imperative in rural, remote and coastal settings, but there are high rates of attrition in rural and remote BC.[3]

To that end, knowledge of barriers and facilitators of OAT provision is critical, but there is a dearth of research on this topic from the perspective of PWUD. In order to improve service delivery in rural and remote areas, this information is sorely needed. The aim of the present qualitative study is to identify and characterise the unique factors that influence access to OAT in a rural and coastal community in BC disproportionately impacted by toxic drug deaths.

METHODS

This study was conducted in a jurisdiction with a population of approximately 21,000 residents and covers 5000 km^2 of land (inclusive of small islands and more remote areas). The study community is characterised by a coastal town-centre that is more densely populated compared to nearby smaller inhabited areas that are isolated by 40–60 km of roads or require approximately 45 min of ferry travel to and from an inhabited island. Remote areas of the region are limited in health infrastructure, have no local pharmacies or other substance use services, and residents are restricted to a corner store or gas station for amenities.

A community-based and applied public health research approach was undertaken to combat community marginalisation, and to ensure results inform policy and programmatic changes that are relevant and useful. To achieve this, the research team partnered with a group of local PWUDs, clinicians and other community groups that were established to address the impacts of toxic drug crisis in the region. The team was consulted throughout the study, including during the formation of research objectives and interview guide, for participant recruitment and for the presentation of preliminary results, which provided opportunities for community engagement, to acquire feedback and enhance the accuracy and trustworthiness of the results. Approval for this study was obtained through our Institution's Research Ethics Board.

The COVID-19 pandemic and associated in-person restrictions occurred during data collection. To prevent disruptions to the research process, local harm reduction service providers and healthcare clinicians supported the study by recruiting and screening participants, and coordinating interview logistics. Eligibility criteria included frequent illicit substance use (minimum 3–4× per week), minimum 19 years old, and living in the surrounding region. Semi-structured one-to-one interviews were conducted remotely from July to October 2021. After providing written informed consent, PWUD participated in interviews through telephone from their own homes or a private office space. Authors GB and MM conducted the interviews from their private home offices. Interviews lasted 45–60 min and were audio recorded. A cash honorarium of $30 CAD was provided to participants.

Interviews were transcribed by an external transcription service and checked for accuracy by the study team. Authors GB and MM reviewed the transcripts individually and then met to discuss potential themes and develop the coding framework. Transcripts were uploaded and coded according to thematic analysis using NVivo V.12.[14] The lead author coded OAT and rural-specific data into sub-themes described herein.

The authors' positionalities further informed data interpretation. Authors have varied positionalities, inclusive of those with lived experience with substance use and residing in rural communities, clinical experience as prescribers and research expertise in substance use and public health. Due to the small size of the community, and based on feedback from community advisors, limited demographic information is provided to ensure participant confidentiality.

RESULTS

Overall study sample demographic characteristics and prescribed and non-prescribed substance use are provided in Tables 1 and 2, respectively. Twenty-seven PWUD participated in this study. Their perceptions and experiences related to OAT access are in the following pages.

Proximity to health services

Living in a more densely populated area of the study's rural and coastal setting was a cornerstone to the accessibility of pharmacies and substance use programmes amongst respondents. Nearly all of the study participants reported living in a

Table 1: Study participant demographics (*n*=27)

Characteristic	#
Age, median (range)	42.6 (19–62)
Ethnicity	
Indigenous	8
White	19
Gender	
Cis man	13
Cis woman	14
Income source (last 30 days)	
Full-time employment	2
Part-time employment	8
Drug selling	6
Reselling goods	2
Social assistance	26
Sex work	1
Other	13
Housing	
Supportive housing	13
Apartment	2
House	3
Shelter	4
Other	5

Table 2: Prescribed and non-prescribed substance use (*n*=27)

Characteristic	#
Substance use (last 30 days)	
Fentanyl	25
Heroin	12
Opiates (diverted)	1
Crystal meth	17
Crack cocaine	14
Cocaine (powder)	7
Alcohol	6
Benzodiazepines	9
Cannabis	6
Other	6
Type of OAT[a]	
Buprenorphine (SL or IM)	3
Methadone	11
Slow-release oral morphine	5
Fentanyl transdermal	1
Hydromorphone	3

[a]Prescribed and non-prescribed OAT. OAT: Opioid agonist treatment, SL: Sublingual, IM: Intramuscular

centrally-located neighbourhood consisting of private residences and apartment buildings that were within walking distance to an overdose prevention site, community pharmacies and medical offices and the local OAT clinic. Living within walking distance to a pharmacy in particular eased the burden of OAT mediation pickup and required daily witnessed ingestion (DWI; i.e., pharmacist observation and verification of medication consumption). To illustrate: *'I live close, so it's really, it's not inconvenient to get up in the morning and go for a walk'* (P1), and *'I just walk across the street. I'm usually the first one there [pharmacy] so I don't have to see anyone and I'm in and out'* (P9). For participants who lived in particularly isolated areas far from the pharmacy, DWI created OAT access struggles.

Some participants lived in areas considered particularly isolated (including on small islands). These areas were characterised by having few neighbours, limited community infrastructure and lacked reliable private or public transportation; which were described as burdens to OAT access. For example: *'It's not like you just hop off the ferry and you're in town.'* (P26), showcasing how the burdensome travel to an OAT-dispensing pharmacy continued following a ferry ride from a small island. Broadly, participants in isolated areas described feeling trapped: *'Yeah, I feel locked down. I'm on the Coast. I'm on the Coast, and I'm on methadone'* (P1). Most participants emphasised that owning a personal vehicle is necessary in their community, for example, *'without a vehicle you're pretty much screwed'* (P18), but their travel options were restricted to walking, bicycling or hitchhiking: *'We had a truck and when the truck died… we had to hitchhike into town and stuff'* (P11). Resources required to own and operate personal vehicles are largely unattainable due to cost: *'Because not all of us can afford the gas too. Like it's just, everything's tripled, doubled, the [price of] drugs, the gas, the [housing] rentals'* (P8).

Variations in pharmacy operations

OAT access was facilitated by pharmacies with extended hours of operation. For example, one pharmacy held hours of 8 am to 10 pm, which participants described as aligning with their work and sleep schedules: *'I don't have to worry as much about missing it [OAT], you know, because I've got till 10:00 o'clock to go get it'* (P22). Many participants also highlighted the benefit of pharmacies with OAT delivery services, especially given the transportation challenges within the setting: *'They actually bring it right here, getting it delivered is the best thing I guess'* (P15). When asked about OAT program improvement, some participants brought

up pharmacy delivery services: *'I wish they'd bring it right to my building actually'* (P7).

DWI requirements were the most frequently mentioned barrier to OAT. Participants who lived in isolated geographic locations spoke of the burden of DWI and how this amplified feeling stuck:

I don't get carries (take-home OAT doses), which is a big thing because it keeps me really locked down in town. Like I can't go anywhere, right? Because if I want to go somewhere, I have to make plans, right? And it's because I'm using. Because if you want to have the privilege of a freedom and be on opioids in this province, you have to be clean. You can't be using (P1).

Some participants identified that the energy and resources required to get to a pharmacy daily, or in some cases multiple times per day, in a rural community were physically and emotionally exhausting. One participant likened their experience of being on OAT to being *'on parole'* (P8). Others noted that DWI requirements felt coercive as the physical consequences of not picking up OAT resulted in painful physical withdrawal, as illustrated by one participant:

You can't go away from the city or from the town or whatever and go to another place because it seems like you've got to get that, get that drink [methadone] and, I don't know. It just seems like a leash where you just can't go too far or go for a while away for, because you need that drink (P25).

Participants emphasised that OAT delivery to residences or shelters and/or being prescribed take-home doses would be more convenient and provide more freedoms than required DWI at pharmacies.

Prescriber characteristics and opioid agonist treatment access

Participants described characteristics of healthcare providers that facilitated access to OAT that included: (1) being able to *'count'* on prescribers; (2) responsiveness to dose changes or other needs, (3) being located within close proximity, and (4) providing wrap-around social supports. Prescribers who made dose adjustments by phone, particularly during non-working hours, were facilitators of OAT access and prevented OAT termination. To illustrate:

[The prescriber] helped me with legal like issues and police problems and helped me with treatment and housing and helped me with all sorts of shit that I didn't think I would be able to or ever do and [they've] done it. And [they've] been available like after hours, you know. Like sometimes at 10:00 o'clock at night, [they've] been available to answer [their] phone so I could get a prescription, you know, if mine was cut off or something (P22).

Conversely, several participants raised concerns about patient-provider power imbalances and not feeling like a partner in OAT decisions. One participant explained having an allergy to morphine to a prescriber, but it was prescribed nonetheless:

And it said right on my medical stuff, right? It says you can't – you know, I'm allergic to it [morphine], right? I can't take that. I got to take Oxys. And [they] says, 'Oh, no, no. It's got this Special K in it. You're allowed to take it.' And I says, 'Are you sure?' I said, 'Okay, well, I'll start taking it.' Well, I started taking it, and then after about a week I was just I turned into like a jellyfish or some fucking thing (P2).

Others described providers suggesting one OAT agent over others: *'They just want to put you on Suboxone and then straight onto Sublocade and honestly it wouldn't matter to me but I feel like they're pushing the Sublocade'* (P3) and *'I never wanted to get on methadone in the first place. They kind of pushed it on me'* (P9). Some participants said that their OAT was discontinued by their prescriber due to challenging therapeutic relationships:

I got off the program a few times, just because of not seeing eye to eye with [my prescriber] at the times. So um… yeah, so then I would buy it [OAT medication] on the street, basically, right? And which is, I guess, better, because it's actual pharmaceutical (P18).

When asked about access approaches such as PSS, no participants had access: *'Like I asked [my prescriber] about why they're not doing it [PSS] and [they] said … it would be giving up on us. And I told [them], "The only thing that's giving up on us is not giving us a choice"' (P5)*. Similarly, another participant explained, *'I asked [my prescriber] about the safer supply program and [they] said that clinic does not support the safer supply program. I asked why and [they] wouldn't tell me'* (P23), which further left participants not feeling like partners in medical decisions.

Individuals' goals and opioid agonist treatment access

Participants who had positive experiences with OAT and routinely accessed it often had goals of wanting to live a *'normal'* life: *'I'm getting 1,000*

milligrams a day, ten pills a day. And that lasts me 24 h and it keeps me, well, normal. Functioning' (P24). Others wanted to cease illicit drug and OAT use: '*I don't want to be, you know, just addicted to this [OAT medications] forever, right. I want to slowly… once I finally get clean and, in a spot, where I feel stable, I want to come down and finally get off of it [OAT medications]*' (P22). Participants who described OAT as meeting their needs and controlling withdrawal symptoms were often on higher doses of OAT: '*I have slowed down in years … but I'm on a high dose right now*' (P12). Some participants augmented their use of illicit opioids with OAT as withdrawal management: '*We're using it [unregulated opioids] recreational. But if we stop altogether, we'd be pretty sick but the Kadian would smooth it over so that we're not pooping and throwing up and everything*' (P24). In addition, participants who felt that OAT brought reprieve from the *'chaos'* of a life *'overrun with drugs',* also generally reported positive OAT experience.

Amongst participants who were dissatisfied with accessing OAT, ongoing illicit substance use was commonly mentioned: '*People like to get high. Like is it – is it okay to be high?*' (P1). Participants who expressed challenges shared intentions of reducing harm related to their active substance use, rather than aiming to end illicit drug use. All participants expressed the desire to avoid experiencing opioid withdrawal at all costs. According to one participant, '*If I missed my meds, then I was twice as sick, and twice as liable to go out and go do stupid shit to make money*' (P6).

DISCUSSION

Our study results highlight several intersecting contextual-specific factors impacting access to OAT in a rural and coastal setting. OAT facilitators included a dispensation site that was close to participants' residences, pharmacies with extended hours of operation, pharmacy delivery options, ability to reach OAT prescribers off-hours and being prescribed higher doses of OAT. Barriers included inadequate or unreliable transportation to pharmacies, lack of service delivery models with a harm reduction approach, no take-home doses and required DWI. Participant-identified goals also factored into participant dis/satisfaction. Participant experiences revealed practical ways to improve OAT access in our study setting.

Geographical and transportation barriers to OAT have been well-described in existing literature.[1,2] Evidence demonstrates that increased distance travelled to an OAT dispensation site is negatively associated with treatment retention.[15] Every additional mile a person must travel to an OAT provider or a dispensing pharmacy reduces their likelihood of engaging in or maintaining on OAT.[16,17] Based on our results and some of the authors' clinical experience, there are many reasons that affect OAT retention in rural settings (e.g., lack of reliable transportation coupled with individual's chronic pain or mobility issues, precarious housing and extreme weather). However, further longitudinal research is needed to confirm these factors. Results from our study highlighted the positive influence pharmacy home deliveries had on OAT satisfaction amongst participants. Expanding OAT home delivery to rural and remote areas would help mitigate a variety of travel burdens (e.g., transportation, finances, time). Additional investments in public transportation systems would help to address travel barriers, a common social determinant experienced by PWUD and other populations that experience marginalisation when accessing healthcare.[8]

Many participants in the present study resided in the area's more densely populated neighbourhood in close proximity to pharmacies. Nonetheless, there was dissatisfaction with OAT services, indicating that travel alone does not fully explain barriers to OAT, which has also been identified in other North American settings.[16] Stigma and conservative attitudes towards drug use in rural and coastal settings, along with limited patient-provider co-decision making, created barriers to routine access to OAT.[18,19]

Our study further supports previous research identifying that DWI restricts people's sense of freedom and negatively affects OAT treatment satisfaction.[20,21] To address DWI impediments, take-home doses were commonly requested amongst participants but under current guidelines for the treatment of OUD, patients can only receive take-home doses if they demonstrate urinalysis free from illicit substances, a period of cognitive and emotional stability demonstrated by regular OAT appointment attendance, and no signs of injection drug use.[22] Amending these requirements to a lower barrier model may

reduce OAT attrition. For example, relaxed regulations during the COVID-19 pandemic have demonstrated that providing take-home doses of methadone can be effective to improve OAT access, with reported rates of OAT discontinuation or interruptions declining and no increases in overdose mortality amongst this population.[23,24] Prescribing take-home doses of full-agonist OAT to people who experience a high degree of health and social instability (e.g., living in shelters, sleeping outside, drug-induced psychosis and sleep deprivation) must balance the benefits versus risk of unintended consequences, including intended or unintended diversion, overdose and loss of medication. For such individuals who do not live close to clinics or pharmacies, there is a need to explore other options that support access to OAT but also promotes patient safety including peer delivery of OAT and virtual-witnessing technologies,[25,26] although future research is needed to fully understand the feasibility of these novel programmes across the rural and coastal settings.

While success with buprenorphine/naloxone programmes in rural and remote settings has been documented, in the literature, due to advantages in safety and granting early take-home doses,[27] our study is unique due to the variety of OAT medications that were discussed and available to the study sample. Active substance use was a common characteristic of study participants and from the authors' clinical experience, full-agonist OAT medications are often the treatment of choice for this population, and prescribers must collaborate with patients and provide options based on available treatments.

Scale-up of OAT delivery systems is challenging due to federal regulations that restrict OAT dispensing to few providers. Our study reinforces previous results that low-OAT prescriber availability leads to homogenous prescribing practices.[9] Moreover, rural healthcare organisations are less likely to implement novel practices due to lack of training and support from local health leadership and community.[28] To expand the OAT prescribing workforce in BC, training programmes have been developed to authorise nurses' scope of practice to include OAT prescribing.[29] Nurses, particularly those who already work in substance use settings, are well-positioned to prescribe OAT due to pre-existing therapeutic relationships with PWUD and experience administering OAT medications. In addition to nurses, pharmacists also have working relationships with people prescribed OAT, due to linkages as healthcare professionals at OAT dispensing sites, and may be available during times that OAT clinics may be closed (e.g., evenings and weekends).[30]

Limitations

Due to pandemic-related restrictions, in-person research activities were limited and this may have impacted interview length, rapport and recruitment. Despite aiming to recruit a diverse study sample that represented the region, most participants lived centrally and actively used unregulated street drugs. Future research should aim at recruiting a diversity of participants who represent both isolated communities of the region and people who are in early or prolonged remission from substance use. In addition, while some of the study participants self-identified as Indigenous, given the small sample size, themes related to Indigeneity were not identified. These limitations highlight the need for future research that specifically explores barriers that may be exacerbated for racialised and isolated communities. Finally, this study focused on characterising the unique drug use and harm reduction features of a rural and coastal community and not solely on OAT access. Therefore, more in-depth and longitudinal studies that focus specifically on OAT accessibility and acceptability are warranted.

CONCLUSION

OAT access in rural and coastal settings is confronted with various challenges. To the authors' knowledge, this is the first qualitative study to analyse factors that impact OAT accessibility from the perspectives of PWUD in rural and coastal BC. The results demonstrate that OAT access is multi-factorial, and geographic proximity alone does not fully explain OAT accessibility issues in the rural and coastal regions. People prescribed OAT who live in rural and coastal regions make significant economic and social sacrifices to adhere to OAT regimens. There are clear opportunities to improve health equity

by taking the onus of associated costs and time off patients and redirecting it to health systems. Greater innovation in OAT dispensing that is tailored to treatment goals is urgently required to improve OAT access and uptake in rural and coastal Canadian communities.

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The occasional peripherally inserted central catheter insertion updated

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INTRODUCTION

A peripherally inserted central catheter (PICC) is a thin flexible catheter that can be inserted through a peripheral vein in the upper arm and passed into the superior vena cava (SVC) providing central venous access.[1-3] PICCs can stay in place for several months and have a variety of clinical uses including administration of long-term intravenous (IV) antibiotics, parenteral nutrition and chemotherapy.[1,4] While large healthcare institutions often have dedicated teams of registered nurses with specialty training to insert PICCs, many rural and remote communities do not have the luxury of a PICC team, and therefore, rural physicians may be required to insert them.

INDICATIONS

- IV therapies lasting >1 week, i.e. antibiotics
- Hyperosmolar solutions, i.e., dextrose 50% and total parenteral nutrition
- Administration of caustic agents, i.e., chemotherapy and vasoactive drugs
- Difficult peripheral venous access in patients requiring frequent blood draws or IV administration and
- Difficult central catheter placement due to anomalous anatomy in the neck and/or thorax.[1,4-6]

CONTRAINDICATIONS

There are no absolute contraindications, only relative contraindications:

- Inability to locate vein or small vein diameter (<3–4 mm)
- Oral therapy is an available, appropriate alternative to IV therapy
- Previous axillary lymph node dissection and/or mastectomy on the side of the insertion
- Persistent cough or vomiting (catheter migration risk)
- Site-specific skin infections, radiation, burns, oedema
- End-stage renal disease (veins preserved for fistula).[4-6]

ANATOMY

PICCs are inserted into the basilic, cephalic and brachial veins [Figure 1].[4,7,8] The basilic vein is most commonly used due to its large diameter, superficial location and linear course to the SVC.[4,7,9] The

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cephalic vein often enters the axillary vein at a sharp angle, has a non-linear path and is smaller than the basilic vein, making catheter insertion difficult.[4,7,9] The paired brachial veins are the deepest of the 3 veins but, due to their proximity to nerves and the brachial artery, they are often avoided.[4,7,9] The PICC tip should be placed at the distal third of the SVC at the cavoatrial junction.[10] When determining which arm to use, consider the patient's preference, hand dominance, skin at the insertion site and vein size.[7]

Consider the best location for PICC insertion by using the Zone Insertion Method (ZIM) which has been shown to decrease catheter-related bloodstream infections, deep vein thrombosis and phlebitis.[11] With the ZIM, the upper arm is divided into three zones [Figure 2].[11] The red zone comprises the distal third of the upper arm. It is composed of smaller veins and is known for catheter instability due to its proximity to the elbow joint.[11] The yellow zone is the proximal third of the upper arm. While it may house a large diameter brachial vein, this moist area has a high number of hair follicles and can be unstable due to its proximity to the shoulder.[11] The green zone is located in the middle third of the upper arm. It is the ideal location for catheter insertion, specifically, the proximal half known as the ideal zone, due to its stability, lack of moisture and vein access.[11]

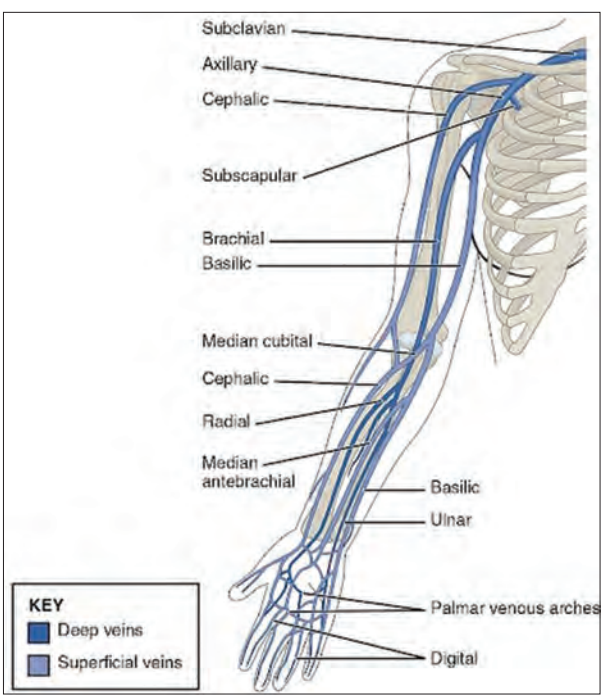

Figure 1: Upper arm venous anatomy.

ULTRASOUND GUIDANCE

Before the introduction of ultrasound (US) guidance, PICCs were commonly inserted into the antecubital fossa.[12] Today, with US assistance, deeper veins in the upper arm are the preferred site for PICC insertion as they have been shown to increase patient satisfaction and line longevity.[11,13] US guidance helps the practitioner identify the most appropriate vein, assists with navigation of needle insertion, increases insertion success rates, reduces complications and results in fewer referrals to interventional radiology to complete the insertion under fluoroscopy.[14-17]

When using the US, hold the linear probe with the non-dominant hand. Placing the probe in a transverse view displays the vein as an anechoic circle with a thin vessel wall on the monitor, helping identify anatomical structures and guide needle insertion.[18] Placing the probe parallel to the vein in a sagittal view displays the vein as a long tube, allowing the practitioner to follow the vein course and identify anatomical abnormalities.[18] It is imperative that the practitioner is able to differentiate a vein from an artery in the US, as an accidental arterial dilation can be limb-threatening. Pulsatile feedback and compressibility are the essential vessel attributes to assist with identification.[19] A suitable vein should be easily compressible and provide no pulsatile feedback. The inability to compress the vein completely or partially is concerning for a thrombus or other pathology, rendering the vein inappropriate for insertion.[19] An artery will resist compression, provide pulsatile feedback and typically have a thicker, more hyperechoic

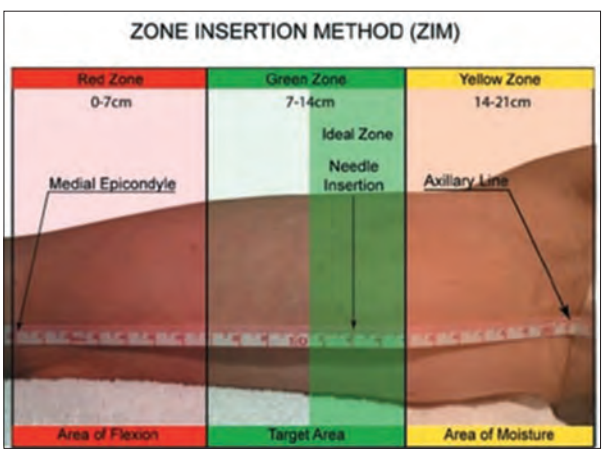

Figure 2: Identify the best location for peripherally inserted central catheter insertion using the zone insertion method.

wall than a vein.[19] Using the US's colour Doppler mode can also help the practitioner distinguish arteries from veins by characterising the direction of blood flow.[19]

The cephalic vein is located superficially on the anterolateral side of the upper arm in the ZIM green zone and sits on top of the biceps brachii muscle [Figure 3].[8,11] The brachial vein and basilic veins are located on the medial side of the upper arm in the ZIM green zone. Locate the brachial artery by applying pressure mid-shaft on the upper arm. The vessels on either side of the artery are the brachial veins. The basilic vein is located medially and superficial to the brachial veins. The median and ulnar nerve run between the basilic and brachial veins [Figure 4].[8,9,11]

INTRAVASCULAR ELECTROCARDIOGRAPHY WAVEFORM GUIDANCE

If available, internal electrocardiography (ECG) monitoring can assist the practitioner to more accurately place the PICC at the cavoatrial junction by providing real-time PICC tip location.[20-23] This method cannot be used on patients who have a pacemaker or do not have regular P-waves (i.e., atrial fibrillation) as it relies on changes in P-wave morphology.[20-22] Practitioners are generally eligible to receive training for intravascular ECG guidance from their PICC supplier.

EQUIPMENT

- Disposable waterproof paper soaker pad
- Tourniquet
- US machine
- Sterile and non-sterile gel
- Skin marker
- Chlorhexidine 2% with alcohol 70% (swabs)
- Lidocaine 1% without epinephrine
- Non-sterile tape measure
- Eye protection
- Face mask
- Surgical cap/hair bouffant
- Sterile gown and gloves
- Sterile drape and towels
- PICC caps
- PICC insertion kit-catheter, guidewire, echogenic needle, scalpel, gauze, sterile tape measure, obturator, peel-away introducer and 10 mL syringe
- Sterile saline flush
- Sterile US probe cover
- Securement device (StatLock™ PICC Stabilization Device or SecurAcath™)
- Central venous access device sterile transparent dressing.

PROCEDURE

1. Gather supplies
2. Have the patient lie supine with the chosen arm abducted and externally rotated out to 90°
3. Identify the vein(s) for PICC insertion:
   a. Apply a tourniquet to the patient's arm near the axilla. Apply non-sterile US gel to the upper arm. Using the linear US probe, identify the suitable vein for PICC insertion. Preferably, identify two veins for insertion (basilic and brachial/cephalic vein)

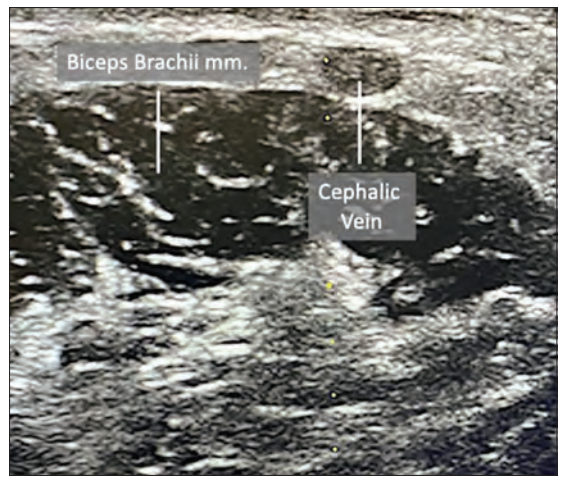

Figure 3: Transverse ultrasound view of the cephalic vein of the upper arm.

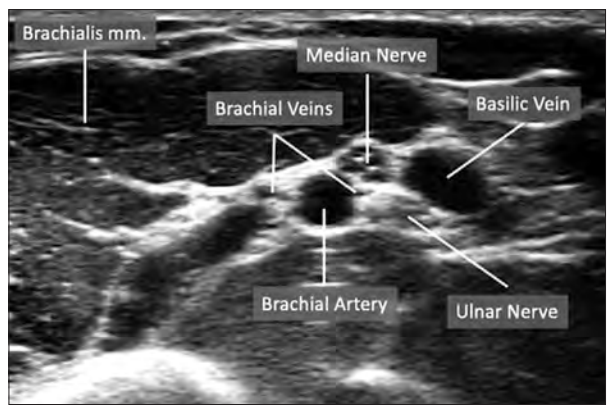

Figure 4: Transverse ultrasound view of the structures of the medial upper arm.

b. With the skin marker create three markings at 1 cm increments on the chosen vein(s) - these will serve as possible site insertions
c. Release the tourniquet. To reduce the incidence of future venous thrombosis, measure the chosen vessel(s) without a tourniquet to ensure that the catheter will not occupy more than 45% of the vessel lumen
d. Wipe off the gel.

4. Cleanse the marked insertion site for 30 seconds using chlorhexidine swabs
5. Inject enough lidocaine to form a bleb (approximately 0.3 ml) at the marked insertion sites
6. Determine the desired internal length of the PICC using the non-sterile tape measure:
   a. Ensure the patient's arm is at a 90° angle to the thorax
   b. Measure the course from the most distal marked site on the arm to the joint space below the acromioclavicular joint, to the sternal notch and then to the sternal angle. If using the left arm, bypass the sternal notch when measuring.
7. Set up sterile field:
   a. Wash hands
   b. Don mask, eye protection, hair bouffant, sterile gown and sterile gloves
   c. With the aid of an assistant, place the sterile fenestrated drape on the patient covering them head to toe, with the fenestration over the marked insertion site.
8. Using the sterile technique, open the PICC kit, sterile saline and PICC caps onto the sterile field
9. Prepare the PICC for insertion:
   a. Using the scalpel, cut the PICC to the desired internal length measured in Step 6, leaving an extra 3–5 cm for the external securement device. The catheter has external markings spaced 1 cm apart. Confirm the length using the sterile tape measure
   b. Insert the obturator into the catheter approximately 1 cm from the end so that the catheter has a soft tip
   c. Pre-flush PICC lumen(s) and cap(s) with sterile saline.
10. Cleanse the insertion site again with chlorhexidine swabs for 30 seconds using a back-and-forth linear scrubbing motion
11. Have your assistant apply non-sterile gel onto the US probe. With their help, sheath the sterile US sleeve over the probe. To reduce air bubbles, apply a sterile elastic band around the end of the probe. Apply a small amount of sterile US gel on the outside of the probe cover
12. Have your assistant re-apply the tourniquet near the patient's axilla underneath the sterile field
13. Use the US to re-identify the vein at the marked site
14. Use the US to perform in-plane/out-of-plane dynamic needle guidance when inserting the echogenic needle into the vein[19]
    a. Out-of-plane approach: This is the most common approach. Place the needle perpendicular to the transducer, which is in a transverse view. Use probe rocking, sliding, tilting, and/or compression to help localise the needle from the skin surface. Maintaining continuous visualisation of the needle, advance it until you visualise the hyperechoic dot (tip) inside the anechoic vessel [Figure 5]. You should now have blood return. Be vigilant not to mistake the needle shaft for the tip, which can result in overreaching of the needle and damage to surrounding structures
    b. In-plane approach: Place the needle parallel to the transducer, which is in a sagittal view, allowing for visualisation of the entire needle shaft and tip during insertion. This view is often employed by the advanced practitioner as the inability

Figure 5: Successful insertion of an echogenic needle into the vein on transverse view.

to see surrounding structures can result in incorrect vessel cannulation and/or damage to surrounding structures. Use probe rocking, sliding, tilting, and/or compression to help localise the needle from the skin surface. Maintaining continuous visualisation of the needle, advance it until you visualise the hyperechoic tip inside the vessel [Figure 6]. You should now have blood return

c. Due to varied patient anatomy, there is no standard angle of needle insertion. However, insertion at 45° for veins <1 cm deep and 90° for veins >1 cm deep is a commonly used guide.

15. Advance guidewire through the access needle and gently lower your needle angle
    a. The wire should advance smoothly. If you meet resistance do not advance it. Using the US, re-identify the vein using a sagittal view. The needle may be malpositioned and/or the vein is not fully cored, requiring manipulation. Re-adjust and attempt to advance the wire again.
16. Slide the needle off the end of the guidewire leaving the guidewire in place. Have your assistant release the tourniquet
17. Thread the introducer over the guidewire until it is fully in the vein
    a. You may need to cut the skin (<0.5 cm) with the scalpel to make room for the introducer.
18. Remove the guidewire. Remove the inner cannula of the introducer. Cover the open introducer with a sterile finger to prevent air embolism
19. Feed prepped PICC line through the introducer at 1 cm/s to the desired length
    a. To reduce catheterisation of the jugular vein, ask the patient to turn their head and tuck their chin under the sterile field towards their shoulder on the side of the PICC insertion arm. Have them take deep regular breaths, slowly advancing the catheter with each breath to draw the PICC into the SVC.
20. Once the PICC is fully inserted, aspirate and flush each lumen with 10 mL of saline to ensure patency and blood return
    a. If the patient can hear a whooshing in their ear, the PICC may be in the jugular vein (confirm with neck US). Reposition the catheter by pulling it back, leaving approximately 10 cm internally. Repeat step 19.
21. Remove the tear-away introducer
22. Place pre-flushed caps on the PICC. Aspirate and flush each lumen with 20 mL of normal saline
23. Apply StatLock™ PICC Stabilization Device or SecurAcath™. Remove the obturator from the catheter
24. Apply a 2 × 2 gauze at the PICC insertion site if oozing. Apply a transparent sterile dressing over the securement device (+/–gauze) and as much of the external catheter as possible
25. Verify catheter placement with a chest X-ray. The catheter should be positioned at the cavoatrial junction-2 vertebral bodies below the carina[24]
    a. If the PICC needs to be advanced, you can advance the catheter within 2 h of insertion to maintain sterility. Outside of this window requires a new PICC
    b. If the PICC needs to be withdrawn, this can be done at any time after insertion.
26. Document date, time, placement verification, internal and external measurements, lot # and that the PICC is ready for use.

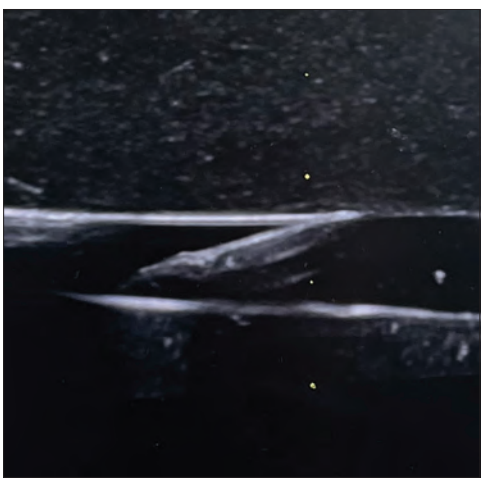

Figure 6: Successful insertion of an echogenic needle into the vein on sagittal view.

COMPLICATIONS

Complications can arise at any point from the time the PICC is inserted until it is removed. The complications include air embolism, bleeding from

the site, blood clots, cardiac arrhythmias (often caused by the PICC line in the right atrium), infection, migration or malposition of the catheter, nerve injury, phlebitis and infiltration.[4,25] There is an increased risk of infection for every additional lumen attached to the catheter.[25] The most common organisms associated with hospital-acquired catheter-related bloodstream infections include coagulase-negative staphylococci (part of normal human skin flora), *Enterococcus* spp. and *Staphylococcus aureus*.[25]

MAINTENANCE

Line care

- Flush each lumen with 20 mL saline using the push-pause method (short boluses of 1 mL) before and after each use and every 7 days if dormant[26]
- Change caps every 7 days.[26]

Dressing

- Change initial dressing within 24 h if gauze is used at the PICC site, otherwise change every 7 days.[26]

Securement device

- If using a StatLock™ PICC Stabilization Device, change every 7 days[26]
- If using a SecurAcath™ leave it in place until PICC removal.[26]

PATIENT INSTRUCTIONS

To maintain PICC integrity and reduce complications, patients should avoid lifting objects over 4.5 kg, avoid repetitive activities such as shovelling and vacuuming, avoid tight clothing over the PICC site and keep the PICC dry (cover with a plastic bag when showering).[26,27] Advise patients to contact their healthcare provider if they develop arm or neck swelling, the external catheter length changes or if they notice changes to the PICC site (erythema, tenderness, or swelling).[26,27] Advise patients to attend the nearest emergency department if they develop shortness of breath, cough, chills, fever and/or neck or shoulder pain.[26,27]

CONCLUSION

With the assistance of US guidance and internal ECG monitoring when available, the insertion of PICCs by physicians in rural and remote communities is an attainable endeavour.

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Case Report

Drinking the disease: A family affected by arsenic in well water

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INTRODUCTION

Worldwide, it is estimated that over 220 million people in 56 countries are exposed to unsafe concentrations of arsenic derived from their drinking water and food.[1] The highest levels are found in the groundwater of Argentina, Bangladesh, Cambodia, Chile, China, India, Mexico, Pakistan, the United States and Vietnam.[2] Canadians are also exposed to arsenic through multiple conduits including in food, soil, ambient air and drinking water.[3] In Canada, over 3 million Canadians, or 10% of the total population, obtain their drinking water from private wells.[4] In one report from Nova Scotia, the provincial government reported that 42% of residents rely on private wells, and it is estimated that one in five of these private well users may have unsafe levels of arsenic in their untreated water.[5] In addition, a news report from 2022 warned of exceptionally high arsenic levels in the groundwater in Newfoundland.[6] Shortly thereafter, the provincial government announced it would supply 2000 free test kits to well owners as part of a groundwater study.[6]

In the United States where we practise, over 44 million people use water from domestic private wells, with 2.1 million of these estimated to have arsenic levels above 10 ppm, which is the maximum internationally established threshold.[7] In Wisconsin where our patients live, it is estimated that 25% of residents (1.5 million people) acquire their drinking water from private wells.[8] Arsenic is most frequently found due to prior geological glacial exposure, consequentially resulting in substantial amounts of the mineral in ground deposits nation-wide.[9] Arsenic cannot be tasted, seen or smelled and can vary in concentration in home water samples even in neighbouring areas.[7]

Previous research has explicated that if arsenic is not identified and filtered from potable water, a variety of frequently seen medical conditions may arise from chronic exposure, some of which are life-threatening.[10] These include lung, renal, bladder and skin cancers, as well as type 2 diabetes mellitus, hypertension, polyneuropathy and cardiac QTc prolongation.[10,11] Non-specific cutaneous lesions such as thickening of the palms and soles are also associated with arsenic toxicity, comprising an important physical manifestation physicians need to be aware of.[12]

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More recent research adds neurological disorders as a potential symptom, with a contributory role of environmental arsenic in mitochondrial dysfunction and neurotoxicity.[13] In their study of children's exposure to arsenic-containing well water, Wasserman *et al*. reported that 'exposure to arsenic was associated with reduced intellectual function after adjustment for socio-demographic covariates'.[14]

CASE REPORT

A 25-year-old man and his wife moved to Wisconsin in December of 2021 into a house built in the 1970s. At the time of moving, they were aware that they had poor water quality despite the home's water treatment system, which included a neutraliser, water softener and filtering unit. The owners installed a reverse osmosis system 1 month later, assuming it would remove any harmful components from the water they used for daily drinking and cooking. The owners then installed a polyvinyl chloride well liner 5 months later, in May of 2022, with the hope of improving the water's appearance, but saw no improvement.

Approximately 1 year after moving in, in February of 2023, the patient first began to experience vague symptoms consisting of vision changes, dizziness, disorientation, brain fog and transient neuropathy in his lower extremities. The symptoms became progressively worse and caused concern for him and his wife. At the same time, their newborn daughter, born in January 2023, had developed a persistent nocturnal cough without a clear aetiology. Neither parent smoked. The patient did not seek formal medical care as his wife is a physician assistant.

In April 2023, the patient's wife ordered a hair mineral analysis due to concern for potential heavy metal toxicity. The results showed an elevated arsenic level of 0.41 parts per million (ppm), with normal being <0.03 ppm [Table 1]. They surmised that the non-reverse osmosis-treated water being used for bathing contained arsenic, causing a high reading on the hair test. They continued to drink the reserve osmosis-treated water. The following month, the patient's wife's hair mineral analysis also returned with high levels of arsenic (0.52 ppm).

With appropriate suspicion, the couple tested their well water for arsenic and found the level to be 40 ppm, much higher than the international standard for drinking water of <10 ppm. They analysed their reverse-osmosis-treated water and found it still contained 20 ppm of arsenic. They decided to drill a new deeper well into the aquifer further away from the home at that time. Their arsenic levels were thereafter tested to be below detectable levels.

Table 1: Timeline and results of arsenic hair analysis levels of patient and his wife

Level of arsenic in hair analysis (in parts per million)	April, 2023	May, 2023	November, 2023
Patient	0.041		0.005
Patient's wife		0.052	0.002

The parents realised that they were still using the reverse-osmosis-filtered water from their initial well (still with significant arsenic concentration) for a humidifier in their daughter's bedroom. The infant was exclusively breastfed, so she did not ingest any contaminated water. As Duan *et al*. note, 'The use of ultrasonic humidifiers filled with tap water poses an arsenic inhalation risk. In addition to drinking water intake, inhalation is also an important route of arsenic exposure'.[15]

The patient and daughter's symptoms eventually resolved months following the installation of the new well. Both parents' hair analyses in November 2023 were below normal limits (0.005 and 0.002, respectively).

DISCUSSION

Since private well testing is not done by local authorities or public health officials, it is up to the well owners to assess their water and filter arsenic through commercially obtained water filters, although based on existing research, we know that this is infrequently done.[16] Aside from organic arsenic found innately in groundwater, inorganic arsenic is also an ingredient in pesticides and was previously used as a wood preservative. Although this wood treatment process has been discontinued, the ongoing leaching of residue from treated wood has been reported as a continuous source of contamination in soil and water.[17] The homeowners are confident that their groundwater was contaminated from the treated wood foundation of their home, as their old well was shallow and only three feet away from the foundation. The owners also tested three other wells on properties they own nearby (0.91 miles, 0.85 miles and 0.30 miles away),

two with arsenic levels being undetected and one at 2 ppm. All three were a significant distance from any home foundation.

CONCLUSION

This case study illustrates the importance of a thorough history and assessment of environmental aetiologies of clinical presentations. High levels of arsenic in well water may serve as a cause of varied and serious symptomatology in patients of all ages. It is important to ask patients about their principal water source when faced with vague and unusual symptoms, particularly in rural areas.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Curling rings and birthing wings: Bridging the gap in rural obstetrics

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Winner of the SRPC student essay contest

'Push hard, hard, hard'! In the midst of the delivery room, the family medicine doctor urged the labouring mother. It was a stark contrast to just hours earlier when the same doctor had echoed those words while curling at the local club.

The connection between these seemingly unrelated events began earlier that evening when, on my first clinical placement in rural Southwestern ON, the doctor invited me to join a curling session. I had just arrived the day before, and curling was evidently a community staple. Intrigued, I accepted the invitation.

As we prepared a patient for induction, the doctor explained the local enthusiasm for curling. My response revealed my limited experience, having curled only once in gym class. Undeterred, the doctor encouraged me to join that evening, setting the stage for an unexpected blend of medical observations and community integration.

'Hurry hard, hard, hard'! My preceptor shouted down the ice as I scooted with my broom awkwardly towards the button, fighting to keep my balance. After a long day in the clinic, this break from the hospital was exactly what I needed. Amidst the excitement of the curling game, the doctor asked if I wanted to be notified when the labouring mother was ready to push. Eager for the experience, I enthusiastically agreed. As a 2nd-year medical student, with limited hospital exposure, I was excited to witness my first birth. 'Even if it is at 2 am?' She clarified. 'Absolutely'.

In the backdrop of my medical school studies, I had explored the decline of family practice obstetrics in rural Ontario. Reasons such as fear of litigation and challenging call schedules had contributed to the emergence of 'maternal care deserts' across the province over the past 20 years.[1] Ironically, before this placement, I had dismissed obstetrics as a potential career path due to similar concerns.

I returned to the hospital that night at 11 pm, hardly past my bedtime and I observed the intensity of labour. The doctor and nurses guided the mother through contractions, and I played a supporting role, handing supplies and offering encouragement. The wave of emotions in the room once Mom gave the final push, and a gush of fluid arrived with a screaming babe, overcame me. I was in awe of Mom's strength and the doctors calm and

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collected approach to the delivery. 'Did you see that, Dad? It's a boy'! The Doc exclaimed, as she quickly inspected the baby and placed him on Mom's chest. The parents had not been informed of the sex earlier in the pregnancy, so they were just as surprised as I was to welcome their son into the world. 'Welcome, Jack', our patient exclaimed exhausted after the past 12 h of labour. 'Would you like to cut the cord, Dad?' The doctor offered, he shook his head vigorously, after which the physician offered this experience up to me, which I eagerly accepted.

Once Mom and babe were settled, I returned home after a long day. I reflected about the day's events, with a new appreciation for the family medicine generalist as an avenue for obstetrical care in rural communities.[2] I went to bed that night with my previous preconceptions about rural obstetrical care obliterated, an excitement about rural obstetrical care that I am excited to bring into my future career as a rural family physician and a new appreciation of the challenges and joys of curling.

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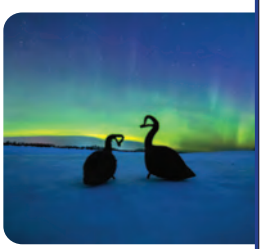

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HANG TEN AND TRIAGE: SURFING HAIDA GWAII WITH DR. BLACK

When and why did you move to Haida Gwaii British Columbia, and what was your initial experience like? What did you think?

I first went in as a resident in 2015 with UBC Rural Family Medicine. I was there from July until October, and I started working right away. The hospital was short staffed, but I still had a great time working with the physicians that were there and the nurses. One thing that stuck with me was how very quickly I was accepted into the community. Before I knew it, I was invited to gatherings and potlucks and people were really keen to get me surfing!

That's where my surfing life started. I had a few doctors that lent me wet suits, loaned me surf boards, and said they'd take me out and try to teach me how to get on a wave. Looking back now, I think about how awesome everyone was. There was this immediate acceptance from people that was really unique and special. It really hooked me into Haida Gwaii.

I'm originally from a small town in Ontario, so I grew up having a general sense of who my neighbours were and the families in town, and feeling pretty safe. Haida Gwaii has felt really comfortable for me. Halfway through my rotation, my partner joined me on the island and he felt the exact same!

Tell me about your experience working on Haida Gwaii. What does a day in the life of Dr. Black look like?

On the island, I do a mix of clinic and emergency call. Usually if we have patients in the morning admitted to the hospital, I'll go in a little bit early, around 8 - 8:30 am. There is often a huddle at the nursing station where we meet with the interdisciplinary team to review patients admitted and try to plan for discharge.

From there, I either start seeing patients in Emerge, or I'm in clinic. In the clinic I see patients every 20 or 30 minutes. It's lower volume, but with more complicated medical issues, more trauma informed care.
You don't get too bored, that's for sure!

What is something you would say to another physician or health care professional to bring them out West?

I would say if you're looking for somewhere that has a flexible schedule, if you want to be involved in a longitude of care and work with Indigenous patients in a very empowered community, Haida Gwaii could be the place for you. We do full-spectrum, full-service work, and it's really rewarding.

32nd ANNUAL
Rural and Remote Medicine Conference

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Mini R&R

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