Canadian Journal of Rural Medicine

Journal canadien de la médecine rurale

The official journal of the Society of Rural Physicians of Canada

Le journal officiel de la Société de la médecine rurale du Canada

VOLUME 28, NO. 2, SPRING 2023

VOLUME 28, Nº 2, PRINTEMPS 2023

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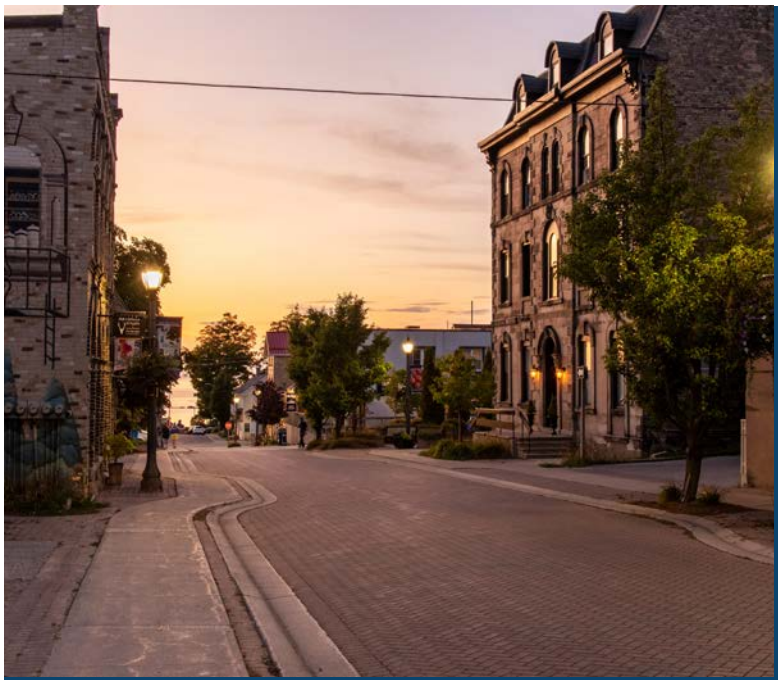
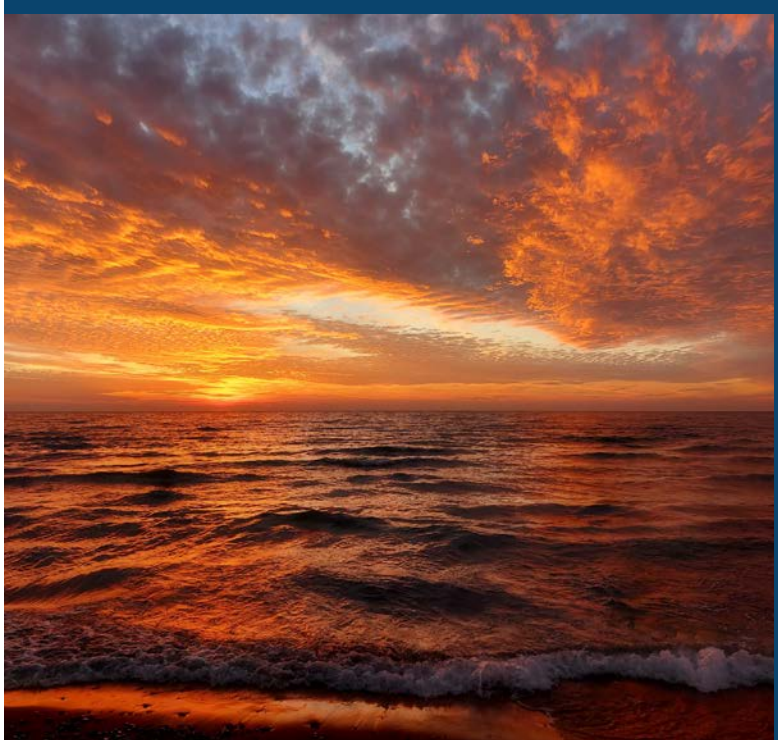
DANS CE NUMÉRO





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Canadian Journal of Rural Medicine
Journal canadien de la médecine rurale

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Canadian Journal of Rural Medicine (*CJRM*) is owned by the Society of Rural Physicians of Canada (SRPC). It appears in Winter, Spring, Summer and Fall. It is printed by The Lowe-Martin Group, Ottawa, ON.

Address all correspondence to:
Editor, *CJRM*
manedcjrm@gmail.com

CJRM is indexed in Emerging Sources Citation Index, MEDLINE/Index Medicus, Web of Science

Publications Mail Agreement no. 4138705.
Send address changes to: SRPC. Box 893, Shawville, QC J0X 2Y0
819-647-7054
819-647-1949; fax: 819-647-2485
info@srpc.ca

ISSN 12037796

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Printed by The Pontiac Printshop Ltd., Shawville, QC

Canadian Journal of Rural Medicine / Journal canadien de la médecine rurale

Vol. 28, No. 2, SPRING 2023 / PRINTEMPS 2023

EDITORIALS / ÉDITORIAUX

ORIGINAL ARTICLES / ARTICLES ORIGINAUX

PROCEDURAL ARTICLE

PODIUM

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Replace me... please?

Peter Hutten-Czapski, MD[1]

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The venerable generalist rural doctor is asking again to be replaced... please hurry up.

Telemedicine was going to do that. Robots and video from afar. That never really panned out. It certainly has helped and was very useful at the height of the pandemic, but no one is replacing me with a robot. Perhaps, it is the chip shortage.

Nurse practitioners were also going to replace us. In the end, few and far between and mostly in the cities. Certainly a help. Mind you quite small practices, and breadth of practice not enough to share call with.

Then, we heard about the electronic medical record. They said it would make the office so much more efficient that we could zip through the day. Yeah, about that. Certainly, it has made us more organised, and my typing skills have improved immensely. However, at the end of the day, I am seeing fewer people, not more. Perhaps, I missed something in the manual on page 147.

Then, the hope was that allied health providers and teams would make us redundant. Do not get me wrong; having more nurses, counsellors and dietitians has been a boon to the rural population, but it has not seemed to edge any one doctor out. Sure, we do fewer paps, well-baby visits, psychotherapy and the like, but somehow there is so much new work, and alas, new committees and administration, that we are running as fast as before.

The next new thing is AI. I tried to convince ChatGPT to write this editorial. I had three different 'extra' projects needing to be done around the ins and outs of my daily practice and no time to do any of them. I was desperate and willing to try anything. How hard could it be to be replaced at the keyboard? Five hundred and twenty words about the challenges of rural practice. After a few attempts, with recurrent prompting, it had style, grammar and a beginning, middle and end. However, no matter how I primed it, it seemed to think that rural medicine can be fixed with telemedicine. OK. The artificial brain still needs a bit of work.

So here I am, stuck, a rural generalist with a bit too many things that I do to be easily replaced. Ultimately, it seems that only a rural generalist physician is going to replace a rural generalist physician. Now, all I have to do is wait for the regional medical schools to flood the rural areas with doctors. Any day. Soon. For sure. I think. OK. Perhaps more of a trickle.

I did not want to retire yet anyway.

Access this article online

Quick Response Code:

Website: www.cjrm.ca

DOI: 10.4103/cjrm.cjrm_3_23

Received: 13-01-2023 **Revised:** 13-01-2023 **Accepted:** 31-01-2023 **Published:** 24-03-2023

How to cite this article: Hutten-Czapski P. Replace me... please? Can J Rural Med 2023;28:43-4.

Remplacez-moi... S'il vous plaît.

Peter Hutten-Czapski, MD[1]

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Le vénérable médecin généraliste de campagne demande à nouveau à être remplacé. dépêchez-vous.

La télémédecine devait tout résoudre. Des robots et des vidéos à distance. Ça n'a jamais vraiment marché. Cela a certainement aidé et a été très utile au plus fort de la pandémie, mais personne ne me remplacera par un robot. C'est peut-être à cause de la pénurie mondiale de puces.

Les infirmières et infirmiers praticiens allaient également nous remplacer. Finalement, ils sont peu nombreux et travaillent surtout dans les villes. C'est certainement un bon soutien. Il faut dire que les cabinets sont assez petits et que l'étendue de la pratique n'est pas suffisante pour partager les appels.

Puis nous avons entendu parler du dossier médical électronique. Ils disaient que ça rendrait le cabinet tellement plus efficace que la journée SE terminerait comme une lettre à la poste. Voyons cela de plus près. Il est certain que cela nous a rendus plus organisés et que mes compétences en dactylographie SE sont considérablement améliorées. Cependant, à la fin de la journée, je vois moins de gens, pas plus. J'ai peut-être manqué quelque chose dans le manuel à la page 147.

Ensuite, on a espéré que les prestataires et les équipes de soins paramédicaux nous rendraient inutiles. Ne vous méprenez pas, le fait d'avoir plus d'infirmières/infirmiers, de conseillères/conseillers et de diététiciennes/diététiciens a été d'une grande aide pour la population rurale, mais cela n'a pas semblé faire partir un seul médecin. Bien sûr, nous faisons moins de Pap, de visites de bébés, de psychothérapies et autres. D'une certaine manière, il y a tellement de nouveau travail, et hélas, de nouveaux comités et de nouvelles administrations, que nous fonctionnons aussi vite qu'avant.

La prochaine nouveauté est l'IA. J'ai essayé de convaincre ChatGPT d'écrire cet éditorial. J'avais 3 projets " supplémentaires " différents à réaliser autour des tenants et aboutissants de ma pratique quotidienne et pas le temps de les réaliser. J'étais désespéré et prêt à tout essayer. Me remplacer au clavier ne devrait être si difficile, n'est-ce pas? Cinq cent vingt mots sur les défis de la pratique rurale. Après quelques tentatives, avec des invites récurrentes, le texte avait un style, une grammaire et un début, un milieu et une fin. Cependant, peu importe la manière dont je l'ai amorcé, il semblait penser que la médecine rurale pouvait être résolue par la télémédecine. BON. Il semblerait que le cerveau artificiel a encore besoin d'un peu de travail.

Me voilà donc coincé, un généraliste rural avec un peu trop de travail pour être facilement remplacé. En fin de compte, il semble que seul un médecin généraliste rural est en mesure de remplacer un médecin généraliste rural. Il ne me reste plus qu'à attendre que les écoles de médecine régionales inondent les zones rurales de médecins. J'attends toujours...c'est pour bientôt...c'est sûr...Je pense. Bon. Cela SE fera probablement petit à petit.

De toute façon, je n'avais pas l'intention de prendre ma retraite.

Sarah Lespérance, MD, CCFP

President, SRPC, Petitcodiac, NB, Canada

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President's Message – A national advanced skills and training program for rural practice

As rural physicians, we pride ourselves on being generalists, with flexibility, a broad knowledge base, and a willingness to learn new skills to serve our patients. Our training prepares us well for this, and we find great satisfaction in the variety and challenge of our work. However, sometimes, we notice a pattern evolving, where the same issue requiring patient transfer seems to present itself, new diseases occur with increased frequency, or the departure of a valued colleague means a sudden need for enhanced skills within our community.

Depending on where in this country a physician works, access to advanced skills training can be difficult to obtain once residency is complete. There are also the challenges of securing locum support, and the financial strain of leaving one's practice to complete training, while overhead and costs of living remain.

For these reasons, the SRPC is thrilled to announce the launch of a National Advanced Skills and Training Program for Rural Practice. In partnership with the Foundation for Advancing Family Medicine (FAFM), we are collaborating with multiple partner organisations to broaden the capacity of inter-professional comprehensive primary care in Canada, with an overall goal of addressing critical labour shortages and enhancing labour mobility and utilisation.

The SRPC's key role is to administer a program that offers support for physicians to access a variety of existing training opportunities to increase their generalist skill set, to fill gaps identified by individual physicians and communities. This project has been modelled after the Rural Coordination Centre of British Columbia's Advanced Skills and Training Program. The FAFM has granted the SRPC funding that will allow us to offer numerous rural family physicians funding for training, income replacement and locum support, to meet an identified clinical need in the practice communities they serve. We feel this program will result in an increased ability to attract, develop and retain physicians in rural and indigenous communities. In addition, we hope that the relationships forged through training will enhance networks of care and offer valuable mentorship opportunities to participants. A robust evaluation and review process is planned, with the goal of securing funding on an ongoing basis.

While the SRPC is excited to offer this new opportunity to our members, we hope that this is only the beginning of enhanced training, mentorship and educational opportunities we offer to rural and remote healthcare providers across the country.

Received: 15-01-2023 **Accepted:** 31-01-2023 **Published:** 24-03-2023

How to cite this article: Lespérance S. President's Message – A national advanced skills and training program for rural practice. Can J Rural Med 2023;28:45-6.

Access this article online

Quick Response Code:

Website: www.cjrm.ca

DOI: 10.4103/cjrm.cjrm_4_23

Message de la présidente. Un Program national de compétences et formation avancées pour la pratique en milieu rural

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En tant que médecins ruraux, nous sommes fiers d'être des généralistes, flexibles, dotés d'une large base de connaissances et prêts à acquérir de nouvelles compétences pour servir nos patients. Notre formation nous prépare bien à cela, et nous trouvons une grande satisfaction dans la variété et le défi de notre travail. Cependant, parfois, nous remarquons l'évolution d'un modèle où le même problème nécessitant le transfert d'un patient semble SE présenter, où de nouvelles maladies apparaissent avec une fréquence accrue, ou encore où le départ d'un collègue apprécié signifie un besoin soudain de compétences améliorées au sein de notre communauté.

Selon l'endroit où le médecin travaille dans le pays, l'accès à la formation aux compétences avancées peut être difficile à obtenir une fois la résidence terminée. Il faut également relever le défi d'obtenir un soutien de suppléance et le fardeau financier que représente le fait de quitter son cabinet pour suivre une formation, avec les frais généraux et le coût de la vie toujours présents.

Pour ces raisons, la SRPC est ravie d'annoncer le lancement d'un Program national de compétences et formation avancées pour la pratique en milieu rural. En partenariat avec la Fondation pour l'avancement de la médecine familiale (FAFM), nous collaborons avec plusieurs organisations partenaires afin d'élargir la capacité des soins primaires complets interprofessionnels au Canada, dans le but général de combler les pénuries critiques de main-d'œuvre et d'améliorer leur mobilité et utilisation.

Le rôle principal de la SRPC est d'administrer un program qui offre un soutien aux médecins pour qu'ils accèdent à une variété d'opportunités de formation existantes afin d'augmenter leur ensemble de compétences généralistes, ains que pour combler les lacunes identifiées par les médecins individuels et les communautés. Ce projet a été modelé sur le program de formation et de compétences avancées du " Rural Coordination Centre of British Columbia ". La FAMF a accordé à la SMRC une subvention qui nous permettra d'offrir à nombreux médecins de famille ruraux un financement pour la formation, le remplacement du revenu et la suppléance afin de répondre à un besoin clinique identifié dans les communautés de pratique qu'ils servent. Nous pensons que ce program permettra de mieux attirer, développer et conserver les médecins dans les communautés rurales et autochtones. En outre, nous espérons que les relations forgées au cours de la formation amélioreront les réseaux de soins et offriront de précieuses opportunités de mentorat aux participants. En outre, dans le but d'assurer un financement permanent, un solide processus d'évaluation et de révision est prévu.

La SRPC est ravie d'offrir cette nouvelle possibilité à ses membres. Nous espérons que ce n'est qu'un début dans l'amélioration des possibilités de formation, de mentorat et d'éducation offertes aux fournisseurs de soins de santé des régions rurales et éloignées de tout le pays.

Original Article

Urban-rural divide in COVID-19 infection and vaccination rates in healthcare workers in British Columbia, Canada

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This article has been peer reviewed.

Access this article online

Quick Response Code:

Website: www.cjrm.ca

DOI: 10.4103/cjrm.cjrm_24_22

Abstract

Introduction: Healthcare workers (HCWs) play a critical role in responding to the COVID-19 pandemic. Early in the pandemic, urban centres were hit hardest globally; rural areas gradually became more impacted. We compared COVID-19 infection and vaccine uptake in HCWs living in urban versus rural locations within, and between, two health regions in British Columbia (BC), Canada. We also analysed the impact of a vaccine mandate for HCWs.

Methods: We tracked laboratory-confirmed SARS-CoV-2 infections, positivity rates and vaccine uptake in all 29,021 HCWs in Interior Health (IH) and all 24,634 HCWs in Vancouver Coastal Health (VCH), by occupation, age and home location, comparing to the general population in that region. We then evaluated the impact of infection rates as well as the mandate on vaccination uptake.

Results: While we found an association between vaccine uptake by HCWs and HCW COVID-19 rates in the preceding 2-week period, the higher rates of COVID-19 infection in some occupational groups did not lead to increased vaccination in these groups. By 27 October 2021, the date that unvaccinated HCWs were prohibited from providing healthcare, only 1.6% in VCH compared with 6.5% in IH remained unvaccinated. Rural workers in both areas had significantly higher unvaccinated rates compared with urban dwellers. Over 1800 workers, comprising 6.7% of rural HCWs and 3.6% of urban HCWs, remained unvaccinated and set to be terminated from their employment. While the mandate prompted a significant increase in uptake of second doses, the impact on the unvaccinated was less clear.

Conclusions: As rural areas often suffer from under-staffing, loss of HCWs could have serious impacts on healthcare provision as well as on the livelihoods of unvaccinated HCWs. Greater efforts are needed to understand how to better address the drivers of rural-related vaccine hesitancy.

Keywords: COVID-19, rural medicine, vaccination, vaccine mandate

Résumé

Introduction: Les travailleurs de la santé (TS) jouent un rôle essentiel dans la réponse à la pandémie de COVID-19. Au début de la pandémie, les centres

Received: 28-03-2022 **Revised:** 13-06-2022 **Accepted:** 22-06-2022 **Published:** 24-03-2023

How to cite this article: Yassi A, Barker S, Lockhart K, Taylor D, Harris D, Hundal H, *et al*. Urban-rural divide in COVID-19 infection and vaccination rates in healthcare workers in British Columbia, Canada. Can J Rural Med 2023;28:47-58.

urbains ont été les plus durement touchés à l'échelle mondiale; les zones rurales ont progressivement été plus touchées. Nous avons comparé l'infection à la COVID-19 et l'adoption du vaccin chez les travailleuses et travailleurs de la santé vivant dans des zones urbaines et rurales au sein de deux régions sanitaires de la Colombie-Britannique (C.-B.), au Canada, et entre ces régions. Nous avons également analysé l'impact d'un mandat de vaccination pour les travailleuses et travailleurs de la santé.

Méthodes: Nous avons suivi les infections au SRAS-CoV-2 confirmées en laboratoire, les taux de positivité et l'adoption du vaccin chez les 29 021 TS d'Interior Health (IH) et les 24 634 TS de Vancouver Coastal Health (VCH), par profession, âge et lieu de résidence, en les comparant à la population générale de cette région. Nous avons ensuite évalué l'impact des taux d'infection ainsi que du mandat sur le recours à la vaccination.

Résultats: Bien que nous ayons trouvé une association entre l'adoption du vaccin par les TS et les taux de COVID-19 des travailleurs de la santé au cours de la période de deux semaines précédentes, les taux plus élevés d'infection par la COVID-19 dans certains groupes professionnels n'ont pas entraîné une augmentation de la vaccination dans ces groupes. En date du 27 octobre 2021, date à laquelle il était interdit aux travailleuses et travailleurs de santé non vaccinés de fournir des soins de santé, seul 1,6% des travailleuses et travailleurs de la VCH, contre 6,5% des travailleuses et travailleurs de l'IH, n'étaient toujours pas vaccinés. Les travailleuses et travailleurs ruraux des deux zones présentaient des taux de non-vaccination significativement plus élevés que les citadins. Plus de 1 800 travailleuses et travailleurs, soit 6,7% des TS ruraux et 3,6% des TS urbains, n'étaient toujours pas vaccinés et devaient être licenciés. Bien que le mandat ait entraîné une augmentation significative de la prise des deuxièmes doses, l'impact sur les personnes non-vaccinées était moins clair.

Conclusions: Comme les zones rurales souffrent souvent d'un manque de personnel, la perte de TS pourrait avoir de graves répercussions sur la prestation des soins de santé ainsi que sur les moyens de subsistance des TS non-vaccinés. Des efforts plus importants sont nécessaires pour comprendre comment mieux aborder les facteurs d'hésitation à SE faire vacciner en milieu rural.

Mots-clés: Travailleuses et travailleurs de la santé, COVID-19, vaccination, mandat de vaccination, milieu rural

INTRODUCTION

Healthcare workers (HCWs) have been on the frontlines of the world's fight against COVID-19, striving to care for COVID-19 patients while also trying to manage regular and ongoing healthcare demands during a pandemic. Significant pressures faced by HCWs during the COVID-19 pandemic have included an increased health system burden, risk of infection, burnout, mental health stresses, risk of healthcare worker shortages and concerns about family transmission.[1] HCWs in rural settings face even greater pressures, as there are often even greater staffing shortages.[2,3]

British Columbia (BC), Canada, instituted mandatory vaccination of healthcare workers; long-term care (LTC) workers were to be vaccinated before 12 October 2021,[4] and those working in acute care and other publicly-funded healthcare facilities were to be vaccinated by 26 October 2021.[5] Vaccine mandates have been discussed for decades for healthcare workers for other communicable diseases such as influenza,[6,7] and while some jurisdictions chose to allow those working in healthcare to remain unvaccinated against COVID-19, the upswing in cases across the world and the Omicron variant[8] led many countries to move towards mandating vaccination for HCWs during this pandemic.[9,10]

In the United States, HCWs from rural areas reported significantly less willingness to take a vaccine in the early phases of the pandemic (26%), compared to their suburban (35%) and urban (37%) peers,[11] with this trend persisting throughout the pandemic.[12] Murthy *et al.* found adult COVID-19 vaccination coverage lower in rural (38.9%) than in urban counties (45.7%) overall, including amongst adults aged 18–64 years (29.1% rural, 37.7% urban), those aged ≥65 years (67.6% rural, 76.1% urban), women (41.7% rural, 48.4% urban) and men (35.3% rural, 41.9% urban).[13] Data on barriers and facilitators to uptake of COVID-19 vaccines within Canada are scarce as Canada has had strong vaccine uptake (81.8% of the Canadian population as of 21 March 2022[14]); however, the range is 70.8% of those in Nunavut to 91.5% in Newfoundland and Labrador.[15] It is well known

that rurality comes with its own set of challenges including recruiting and retaining family physicians and other healthcare professionals,[16-18] making lower vaccine uptake in the face of a mandate requiring vaccination all the more concerning. Access and acceptance disparities in vaccine access have been documented, i.e. people from rural locations having to travel outside their counties to receive a vaccine.[19] This trend has been seen elsewhere as well.[20,21]

Globally, there are disparities noted in the uptake of childhood vaccines with those living in rural locations being less likely to vaccinate their children.[22,23] Rurality itself is defined as an important social determinant of health.[24] As such, there is a particular need to assess the impact not only of COVID-19 infections, but also of how COVID-19 vaccination policies are working in rural compared to urban areas.

As BC brought in a mandate that required vaccination of all HCWs, we sought to compare and contrast rural and urban differences in (1) COVID-19 rates; (2) vaccine uptake, within and between health regions; (3) differences within occupational groups; (4) differences by age-group; (5) impact of higher COVID rates in the previous month on subsequent vaccine uptake and (6) the impact of mandated vaccination (on threat of termination of employment) on vaccine uptake in both settings. Specifically, as vaccine uptake is well established to be an important determinant of COVID-19 morbidity, we sought to understand the extent to which rurality-impacted COVID-19 infection rates, vaccine uptake and drivers of vaccination within two of the five large health regions located in BC, Canada, one mainly rural, located in the interior of the province, namely Interior Health (IH), and one more urban, Vancouver Coastal Health (VCH).

Our study provided an opportunity to examine this question in one of the first jurisdictions to implement a vaccine mandate specifically for healthcare workers.

METHODS

Definition of rural

As discussed by Clark *et al.*,[25] studies vary in how they define 'rural' and 'urban', which can make comparisons difficult.[26] For the purposes of our analyses, we defined a major urban centre as having a regional population >40,000 people and everyone living outside of these areas as rural. As the definition of rurality must always be nuanced to reflect local understandings and realities with relative local comparisons, rather than absolute evaluations across all settings, we deferred to how communities in the Interior of BC define themselves with respect to being rural rather than urban and have explicitly adopted the BC definitions in this study.[27]

Cohort description

The cohort included all healthcare workers employed by IH (n = 29,021) and VCH (n = 24,634) for at least 1 day between 1 March 2020 and 11 November 2021. When analysis considered a specific date within that interval, a subset of the cohort was used, excluding those who did not have an active appointment on that date. In order to be included in this study, HCWs must have been employees of the health authority and thus physicians were not included.

Database

Healthcare worker records were obtained from the provincial Workplace Health Indicator Tracking and Evaluation (WHITE™) database. Following ethics approval (UBC Behavioural Ethics Certificate H21-01380), the data fields extracted included worker demographics (age group, gender, home location), job details (job title, job category, subsector, job location, job start date, and if applicable, job end date), severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) polymerase chain reaction (PCR) testing information (date, test result) and COVID-19 vaccination status (date of vaccine and type of vaccine). Data on the background communities were obtained from the B.C. Centre for Disease Control and included vaccinations (daily vaccination dose totals by health region) and infection totals (daily positive and negative test counts by health region, including age group for positive cases), with regional population data obtained from Statistics Canada. Home and work locations were provided by the local health area (LHA), a subdivision of the regional health authorities; these were further classified as either

urban or rural based on population size of the LHA. Jobs were classified into six categories and ages were classified into four categories.

Statistical analysis

For each health authority, we calculated the SARS-CoV-2 infection rate (per 100,000 population) over time as a 7-day moving average, also plotting the cumulative proportion with 2 or more doses of vaccine, for both HCWs and the background community from 1 March 2020 to 11 November 2021. The background community infection rates were both region and age adjusted by weighting positive cases to match the residence and age range distribution of the workforce. Over the same period, we plotted the same variables for HCWs alone, comparing those residing in rural locations with those residing in urban locations.

SARS-CoV-2 infection rates and COVID-19 vaccination status were tabulated by health authority, occupation group, home residence type (urban/rural) and age group. To address our first four research questions (COVID infection and vaccine uptake respectively, and any differences in this regard between occupational or age groups), effect size models using logistic regression were used to calculate odds ratios. The dependent variable was whether the individual had received at least one dose of vaccine prior to a specified date or not or whether the individual had tested positive for SARS-CoV-2 at least once prior to a specified date. The variables of interest included the home residence type (rural or urban), occupation group and age group. These values were calculated on the day before the vaccine mandate announcement, 12 September 2021, and the day the mandate took effect on 27 October 2021.

To ascertain the extent to which COVID-19 rates in the period prior to vaccination drove vaccination rates (question 4), we considered the period when vaccination was available to healthcare workers, from 15 December 2020 to 11 November 2021. For each date in this observation period, we counted one observation per HCW, where the response was 0 if the HCW was unvaccinated on that date and 1 if they received the first dose on that date, excluding all days after the first dose. The variable of interest was the community infection rate for the home region of the HCW on that date; for this, we calculated the daily 14 day moving average background community SARS-CoV-2 infection rate for each region. To account for repeated measures on a single HCW, conditional logistic regression was used, with each individual HCW making up one of the strata. Anyone who had tested positive prior to 15 December 2020 was also excluded from the calculation.

To examine the final question, the extent to which the mandate for compulsory vaccination of all HCWs drove vaccination uptake, we examined the period from 1 July 2021 to 27 October 2021, using segmented regression analysis[28] of the interrupted time series (ITS) to estimate the immediate and sustained effects on the rate of vaccination following the announcement, where the rate is measured as the proportion of workers who received the dose on a given day out of the total number of workers who had not yet received that dose. For workers in the LTC sector, the mandate took affect a few days earlier; therefore, LTC workers were excluded from this analysis.

RESULTS

Figure 1 shows the HCW and background community SARS-CoV-2 infection rates in IH displayed against vaccination status in these respective groups. The initial small peak shown in Figure 1 could be related to a combination of increased case finding activities in HCWs as well as the less clear guidance on personal protective equipment (PPE) use and less availability of PPE than was the case subsequently. In September and October 2020, HCW infections trailed off significantly, even more so than community infections. In the second wave (beginning towards the end of October 2020), again, a peak occurred wherein HCW COVID-19 rates exceeded community rates, again possibly related to increased case results associated with the policy of testing asymptomatic HCWs during outbreaks. In addition, Figure 1 shows that HCW vaccination was steadily higher than that of the general population.

Figure 2 shows that while VCH experienced a larger initial impact, it did not experience the same intensity of infections in the fourth wave as IH [Figure 1], and that, unlike IH, the HCWs in VCH were largely protected in the third wave.

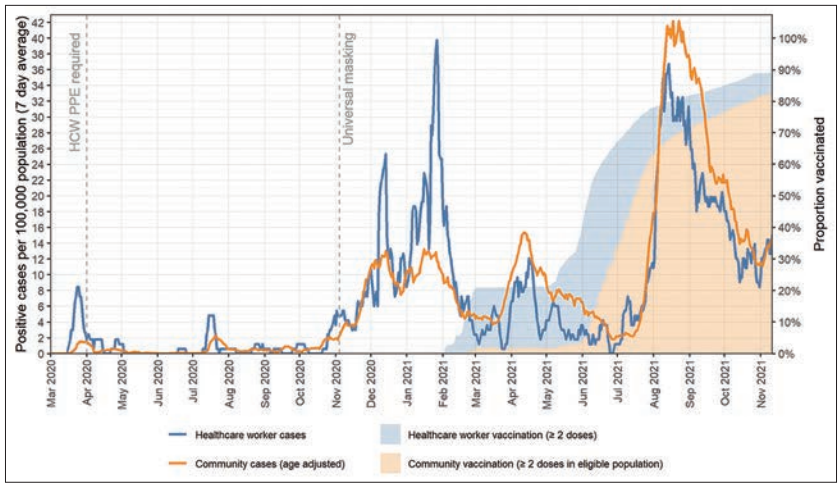

Figure 1: IH COVID-19 case rate in healthcare workers and the age-adjusted community rate, showing the proportion fully vaccinated. IH: Interior Health.

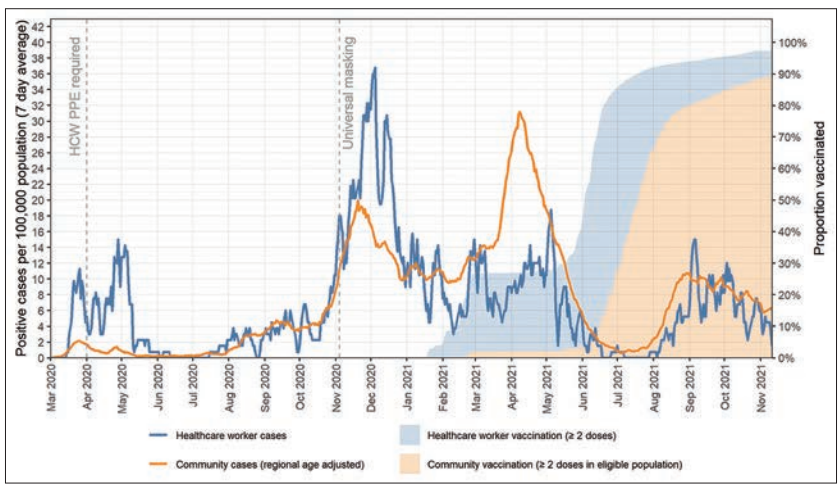

Figure 2: VCH COVID-19 case rate in healthcare workers and the age-adjusted community rate, showing the proportion fully vaccinated. VCH: Vancouver Coastal Health.

Figure 3 shows the urban and rural breakdown of vaccination and cases in healthcare workers in the two jurisdictions (IH and VCH combined). Rural cases have followed a similar trend to their urban counterparts with the exception of spikes in the last 2 months (September–October 2021) where rural cases outpaced those in urban locations.

Table 1 shows that a larger proportion of HCWs living in urban settings were vaccinated compared to their rural counterparts overall. Table 1 further shows a higher rate of unvaccinated rural-dwelling workers (11.3% urban vs. 13.8% rural; odds ratio: 0.79; 95% confidence interval [CI]: 0.73–0.86; $P < 0.001$). Those dwelling rurally and employed by VCH were more than twice as likely to be unvaccinated both on 12 September 2021, the day before the mandate was announced for the entire healthcare workforce (odds ratio: 2.25; 95% CI: 1.85–2.74; $P < 0.001$) and 27 October 2021, when this mandate came into effect (odds ratio: 2.89; 95% CI: 2.20–3.79; $P < 0.001$).

A separate analysis was conducted of only the subset of healthcare workers who worked in LTC facilities, using August 12th, the date of the announcement that all LTC workers would require vaccination. The rate of first doses was shown to significantly increase, but 177 of 5736 (3.1%) LTC workers remained unvaccinated at the time the mandate came into effect, and importantly, 86 (48.6%) of unvaccinated LTC workers were in rural areas.

Before the mandate announcement (12 September 2021), the SARS-CoV-2 infection rate was significantly lower for IH than VCH (3.4% IH vs. 3.9% in VCH; odds ratio: 0.87; 95% CI: 0.79–0.97; $P = 0.009$); rural workers indeed had

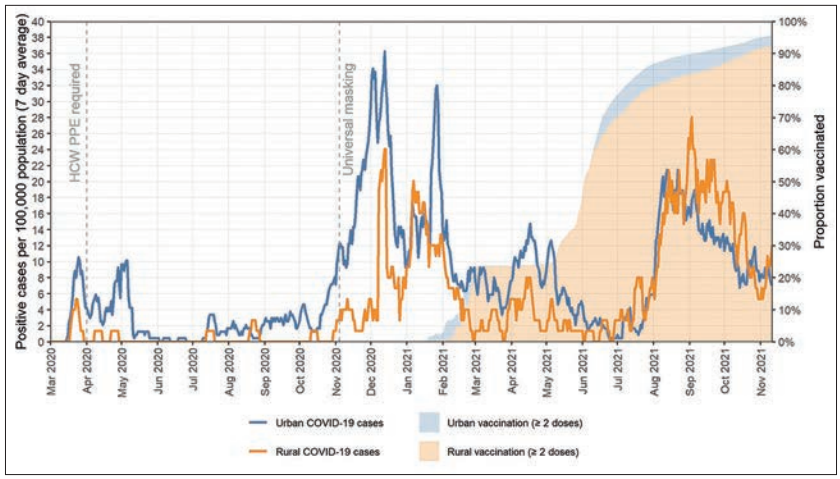

Figure 3: COVID-19 case rate and proportion vaccinated comparing urban and rural populations.

a significantly lower infection rate across both health authorities (2.2% vs. 4.1% amongst urban counterparts; odds ratio: 0.54; 95% CI: 0.47–0.62; $P < 0.001$). Worrisomely, a full 12.2% of HCWs in Interior Health were unvaccinated compared to 3.6% in VCH (odds ratio: 3.76; 95% CI: 3.46, 4.09; $P < 0.001$), despite all being subject to the same provincial policies. The relative difference between health authorities continued to 27 October 2021, when 6.5% of HCWs in Interior Health were still unvaccinated compared to only 1.6% in VCH (odds ratio: 4.17; 95% CI: 3.68–4.72; $P < 0.001$).

Table 1 shows occupational roles and it can be seen that a total of 5.8% of LPN/care aides in IH had contracted PCR-confirmed SARS-COV-2 infections, compared to 4.1% of the IH healthcare workforce overall; in VCH, the corresponding figures were 5.7% and 4.2%. Within IH across both time points, LPN/care aides, administrative and support workers had significantly lower vaccination rates, and nurses and allied health workers had higher vaccination rates. Within VCH, only support workers had a significantly lower vaccination rate, and nurses had a higher vaccination rate.

When considering the differences between age groups, within IH, the vaccinated rate in HCWs was significantly lower in the age group 30–39 years across both time points; simultaneously, the SARS-CoV-2 infection rate was significantly higher in that age group at both time points. In VCH, differences in vaccination by age group did not appear consistent between time points; however, when we considered SARS-CoV-2 infection rates, we found that the infection rate was higher for those aged 39 and under. We analysed the entire workforce of both regions combined to determine differences between urban and rural-dwelling workers, taking age and occupational mix into consideration. We found that rural workers were vaccinated at a significantly lower rate than their age-adjusted and occupation-adjusted counterparts in urban areas, both by September 12th before the mandate was announced (odds ratio: 0.57; 95% CI: 0.53–0.62; $P < 0.001$), and by October 27th when the mandate came into force (odds ratio: 0.55; 95% CI: 0.50–0.61; $P < 0.001$).

In exploring whether infection rates drove vaccine uptake in HCWs, we found that an average increase of 1 case per 100,000 in the community SARS-CoV-2 infection rate was associated with a 3.5% (95% CI: 3.2%–3.8%) increased likelihood of vaccination 2 weeks later.

Our analysis showed the extent to which the announcement of the provincial vaccine mandate requiring all BC healthcare workers to be vaccinated before 27 October 2021 drove up vaccination rates. Interrupted time series (ITS) segmented regression analysis of the period from 1 July 2021 to October 27 showed significant effects over the vaccine mandate period, with similar effects in both urban and rural settings [Table 2]. However, while the daily proportion of unvaccinated workers who received first doses showed an immediate rate increase of 0.78%, (from 1.01% vaccinating per day to 1.79%), the sustained effect was a daily reduction of 0.028% HCWs being

Table 1: Healthcare worker's unvaccinated rate by region on the date of the announcement of the mandate and when it took effect, by residence type, occupation and age group

Worksite region	Exposure group	Remaining unvaccinated							
		12 September 2021				27 October 2021			
		Percentage	#/*n*	OR (95% CI)	COVID + (%)	Percentage	#/*n*	OR (95% CI)	COVID + (%)
IH	Urban	11.3	1703/15,077	0.79 (0.73-0.86)*	4.1	6.0	906/15,145	0.81 (0.73-0.90)*	4.6
	Rural	13.8	1246/9002	1.26 (1.17-1.36)*	2.3	7.3	651/8973	1.23 (1.11-1.36)*	3.1
	LPN/care aides	15.1	1136/7507	1.45 (1.34-1.57)*	4.9	7.6	567/7470	1.30 (1.17-1.45)*	5.8
	Nurses	7.6	493/6479	0.51 (0.46-0.56)*	2.9	4.5	288/6470	0.60 (0.53-0.69)*	3.6
	Administration	13.9	492/3543	1.19 (1.07-1.32)*	2.4	7.9	282/3574	1.29 (1.13-1.48)*	2.6
	Allied health	6.9	214/3117	0.49 (0.43-0.57)*	2.2	3.9	122/3121	0.55 (0.46-0.67)*	2.8
	Support	17.8	566/3176	1.69 (1.52-1.86)*	3.3	8.2	262/3203	1.35 (1.18-1.55)*	4.0
	39 and under	13.5	1413/10,450	1.23 (1.14-1.33)*	4.2	6.8	721/10,563	1.11 (1.01-1.24)*	5.0
	40-49	11.7	643/5476	0.94 (0.86-1.03)	2.9	6.5	360/5508	1.02 (0.90-1.15)	3.7
	50-59	10.8	580/5385	0.83 (0.76-0.92)*	3.1	6.0	320/5353	0.90 (0.79-1.02)	3.7
	60 and over	11.3	313/2768	0.90 (0.80-1.02)	1.8	5.8	156/2694	0.88 (0.74-1.04)	2.0
	Overall	12.2	2949/24,079	-	3.4	6.5	1557/24,118	-	4.1
VCH	Urban	3.2	569/17,696	0.44 (0.37-0.54)*	4.1	1.4	232/16,736	0.35 (0.26-0.45)*	4.4
	Rural	7.0	132/1898	2.25 (1.85-2.74)*	1.8	3.9	70/1795	2.89 (2.20-3.79)*	2.2
	LPN/care aides	4.1	189/4559	1.23 (1.03-1.45)*	5.3	1.9	84/4383	1.25 (0.97-1.61)	5.7
	Nurses	2.8	187/6733	0.69 (0.58-0.81)*	3.6	1.3	83/6318	0.73 (0.57-0.94)*	4.0
	Administration	4.2	157/3703	1.25 (1.04-1.50)*	3.5	1.8	66/3605	1.16 (0.88-1.53)	3.9
	Allied health	3.0	97/3283	0.79 (0.64-0.98)*	2.8	1.3	40/3168	0.74 (0.53-1.03)	2.9
	Support	8.0	55/690	2.45 (1.84-3.26)*	4.0	3.4	23/670	2.24 (1.45-3.45)*	4.3
	39 and under	3.4	281/8312	0.90 (0.78-1.06)	4.7	1.4	109/7672	0.80 (0.63-1.01)	5.0
	40-49	3.1	141/4478	0.85 (0.70-1.02)	3.9	1.3	58/4346	0.77 (0.58-1.03)	4.5
	50-59	4.2	186/4402	1.26 (1.06-1.49)*	3.0	1.9	80/4.280	1.20 (0.93-1.56)	3.2
	60 and over	3.9	93/2402	1.10 (0.88-1.37)	2.7	2.5	55/2233	1.64 (1.22-2.21)*	2.8
	Overall	3.6	701/19,594	-	3.9	1.6	302/18,531	-	4.2
Overall (both VCH and IH combined)	Urban	6.9	2272/32,773	0.51 (0.48-0.55)*	4.1	3.6	1138/31,881	0.52 (0.47-0.57)*	4.5
	Rural	12.6	1378/10,900	1.94 (1.81-2.08)*	2.2	6.7	721/10,768	1.94 (1.76-2.13)*	3.0
	LPN/care aides	11.0	1325/12,066	1.55 (1.45-1.67)*	5.0	5.5	651/11,853	1.42 (1.29-1.57)*	5.8
	Nurses	5.1	680/13,212	0.50 (0.46-0.55)*	3.2	2.9	371/12,788	0.57 (0.51-0.64)*	3.8
	Administration	9.0	649/7246	1.10 (1.00-1.20)*	3.0	4.8	348/7179	1.14 (1.02-1.29)*	3.2

Contd...

Table 1: Contd...

Worksite region	Exposure group	Remaining unvaccinated							
		12 September 2021				27 October 2021			
		Percentage	#/n	OR (95% CI)	COVID + (%)	Percentage	#/n	OR (95% CI)	COVID + (%)
	Allied health	4.9	311/6400	0.52 (0.46-0.58)*	2.5	2.6	162/6289	0.54 (0.46-0.64)*	2.8
	Support	16.1	621/3866	2.32 (2.12-2.55)*	3.5	7.4	285/3873	1.88 (1.65-2.14)*	4.1
	39 and under	9.0	1694/18,762	1.16 (1.09-1.25)*	4.4	4.6	830/18,235	1.08 (0.99-1.19)	5.0
	40-49	7.9	784/9954	0.92 (0.85-1.00)*	3.3	4.2	418/9854	0.96 (0.86-1.08)	4.0
	50-59	7.8	766/9787	0.91 (0.84-0.99)*	3.1	4.2	400/9633	0.94 (0.84-1.05)	3.5
	60 and over	7.9	406/5170	0.93 (0.83-1.03)	2.2	4.3	211/4927	0.98 (0.85-1.13)	2.4
	Overall	8.4	3650/43,673	-	3.6	4.4	1859/42,649	-	4.1

*Unadjusted OR is significant at 95% confidence. LPN: Licensed practical nurse, OR: Odds ratio, CI: Confidence interval, IH: Interior Health, VCH: Vancouver Coastal Health

vaccinated each day after the announcement. This showed a sustained cumulative effect of -1.29% over the 45-day period between the mandate announcement and implementation, such that the overall impact of the mandate on first dose uptake was unclear [Figure 4]. When second doses were considered, the immediate effect was not significant, but the sustained effect showed a significant increase, as would be expected [Figure 5]. The sustained effect rate increase, of 0.063% second doses daily, after the mandate announcement, showed a sustained cumulative effect of 2.77% over the period.

DISCUSSION

Globally, HCWs have faced a heavy emotional and physical toll during the pandemic, including shouldering care for children and elderly relatives along with their essential health system role.[29] Notwithstanding reports[30,31] of peaks in HCW infections in the early stages possibly being attributed to increased testing, these studies, as well as results here, show that some occupational groups of HCWs were at particularly higher risk of COVID-19 infection.[30] The combined burden of psychological, social and physical work-related stressors has caused those working on the frontlines of healthcare to quit in unprecedented numbers.[32]

The rural–urban divide in vaccine uptake by HCWs is concerning. While we found an association between vaccine uptake by HCWs and HCW COVID-19 rates in the preceding 2-week period as would be expected, the higher rates of COVID-19 infection in some occupational groups did not lead to increased vaccination in these groups.

For some HCWs who may be vaccine hesitant, mandates exacerbated an already stressful situation.[33] In some jurisdictions, vaccine mandates have been highly effective in driving up vaccinations; in France, the law on mandatory vaccination for HCWs led to a massive boost in vaccination rates, from 60% in July (when the new requirement was announced) to over 99% in October,[34] with COVID-19 cases declining.[35] However, it is important to note the downside to vaccine mandates for HCWs[36] – while vaccination increased, those who chose not to be vaccinated lost their jobs and were lost to the healthcare system[37] - at least temporarily - with

Table 2: Effect of the vaccine mandate on the vaccination rate for both first and second doses, using segmented regression interrupted time series analysis

Subgroup	First doses (95% CI)		Second doses (95% CI)	
	Immediate effect	Sustained effect	Immediate effect	Sustained effect
IH	0.67 (0.22-1.11)*	−0.028 (−0.044-−0.013)*	0.15 (−0.23-0.53)	0.055 (0.042-0.068)*
VCH	1.25 (0.48-2.01)*	−0.023 (−0.050-0.003)	−0.19 (−0.71-0.33)	0.094 (0.076-0.112)*
Urban	0.69 (0.19-1.19)*	−0.020 (−0.037-−0.003)*	0.03 (−0.36-0.41)	0.067 (0.053-0.080)*
Rural	0.88 (0.33-1.42)*	−0.040 (−0.059-−0.022)*	0.22 (−0.28-0.72)	0.055 (0.038-0.072)*
LPN/care aides	0.82 (0.22-1.42)*	−0.027 (−0.047-−0.006)*	−0.14 (−0.53-0.24)	0.052 (0.039-0.065)*
Nurses	0.64 (0.15-1.13)*	−0.030 (−0.047-−0.013)*	0.24 (−0.18-0.65)	0.045 (0.031-0.060)*
Administration	0.65 (0.12-1.18)*	−0.013 (−0.031-0.006)	0.33 (−0.24-0.91)	0.087 (0.067-0.107)*
Allied health	1.05 (0.48-1.61)*	−0.040 (−0.059-−0.021)*	−0.10 (−0.68-0.48)	0.065 (0.045-0.085)*
Support	1.18 (0.45-1.92)*	−0.046 (−0.072-−0.021)*	−0.06 (−0.62-0.50)	0.065 (0.046-0.084)*
39 and under	0.68 (0.16-1.20)*	−0.033 (−0.051-−0.015)*	0.05 (−0.33-0.44)	0.060 (0.046-0.073)*
40-49	0.73 (0.14-1.31)*	−0.022 (−0.043-−0.002)*	0.11 (−0.39-0.60)	0.065 (0.048-0.082)*
50-59	1.02 (0.39-1.64)*	−0.028 (−0.050-−0.007)*	0.16 (−0.34-0.67)	0.072 (0.055-0.089)*
60 and over	1.01 (0.49-1.52)*	−0.016 (−0.034-0.001)	0.19 (−0.34-0.73)	0.057 (0.039-0.075)*
Overall	0.78 (0.31-1.25)*	−0.028 (−0.044-−0.012)*	0.09 (−0.29-0.47)	0.063 (0.050-0.076)*

*Effect of the mandate compared is significantly different from 0 at 95% confidence. No subgroup is significantly different from the other subgroups.
CI: Confidence interval, LPN: Licensed practical nurse, IH: Interior Health, VCH: Vancouver Coastal Health

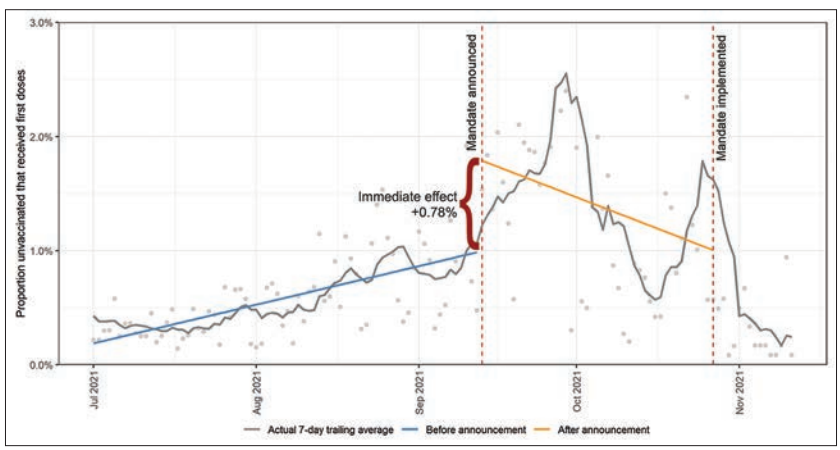

Figure 4: Overall daily proportion of unvaccinated who received first doses from 1 July 2021 to 11 November 2021, with the segmented regression ITS predicted values (blue and orange lines). ITS: Interrupted time series.

the long-term effects not yet known. The impacts have been felt more in small towns and rural locations,[37,38] which were already suffering from staff-shortages. In our study, over 1800 workers, comprising 6.4% of rural HCWs and 3.5% of urban HCWs, remained unvaccinated when the mandate was enforced, despite consequent employment termination.

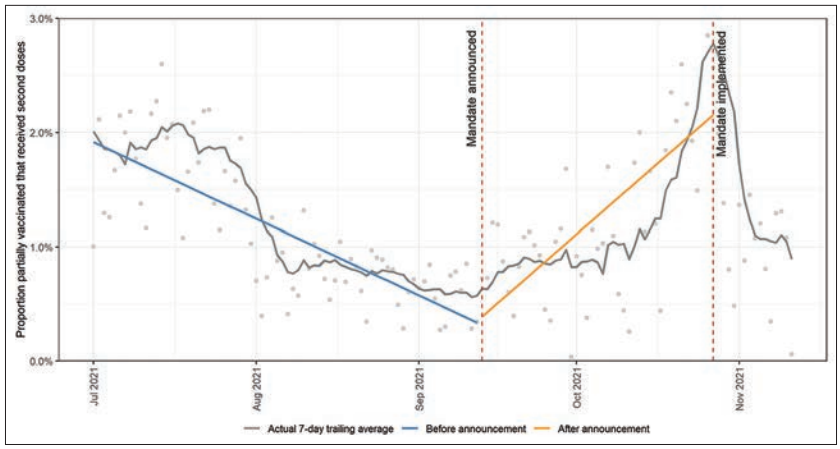

Figure 5: Overall daily proportion of partially vaccinated workers who received second doses from 1 July 2021 to 11 November 2021, with the segmented regression ITS predicted values. ITS: Interrupted time series.

Similar to other studies,[39] we expected mandates to drive up vaccination rates. In a study of 6 countries, it was noted that countries with pre-intervention vaccine uptake below average had a more pronounced increase in daily vaccinations following mandatory COVID-19 certificates compared with those where uptake was already average or higher.[36] As such, we expected that the BC mandate for HCWs would have significantly narrowed the gap in vaccine uptake between rural and urban HCWs. We found, however, that while the vaccination mandate increased vaccine rates in HCWs in BC, the policy fell short of achieving very high levels of uptake. The vaccine mandate had a significant, albeit small, effect on uptake of second doses, suggesting some impact amongst those hesitant to be vaccinated. It did not significantly impact first dose uptake, indicating a lack of significant change amongst those who decisively rejected vaccination.

Limitations

The data used on vaccination in this study were taken directly from provincial immunisation figures and we have confidence in their validity. Nonetheless, possible limitations of this study include differences in testing strategies in various parts of the province of BC at different points in the pandemic and between HCWs and the general population; VCH began vaccinating HCWs in December of 2020 and IH began in January of 2021 which may have slightly impacted uptake, although is unlikely to have had a major impact on the results. Furthermore, we used local definitions of 'rural' and 'urban' based on the configuration of the population in our two health authorities.

Future research

With ongoing concern and uncertainly regarding emerging Omicron variants,[40] further research is needed to better understand the reasons behind vaccine hesitancy and what can be done to address these factors. The analysis presented here was conducted based on data ending just before Omicron spread rapidly in this jurisdiction; further analysis is needed to assess the long-term impact on vaccine uptake given the lower effectiveness of the vaccine against Omicron[41] and possible requirements for more than a third dose (or booster) in future. Specifically, it is crucial that we acquire a deep understanding of how rurality impacts the 7Cs of vaccine hesitancy[42] (complacency: not perceiving diseases as high risk enough to bother taking action; constraints: structural and psychological barriers; confidence: trust in the effectiveness and safety of vaccines, the system that delivers these and/or motivations of policymakers; calculation: calculating one's own risk; and aspects pertaining to collective responsibility, i.e. willingness to protect others; as well as conspiracy: the tendency to endorse conspiratorial beliefs about vaccination and compliance: the tendency to adhere to regulations). Moreover, with ongoing boosters possibly essential to protect the health of the public, it is necessary that attention be paid to how to increase uptake of vaccinations in rural healthcare workers without aggravating staff shortages in these areas. Given that rural HCWs'

beliefs, behaviours and actions are reflective of their communities,[43,44] there may be value in examining the impacts of rural community-based strategies at the local level[45] with the view to improving the effectiveness of vaccination uptake and other public health/health literacy initiatives/campaigns. Intervention studies exploring the use of trusted local leaders and the impact on vaccine uptake are needed.

CONCLUSION

Since conducting this study, there has been Canadian media coverage of exorbitant wait times for healthcare reported to be driven by staffing issues; the underlying factors impacting staffing shortages must be further explored. In this context, greater efforts are needed to understand the urban–rural divide and the role of vaccine policy.

Financial support and sponsorship: Funding for this study was received from the Canadian Institutes of Health Research (CIHR) under grant (VS1-175519), "Protecting healthcare workers from COVID-19: a comparative contextualized analysis". AY also received funding from the Canada Research Council as a CRC Chairholder.

Conflicts of interest: There are no conflicts of interest.

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ORIGINAL ARTICLE

Systematic review of the use of metformin compared to insulin for the management of gestational diabetes: Implications for low-resource settings

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This article has been peer reviewed.

Abstract

Introduction: This systematic review examines the effectiveness of metformin treatment compared to insulin treatment for gestational diabetes within the context of a low-resource environment.

Methods: Electronic data searches of Medline, EMBASE, Scopus and Google scholar databases from 1 January, 2005 to 30 June, 2021 were performed using medical subject headings: *'gestational diabetes or pregnancy diabetes mellitus'* AND *'Pregnancy or pregnancy outcomes'* AND *'Insulin' AND 'Metformin Hydrochloride Drug Combination*/or *Metformin*/or *Hypoglycemic Agents'* AND *'Glycemic control or blood glucose'*.

Randomized controlled trials were included if: participants were pregnant women with gestational diabetes mellitus (GDM); the interventions were metformin and/or insulin. Studies among women with pre-gestational diabetes, non-randomised control trials or studies with a limited description of the methodology were excluded. Outcomes included adverse maternal outcomes: weight gain, C-section, pre-eclampsia and glycaemic control and adverse neonatal outcomes: birth weight, macrosomia, pre-term birth and neonatal hypoglycaemia. The revised Cochrane Risk of Bias Assessment for randomised trials was used for the evaluation of bias.

Results: We screened 164 abstracts and 36 full-text articles. Fourteen studies met the inclusion criteria. The studies provide moderate to high-quality evidence demonstrating the effectiveness of metformin as an alternative therapy to insulin. Risk of bias was low; multiple countries and robust sample sizes improved external validity. All studies were from urban centres with no rural data.

Conclusion: These recent high quality studies comparing metformin to insulin for the treatment of GDM generally found either improved or equivalent pregnancy outcome and good glycaemic control for most patients, although many required insulin supplementation. Its ease of use, safety and efficacy

Received: 14-05-2022 **Accepted:** 24-06-2022 **Published:** 24-03-2023

How to cite this article: Kattini R, Kelly L, Hummelen R. Systematic review of the use of metformin compared to insulin for the management of gestational diabetes: Implications for low-resource settings. Can J Rural Med 2023;28:59-65.

Access this article online

Quick Response Code:

Website: www.cjrm.ca

DOI: 10.4103/cjrm.cjrm_40_22

suggest metformin may simplify the management of gestational diabetes, particularly in rural and other low-resource environments.

Keywords: Gestational diabetes, metformin, rural, treatment

Résumé

Introduction: Cette revue systématique examine l'efficacité du traitement par metformine par rapport au traitement par insuline pour le diabète gestationnel dans le contexte d'un environnement à faibles ressources.

Méthodes: Des recherches de données électroniques ont été effectuées dans les bases de données Medline, Embase, Scopus et Google scholar du 1er janvier 2005 au 30 juin 2021 en utilisant les termes MeSH: *'gestational diabetes or pregnancy diabetes mellitus'* AND *'Pregnancy or pregnancy outcomes'* AND *'Insulin'* AND *'Metformin Hydrochloride Drug Combination/or Metformin/or Hypoglycemic Agents'* AND *'Glycemic control or blood glucose'.*

Les essais contrôlés randomisés ont été inclus si: les participantes étaient des femmes enceintes atteintes de diabète gestationnel (DG); les interventions étaient la metformine et/ou l'insuline. Les études portant sur des femmes atteintes de diabète prégestationnel, les essais contrôlés non randomisés ou les études dont la description de la méthodologie était limitée ont été exclus. Les résultats comprenaient des résultats maternels défavorables: prise de poids, césarienne, prééclampsie, contrôle glycémique et des résultats néonatals défavorables: poids de naissance, macrosomie, naissance prématurée et hypoglycémie néonatale. La version révisée de l'évaluation du risque de biais de Cochrane pour les essais randomisés a été utilisée pour l'évaluation du biais.

Résultats: Nous avons examiné 164 résumés et 36 articles complets. Quatorze études répondaient aux critères d'inclusion. Les études fournissent des preuves modérées à de haute qualité démontrant l'efficacité de la metformine comme thérapie alternative à l'insuline. Le risque de biais était faible; la multiplicité des pays et la taille robuste des échantillons ont amélioré la validité externe. Toutes les études provenaient de centres urbains, sans données rurales.

Conclusion: Ces études récentes de haute qualité comparant la metformine à l'insuline pour le traitement du DG ont généralement constaté une amélioration ou une équivalence de l'issue de la grossesse et un bon contrôle glycémique pour la plupart des patientes, bien que beaucoup d'entre elles aient eu besoin d'un supplément d'insuline. Sa facilité d'utilisation, son innocuité et son efficacité suggèrent que la metformine pourrait simplifier la prise en charge du diabète gestationnel, notamment en milieu rural et dans d'autres environnements à faibles ressources.

Mots clés: Diabète gestationnel, traitement, metformine, rural

INTRODUCTION

Rural Canadians are estimated to have higher rates of diabetes, complications and undiagnosed diabetes.[1-5] This difference extends to pregnancy where increased rates of gestational diabetes mellitus (GDM) contribute to higher maternal and neonatal morbidity.[6-8] While GDM affects approximately 6% of Canadian pregnancies, rates are much higher (12%) in Northwest Ontario with a large First Nations population.[9]

Treatment of GDM decreases the risk of adverse pregnancy outcomes.[10] For decades, insulin has been the recommended treatment but requires self-administration by injection and regular monitoring of glucose levels.[11] This can be challenging in rural areas where physician and dietary resources are limited and weather and geography can make frequent follow up impractical.

Metformin, an oral biguanide hypoglycaemic, has recently been introduced as a more user-friendly alternative to insulin in the treatment of GDM.[12,13] It improves glucose metabolism by suppressing hepatic glucose production and increases gut metabolism and peripheral glucose uptake.[14] Unlike other hypoglycaemics, there is no associated risk of hypoglycemia.[15]

This review of recent literature compares the effectiveness of metformin to insulin in improving pregnancy outcomes and achieving glycaemic control in women with diabetes in pregnancy.

METHODS

Data sources

Electronic data searches of Medline, Embase, Scopus and Google Scholar databases from 1 January, 2005

to 30 June, 2021 were performed using medical subject headings terms: '*gestational diabetes or pregnancy diabetes mellitus'* AND '*Pregnancy or pregnancy outcomes'* AND *'Insulin' AND 'Metformin Hydrochloride Drug Combination*/or *Metformin*/or *Hypoglycemic Agents'* AND *'Glycemic control or blood glucose'*.

Study selection

Studies were included if they met 3 criteria: participants were pregnant women with GDM; the interventions were metformin with or without supplemental insulin, and insulin alone; studies were randomized controlled trials reporting on the outcomes of interest. Studies among women with pre-gestational diabetes, non-randomised control trials or studies with a limited description of the methodology, non-English language and abstracts/posters were excluded.

Outcomes studied were adverse maternal outcomes: Weight gain, C-section, pre-eclampsia and glycaemic control and adverse neonatal outcomes: Birth weight, macrosomia, pre-term birth and neonatal hypoglycaemia.

Data extraction and quality assessment

Data included authors, year published, number of subjects, study design, results. The revised Cochrane Risk of Bias Assessment for randomised trials was used for the evaluation of bias.[16]

RESULTS

The review included 14 randomised controlled trials on the use of metformin as a treatment for GDM.[17-30] All studies compared the pregnancy outcomes of metformin-treated patients with insulin-treated patients, and all examined the effectiveness of metformin in achieving glycaemic control. Eleven countries were represented with 60–751 participants (average 180) [Figure 1].

Pregnancy outcomes

Maternal outcomes for women treated with metformin compared to insulin, experienced lower maternal weight gain in 7 studies[17,18,22-25,29][Table 1].

All but two studies found C-section rates were unaffected by metformin use. A 2011 study (n = 97) identified a tendency towards

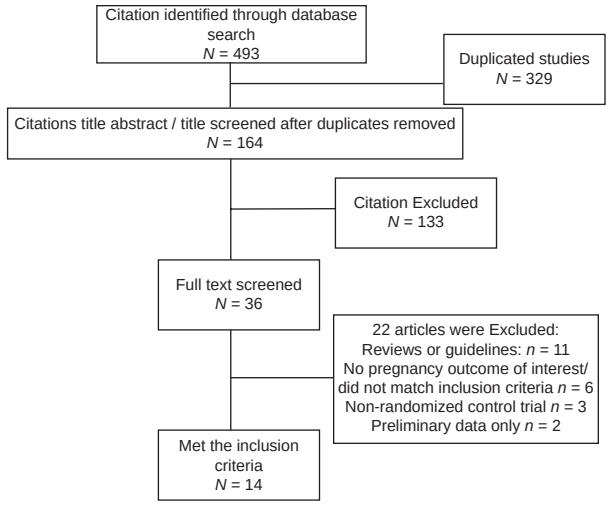

Figure 1: Study selection flow chart.

increased C-sections, while a larger 2021 study (n = 200) found a lower incidence.[21,24]

Neonatal outcomes were favourable: 4 studies have found less hypoglycaemia in the metformin-treated group.[17,25,27,29] Neonatal birth weight was found to be significantly lower in the metformin group compared to insulin in four different studies.[17,20,21,23] Rates of pre-term birth were lower in the metformin group in 1 study which excluded women who required insulin supplementation.[28] Two studies found an increase in pre-term births (P = 0.04), but no increased incidence of either neonatal respiratory distress or neonatal intensive care unit (NICU) admission.[25,27]

Other pregnancy outcomes not assessed across all studies found a positive metformin profile associated with severe maternal hypoglycaemia, mean neonatal glucose level at birth, neonatal jaundice, respiratory distress and NICU admission[17,22-25,29] [Table 2].

Glycaemic control

All 14 studies concluded that metformin was effective in the management of GDM, but in 12 studies, between 3% and 46% of patients started on the metformin required supplemental insulin to maintain glycaemic control [Table 2]. Patient satisfaction with metformin use was high.[25,29] Rowan's 2008 study (n = 751) found more women would choose to receive their assigned metformin treatment again (76.6% vs. 27.2%, P < 0.001) compared to insulin-treated women.[25]

Patients on combination therapy had lower median dose of insulin (42 vs. 50 units. P = 0.002)

Table 1: Maternal outcomes for metformin use compared to insulin for the treatment of gestational diabetes

Author (year)	Weight gain	C-sections	Pre-eclampsia	Glycemic control	Women in the metformin group who required insulin supplementation, *n* (%)
Ainuddin *et al.*, (2015)[17]	↓	↔	↓	↔	32 (43)
Ashoush *et al.*, (2016)[18]	↓	↔	↔	↔	11 (23)
Ghomian *et al.*, (2019)[19]	↔	↔	↔	↔	30 (17)
Hamadani *et al.*, (2017)[20]	↔	↔	N/A	↔	N/A
Ijäs *et al.*, (2011)[21]	↔	↑	N/A	↔	15 (32)
Mesdaghinia *et al.*, (2013)[22]	↓	↔	↔	↔	22 (22)
Niromanesh *et al.*, (2012)[23]	↓	↔	↔	↔	11 (14)
Picon-Cesar *et al.*, (2021)[24]	↓	↓	↔	↔	24 (21)
Rowan *et al.*, (2008)[25]	↓	↔	↔	↔	168 (46)
Ruholamin *et al.*, (2014)[26]	N/A	↔	↔	↔	2 (3)
Saleh *et al.*, (2016)[27]	N/A	↔	↔	↔	N/A
Somani *et al.*, (2016)[28]	↔	↔	↔	↔	8 (25)
Spaulonci *et al.*, (2013)[29]	↓	↔	↔	↔	12 (26)
Tertti *et al.*, (2013)[30]	↔	↔	↔	↔	23 (21)

↔: No significant difference between metformin group and insulin group, ↑: Significantly higher in metformin group compared to insulin group, ↓: Significantly lower in metformin group compared to insulin group, N/A: Not available

Table 2: Neonatal outcomes for metformin use compared to insulin for the treatment of gestational diabetes

Author (year)	Birth weight	Neonatal hypoglycemia	Preterm birth	LGA/macrosomia
Ainuddin *et al.*, (2015)[17]	↓	↓	↔	↔
Ashoush *et al.*, (2016)[18]	↔	↔	↔	↔
Ghomian *et al.*, (2019)[19]	↔	↔	↔	↔
Hamadani *et al.*, (2017)[20]	↓	N/A	N/A	N/A
Ijäs *et al.*, (2011)[21]	↓	↔	N/A	↔
Mesdaghinia *et al.*, (2013)[22]	↔	↔	↓	↔
Niromanesh *et al.*, (2012)[23]	↓	↔	↔	↓
Picon-Cesar *et al.*, (2021)[24]	↔	↔	↔	↔
Rowan *et al.*, (2008)[25]	↔	↓	↑	↔
Ruholamin *et al.*, (2014)[26]	↔	↔	↔	↔
Saleh *et al.*, (2016)[27]	↔	↓	↑	↔
Somani *et al.*, (2016)[28]	↔	↔	↔	↔
Spaulonci *et al.*, (2013)[29]	↔	↓	↔	↔
Tertti *et al.*, (2013)[30]	↔	↔	↔	↔

↔: No significant difference between metformin group and insulin group, ↑: Significantly higher in metformin group compared to insulin group, ↓: Significantly lower in metformin group compared to insulin group, N/A: Not available, LGA: Large for gestational age

and had similar pregnancy outcomes to those treated with metformin alone.[25] The group of patients requiring insulin supplementation had distinct baseline characteristics: higher body

mass index, glucose levels and gestational age at diagnosis and had a higher proportion of Maori or Pacific Islander Indigenous patients (30% vs. 13%, $P < 0.001$).[25]

The study with the highest proportion of participants requiring supplemental insulin (46%), occurred in 10 urban obstetrical hospitals in New Zealand and Australia, and enrolled 363 patients in the metformin group.[25] They defined adequate control as <30% of glycaemic measurements in the reference range (fasting <5.5 mmol/L; 2-h pc <7.0 mmol/L). These target levels are less stringent than present recommended Canadian values of 5.3 mmol/L and 6.7 mmol/L.[4] Insulin supplementation commenced at a median of 20.4 days (interquartile range 12.4–27.5) after beginning metformin.

Assessment of risk of bias

Bias risk was assessed using the Cochrane risk-of-bias tool for randomised trials (RoB 2)[16] which assesses studies across 7 fields including randomisation process, deviation from intervention, missing data outcomes, measurement of outcomes, selection of results reported and overall bias risk. Thirteen of the included studies had a low risk of bias and 1 study had minimal bias concerns [Figure 2].

DISCUSSION

All 14 studies found metformin-treated patients had improved, or equivalent, pregnancy outcomes. Metformin was protective of neonatal hypoglycemia, macrosomia and maternal weight gain. Two studies documented a higher number of pre-term births in patients using metformin, but no increase in neonatal respiratory distress or NIU admission.[24,26] Nine studies found no difference.[17-20,22-25,27-30] This finding is supported by a 2021 meta-analysis of 4545 subjects (including type 2 diabetes mellitus patients) that found an equivalent incidence of pre-term birth.[31]

Metformin was effective for glycaemic control, but 3%–46% of patients required supplemental insulin for glycaemic control in eight studies[17-19,23-25,29,30] [Table 1].

Diabetes Canada supports the use of metformin or insulin for the treatment of GDM when diet and physical activity fail to achieve adequate glycaemic control, but counsels that metformin crosses the placenta.[32] While follow-up studies have not shown developmental concerns, longer-term studies are needed.[32,33] The literature generally compares an intervention to 'routine care' and assumes insulin therapy is accompanied by adequate monitoring and follow up. This may not be the case in all rural practices, where metformin may be more manageable than insulin therapy.

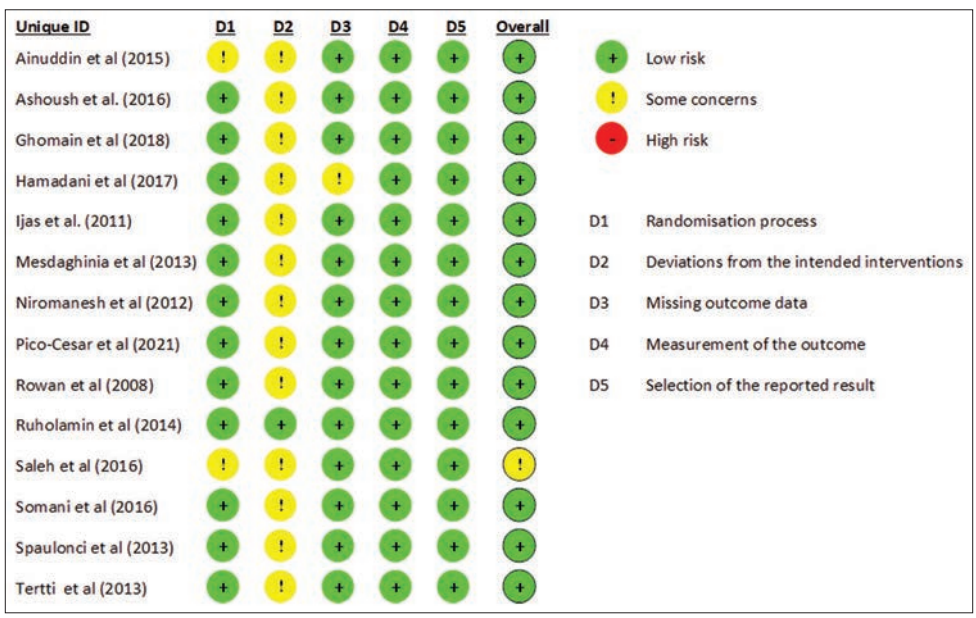

Figure 2: Assessment of the risk of bias in the included studies Version 2 of the Cochrane risk-of-bias tool for randomised trials.

Adopting practical and effective treatment approaches is particularly important in primary care and rural and remote communities where access to specialist care is limited.

Limitations

There was no direct rural context in the reviewed studies. They were in large urban centres and no rural population subsets were identified. It was assumed that adequate dietary and clinical support and monitoring existed. Patient performance of glycaemic monitoring or insulin administration was not measured.

CONCLUSION

Recent high quality studies comparing metformin to insulin for the treatment of GDM generally found either improved or equivalent pregnancy outcome and good glycaemic control for most patients, although many required insulin supplementation. Its ease of use, safety and efficacy suggest metformin may simplify the management of gestational diabetes, particularly in rural and remote communities.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

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Original Article

Surgery in the western Canadian Arctic: The relative impact of family physicians with enhanced surgical skills working collaboratively with specialist surgeons

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This article has been peer reviewed.

Access this article online

Quick Response Code:

Website: www.cjrm.ca

DOI: 10.4103/cjrm.cjrm_44_22

Abstract

Introduction: Little is known about the surgical needs of rural, remote or circumpolar populations in Canada; these same regions are also home to half of all Indigenous people in the country. In the present study, we sought to understand the relative impact of family physicians with enhanced surgical skills (FP-ESS) and Specialist Surgeons in the surgical care of a mostly Indigenous rural and remote community in the western Canadian Arctic.

Methods: A descriptive and retrospective quantitative study was conducted to determine the number and range of procedures performed for the defined catchment population of the Beaufort Delta Region of the Northwest Territories, as well as the type of surgical provider and location of that service, over the 5 years from 1 April, 2014, to 31 March, 2019.

Results: FP-ESS physicians in Inuvik performed 79% of all endoscopic and 22% of all surgical procedures, which accounted for nearly half of the total procedures performed. Over 50% of all procedures were performed locally (47.7% by FP-ESS and 5.6% by visiting specialist surgeons). For surgical cases alone, nearly one-third were performed locally, one-third in Yellowknife and the remaining one-third out-of-territory.

Conclusions: This networked model reduces the overall demand on surgical specialists, who can better focus their efforts on surgical care that is beyond the scope of FP-ESS. With nearly half of the procedural needs of this population being met locally by FP-ESS, there are decreased health-care costs, better access and more surgical care closer to home.

Keywords: Family physicians with enhanced surgical skills, rural medicine, rural specialists, specialist surgeons, surgery

Résumé

Introduction: On connaît peu les besoins en chirurgie des populations rurales, éloignées ou circumpolaires du Canada; ces mêmes régions abritent également la moitié de tous les peuples autochtones du pays. Dans la présente étude, nous

Received: 01-06-2022 **Revised:** 04-08-2022 **Accepted:** 04-08-2022 **Published:** 24-03-2023

How to cite this article: Falk R, Topstad D. Surgery in the western Canadian Arctic: The relative impact of family physicians with enhanced surgical skills working collaboratively with specialist surgeons. Can J Rural Med 2023;28:66-72.

avons cherché à comprendre l'impact relatif des médecins de famille ayant des compétences chirurgicales améliorées (FP-ESS) et des chirurgiens spécialistes dans les soins chirurgicaux d'une communauté rurale et éloignée principalement autochtone dans l'Arctique canadien occidental.
Méthodes: Une étude quantitative descriptive et rétrospective a été menée pour déterminer le nombre et l'éventail des procédures effectuées pour la population desservie définie de la région du delta de Beaufort des Territoires du Nord-Ouest, ainsi que le type de fournisseur de services chirurgicaux et le lieu de ce service; sur une période de 5 ans allant du 1er avril 2014 au 31 mars 2019.
Résultats: Les médecins de la FP-ESS à Inuvik ont effectué 79% de toutes les procédures endoscopiques et 22% de toutes les procédures chirurgicales, ce qui représente près de la moitié du total des procédures effectuées. Plus de 50% de toutes les procédures ont été effectuées localement (47,7% par la FP-ESS et 5,6% par des chirurgiens spécialistes en visite). Pour les cas chirurgicaux seulement, près d'un tiers ont été effectués localement, un tiers à Yellowknife et le dernier tiers à l'extérieur du territoire.
Conclusions: Ce modèle en réseau réduit la demande globale de spécialistes en chirurgie, qui peuvent mieux concentrer leurs efforts sur les soins chirurgicaux qui ne relèvent pas de la compétence de la FP-ESS. Comme près de la moitié des besoins procéduraux de cette population sont satisfaits localement par la FP-ESS, les coûts des soins de santé diminuent, l'accès est amélioré et les soins chirurgicaux sont plus proches du domicile.

Mots clés: Chirurgie, spécialistes ruraux, chirurgiens spécialisés, médecins de famille aux compétences chirurgicales renforcées, médecine rurale

INTRODUCTION

Little is known about the surgical needs of rural, remote or circumpolar populations in Canada; these same regions are also home to half of all Indigenous people in the country.[1,2] In 2015, the Truth and Reconciliation Commission (TRC) of Canada established a list of 94 Calls to Action 'to redress the legacy of residential schools and advance the process of Canadian reconciliation'.[3] Seven of these relate to healthcare for Indigenous Canadians. While none of them refers to surgical care specifically, Call to Action 19 calls upon 'the federal government, in consultation with Aboriginal peoples, to establish measurable goals to identify and close the gaps in health outcomes between Aboriginal and non-Aboriginal communities…'.[3] One step in closing this gap and improving surgical outcomes is to better understand the burden of surgical disease and how current models of service delivery meet those needs.

For remote populations too small to support local specialist surgeons, surgical care can be delivered by itinerant specialist surgeons, community family physicians with Enhanced Surgical Skills (FP-ESS) and/or by transferring all cases to referral hospitals.[4-6] In the Beaufort Delta Region, (BDR) Northwest Territories, surgical care is provided by integrating these three options in an informal networked model. The FP-ESS physicians in the community provide consistent coverage, continuity of care and interact with and are supported by visiting surgeons from obstetrics and gynaecology, general surgery, otolaryngology and orthopaedic surgery. For cases too complex to be performed locally and/or which require other surgical specialities, patients must travel by air to the secondary (Yellowknife; 1103 km from Inuvik) or tertiary level (Edmonton; 922 km from Yellowknife) hospitals. Further details about this networked model for surgical care and the working relationship between FP-ESS and specialist surgeons can be found in our recent publication.[7]

In the present study, we sought to understand which surgical procedures were performed by which type of surgical provider, at each level of the health-care system for any Beaufort Delta resident from 1 April, 2014 to 31 March, 2019. With this data, we intend to demonstrate the relative impact of each of the surgical specialities, as well as that of FP-ESS, on the overall surgical care for this population. To our knowledge, this perspective of a rural surgical system in a circumpolar and mostly Indigenous region, has never been demonstrated in the literature.

METHODS

A descriptive and retrospective quantitative study was designed to determine the number and range of procedures performed for the defined catchment

population of the Beaufort Delta Region of the Northwest Territories (6931 people), as well as the type of surgical provider and location of that service, over the 5 years from 1 April, 2014 to 31 March 2019. This study was conducted within a larger mixed methods project focused on programme planning and evaluation;[8] only the quantitative findings are reported in this paper.

Given inaccuracies identified in a preliminary review of the data held within the territorial Human Resources Information System (HRIS), and the challenges in extracting the required data from that source, the study was limited to the procedure data contained within the Discharge Abstract Database and the National Ambulatory Care Reporting Service of the Canadian Institute for Health Information (CIHI).[9]

Inclusion/exclusion criteria

All residents of the Beaufort Delta Region, with a postal code from one of its eight communities, who underwent a surgical procedure were included in the data request to CIHI. Non-residents (primary residents outside of the BDR) were excluded. To prevent inadvertent reidentification of patients from a relatively small data set, community of origin and patient's age could not be released. Procedures were broadly defined as any endoscopic procedure of the gastrointestinal tract or any surgical procedure performed in the operating theatre (day surgery or in-patient). Surgical providers were defined as either FP-ESS or specialist surgeons (i.e.: Cardiovascular/thoracic surgery, general surgery, neurosurgery, obstetrics/gynaecology, ophthalmology, orthopaedic surgery, otolaryngology, plastic surgery, urology, vascular surgery, dental/oral surgery and the paediatric surgical subspecialties) or gastroenterologists. The only other providers included in our analysis were interventional radiologists as they perform procedures which would otherwise require an operation. The locations where procedures were performed were defined as Inuvik (Inuvik Regional Hospital), Yellowknife (Stanton Territorial Hospital) or out-of-territory. Most out-of-territory services are provided at any of several hospitals in Edmonton, Alberta, but some patients received care elsewhere in Canada. After reviewing the raw dataset from CIHI, procedures were excluded if they were not surgical in nature (supportive care such as intubations and central line placements) or if they were provided by non-surgeons.

Data analysis

The raw dataset from CIHI was imported into Microsoft Excel; data cells were grouped by region and type of surgical provider, then counted individually by procedure performed. CIHI databases record procedures using codes based on the Canadian Classification of Health Interventions (CCI). Each of these procedure codes had to be decoded to a commonly recognised procedure name. These data were then entered into a summary table and the total numbers of procedures by provider type and region were calculated. These totals were then used to generate pie charts demonstrating the proportion of all combined procedures (surgical procedures and GI endoscopy), all surgical procedures, and all gastrointestinal endoscopies by the surgical provider and by region; a bar graph was also created to demonstrate the proportion of types of procedures (endoscopy, general surgical, gynaecologic-obstetrical or of other surgical specialities) performed by FP-ESS relative to those respective specialist surgeons. When fewer than 5 of a given procedure were performed over the 5-year study period, that procedure was included in a more general category (for example, specific lower extremity fractures were counted within a category 'other lower extremity fractures' rather than by the specific bone and type of fracture).

During an initial review of HRIS data, examples were found of incorrect specialists doing a procedure (for example, a paediatrician performing gynaecological surgery; a neurosurgeon was listed as doing a vascular procedure normally done by a general surgeon). Within the data reviewed from CIHI databases, most laparoscopic cholecystectomies performed in Inuvik were coded as being done by family physicians instead of by general surgeons (CIHI does not include a category for FP-ESS). When it was obvious which type of provider would have performed a given surgery, that provider was substituted for the one listed. When there was a cross-over in provider competencies, the provider listed in the original dataset remained the provider

for that procedure. An example would include carpal tunnel release; during the study period, all in Inuvik were listed as being performed by FP-ESS. Without cross-referencing data by accessing patient charts, there would be no way to determine which if any of those procedures were performed by a visiting orthopaedic surgeon.

Ethics

Research Ethics Board approval was granted from the University of British Columbia and from Aurora College; a research license was obtained from the Aurora Research Institute; a Research Agreement was obtained through the Research Coordinator at the Department of Health and Social Services for permission to approach staff of the Northwest Territories Health and Social Services Authority.

RESULTS

The extracted summary data were first categorised according to which type of surgical care provider (FP-ESS or specialist) was delivering which proportion of procedures. Second, we examined where these procedures were performed across the surgical system. Third, given the overlap in the scope of practice of FP-ESS with general surgery, obstetrics/gynaecology, and gastroenterology, we compared the proportion of those types of procedures by the surgical provider. Finally, we determined the five most common surgical procedures by type of surgical provider at each of the three levels of the surgical system.

FP-ESS and Specialist surgeons (total proportions)

FP-ESS physicians provided 47.7% of the total surgical and endoscopic procedures performed for the catchment population over the 5-year study period; all such procedures were performed at the Inuvik Regional Hospital. Surgical specialists performed 52.3% of the total number of procedures in all locations, including Inuvik, Yellowknife and out-of-territory [Figure 1].

In terms of surgical procedures, FP-ESS performed 21.9%, while specialist surgeons, whether in Inuvik, Yellowknife or out-of-territory, performed the majority (78.1%) of procedures.

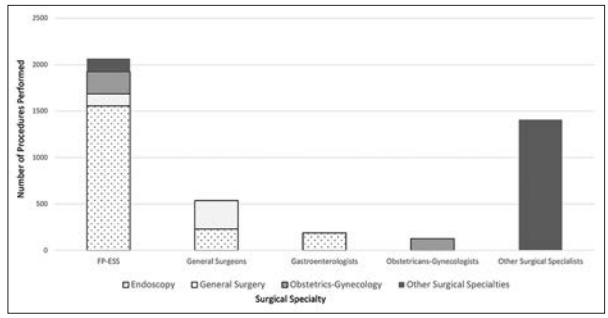

Figure 1: Proportion of surgical procedures by most responsible surgical provider. each bar represents the type of surgical provider; procedures are coded by type (endoscopy, general surgery, obstetrics-gynaecology and other surgical specialities) to demonstrate the relative proportion of each type provided by FP-ESS and relative to the total for that speciality. For example, obstetrics-gynaecology procedures constituted 11.5% of the total procedures performed by FP-ESS, but FP-ESS accounted for 65.2% of all of the obstetrics-gynaecology procedures performed over the study period. FP-ESS: Family physicians with enhanced surgical skills.

For all endoscopic procedures, FP-ESS did 78.7%, while general surgeons and gastroenterologists did 12.1% and 9.2%, respectively).

Proportions by region

When considering the total proportion of procedures by region, more than half of all procedures (53.1%) were performed locally in Inuvik; 25.7% and 19.3% were performed in Yellowknife or out-of-territory, (Hay River 2%), respectively.

For surgical procedures, these proportions were 31.2% (Inuvik), 35.6% (Yellowknife), and 29.7% (out-of-territory), while the endoscopic procedures were predominantly done in Inuvik (79.2%), with only 14% and 6.8% done in Yellowknife and out-of-territory, respectively).

Proportion of procedures by family physicians with enhanced surgical skills and by speciality

The procedures performed by FP-ESS are broken down by type of procedure, grouped as endoscopy, general surgery, obstetrics/gynaecology and others [Figure 1]. The groupings were done to reflect the scope of practice of FP-ESS physicians working in the region but also to allow a comparison of the relative contribution of FP-ESS compared with specialist surgeons in surgical care within each of those traditional

fields. Endoscopy accounted for most of the procedures performed by FP-ESS (75.4%). When considering the volume of surgical procedures, 46.9% of the procedures performed by FP-ESS were obstetrics-gynaecology cases and 25.4% were general surgery cases, with those making up 65.2% and 29.7% of the total procedures within each of those specialities, respectively.

Most Common procedures by type of surgical provider

Table 1 lists the five most common procedures performed by a given surgical provider at each of the three levels of the health-care system for residents of the Beaufort Delta: Inuvik, Yellowknife and out-of-territory (most of which are in Edmonton).

DISCUSSION

For the mostly Indigenous population living in the Beaufort Delta Region over the 5-year study period, FP-ESS physicians in Inuvik performed 79% of all endoscopic and 22% of all surgical procedures, which accounted for nearly half of the total procedures performed for that population. FP-ESS performed 65% of the obstetrics-gynaecology procedures and almost 30% of the general surgical cases. While the FP-ESS scope of practice within any given surgical field is narrower than that of the respective surgical specialist, the fact that most ob-gyn procedures were performed by FP-ESS indicates that their narrower scope covers most ob-gyn cases in this region. This observation is consistent with published literature which states that the majority of surgical presentations should be manageable at the district, first-level hospital, a site at which the Essential and Emergency Surgical Care package should be available.[10,11] On the other hand, most general surgical procedures were performed by general surgeons, and not by FP-ESS, which suggests that many of the general surgical cases were too complex for the scope of FP-ESS. However, nearly 30% of those cases done by FP-ESS reduced the volume of surgical care that needed to be done by general surgeons within the system.

There is growing recognition of the importance of providing surgical care closer to home; this has been especially true for maternity care[12-14] and 'contributes to well-being, cultural continuity and kinship' for Indigenous communities.[15] Surgery closer to home not only improves access but also decreases the significant cost of medical travel in the Far North. Based on our data, more than 50% of all procedures were performed locally within the Beaufort Delta Region (47.7% by FP-ESS and 5.6% by visiting specialist surgeons), which also represented 80% of all endoscopic procedures and nearly one-third of all surgical cases. Another third of the surgical cases were performed in Yellowknife, and the remaining third out-of-territory. Ultimately, the local FP-ESS service stabilises the surgical services in this region, enabling continuous surgical backup for the maternity programme and supporting the other local rural generalist physicians. The service also increases the efficiency of the itinerant surgeons. Since FP-ESS are doing the common cases, the specialists are maximising their time by focusing on the more complicated cases. A further analysis of such datasets could also contribute to expanding surgical programmes within the Northwest Territories, thereby reducing medical travel costs and improving access closer to home.

Finally, the quality of surgical care and data on patient outcomes should be considered when determining the scope of surgical care in local hospitals. Unfortunately, in the data sources accessed, there were no morbidity and mortality data or other quality control measures available. In addition, rural surgical outcome data are challenging to obtain at the best of times because of both the small sample sizes and the lack of health information infrastructure to collect such data.[15] We acknowledge that the goal is high-quality surgery, wherever that surgery is performed. There exists a balance between access to surgical care close to home in a lower-resourced facility compared to the surgical care available in a high-resourced urban setting, but requiring long delays in definitive care and other challenges associated with travel.[16] Indigenous and non- Indigenous rural and remote communities should also be engaged, and their values incorporated into decision-making around how their services are provided.[17] The Rural Surgery and Obstetrics Network in British Columbia, Canada, is currently undergoing an evaluation phase and will soon provide outcome data where FP-ESS and specialist surgeons function collaboratively in a formal network.[18,19]

Table 1: Top 5 Most Common Procedures by Surgical Provider and by Level of the Surgical System

	Inuvik	Yellowknife	Out-of-Territory
FP-ESS	cesarean section tubal ligation/salpingectomy dilation & curettage herniorrhaphy appendectomy	N/A	N/A
General Surgery	cholecystectomy *	cholecystectomy appendectomy herniorrhaphy hemicolectomy laparotomy (any indication)	breast surgery cholecystectomy low-anterior resection appendectomy herniorraphy
Obstetrics-Gynecology	hysterectomy incontinence/prolapse surgery *	hysterectomy cesarean section adnexal surgery incontinence/prolapse surgery endometrial ablation	cesarean section *
Orthopedics	*	fracture fixation (arm, leg, other) knee arthroplasty knee arthroscopy hip arthroplasty ACL reconstruction	fracture fixation (arm, leg, other) back surgery hardware removal knee arthroplasty hip arthroplasty
Otolaryngology	tympanostomy tympanoplasty septo-rhinoplasty *	tympanoplasty tonsillectomy biopsies/excisions	*
Ophthalmology	N/A	cataract surgery *	retinal surgery eye lid surgery related to occular muscle *
Other Specialities	N/A	cystoscopy urethral dilation *	cystoscopy related to renal stones mandible fixation hand surgery pneumonectomy

This table lists the 5 most common procedures by the surgical provider and by the level of the surgical system (Primary - Inuvik, Secondary - Yellowknife, or Tertiary - Out-of-territory) for residents of the Beaufort Delta Region. *Other procedures were performed, but fewer than 5 of any of those other procedures were performed over the study period based on the data available from CIHI; Given the small datasets for a rural/remote population, these cannot be reported for reasons of privacy/confidentiality. CIHI: Canadian institute for health information, FP-ESS: Family Physicians with Enhanced Surgical Skill, N/A: Not available

Such formal networks are increasingly recognised as critical to high-quality rural surgery, maternity care and anaesthesia, also requiring adequate nursing and appropriate allied health professionals to function.

Limitations

The CIHI datasets used in this study depend on inputs from the NWT, which were known to have inaccuracies, as described in the Methods section. This issue would lead to an under or over-representation of procedures within some provider categories. The decoding of the CCI intervention codes into common procedure names could also have introduced error; this was likely at least in part mitigated by using more inclusive general categories to capture procedures.

The procedures included in this study are only those performed in the operating room (OR) or endoscopy suite and exclude minor procedures performed in the emergency room or outpatient setting. For example, a minor hand procedure done in the OR in Inuvik would be included in the data, while the same procedure done in an outpatient treatment room in Yellowknife or Edmonton

would be excluded. This would result in an overall under-representation of procedures, especially those performed in Yellowknife or out-of-territory relative to Inuvik. To more fully account for the burden of surgical conditions for the catchment population (which would include non-operative management) and the surgical activities of surgical care providers, consultations could have been included (this was the intent with the original study design, as both consultations and procedures represent the majority of surgical activities of any surgeon but was not possible given the state of the territorial health information systems).

Finally, in the present study, the surgical burden of the Beaufort Delta Region's population is only represented by those who underwent a surgical procedure and does not include any measurement of those who did not access care. Barriers to access healthcare are an important consideration for any population and are especially so given the historical and colonial context, which has negatively impacted Indigenous Canadians.

CONCLUSIONS

In summary, this networked model for the mostly Indigenous population living in the Beaufort Delta Region of the NWT includes community FP-ESS physicians and specialist surgeons based in Yellowknife and out-of-territory. Nearly half of the procedural needs of this population can be met by FP-ESS physicians, enabling better access and more care close to home, which in turn decreases costs to the health-care system. This model reduces the overall demand on surgical specialists, who can better focus their efforts on surgical care which is beyond the scope of FP-ESS. Similar models could aid in providing health administrators with a framework for future planning of sustainable surgical services in rural and remote settings. Through an improved understanding of the surgical needs of circumpolar Indigenous populations and of such models of surgical care delivery, where FP-ESS and specialist surgeons function collaboratively in a network, we hope to strengthen how surgical care can be delivered to rural and remote populations and to respond to the Calls to Action put forth by the TRC.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

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ORIGINAL ARTICLE

Staffing rural emergency departments in Ontario: The who, what and where

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DOI: 10.4103/cjrm.cjrm_51_22

Abstract

Introduction: The emergency department (ED) in rural communities is essential for providing care to patients with urgent medical issues and those unable to access primary care. Recent physician staffing shortages have put many EDs at risk of temporary closure. Our goal was to describe the demographics and practices of the rural physicians providing emergency medicine services across Ontario in order to inform health human resource planning.

Methods: The ICES Physician database (IPDB) and Ontario Health Insurance Plan (OHIP) billing database from 2017 were used in this retrospective cohort study. Rural physician data were analysed for demographic, practice region and certification information. Sentinel billing codes (i.e., a billing code unique to a particular clinical service) were used to define 18 unique physician services.

Results: A total of 1192 physicians from the IPDB met inclusion as rural generalist physicians out of a total of 14,443 family physicians in Ontario. From this physician population, a total of 620 physicians practised emergency medicine which accounted for 33% of their days worked on average. The majority of physicians practising emergency medicine were between the ages of 30 and 49 and in their first decade of practice. The most common services in addition to emergency medicine were clinic, hospital medicine, palliative care and mental health.

Conclusion: This study provides insight into the practice patterns of rural physicians and the basis for better targeted physician workforce-forecasting models. A new approach to education and training pathways, recruitment and retention initiatives and rural health service delivery models is needed to ensure better health outcomes for our rural population.

Keywords: Emergency medicine, health human resource planning, rural physicians

Résumé

Introduction: Le service d'urgence des communautés rurales est essentiel pour la prise en charge des patients présentant des problèmes médicaux urgents et de ceux qui ne peuvent accéder aux soins primaires. En raison de la récente pénurie de médecins, de nombreux services d'urgence risquent de fermer temporairement. Notre objectif était de décrire les caractéristiques démographiques et les pratiques des médecins ruraux qui fournissent des services de médecine d'urgence en Ontario afin d'éclairer la planification des ressources humaines en santé.

Received: 30-06-2022 **Revised:** 25-12-2022 **Accepted:** 02-02-2023 **Published:** 24-03-2023

How to cite this article: Randle T, Garg A, Mago V, Choudhury S, Ohle R, Strasser R, *et al*. Staffing rural emergency departments in Ontario: The who, what and where. Can J Rural Med 2023;28:73-81.

Méthodes: La base de données des médecins de l'ICES (IPDB) et la base de données de facturation de l'assurance-santé de l'Ontario (OHIP) de 2017 ont été utilisées dans cette étude de cohorte rétrospective. Les données sur les médecins ruraux ont été analysées pour obtenir des renseignements sur la démographie, la région de pratique et la certification. Les codes de facturation sentinelle (c'est-à-dire un code de facturation unique pour un service clinique particulier) ont été utilisés pour définir 18 services médicaux uniques.
Résultats: Sur un total de 14 443 médecins de famille en Ontario, 1 192 médecins de l'IPDB ont été inclus en tant que médecins généralistes ruraux. Parmi cette population de médecins, 620 pratiquaient la médecine d'urgence, ce qui représentait 33% de leurs jours de travail en moyenne. La majorité des médecins qui pratiquaient la médecine d'urgence étaient âgés de 30 à 49 ans et en étaient à leur première décennie de pratique. Les services les plus courants en plus de la médecine d'urgence étaient la clinique, la médecine hospitalière, les soins palliatifs et la santé mentale.
Conclusion: Cette étude permet de mieux comprendre les modes de pratique des médecins ruraux et de jeter les bases de modèles de prévision des effectifs médicaux mieux ciblés. Une nouvelle approche des parcours d'éducation et de formation, des initiatives de recrutement et de rétention et des modèles de prestation de services de santé en milieu rural est nécessaire pour garantir de meilleurs résultats en matière de santé pour notre population rurale.

Mots-clés: Médecine d'urgence, médecins ruraux, planification des ressources humaines en santé

INTRODUCTION

Many rural patients face significant challenges in accessing primary care. As a result, the emergency department (ED) has become essential for meeting a community's healthcare needs. In addition, previous research has shown that rural residents in Ontario are more likely than their urban counterparts to visit an ED for medical attention.[1,2] Rural ED staffing has been an ongoing challenge since the 1990s with more than 40% of rural EDs in 2017 reporting a physician shortage, and the gap is expected to increase over the next decade.[3,4] With the onset of the COVID-19 pandemic, the physician shortage has grown beyond the expected level and has put many rural EDs at risk of temporary closure.[5] In 2022, more than 20 rural EDs in the province of Ontario temporarily closed with nearly every other province experiencing a similar pattern of closures due to staffing shortages. The closure of a single ED in Northern Ontario may result in several hours of additional travel to the next closest ED due to their geographic distribution.

Previous research has examined the range of services provided by family physicians and found that rural family physicians work to a fuller extent of their scope of practice than their urban colleagues.[6,7] However, these studies rely on survey data that can suffer from low response rates, recall bias and over-representation from some physician demographics. As well, the number of clinical services examined in these studies did not span the full range of services that family physicians can provide. Rural physicians have been described as 'extended generalists' and there is growing focus on Rural Generalist Medicine as a distinct field of practice.[8-10] A better understanding of the services provided by rural physicians is important for health human resource planning (HHRP).

Our aim was to describe the demographics and practice patterns of physicians providing emergency medicine throughout rural Ontario. Using the ICES Physician Database (IPDB) and the Ontario Health Insurance Plan (OHIP) database, we identified rural physicians providing emergency medicine and other services. Given the differences in geography and resource availability, their practices were further described based on whether they practised in Northern or Southern Ontario.

METHODS

Setting

Ontario's landmass is 909,000 km^2 with 88% of the area located in Northern Ontario. Conversely, Northern Ontario only constitutes 6% of the province's population of 13.4 million.[11] Approximately 14% of Ontario's population is located in small rural communities with <1000 people and another 10% of the population live in communities of 1000–30,000 people.[12] Northern Ontario has two of the

16 academic health science centres in the province, three of the 44 community hospitals (i.e., defined as hospitals with >100 acute care beds) and 32 of the 90 rural and small urban hospitals (i.e., defined as hospitals with <100 acute care beds).[13]

The demographics and practice patterns of rural physicians practising emergency medicine was described based on their geographic location in either Northern or Southern Ontario. Wenghofer *et al.*, defined the boundary between Northern and Southern Ontario using the former Local Health Integration Network (LHIN) boundaries.[7] Similarly, for this analysis, the areas formerly known as the Northeast LHIN and Northwest LHIN were considered Northern Ontario.[14] This geographic descriptor was included in the analysis because of the differences in resources (e.g., significant differences in distances to major referral centres and locum coverage in Southern Ontario) for rural physicians practising in Northern and Southern Ontario.

Data

This retrospective cohort study used the 2017 IPDB and OHIP billing database. These were the most recent datasets available when the analysis was performed due to a time lag from when the data were generated to when it was available for analysis on the ICES system. These data sets were accessed using a secure virtual connection through the IDAVE system. The IPDB dataset contains encoded physician demographic information, physicians' practice region (i.e., LHIN region and rurality) and certification information. The OHIP dataset includes all physicians' billing information including the date of service, service type and service location.

Physician population

The physicians examined were those often referred to as general practitioners (GP) who completed the rotating internship prior to the early 1990s and those who completed at least 2 years of family medicine training certified by the College of Family Physicians of Canada (CFPC). Our physician population is referred to as rural family physicians, in this paper. They were selected from the IPDB based on several criteria including OHIP specialty code, the submitted OHIP billings and physician rurality. The first step was to select physicians with an OHIP billing specialty code listed as 'family physician or general practitioner'. This criterion also captured CFPC certified physicians with certificates of added competence in emergency medicine since the IPDB lists their OHIP specialty as 'family physician or general practitioner'. Unfortunately, these physicians are not consistently identified in the IPDB and therefore we were unable to identify the number working in rural communities. A small subset of the physicians with an OHIP specialty code of 'family physician or general practitioner' were classified in the IPDB as practising specialists (e.g., general surgery, internal medicine, or obstetrics) based on their billing codes. These physicians were removed from the analysis since this was either an error or more likely they were physicians who held dual certifications in both family medicine and their listed specialty. In the second step, several hundred physicians with missing data for the OHIP billing specialty code were analysed to determine whether they were providing one of the services being investigated using the family practice billing codes listed in the OHIP schedule of benefits.[15]

In the third step, physicians who fell within the above criteria were further subdivided according to their rurality index of Ontario (RIO) score.[16] The index combines the population, travel time to basic referral centres and travel time to advanced referral centres into a single measure of rurality. For the purpose of this paper, we have considered 'rural practice' to be that which is located in a community with a RIO score of 40 or greater.[17] This definition is used widely in the literature including by ICES.[18] As an example, the municipality of East Ferris in northeastern Ontario has a RIO score of 45. Their population is 4750, their basic referral centre is 16 km away (North Bay) and their advanced referral centre is 162 km away (Sudbury).

Physician services

Given that family physicians have a broad scope of practice, we first wanted to identify all of the services being provided by rural family physicians in their communities and then analyse those physicians practising emergency medicine. Using the Ontario Schedule of Benefits, a total of 18

services were identified along with the billing codes associated with those services.[15] These services were used as a proxy for the diversity of practices that these physicians experience as rural generalist physicians. From an HHRP perspective, quantifying the range of services that these physicians provide in addition to emergency medicine was important to better understand the competing clinical responsibilities that these physicians provide to their communities. The unique set of billing codes for each of the 18 services will be known as sentinel billing codes. The 18 services identified were: Clinic, emergency medicine, anaesthesia, hospital medicine, home visits, mental health, long-term care, obstetrics, palliative care, surgical assisting, chemotherapy administration, sports medicine, chronic pain, care of the elderly, addictions medicine, endoscopy, allergy medicine and sleep medicine. These services were selected based on two of three criteria: (1) there must be a sentinel billing code available to define the service in the OHIP billing database, plus (2) the service must occur in a unique setting, or (3) the service could be reasonably delivered in a focused practice. Given the HHRP focus of this study, we were not interested in individual clinic procedures (e.g., vaccine administration, well-baby checks or Papanicolaou tests) but instead the range of unique services that rural family physicians might provide. To determine whether a physician provided a particular service, we used a minimum threshold for the number of patient encounters to define whether a physician provided that service or not.[19,20] We specified a lower threshold for the services investigated based on the published literature. The thresholds were reduced in several cases to account for the increased number of services being provided by rural family physicians.

Analysis

For rural family physicians that met inclusion criteria, the sentinel billing codes for these physicians were extracted. The codes were then summarised for each physician by service to provide the total number of encounters by service (i.e., the total number of unique daily patient encounters) and the total number of days worked in a particular service. The data were formatted with each row representing a unique rural family physician and each column a service being provided. The thresholds described in the previous section were then applied to the unique daily encounters to determine whether a physician provided that service as per our definition. The revised table was a 0/1 for each of the possible services. Demographic and practice characteristics for each physician were then combined with this table.

A frequency distribution was performed to compare physicians' years in practice to days worked in emergency medicine. Finally, a comparison analysis was performed to examine practice patterns that included the most common services provided, average days worked in emergency medicine, the average number of services provided in addition to emergency medicine as well as the number of physicians with a focused practice in emergency medicine.

Research Ethics

This study received institutional research ethics board approval from Lakehead University (#1466634).

RESULTS

In the IPDB, a total of 1192 rural family physicians were identified out of a total of 14,443 physicians with similar certifications [Table 1]. More than 50% of rural family physicians practised emergency medicine in Northern and Southern Ontario with an additional 10% of physicians providing some care in the ED but not meeting the minimum threshold. Fewer female rural family physicians practised emergency medicine in Southern Ontario versus Northern Ontario and only 10% of physicians practising emergency medicine were under 30 years of age. In both Northern and Southern Ontario, over half of the rural family physicians were in the first decade of their career with an equal percentage in the second and third decades (i.e., 20%) in the south. Notably, in Northern Ontario, more rural family physicians in the third decade than the second practised emergency medicine (i.e., 21% vs. 16%).

For each rural family physician practising emergency medicine, we developed a practice description using the ICES data [Table 2]. On average, these rural family physicians worked

190 days per year for all of the services they provided in the north and south. On average, emergency medicine comprised about 30% of their total days worked in 2017. The range of days worked was from 2 to 242 days in the north and up to 275 days in the south. The rural family physicians on average provided 4.2 services to their communities, including emergency medicine. Many of these physicians (i.e., 64% in Northern Ontario and 54% in Southern Ontario) provided five or more clinical services to their patient population. In Southern Ontario, 14% of the physicians practised only in the ED while only 6% had a similar practice in the north. The most common services in addition to emergency medicine were clinic, hospital medicine, palliative care and mental health.

Rural family physicians in their first decade of practice, proportionally worked more days in emergency medicine with the majority working <50 days per year [Figure 1]. Physicians in their third decade of practice worked more days in the ED than physicians in their second decade.

DISCUSSION

This study provides an important new contribution to understanding the rural family physician workforce providing emergency medicine care in Ontario. Using the OHIP billing database and the IPDB we were able to objectively describe the characteristics and practice patterns of rural family physicians staffing EDs in Ontario. In general, about 50% of rural family physicians practise emergency medicine. As these physicians age, the rate of practice in emergency medicine declines. These rural family physicians spend approximately one-third of their total days working in the ED and more than half of the physicians provide 5 or more clinical services to their community. There was little difference between the demographics in the rural family physician population in the north and south.

This study complements the previous work of Wong and Stewart and Wenghofer *et al*.

Table 1: A description of rural physicians practising emergency medicine in Ontario

	North rural, *n* (%)	South rural, *n* (%)	Total, *n* (%)
Rural family physicians	424	758	1192
Total rural family physicians practising EM	219 (52)	401 (53)	620
Total physicians billing at least 1 EM code	267 (63)	481 (63)	748
Female physicians practising EM	87 (40)	136 (34)	223
Age of physicians practising EM			
<30	12 (5)	32 (8)	44 (7)
30-49	127 (58)	247 (62)	374 (60)
50+	80 (37)	122 (30)	202 (30)
Years in practice of physicians practising EM			
<10	126 (58)	216 (54)	342 (55)
10-19	34 (16)	79 (20)	113 (18)
20-29	45 (21)	82 (20)	127 (20)
30+	14 (6)	24 (6)	38 (6)

EM: Emergency medicine.

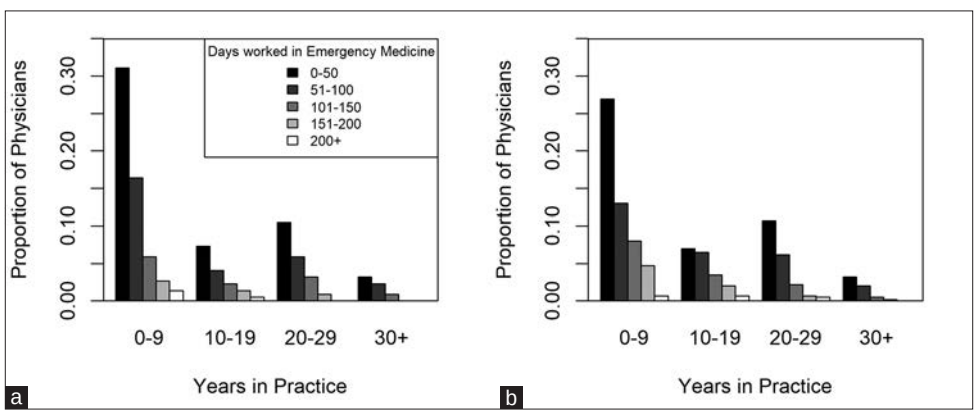

Figure 1: The proportion of days worked in the emergency department by physicians with different years in practice. (a) Northern rural physicians (b) Southern rural physicians.

Table 2: A description of time spent practising emergency medicine and other services provided by these physicians

	Rural North	Rural South
Average total days with at least one billing for all services provided (minimum–maximum)	191 (6–363)	193 (2–344)
Average days with at least one billing in EM (minimum–maximum)	61 (2–242)	66 (2–275)
Percentage of practice in EM based on days (%)	32	34
Average number of services provided including EM (minimum–maximum)	4.2 (1–11)	4.3 (1–10)
Number of services provided by rural family physicians practising EM, *n* (%)		
1**	13 (6)	56 (14)
2	11 (5)	28 (7)
3	11 (5)	37 (9)
4	43 (20)	63 (16)
5	53 (24)	73 (18)
6	41 (19)	57 (14)
7	31 (14)	55 (14)
8+	16 (7)	32 (8)
Five most common services provided by rural physicians practising EM (%)		
1	Clinic (89)	Clinic (80)
2	Palliative care (84)	Palliative care (66)
3	Hospital medicine (83)	Hospital medicine (60)
4	Mental health (36)	Mental health (56)
5	Long-term care (30)	Home visits (25)

**Focused EM practice. EM: Emergency medicine.

because it takes a different approach using a more comprehensive data set and analysis.[6,7] The previous studies relied on survey data and have limitations as noted in our Introduction. The ICES data are more likely to reflect actual services provided because they were collected for billing purposes. This study expands the number of services being examined and provides a more accurate representation of the physician practice patterns and geographical distribution.

Studies using similar data sets from ICES have focused on specific stages of practice (i.e., the years prior to retirement) or attempted to better understand comprehensive primary care and were not focused on the breadth of unique services that family physicians are providing.[19-21] Although this study showed a decline in the number of rural family physicians practising emergency medicine as their career progressed, other studies have demonstrated a similar overall decline in the proportion of family physicians practising emergency medicine and comprehensive primary care.[19,21-23] Understanding why fewer rural family physicians practise emergency medicine as their career progresses is an important research direction that may provide information for future retention strategies.

The COVID-19 pandemic has exacerbated an existing HHRP problem in many rural communities.[5,22] Traditional physician resource planning relied on 'headcount' data or ratios of patients to physicians to determine the appropriate number of doctors for a community. For example, in Ontario during the first iteration of the Rural and Northern Physician Group Agreement contracts in the early 2000s, decision makers used a modified Delphi methodology to determine the physician complements. Their approach used a ratio of 1:1380 (i.e., physicians to patients) with arbitrary multipliers to account for differences in community resources and services to determine the number of funded physician positions.[24] Previous work has recognised the need to move beyond this static and simplistic determination of community need.[19,22] Rural family physicians often practise to a fuller extent of their scope of practice and provide more services than their urban colleagues.[6,7] This has major implications when determining the complement of physicians required for rural communities. With the addition

of each service provided by a rural family physician, their time available to provide the full-spectrum of community-based family practice services declines and thus a greater number of physicians is required within the community.

The challenge of providing primary health care in rural communities may be reflected in the greater ED use observed in rural and northern communities compared to urban centres.[1] The professional expectations of rural family physicians has grown over the past several decades. With the expansion of rural training opportunities across Canada, rural family physicians have considerable responsibility for training medical students and resident physicians. In addition to the educational obligations, these physicians have administrative and leadership roles in their communities, and many are introducing research activities as a component of their practice. These non-clinical activities are not reflected in the OHIP billing database. Not only is the practice of rural medicine changing but so are the physicians working in the rural environment. There is a generational change in the practice style and desired lifestyle of recent graduates who want greater collaborative arrangements and flexibility in their practices.[25]

In 2016, the Canadian Association of Emergency Physicians (CAEP) estimated that Canada required an additional 169 physicians to staff rural EDs.[3] They forecasted that number would grow to 393 by 2021 and to 748 physicians by 2026. This forecasted 'gap' by CAEP was made under the assumption that these physicians work more than 70% of their time in the ED. Since rural family physicians typically work well below this threshold in the ED due to their other clinical responsibilities, the required number of physicians needed for rural communities is likely much higher.

With the recognition that rural EDs and rural medicine in general will face significant staffing challenges in the coming decades, a new approach to planning, recruiting and retaining a rural health workforce is needed.[26] The most recent published physician-supply forecasts in Ontario were completed in 2010 through a collaborative effort by the Ontario government and Ontario Medical Association. However, these forecasts failed to provide an accurate estimate of physician supply, with most scenarios predicting that the province would have a sufficient number of family physicians by 2018.[27] A tailored approach to planning and forecasting the rural workforce must be developed that accounts for the multiple services that these physicians provide. This study provides a basis for understanding the range of services delivered to rural communities and would inform these forecasting models.

In addition to improved modelling and forecasting of the workforce, medical school initiatives that provide early rural experiences to medical learners that promote and recruit new physicians to these practices may prove beneficial.[28-30] The CFPC has recently recommended that family medicine resident programmes in Canada be extended to 3 years.[31] One of the goals of extending the training period for residents is to provide them with better educational and clinical experiences that will improve confidence in core areas of family medicine and promote practices that provide comprehensive care to patients. This study and others demonstrate that a greater importance should be placed on supporting rural generalist physicians to maintain their full spectrum generalist practice as they progress through their career. Finally, the implementation of physician retention strategies that include the opportunity for part-time employment, a larger complement of physicians within the community and an emphasis on physician wellness must be a priority to ensure that gains in the workforce are maintained.[32]

A potential limitation of this study is that physicians who practise under non-fee-for-service compensation models and submit billing codes for a percentage of the clinical fee known as 'shadow billings' may not provide a complete tally of the services provided. Therefore, we consider our analysis to be providing a lower bound on the estimates of physician services being provided. The care provided by nurse practitioners and other allied healthcare professionals is also not captured in the OHIP billing database. In addition, our analysis only examined family physicians and missed the small number of physicians certified by the Royal College of Physicians and Surgeons of Canada who can be identified in the ICES dataset who practised rurally in 2017. This dataset does not include non-OHIP billable services (e. g., coroner or aesthetic medicine) that could potentially account for a proportion of these physicians' time. Finally, our analysis was

performed prior to the pandemic and the staffing situation in rural EDs across the country has become much worse. This analysis should provide a basis for further investigation of the effect of the pandemic on rural EDs.

CONCLUSIONS

Our results provide new insight into the practice patterns of rural family physicians and are consistent with recognition of rural generalist medicine. This new information provides the basis for better targeted physician workforce forecasting models in general and specifically for the rural physician workforce. In addition, the study provides further impetus for developing evidence informed by education and training pathways, recruitment and retention initiatives and rural health service delivery models.

Acknowledgment: This study contracted ICES Data & Analytic Services (DAS) and used de-identified data from the ICES Data Repository, which is managed by ICES with support from its funders and partners: Canada's Strategy for Patient-Oriented Research (SPOR), the Ontario SPOR Support Unit, the Canadian Institutes of Health Research and the Government of Ontario. The opinions, results and conclusions reported are those of the authors. No endorsement by ICES or any of its funders or partners is intended or should be inferred.

Financial support and sponsorship: Tyler Randle was provided with funding from the Northern Ontario School of Medicine through their Summer Medical Student Research Awards. Funding for this project was also provided to David Savage through the Northern Ontario Academic Medical Association's Clinical Opportunities Innovation Fund.

Conflicts of interest: There are no conflicts of interest.

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PROCEDURAL ARTICLE

The occasional bone marrow biopsy

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This article has been peer reviewed.

INTRODUCTION

An 84-year-old patient has had unintended weight loss and weighs 53.2 kg (2 years ago she was 62.1). Routine blood work reveals blast cells on peripheral smear. These are never normal. The internist you consult by phone asks if you can do a bone marrow aspirate to speed diagnosis for your patient pending specialist appointment. It is something you might do only every few years, however, it is safe and can help your patient.

Putting a hole in the bone (trephination) is an ancient technique successfully performed by neolithic surgeons.[1] It is safe in modern times; a survey of 54,890 bone marrow biopsies (BMB) in the UK resulted in only 26 adverse events.[2] Local bleeding is common with prolonged bleeding more likely with thrombocytopenia. Local infections are rare but more common with leucopenia.

BMB and aspiration (BMA) help with the diagnosis of primary haematological and metastatic malignancies as well as other conditions including some anaemias, haemochromatosis and fever of unknown origin (FUO). While one often does both, the aspirate is simpler and may be all you need.

Discuss with your internist or pathologist which would be the most useful test. For FUO, for example, you will want culture, and examination for acid-fast bacteria and fungi, in addition to the biopsy, to look for lymphoma as well as solid tumours.

For the work-up of blast cells, you are interested in lymphomas and leukaemia. You will want to send your aspirate for pathology but also molecular, flow cytometric and cytogenetic studies.

EQUIPMENT

- Sterile drape and gloves
- Gauze
- Chlorhexidine solution
- 2% Xylocaine
- Scalpel handle with #11 or #15 blade
- 10 cc syringe and 25G 25 mm needle for freezing
- 15 G Aspirate or 11G 100 mm bone biopsy needle
- 20 cc syringe
- 6 glass slides
- Two formalin containers for pathology
- An assistant (usually a laboratory technician).

The choice of the needle depends on availability. Many rural doctors

Access this article online

Quick Response Code:

Website: www.cjrm.ca

DOI: 10.4103/cjrm.cjrm_64_22

Received: 04-08-2022 **Revised:** 29-10-2022 **Accepted:** 27-01-2023 **Published:** 24-03-2023

How to cite this article: Hutten-Czapski P. The occasional bone marrow biopsy. Can J Rural Med 2023;28:82-5.

have experience and access to a powered needle such as EZ-IO (TM) or a manual 15G obturated needle for intraosseous access for the aspirate.

If you have an 11G needle, you can obtain a core of the bone marrow. If you are ordering needles, I would suggest a device that has a core-retaining feature such as an 11 gauge T-Lok (TM) needle (Argon Medical Devices catalogue DBMNJ1104TL) [Figure 1].

PROCEDURE

1. Pick your site. The posterior superior iliac crest (PSIC) is my preferred site for BMB as I feel it is safer and easier to access in most patients. The anterior iliac crest is an alternate location for BMB. Other sites may not be deep enough for biopsy but can be used for aspirate. Such sites include the sternum if over 12 years old. At birth, cellular (red) marrow is present in every bone, but with age, it gets replaced distally to proximally by fatty (yellow) marrow in the limbs.[3] Thus, for BMA, you can only use the proximal tibia for patients under 1 year of age
2. Have the patient go prone or in a lateral decubitus position. The PSIC can be landmarked by the pre-sacral dimples, the *'fossae lumbales laterale'*. Use a pen to mark in the middle of the cortex you can feel
3. Prepare your site with a surgical skin preparation such as chlorhexidine. Drape the site. First, use local anaesthetic such as 5 cc of lidocaine hydrochloride 2% to first bleb the skin over the site and then down to and including the periosteum diffusely, as you may not necessarily be doing a biopsy at the exact same spot. Consider intravenous sedation or other measures for additional pain control in an individualised approach[4]
4. A 5-mm stab incision just through the skin with a #11 or #15 scalpel will allow for easy passage of the larger biopsy needle, although it is not necessary for EZ-IO. Visualise the underlying structure to direct the needle. For the PSIC angle, the needle is 30° lateral from the parasagittal plane and 30° inferior from the transverse plane to sample the thickest part of the bone and avoid the sacroiliac joint (SI) [Figure 2]
5. Advance your needle to the periosteum. Then, with the stylet in place, rotate the needle clockwise and counterclockwise and apply firm pressure to penetrate through the cortex of the bone. Decreased resistance indicates you are in the bone marrow cavity. Ensure that the needle is solidly fixed in the bone. Remove the central obturator from your needle
6. If you are using the biopsy needle, it is common practice to first aspirate and reposition through the same incision to advance the needle to a new area of bone for the biopsy

ASPIRATE

7. To aspirate use a 20 cc or larger syringe to apply sufficient suction. Warn the patient that this will be painful, albeit briefly. Quickly draw only a 0.5 ml sample for immediate slide preparation. Avoid heparin for this sample, as this can alter cell morphol-

Figure 1: Equipment list

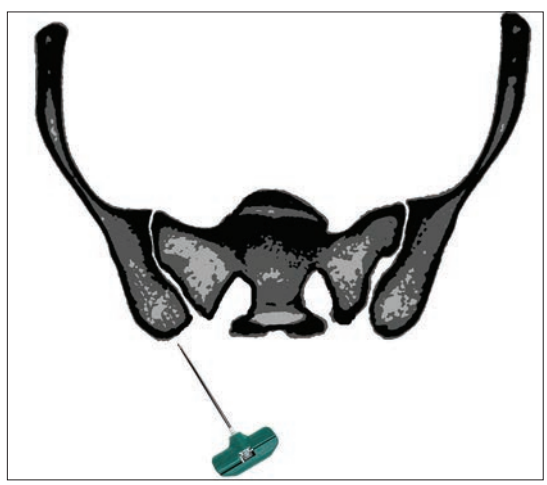

Figure 2: Axial section of PSIC with needle positioned 30° lateral

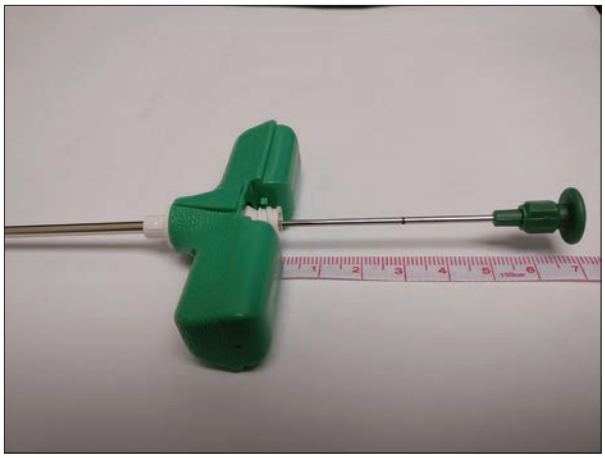

Figure 3: Core length probed at 30 mm

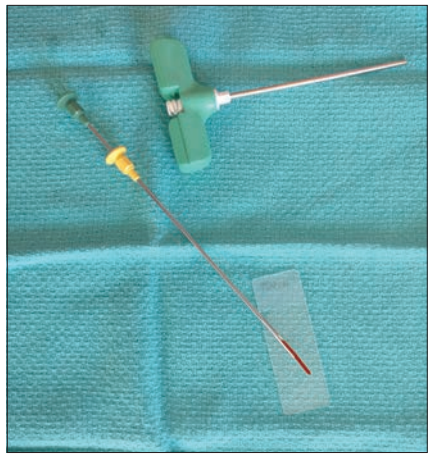

Figure 4: Removing the core

ogy. A small sample will reduce the chances of dilution with blood

8. Ideally, at this point, you have at hand a technician who is experienced in making peripheral blood smears. The techniques are the same and the sample needs to be processed before it clots
9. The presence of bone spicules and fat globules will indicate a proper sample. The pathologist will want you to enrich the sample for these elements. There are multiple ways to do this
10. A simple way is to first transfer a generous drop of the aspirate to each of six slides near the frosted end. That done, tilt each slide in turn and use the same syringe to suck up any excess thinner fluid
11. Have the assistant prepare the thin smear. The assistant will bring another slide at a 30°–45° angle backing up to the drop, allowing the drop to spread along the contact line of the two slides. Then, the upper (spreader) slide is quickly pushed toward the unfrosted end of the lower slide, dragging the drop to create a tongue-shaped smear with a feathered edge. Repeat for each of the slides. Let air dry. Place any residual aspirate (when clotted) into a formalin container
12. If you are looking for haematological cancers, further (larger) samples can then be drawn for other studies to be placed in blood tubes. If you do not know what tube to reach for, use the yellow top. The anticoagulant in yellow top tubes (acid-citrate-dextrose) keeps cells viable and does not interfere with any of the enzymes or reagents employed in molecular, flow cytometric or cytogenetic studies used for the diagnosis and characterisation of myeloma, non-Hodgkin's lymphomas and leukaemias
13. For FUO, you will also want additional aspirate for blood culture tubes, a transport medium and a sterile urine container.

BIOPSY

14. If you are also doing a biopsy, you will need to advance the needle with continued clockwise and counter-clockwise rotation a further 20–30 mm. For myeloma, lymphoma and metastasis aim for a longer specimen size, as marrow involvement is heterogeneous in those illnesses. Do not advance more than 50mm to limit the risk of exiting the bone through another cortex
15. Gently insert a probe into the back of the needle to check for the desired sample length
16. For the T-Lok (TM), the needle core length is the distance between the probe mark and the needle hub [Figure 3]. When the mark is equidistant from the needle hub and the plastic end of the probe, the core will be 20 mm long
17. Insert the extraction cannula into the needle without rotation to trap the core at this point. When fully inserted rotate the barrel of the needle a full 360° to sever the bone marrow core from its base. Now back the needle out with clockwise and counterclockwise rotation
18. As with most needles with a core retention feature, the core should exit from the operator's side of the device
19. Remove the extraction cannula and use the core probe from the operator's side of the extraction cannula to extract the core [Figure 4]

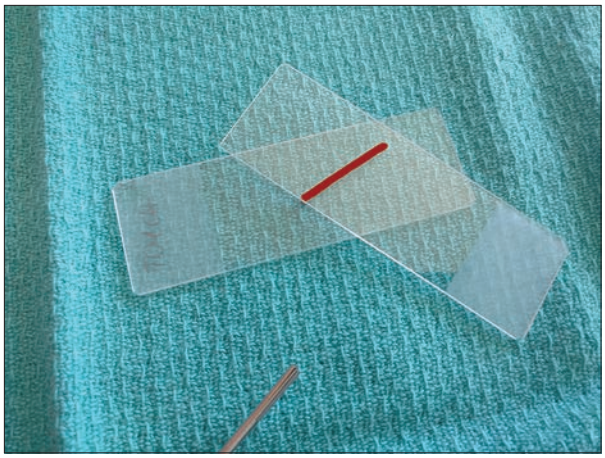

Figure 5: Touch samples

20. For older reusable BMB needles, the technique differs in that once you are at depth you have to rock the needle in several planes to break off the core at the region of the tip. Back off the needle and insert the blunt probe (failing that reinsert the trocar) to have the core exit from the patient's side of the needle
21. If your aspirate sample was thin or you are not sure, core touch samples are desired [Figure 5]. Use a glass slide to contact the core from several angles and let the air dry. When done place the core in formalin for histopathology processing
22. After the procedure, apply a strip of tape to close the skin and a pressure dressing. Have the patient lie on their back for 15–30 min to keep pressure on the area. The bandage can be removed in 24 h.

CONCLUSION

The bone marrow biopsy and aspirate are related procedures that can easily become part of a rural doctor's tool kit to improve access to timely diagnosis.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

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Pan-Canadian physician licensure will improve access to care for rural, remote and Indigenous communities across Canada

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This article has been peer reviewed.

After 10 years of practising rural medicine concurrently in several provinces, I have found the administrative challenges of obtaining and maintaining multiple provincial licenses disheartening. The redundant bureaucratic requirements hinder one's ability to assist colleagues in other jurisdictions. Colleagues report challenges with health care staff shortages, intensified by the acuity and volume of patients throughout the pandemic, which have led to overwork, low morale and burnout. Ultimately, this has affected the ability of many emergency, obstetrical, surgical, laboratory and diagnostic facilities to remain open. Closures and near-closures are especially impactful in rural-remote locations, where struggles to fill coverage gaps with locum physicians block patients from receiving timely care and increase transfers to distant centres. The lack of regulatory support for leveraging technology to provide appropriate cross-border virtual care further exacerbates the shortcomings.

There have been, for some years, discussions about a pan-Canadian approach to medical licensure to alleviate barriers for physicians to provide patients access to care regardless of where they live in Canada.[1] A sentiment I have been hearing recently is: *National licensure would lead to a mass exodus of rural physicians – leaving rural communities and moving to urban settings.* I strongly disagree with this myth, which has not been supported by data. In fact, it is the barriers to practise medicine across provincial borders that discourage the sustainability of rural practices, as local physicians are forced to work sometimes inhumane, extended periods without relief.

From 2014 to 2021, a comprehensive study[2] on factors impacting the rural physician workforce was led by the College of Family Physicians of Canada and Society of Rural Physicians of Canada (SRPC), in partnership with other stakeholder organisations, through a Taskforce.[3] It examined factors impacting rural physicians' choice to practise rurally. This work led to the Rural Road Map for Action that included a key recommendation on national licensure.[4] Logic suggests that introducing a pan-Canadian

Received: 17-10-2022 **Accepted:** 23-11-2022 **Published:** 24-03-2023

How to cite this article: Sue K. Pan-Canadian physician licensure will improve access to care for rural, remote and Indigenous communities across Canada. Can J Rural Med 2023;28:86-8.

Access this article online

Quick Response Code:

Website: www.cjrm.ca

DOI: 10.4103/cjrm.cjrm_80_22

licensure model would enhance rural practices. Fully licensed rural physicians who wish to move to urban settings can already do so without national licensure.

Besides fees up to thousands of dollars, the many levels of overlapping application requirements imposed by regulatory colleges for physicians to obtain licenses outside of their home province are a major deterrent to helping their rural colleagues. Already difficult with advance notice, this is nearly impossible on short notice. I have colleagues being denied locum licenses due to technical regulatory restrictions, even when applying through 'fast track licensure' offered by some provinces. Furthermore, border towns adjacent or intersecting provincial borders are frustrated by being able to only draw from a small pool of locum physicians from one province rather than two, due to cross-provincial licensure barriers.[5]

Pan-Canadian medical licensure has been overwhelmingly supported by the medical community.[6,7] A 2019 survey by the Canadian Medical Association (CMA) confirmed that 91% of physicians supported national licensure. Forty-five per cent of physicians reported that if national licensure existed, they would do locums in other provinces to support their colleagues, and 42% said that they were willing to practise temporarily in rural or remote regions.[8]

After Australia implemented a national licensing system, a study reviewing physician mobility patterns covering rural settings from 2011 to 2013, did not show a major drift away from rural areas.[9] Preliminary data from the Canadian Post-M.D. Education Registry (CAPER) appear to indicate similar outcomes when reviewing Canadian physician mobility patterns from 2000 to 2011.

In June 2021, the SRPC called on the Senate of Canada, the federal government, and its provincial counterparts to consider its recommendation for pan-Canadian medical licensure.[5] Senators who responded supported this recommendation while most provinces and territories have acknowledged this stance. Other medical groups have also engaged in similar advocacy efforts such as the Canadian Association of Emergency Physicians through its petition campaign and the CMA through its federal submissions. At a virtual dialogue with national medical groups hosted by the SRPC in May 2022, there was general agreement that having a pan-Canadian approach to licensure to address the current physician and health human resource shortages should be a priority.

Moving ahead, the SRPC is consulting with medical groups to further explore the impact of licensure on the rural physician workforce as well as access to care for rural populations. This includes conducting an SRPC Fall 2022 membership survey in seeking member perspectives on national licensure. The SRPC is also undertaking a review of factors that influence rural physician decisions to stay or leave rural communities. The outcomes of these activities will be shared at the SRPC April 2023 annual conference in Niagara Falls.

What is encouraging is that some government leaders have taken steps to address this issue. In July 2022, Canada's Council of the Federation announced their commitment to aligning regulatory approaches to remove barriers to improving labour mobility. Further, the four Atlantic premiers wrote to their medical regulators in September 2022, proposing to work with them towards implementing Atlantic regional licensure.

The SRPC looks forward to working with all stakeholders in developing joint solutions to removing these barriers to provide access to care for all Canadians.

Acknowledgment: Thank you to all members of the ad hoc committee on national medical licensure of the Society of Rural Physicians of Canada for their continued encouragement, as well as the support of all other stakeholders across Canada who have been helping advocate for national licensure.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

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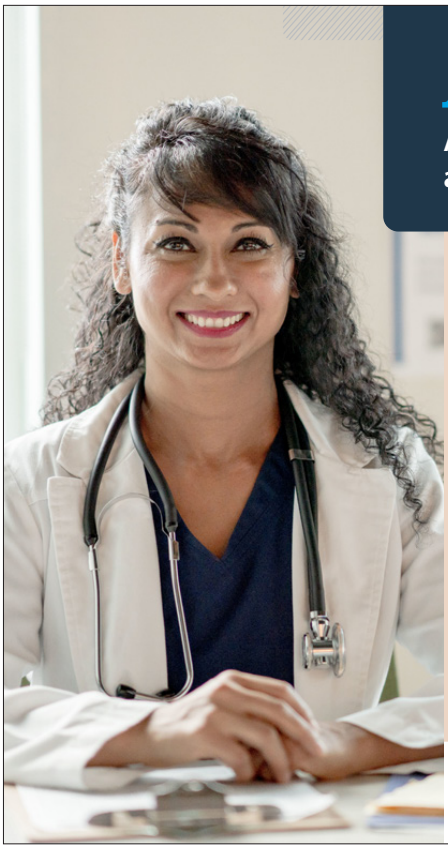

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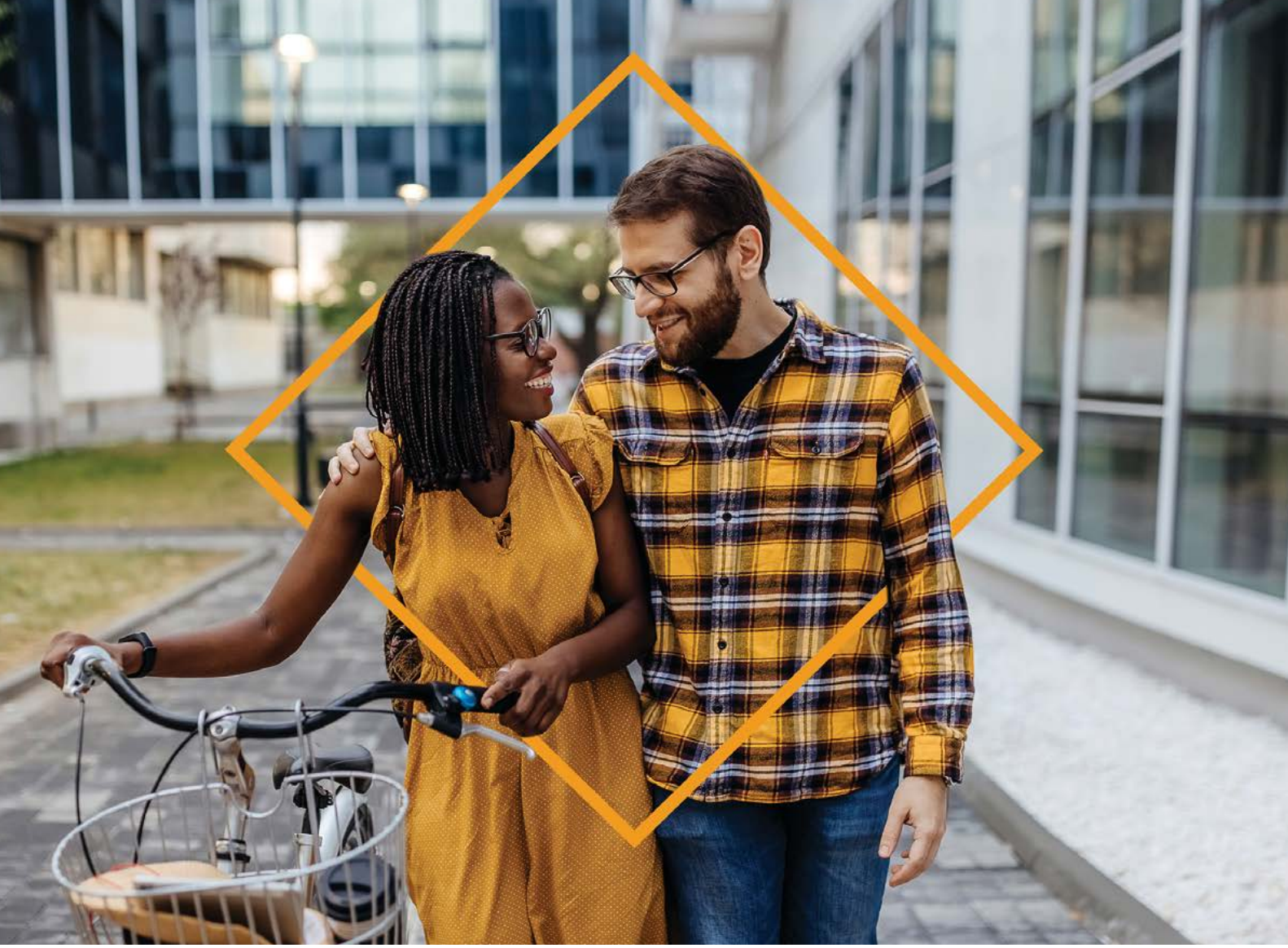

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