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ERRATUM

"Remote BC Mountains," © 2019, by Nicholas J. Bott
36"x48" Oil on canvas
https://www.mountaingalleries.com/artist-nicholas-bott

Nicholas Bott (1941-2021). He was born in the Netherlands and settled in Canada in 1958. Inspired by Van Gogh and Group of Seven, and blending his European values with contemporary developments, his paintings evolved into the post-impressionistic style. Bott distills the landscape elements into powerful aesthetic compositions. His work is held in collections across North America.

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Another rural doctor: The camp doctor

Peter Hutten-Czapski, MD[1]

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While the definition of rural generalist physicians is at times abused and is hard to pin down, one type of rural doctor that would be hard to challenge is the Camp Doctor. The camp is a children's camp and in eastern Canada at least, on a lake. The camp, like rural towns, is 'somewhat unique' to itself and yet similar. It will have some distinguishing feature, be it a language or religious connection, and/or some sport or activity.

The camp may have a doctor, which is common for larger camps, sports camps and/or more remote camps. He or she is someone tasked with dealing with the children (and grownups) and their injuries and sickness, with very limited resources.

As I write this now, off the cell phone coverage map, I have diagnosed multiple strains (with my anxiety that all the imaging rules are not validated for children balanced by the ability to recheck patients three times a day if I want to), a urinary tract infection and multiple otitis media, and we will not mention the cuts, scrapes and bug bites that the nursing staff have already taken care of. Some patients are frequent fliers; personality, homesickness (luckily it has been sunny!) and other reasons not always apparent (although conversations on the landline seem to indicate that parents can have something to do with some behaviours!)

This year we had the added complication of COVID-19. Currently, we are dealing with a small outbreak at the camp where I have volunteered. It is not as bad as some other camps I hear rumours about (15 counsellors down at a camp – yikes! How can you keep functioning in that setting?) Thankfully with the help of the camp's thoroughly prepared administration, the parents get informed. Like an oiled machine, the entire cabin gets tested with rapid antigen kits (we have roughly 900). Positive kids go home with the opportunity to return to camp later in the season. International students get quarantined off camp property. Negative kids get segregated and retested. Dining is al fresco. Masks are worn at all indoor venues. The kids know how, although they need constant reminding! Case counts are holding steady, fingers crossed, for the rest of the session.

If you have kids or grandkids consider joining them at camp as the camp doc. It is hardly as difficult as the work in the kitchen and will be satisfying. The only problem will be covering your office.

Gotta go – the dinner bell has just rung!

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Un autre médecin rural – Le médecin de camp d'été

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Bien que la définition des médecins généralistes ruraux soit parfois malmenée et difficile à cerner, un type de médecin rural qu'il serait difficile de contester est le médecin de camp d'été. Le camp est une colonie de vacances pour enfants qui, dans l'est du Canada, se situe généralement près d'un lac. Comme pour les villes rurales, le camp est un lieu « quelque peu unique » et similaire en soi. Il possède un trait distinctif, qu'il s'agisse d'un lien linguistique ou religieux, avec des sports ou activités.

Le camp peut avoir un docteur, ce qui est courant pour les camps plus grands, les camps sportifs ou des camps plus éloignés. Ce professionnel de la santé a pour tâche de soigner les enfants et les adultes, souffrant de liaisons ou de maladies, avec très peu de ressources.

À l'heure où j'écris ces lignes, hors de la carte de couverture des téléphones portables, j'ai diagnostiqué de multiples souches (mon inquiétude que toutes les règles d'imagerie ne soient pas validées pour les enfants étant contrebalancée par la possibilité de revérifier les patients trois fois par jour si je le souhaite), une infection urinaire, de multiples otites moyennes, sans mentionner les nombreuses coupures, éraflures et piqûres d'insectes dont le personnel infirmier s'est déjà occupé. Certains patients ont tendance à fréquemment essayer de quitter le camp, souvent en raison de leur personnalité, de leur envie de rentrer chez eux (heureusement qu'il a fait beau) et d'autres raisons qui ne sont pas toujours apparentes; même si les conversations par téléphone fixe semblent indiquer que les parents peuvent avoir quelque chose à voir avec certains comportements!)

Cette année, la COVID-19 a ajouté un autre niveau de complexité. Actuellement, nous sommes confrontés à une petite épidémie au camp où je suis bénévole. Ce n'est pas aussi grave que certains autres camps dont certaines rumeurs nous sommes parvenues (15 conseillers en moins dans un camp! Comment est-ce possible de fonctionner dans une telle situation?) Heureusement, avec l'aide de l'administration minutieusement préparée du camp, les parents sont informés. Comme une machine huilée, toute la cabane est testée avec des trousses d'antigènes rapides (nous en avons environ 900). Les enfants testés positifs rentrent chez eux avec la possibilité de revenir au camp plus tard dans la saison. Les étudiants internationaux sont mis en quarantaine en dehors de la propriété du camp. Les enfants testés négatifs sont séparés et testés à nouveau. Les enfants savent comment agir, même s'il faut souvent leur rappeler! Le nombre de cas reste stable. En espérant que cela reste comme ça pour le reste des vacances.

Si vous avez des enfants ou des petits-enfants, envisagez de les rejoindre au camp en tant que médecin de camp d'été. C'est à peine aussi difficile que le travail en cuisine et c'est très satisfaisant.

Je dois y aller. La cloche du souper vient de sonner!

President's message

Sarah Lespérance, MD, CCFP

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Summer is over, but many rural communities saw an influx of travellers over the summer months, multiplying the size of the population and increasing demands on local resources. Despite the extra demands and critical staffing shortages faced, I hope you had the opportunity to see friends and family, or simply enjoy some time off. Perhaps, this included connecting with nature, and the beauty of our rivers, forests, beaches, tundra and other vast and varied Canadian terrain.

As we enjoy the beauty surrounding us, we also see many reminders of the climate-related changes affecting our communities. Devastating forest fires and heat waves experienced in 2021 were a stark reminder of the need for community preparedness, particularly in rural areas. Beyond the health human resource crisis facing our healthcare system, climate change and its impacts will be one of the most significant challenges to healthcare faced by rural and remote Canada in the coming years. The SRPC recognises the importance of this issue and is committed to providing leadership and evidence to drive the climate adaptation. At the Rural and Remote Conference in Ottawa, on Earth Day (22 April 2022), a motion was endorsed unanimously at the SRPC's Annual General Meeting asking the federal government to redirect fuel subsidies to support climate crisis adaptation.[1]

When faced with the devastating effects of climate change, we have the capacity to leverage our strong connections with our communities, seeking methods to adapt, mitigate consequences and protect the most vulnerable citizens from health-related effects. Community strength and resilience lead to many potential solutions, whether through team-based care, sustainable growth and development, indigenous community partnerships, youth engagement or technology. We have the opportunity to gather data and share our knowledge and experience with a broader audience, and the SRPC is actively engaged in supporting this work.[2]

While we gather data, build community partnerships, and speak nationally on the issue, the SRPC must also consider how else we mitigate impacts of climate change. After over 2 years with limited in-person opportunities, we recognise the value of personal connections for our members, but we must also consider effective ways in which to transform our work. We must learn from our experiences in COVID, perhaps looking at virtual options for some meetings, conferences or other events. In doing so, we play an important role in ensuring our summers continue to be ones where we can reconnect with the beauty of the great outdoors.

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2. Available from: https://rhsrnbc.med.ubc.ca/resources/ rural- community-resiliency- to-climate- change/. [Last accessed on 2022 Jul 11].

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Message de la présidente

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L'été est fini, mais de nombreuses communautés rurales on connu un afflux de voyageurs au cours des mois d'été, multipliant la taille de la population et augmentant les demandes en ressources locales. Malgré les demandes supplémentaires et les pénuries critiques de personnel auxquelles nous sommes confrontés, j'espère que vous aviez l'occasion de voir vos amis et votre famille, ou simplement de profiter d'un peu de temps libre. Peut-être cela inclura-t-il un rapprochement avec la nature et la beauté de nos rivières, forêts, plages, toundra et autres terrains canadiens vastes et variés.

Tout en profitant des beautés naturelles qui nous entourent, nous sommes souvent rappelés des changements climatiques qui impactent nos communautés. Les incendies de forêt dévastateurs et les vagues de chaleur vécus en 2021 ont été un rappel brutal du besoin de préparation des communautés, notamment dans les zones rurales. Au-delà de la crise des ressources humaines en santé, à laquelle est confronté notre système de soins de santé, les changements climatiques et ses répercussions vont devenir, au cours des prochaines années, l'un des plus importants défis en matière de soins de santé auxquels seront confrontés les régions rurales et éloignées du Canada. La SMRC reconnaît l'importance de cette situation et s'engage à fournir un leadership et des données probantes pour favoriser l'adaptation au climat. Lors de la conférence Rural & Remote (Régions rurales et éloignées) à Ottawa, à l'occasion du Jour de la Terre (22 avril 2022), une motion a été approuvée à l'unanimité lors de l'assemblée générale annuelle de la SMRC, demandant au gouvernement fédéral de réorienter les subventions aux carburants pour soutenir l'adaptation à la crise climatique.[1]

Face aux effets dévastateurs des changements climatiques, nous avons la capacité de tirer parti de nos liens étroits avec nos communautés, en cherchant des méthodes pour nous adapter, atténuer les conséquences et protéger les citoyens les plus vulnérables des effets sur la santé. La force et la résilience des communautés conduisent à de nombreuses solutions potentielles, que ce soit par le biais des soins en équipe, de la croissance et du développement durables, des partenariats avec les communautés autochtones, de l'engagement des jeunes ou de la technologie. Nous avons la possibilité de recueillir des données et de partager nos connaissances et notre expérience avec un public plus large, et la SMRC s'engage activement à soutenir ce travail.[2]

Pendant que nous recueillons des données, que nous établissons des partenariats communautaires et que nous nous exprimons sur la question à l'échelle nationale, la SMRC doit également envisager d'autres moyens d'atténuer les effets des changements climatiques. Après plus de deux ans de communication à distance, nous reconnaissons l'importance pour nos membres d'avoir des rencontres en personne. Cela étant dit, nous devons également envisager des moyens efficaces de transformer notre travail. Par conséquent, nous devons tirer les leçons de nos expériences avec la pandémie en envisageant des options virtuelles pour certaines réunions, conférences ou autres événements. Ce faisant, nous jouons un rôle important en veillant à ce que nos étés restent des moments de rapprochement avec la nature et le grand air.

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2. Disponible au: https://rhsrnbc.med.ubc.ca/resources/rural-community-resiliency-to-climate-change/. [Last accessed on 2022 Jul 11].

ORIGINAL ARTICLE

Northern Ontario's Rural Physician Teams: Who, why and for how long

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Abstract

Introduction: This study examines the state of Rural and Northern Physician Group Agreement (RNPGA) physician teams in rural Northern Ontario in terms of demographics, intent to stay, length of stay, number of physicians relative to the RNPGA-designated complement and perceptions of various workplace and community factors.

Materials and Methods: Data were based on a survey mailed, in 2018, to Ontario physicians in RNPGA communities having a designated complement of 2 or more physicians. Physicians reported on aspects of the work environment, community and intentions to stay.

Results: Sixty-five percent of all practices and 91.7% of those with a designated complement of 2 physicians were at or above their government-designated complement. Intent to stay was higher in groups below complement. The mean length of stay was 11.3 years. More physicians were male (58.7%). Older physicians were more represented in smaller practice groups. Physicians reported positive ratings on several aspects of their work environment, community and intentions to stay. Length of stay in the community was related to strong family ties and was a predictor of intent to stay. Many physicians had neither strong family ties (65.3%) nor a rural upbringing (57.3%).

Conclusion: The results show positive outcomes in terms of: high intentions to stay, satisfaction with workplace and community factors, and full recruitment into RNPGA groups designated for a complement of two physicians. Further research is needed to understand the role of family ties to length of stay, and the role of level of physician complement and group size in retention and recruitment.

Keywords: Physician retention, primary care, quantitative research, rural health services

Résumé

Introduction: Cette étude examine l'état des équipes de médecins de l'Entente relative au groupe de médecins en milieu rural et dans le Nord (EGMMRN) dans les régions rurales du Nord de l'Ontario en termes de données démographiques, d'intention de rester, de durée, de nombre de médecins par rapport à l'effectif désigné par l'EGMMRN, ainsi que de perceptions de divers facteurs liés au milieu de travail et à la communauté.

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Méthodes: Les données sont fondées sur un sondage envoyé par courrier en 2018 aux médecins de l'Ontario dans les communautés associées à l'EGMMRN ayant un effectif désigné de 2 médecins ou plus. Les médecins ont fait état des aspects du milieu de travail, de la communauté et de leurs intentions de rester.
Résultats: Soixante-cinq pour cent de tous les cabinets et 91,7% de ceux dont l'effectif désigné est de 2 médecins se situaient au niveau ou au-dessus de leur effectif désigné par le gouvernement. L'intention de rester était plus élevée dans les groupes en dessous de l'effectif. La durée moyenne de présence était de 11,3 ans. Plus de médecins étaient des hommes (58,7%). Les médecins plus âgés étaient plus représentés dans les petits groupes de pratique. Les médecins ont attribué des notes positives à plusieurs aspects de leur environnement de travail, de leur communauté et de leur intention de rester. La durée de présence dans la communauté était liée à des liens familiaux forts et constituait un facteur prédictif de l'intention de rester. De nombreux médecins n'avaient ni des liens familiaux forts (65,3%) ni une éducation en milieu rural (57,3%).
Conclusion: Les conclusions montrent des résultats positifs en termes d'intentions élevées de rester, de satisfaction à l'égard du lieu de travail et des facteurs communautaires, ainsi qu'un recrutement complet dans les groupes désignés de l'EGMMRN pour un effectif de 2 médecins. D'autres recherches sont nécessaires pour mieux comprendre le rôle des liens familiaux sur la durée de présence, ainsi que le rôle du niveau d'effectif de médecins et de la taille du groupe en matière de rétention et de recrutement.

Mots-clés: Recrutement, rétention, rural

INTRODUCTION

Northern Ontario refers to an area of Ontario occupying over 860,000 km^2 and yet containing only approximately 6% of the provincial population.[1-3] The health of those living in Northern Ontario has historically been shaped by this remoteness and relative rurality. In general, people living in the north tend to die earlier, have more chronic diseases, and report fewer healthy behaviours than people in southern Ontario.[1,2] These health challenges are compounded by chronic physician shortages.[4]

While recent studies show that more physicians are staying in the north, northern physician distribution remains clustered in urban areas, with rural areas remaining underserved.[5,6] Current literature indicates that multiple factors influence physician recruitment and retention.[7-11] Financial incentives have a strong correlation with recruitment but are less effective at long-term, same placement retention.[8,9,12] Selection of applicants to medical education programmes with a focus on rural context and experience correlates with improved outcomes for both rural recruitment and retention.[8,9,12-14] Other proposed factors influencing retention of physicians who already work in the north include partner/spouse satisfaction, community integration, personal attributes and quality of life in a rural community.[7,8]

In Ontario, financial incentives[13] – establishing the Northern Ontario School of Medicine (NOSM)[12] and the introduction of the Rural and Northern Physician Group Agreement (RNPGA)[14] – are strategies that have been used to address the issue of physician recruitment and retention in the north. The RNPGA was introduced in 1996 to improve support, increase the financial feasibility of working in the north, and reduce dissatisfying factors,[14] in part by encouraging the creation of formal physician groups. Each group is funded by the Ministry of Health (MOH) for a specific number of physicians (complement) using a blended capitation model to provide core health care services, including hospital and emergency services in those communities having hospitals, for the population in the group's catchment area. The RNPGA complements range from 1 to 7 physicians, with the majority having more than 1 physician.[15] As of 2017, there were 38 RNPGA physician groups serving over 65,000 patients in small rural northern communities.[14] These road-accessible communities are spread across Northern Ontario from Haileybury, 155 km east of North Bay, to Vermillion Bay, 395 km west of Thunder Bay, as well as on Manitoulin Island in the south and north to Red Lake and Pickle Lake. Very little is known about whether the RNPGA intra-professional teams have resulted in improved support and satisfaction.

In 2018, a survey was conducted in Northern Ontario of physicians from RNPGA communities assigned a complement of 2 or more physicians to assess the role of physician team efficacy in

predicting intent to stay when controlling for other factors related to retention.[16] Variations that might exist between these rural communities in Nurse Practitioner and Physician Assistant numbers, and the influence that may have on the outcomes measured, was not accounted for in this study.

The present secondary analysis of the 2018 survey data looks at the current state of the RNGPA teams in terms of demographics, length of stay, intent to stay and other factors related to retention. The analyses also look at associations between these factors.[7]

MATERIALS AND METHODS

Selection of participants and survey methods

All RNPGA groups with a designated complement of two or more physicians were identified through the database of RNPGA physician groups, published by Health Force Ontario. Individual community clinics and hospitals were contacted to create a list of physicians to whom to send the survey. All physicians actively funded by the RNPGA at the time of the study were sent a paper copy of the survey with postage-paid return envelopes. To encourage participation physicians were offered monetary incentives from project grant funds: an initial $20 incentive for the time to review the survey, followed by an additional $100 upon survey completion. After a month, non-respondents were sent a second survey package.

Survey measures

Physician surveys included demographic items for gender, age group and length of time in the community. The remainder of the survey items were selected to assess constructs of retention factors previously cited in the extant literature, including rural practice preparedness, career opportunities, working conditions, community integration, partner support and intent to stay along with aspects of team functioning. Specific questions to investigate these constructs were formulated based on a review of the previous literature [7,17-23]

Survey items to evaluate the constructs were worded positively and had 5-point Likert-type scale responses ranging from strongly disagree to strongly agree and construct scores based on the items could range from 0 to 5. Intent to stay, was measured using a 5-item measure which included items such as 'I will probably look for a new job in the near future' and 'I am thinking of quitting my job at the present time.' All items for this measure were reverse-coded such that higher scores on the measure indicated a greater intent to stay with the organisation.

For cross-tabulations, length of stay was stratified into three groups based on response (0–<5 years, 5–<15 years and 15 + years) and the lowest and highest 2 age groups were combined. Information on physician complement and the actual number of physicians was gathered from the RNPGA database and community clinics and hospitals. Hospital commitment information for the communities was obtained through the Ontario Medical Association. Physician groups were classified as being either below, at, or above their government-designated complement (level of complement attained) and as having, or not having, hospital commitments.

Statistics

Descriptive analyses were completed including frequency tables for nominal and categorical data and means/standard deviations for continuous data. Comparisons between groups were completed using one-way ANOVAs and *t*-tests to determine between which groups differences were significant. Chi-square tests with *z* values for between column comparisons in proportions were used for cross-tabulations while Pearson correlations were used to test for associations between factors. Regression analysis was used to control for potentially confounding factors and assess factors associated with intent to stay, including age, gender, length of time in the community, complement, hospital commitment and level of complement attained and interactions between complement and age, level of complement attained and hospital commitment. All analyses were conducted using SPSS with statistical significance (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY, USA) assumed at $P < 0.05$ and a minimum difference of 0.5 in the mean scores was considered to be relevant.

Ethics

Approval for this study was obtained from the Lakehead University Research Ethics Board (ID No. 1466559) before the distribution of the survey material.

RESULTS

Eighty-nine physicians actively funded by RNPGA were sent the survey. Seventy-five physicians returned completed surveys for an 84.3% response rate, with 3 nonresponders for the length-of-stay question.

Rural and Northern Physician Group Agreement physician complement and hospital commitment

Of the 38 RNPGA communities, 26 (68.4%) had designated complements of two or more physicians, ranging from 2 to 7, with the most frequent complement being two physicians (12 or 46.2% of the groups), followed by a complement of 6 for 23% of the groups. At the time of the survey, 17 (65.4%) of these 26 groups were either at or above complement and the actual number of physicians in the groups ranged from 1 to 9, with 10 (38.5%) having two physicians. The proportion of physician groups at or above their MOH-designated complement was significantly higher for those groups with a designated complement of two physicians (91.7%) compared to those groups with a designated complement of 3–5 (40.0%) or 6–7 (44.4%) ($P < 0.05$). Eighteen (69.2%) of the communities had hospital commitments as part of their agreement. Half of the communities with a designated complement of two had hospital commitments, compared to 80% and 89% of those with designated complements of 3–5 and 6+ respectively (not significant).

Physician demographics and team size

Just over 40% of the survey respondents were female and physicians ranged from under 30 to 70 + years of age with 50% younger than 50 [Table 1]. The time that the physicians had been in their current community ranged from 1 month to 40 years, with 47.2% having practised in the community for more than 10 years.

There were no significant differences by gender for team size groupings, age of physicians or length of stay in the community. There was a weak negative correlation between the age group of physicians and the actual number of physicians in the practice (Pearson –0.295, $P < 0.05$). Only 5.3% of those under 40 were in a team of two physicians, compared to 47.1% of those aged 60 or older ($P < 0.05$) while 47.4% of the under 40-year-olds were in a practice of six or more physicians, compared to only 11.8% of those aged 60 or older ($P < 0.05$). As would be expected, the length of time in the community was positively correlated with the age group (Pearson correlation 0.639, $P < 0.001$).

Physician intent to stay and perceptions of related variables

Overall, the physicians had a positive perception of all the team and workplace-related variables as well as community integration; mean scores were above 3/5 for all the variables [Table 2]. Rural preparedness had the lowest mean score with particularly low means for the single items of strong family ties and raised in a rural setting. The proportion of respondents with scores reflecting a negative perception (score <3) was <34% for all, but these same 2 items. Only 14.7% of physicians scored intent to stay as <3. While many of the team-related factors and intent to stay were rated at or above 4 by more than half of the respondents, working conditions, organisational commitment,

Table 1: Demographics

Factor	Frequency (%)
Gender (*n*=75)	
Female	31 (41.3)
Male	44 (58.7)
Age group (*n*=74)	
Under 30	4 (5.4)
30-39	15 (20.3)
40-49	18 (24.3)
50-59	20 (27.0)
60-69	15 (20.3)
70+	2 (2.7)
Length of stay in community (*n*=72), Mean±SD (years)	11.3±10.3
0-<5	23 (31.9)
5-<15	26 (36.1)
16+	23 (31.9)

SD: Standard deviation

Table 2: Physician rural practice preparedness and perceptions of team and workplace

Variable	Mean±SD	Percentage with score <3/5 (5 point Likert Scale for individual items)	Percentage with score ≥4/5
Rural practice preparedness overall score	3.21±0.84	33.3	18.6
Individual items			
Strong family ties	2.35±1.52	65.3	17.3
Raised rural	2.67±1.60	57.3	21.3
Prepared for rural leadership	3.18±1.16	17.3	70.6
Adequate rural medicine training	3.60±1.05	13.3	61.3
Community meets personal interest	3.66±1.19	33.3	46.6
Prepared for rural living	3.83±1.05	20.0	65.3
Perception of team performance	3.57±0.53	10.7	31.9
Working conditions	3.59±0.63	14.7	28.0
Organisational commitment	3.63±0.77	17.3	32.0
Community integration	3.65±0.71	16.0	37.2
Career opportunities	3.67±0.86	12.0	51.9
Communication	3.96±0.86	12.0	69.3
Team climate	4.01±0.74	10.7	63.4
Conflict resolution	4.01±0.73	10.7	70.5
Partner support (single item)	4.03±1.00	6.3	78.1
Team efficacy	4.04±0.69	8.0	62.5
Decision making	4.06±0.73	10.7	66.7
Intent to stay	3.89±1.04	14.7	63.9

SD: Standard deviation

perception of team performance and community integration were viewed more neutrally.

Factors related to intention to stay and length of stay

No significant correlation was found between age and respondent's stated intent to stay, nor did the intent to stay differ by gender (males mean 3.89 ± 1.1, females 3.91 ± 1.0) or age group [Table 3]. Mean intent to stay was found to be significantly higher for physicians in practices that were below the designated complement compared to communities at or above the designated complement [Table 3]. In regression analysis for intent to stay, length of stay in the community (P = 0.012) and level of complement attained (P = 0.009) were found to be significant factors (model R^2 = 0.22, P = 0.011) [Table 4]. None of the interaction terms were significant and did not significantly contribute to the model. Significant Pearson correlations were found between intent to stay and factors previously studied in the literature [Table 5]. Finally, a significantly higher proportion (40.4%) of physicians with a length of stay of <5 years had family ties score <3 compared to those with longer lengths of stay (28.6% and 11.1% for 5 to <15 years and 15 + years, respectively).

Table 3: Intent to stay by age group and level of complement attained

Factor	Frequency	Mean intent to stay (score range: Low 0 to high 5)	SD
Age group			
Under 40	19	3.85	0.95
40-49	18	4.14	0.88
50-59	20	3.77	1.30
60+	17	3.8	1.04
Level of complement			
Below complement	25	4.34[a,b]	0.630
At complement	33	3.62[a]	1.30
Above complement	17	3.74[b]	0.764

[a,b]Values with same superscript are significantly different (P<0.05).
SD: Standard deviation

DISCUSSION

While close to two-thirds of RNPGA practices in Northern Ontario with a MOH-designated physician complement of two or more physicians have, at the time of the study, succeeded in reaching or surpassing the government-established

Table 4: Regression analysis for intent to stay

Model	Unstandardised coefficients		Standardised coefficients	t	Significant
1	B	SE	Beta		
Constant	4.014	0.590		6.798	0.000
Hospital commitment	−0.320	0.312	−0.126	−1.027	0.308
Complement	0.091	0.070	0.170	1.297	0.199
Age	−0.263	0.136	−0.308	−1.932	0.058
Gender	0.114	0.240	0.053	0.474	0.637
Length of stay in community	0.041	0.016	0.395	2.570	0.012
Level of complement	−0.449	0.168	−0.312	−2.678	0.009

SE: Standard error

Table 5: Intent-to-stay Pearson correlations with retention variable

Retention variable	Mean response to factor-specific questions (*n*=75)	SD	Pearson correlation with intent to stay
Career opportunities	3.67	0.859	0.458*
Community integration	3.65	0.713	0.609*
Rural practice preparedness	3.21	0.843	0.450*
Working conditions	3.59	0.627	0.517*

**P*<0.01. SD: Standard deviation

target number of physicians, there has much been greater success in achieving the target in practices designated as two physicians. These smaller-sized teams were also more likely to be served by physicians aged 60 and over. More research is needed to determine what the recruiting challenges are for groups with higher designated complements and why more younger physicians are in these groups. Do physicians prefer to work in groups only up to a certain size and if so, why? Do physicians move to smaller practices as they get older, is there a more recent trend towards preferring groups larger than two or have small groups had no recent vacancies for newer physicians to fill? The role of the presence of allied health professionals as part of teams also needs to be considered. Given the relatively high percentage of older physicians in the practices of two physicians, more of these groups may be underserviced in the nearer future as physicians retire.

As has been previously reported in the literature, the current study results indicate a lower proportion of females than males working in the north. While the proportion of females (41.3%), lags slightly behind the 2017 national average of practising female family physicians (45.5%),[24] it is considerably higher than the 25.5% for northern practices reported in 2011.[5] The fact that 50% of the physicians in the study were under 50 is consistent with the national average in 2016 of 50.2 years of age.[24] The age and gender distribution for RNPGA communities with a designated complement of one and physicians working in rural Northern Ontario settings under other funding models would need to be included for a more accurate picture of physicians by gender and age in the north as a whole. The interpretation of age data is also limited by the use of age ranges in the survey rather than reporting exact age.

With close to half (47%) of respondents having been in the community for over 10 years and a mean length of stay of 11.3 years, it is evident that a number of physicians working in the RNPGA teams have stayed for significant periods. While it is difficult to say what the ideal term of retention is for physicians within a given community, it is well known that having a long-term physician relationship is correlated with better patient outcomes, increased community health and better preventative care.[25,26]

The results of this study also suggest that the goal of the RNPGA programme to improve support and reduce dissatisfaction through the promotion of group practice is coming to fruition as physicians responding to the survey scored positively all variables addressed in the survey related to the team, workplace and community, although this outcome may not be related to the RNPGA programme *per se*. The lower proportions of physicians with high scores

for working conditions, perceptions of team performance and organisational commitment indicate that there is room for improvement in these areas. More detailed analysis of individual aspects of working conditions in the future could help determine which aspects seem to be of greatest concern. The lack of association between hospital commitments and intent to stay suggests that other working conditions may be influencing recruitment and retention. There have been concerns that the RNPGA contract has not kept up with other funding models in areas such as remuneration for emergency and inpatient services as well as locum coverage.[27] As over half of those surveyed did not have strong family connections to the community or a background of growing up in a rural setting, these factors may not be as important in rural retention and recruitment as previously thought. However, the proportion of physicians raised in a rural setting may still be higher in the physicians studied than among the general family physician population. The rural upbringing may only impact initial recruitment, and not long-term retention, as has been suggested in the literature.[28] The high proportion of physicians feeling that they were prepared for rural living and had adequate rural medicine training suggests that the NOSM and other rural track training programmes are increasing exposure, interest and preparedness for rural northern medicine.

The finding of higher intent to stay for physicians in practices that are below complement compared to those at or above complement challenges the long-held belief that having adequate physicians would lead to greater intent to stay. Perhaps there is a decreased feeling of obligation or worry that patients would suffer if the physician were to leave in well-serviced practices. This would be coherent with the finding that rural physicians tend to have service-oriented personality traits.[7] Physicians who are in deficit communities may simply feel more of a duty to stay. Alternatively, the RNGPA funding model may be more lucrative when there are fewer than the designated complement of physicians. For example, in cases where there are hospital commitments, the remaining physicians would benefit financially from the increased number of on-call ER shifts. Further study would be needed to better understand the relationship between intentions to stay and the level of complement attained.

Length of stay was also found to be a predictor of intent to stay and was associated with the single item of strong family ties within the rural preparedness construct. The level of strong family ties was lower for physicians who had been in the community for a shorter period. More research will need to be done to clarify whether 'strong family ties' developed over prolonged time in the community for the 15+ years physicians, or whether family ties were a significant factor in facilitating long-term practice.

Limitations

True retention '… the length of time between commencement and termination of employment'.[29] could not be measured with the present cross-sectional survey, although intent to stay has historically been a strong predictor of retention.[30,31] Similarly, the current length of stay is a function of age along with factors related to retention factors. To determine the true length of stay, and the contributing factors, future studies should consider using a prospective design to follow rural physicians over time and collect data as they leave the practice, or alternatively, identify a group of former RNPGA physicians to gain insight into the actual length of stay and reasons for departure from rural communities. This study is also not able to answer questions as to the evolution of the factors throughout an individual's practice over time. The sample size of this survey was relatively small which limited some of the analysis and it is unknown whether the non-responders differed significantly from responders in age or gender. Finally, within a small and cooperative setting in the north, it is possible that physicians might have felt pressured to answer the questions positively.

CONCLUSION

Retention of physicians in rural Northern Ontario remains a complex and multifaceted issue. This study, representing responses from over 80% of physicians practising in RNGPA communities with a designated complement of two or more physicians, indicates physicians largely have high intentions to stay and positive perceptions of

aspects of the workplace, team and community integration as they relate to physician retention.

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ORIGINAL ARTICLE

Orthopaedic Outreach: An innovative programme for orthopaedic patients in remote areas of Newfoundland and Labrador

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Abstract

Introduction: Wait times to see an orthopaedic consultant can be lengthy. Remote communities such as Labrador City and Goose Bay, located in Labrador in the province of Newfoundland and Labrador, often do not have an orthopaedic specialist locally and patients are required to travel great distances to attend clinic appointments. The objectives of this report are to describe our Orthopaedic Outreach Programme where patients receive fracture assessments and care for musculoskeletal concerns at two local clinics by a visiting orthopaedic surgeon. We also describe the justification for the Orthopaedic Outreach Programme and list the benefits; financial and otherwise.

Methods: A review of the programme, operating out of Happy Valley-Goose Bay and Labrador City, using electronic medical records, was undertaken from 1st January 2015 to 31st December 2019 including demographics and procedures completed. Travel and hotel costs were estimated.

Results: Over the last 5 years, the Orthopaedic Outreach Programme treated 1,698 patients at the 2 clinics. Cost savings were estimated at $366,768 per annum. The cost savings over the last 5 years were estimated at a total of $1,833,840. This does not account for patient's time off work and lost revenue that would occur when they make the trip to St John's for a clinic appointment.

Conclusions: Our Orthopaedic Outreach Programme was implemented to improve access to orthopaedic services in the remote areas of Labrador. This report aims to describe the result of a programme focused on providing orthopaedic care to individuals who would otherwise be required to travel great distances for their care.

Keywords: Orthopaedics, outreach, remote

Résumé

Introduction: Les temps d'attente pour voir un orthopédiste peuvent être longs. Les communautés éloignées telles que Labrador City et Goose Bay, situées au

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Labrador dans la province de Terre-Neuve-et-Labrador, n'ont souvent pas de spécialistes en orthopédie sur place et les patients doivent parcourir de grandes distances pour se rendre à leurs rendez-vous en clinique. Les objectifs de ce rapport sont de décrire notre Programme de sensibilisation à l'orthopédie dans le cadre duquel les patients reçoivent des évaluations de fractures et des soins pour des problèmes musculosquelettiques dans deux cliniques locales par un orthopédiste en visite. Nous décrivons également la justification du programme et énumérons les avantages, financiers et autres.

Méthodes: Un examen du programme, opérant à partir de Happy Valley-Goose Bay et Labrador City, à l'aide de dossiers médicaux électroniques, a été entrepris du 1er janvier 2015 au 31 décembre 2019, y compris les données démographiques et les procédures effectuées. Les frais de déplacement et d'hôtel ont été estimés.

Résultats: Au cours des 5 dernières années, le programme de sensibilisation à l'orthopédie a traité 1 698 patients dans les deux cliniques. Les économies de coûts ont été estimées à 366 768 $ par an. Les économies réalisées au cours des 5 dernières années ont été estimées à un total de 1 833 840 $. Ce montant ne tient pas compte du temps d'arrêt de travail des patients et des pertes de revenus qui se produiraient lorsqu'ils se rendent à St John's pour un rendez-vous à la clinique.

Conclusion: Notre Programme de sensibilisation à l'orthopédie a été mis en œuvre pour améliorer l'accès aux services orthopédiques dans les régions éloignées du Labrador. Ce rapport vise à décrire le résultat d'un programme axé sur la fourniture de soins orthopédiques à des personnes qui, autrement, seraient obligées de parcourir de grandes distances pour recevoir leurs soins.

Mots-clés: Rural; orthopédie; orthopédistes

INTRODUCTION

The provision of medical services to remote communities in Newfoundland and Labrador is challenging and orthopaedic needs are increasing. [1-3] Wait times, prohibitive costs (such as travel, childcare and time) and travel issues all contribute to obstruction of care to patients. Labrador is only accessible by boat or plane and is over 1000 km from St. John's, where a full complement of orthopaedic care is offered. One solution adopted by many surgical specialties in Newfoundland and Labrador are outreach clinics where surgical specialists travel to remote communities to provide service. [4-7] Such clinics are considered a crucial policy choice to increase the accessibility of specialist services and their integration with rural medical care. Orthopaedic surgeons from St John's have been providing clinical care in Labrador since 2013. Similar orthopaedic visiting consultant clinics have been successfully employed elsewhere and our aim is to show the successful implementation of our program and the benefits. [8,9]

Our Orthopaedic Outreach Programme uses visiting consultant orthopaedic surgeons who run clinics providing on-site musculoskeletal care for individuals in two Labrador communities; Labrador City, population 7400 and Goose Bay, population 8000. These services include new patient consultations, follow-up visits and post-operative checks. We aim to show that these Outreach clinics allow for the provision of orthopaedic care to be delivered at the same quality and level as an urban setting, at a fraction of the cost. This paper details The Orthopaedic Outreach Programme and documents specific services provided and the benefits, both personal and financial, for the patients, surgeons and trainees. Although the programme was first started in 2013, the last 5 years were chosen for ease of data collection.

Newfoundland and Labrador is the most eastern province in Canada, with a population of 521,542 (2019) spread over a large geographical area of 405,212 km^2 [Figure 1]. The province itself is unique in that it is composed of the insular region of Newfoundland and the continental region of Labrador to the northwest. Healthcare in Newfoundland and Labrador is delivered through 4 Regional Health Authorities which deliver health services to meet the needs of the population within their respective geographic areas. Labrador-Grenfell Health covers Labrador and all communities north of Bartlett's Harbour on the Northern Peninsula. The catchment area for Labrador-Grenfell includes approximately 37,000 people. The indigenous groups in this area include the Innu, Inuit and Southern Inuit. The population in Labrador has a marked

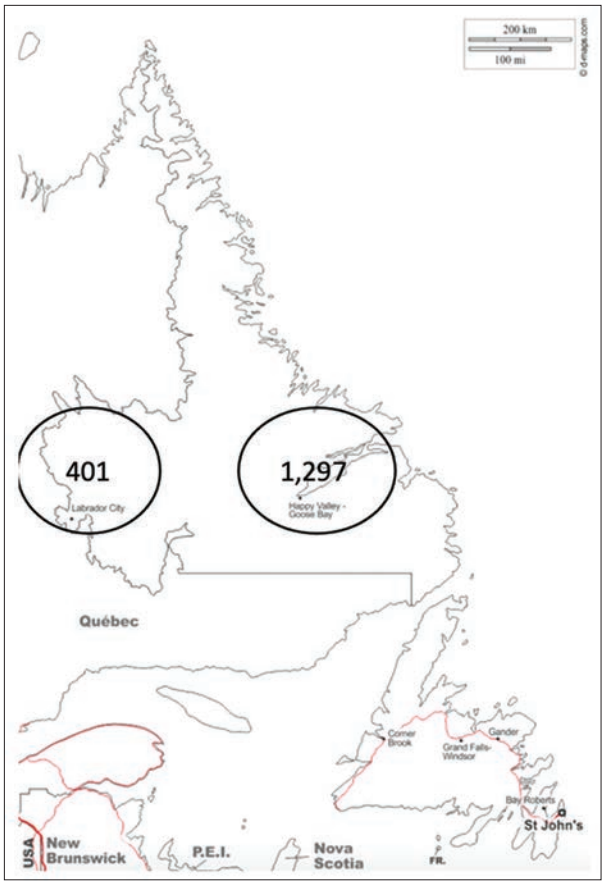

Figure 1: Area of service and Orthopaedic Outreach encounters in Newfoundland and Labrador from 1 January, 2015, to 31 December, 2019.

disparity in health outcomes compared to national averages and has contributing factors in addition to their remoteness. These include high rates of smoking, prenatal substance abuse, high rates of obesity, high rates of suicide and lower levels of education. [10,11]

Programme description

Orthopaedic surgeons visit the two remote Orthopaedic Outreach clinics (the Labrador Health Centre, Happy Valley-Goose Bay and the Labrador West Health Centre, Labrador City) multiple times a year to deliver the full complement of non-operative care. Patients are referred to the orthopaedic outreach clinic pathway in one of two ways. First, in-hospital patients with recent discharges for emergent or elective procedures at the tertiary care centre in St. John's, Newfoundland, may be referred for orthopaedic follow-up at the time of surgery and identified as vulnerable to challenges with post-operative visits. These challenges include long waits in the St. John's clinic, consultation when family members might not be present, and the coordination and cost of transportation to and from said clinic. Second, primary care providers in Labrador may send referrals for musculoskeletal concerns and fracture assessments to the orthopaedic central intake centre in St. John's, where patients from remote catchment areas in Labrador are identified as candidates for consultation to one of the two outreach clinics. The only screening criteria is that the patient must be older than 16 years of age, as travelling paediatric orthopaedic services are not available.

A team of orthopaedic surgeons supports the overall programme with subspecialty training in trauma, arthroplasty, musculoskeletal oncology, foot and ankle, upper extremity, hand and wrist, spine, and sports injury. In addition to the orthopaedic surgeon, resources dedicated to the outreach clinics at the time of this report comprise local staff, including license-practical nurses and administrative office workers. No additional resources are needed beyond what is found locally. New patients scheduled for the Orthopaedic Outreach clinics undergo radiographic imaging at each of the two community hospitals, based on predetermined protocols, before their visit. Rural hospitals have province-wide Picture Archiving and Communication System (PACS) access.

Patients often attend the clinics with a partner or close family member, providing an opportunity for a collateral history and comfort for the patient. This may be of particular importance if there is a language barrier. Personal costs to visit the two clinics, including flights, hotel stay and time off work, are significantly reduced for the patient's escort, although these were not estimated in our review.

If operative intervention is recommended, all pre-operative activities are completed in the community setting. Referrals are made by the visiting orthopaedic surgeon to the appropriate subspecialist should this be required before booking for surgery. Patients then have a single trip to St. John's and visit for their surgery which would include the preadmission clinic appointment, surgical procedure and immediate recovery period.

Minor orthopaedic procedures (such as injections, bracing assessments, casting and

diabetic foot care) are also completed through the same outreach effort. Furthermore, on occasion, surgeons have been asked to assist with acute emergencies as they present to the emergency departments in the two communities. These procedures help to augment the skills of highly trained rural primary care and emergency physicians.

When appropriate and feasible, follow-up for post-operative orthopaedic patients from Labrador is completed in their home health centres. The primary care physicians are supported through telephone and virtually by the orthopaedic surgeons. When follow-up times correspond to the Orthopaedic Outreach clinics, follow-up may be provided directly by the visiting surgeon in Goose Bay or Labrador City.

The programme is administered using the existing clinic space and resources already functioning in the community centres. In addition to flight costs for the surgeon and trainee, an Electronic Medical Record (EMR) system and access to PACS are necessary for the success of the Orthopaedic Outreach clinic. No additional costs beyond the flight and accommodation costs for the surgeon are required to run the programme.

METHODS

A review of the attendance at the outreach clinics was undertaken for 1st January 2015, through 31st December 2019. The review of the programme included a determination of the number of new patient visits and rechecks as well as procedures completed and patient demographics. A determination was also made whether the visit was the initial encounter with Orthopaedic Outreach or if there were prior encounters for the same patient.

Clinic attendance and relevant clinical characteristics were extracted from the EMRs by manual review. Analyses and descriptive statistics were accomplished by exporting to a simple Excel spreadsheet (Microsoft Inc, Redmond, Washington). Travel costs were calculated by averaging roundtrip costs of flights between Labrador and St John's throughout the year. In addition, hotel costs were averaged by looking at budget hotels and averaging the nightly cost of a hotel stay throughout the year in St John's.

RESULTS

The Orthopaedic Outreach programme treated 1698 patients, 1297 at Happy Valley, Goose Bay and 401 in Labrador City, between 1st January 2015 and 31st December 2019 [Figure 1]. This included 1,251 (74%) first-time referrals for musculoskeletal issues and 447 patients (26%) for re-checks. A new referral was defined as the initial visit to the Orthopaedic Outreach Programme and was not necessarily the patient's first encounter with an orthopaedic surgeon.

Over the 5 years, 1698 clinic encounters occurred at the two outreach clinics with an average of 170 encounters per annum at each site. We estimate cost-of-care (or, conversely, potential savings) per encounter as shown in Table 1. Cost of flying surgeons into Labrador and their hotel costs were not directly determined but would be about $2000 a year.

The actual care provided in an outreach clinic is cost-neutral compared to that provided in person at a standard clinic at the tertiary care centre in St. John's. However, additional hidden costs not accounted for, including transport and accommodation, are estimated at $403,920 for 2019 [Table 1]. This translates into $336,600 in transportation savings and 67,320 in accommodation savings, less an amount for the costs to bring a surgeon to Labrador. Estimates of transportation savings alone would comprise 83% of the total savings of $403,920 [Table 1].

DISCUSSION

A model of rural clinical orthopaedic surgery has been successfully implemented in our health care setting. The preliminary results presented provide evidence of both the feasibility of this mode of service delivery and cost-savings in providing outreach care to patients living in remote communities.

Clinical specialist outreach is a more effective and cost-efficient way of providing orthopaedic services to patients with musculoskeletal conditions who require referral to a central urban hospital. The ability to provide specialist outreach clinics must include a team-based approach. The time away from a consultants' home institution and absence from the call schedule does require a certain understanding that requires flexibility

Table 1: Estimated costs of transportation and accommodation (or potential savings) for patients and/or providers (provincial government) travelling to St. John's for follow-up care

Year	New patient (LHC/LWH/ total)	Follow up	Transportation ($)	Hotel ($)	Cost/savings ($)
2015	122/0/122	36/0/36	142,200	28,440	170,640
2016	236/0/236	64/0/64	270,000	54,000	324,000
2017	179/101/280	133/6/139	377,100	75,420	452,520
2018	179/151/330	109/8/117	402,300	80,460	482,760
2019	152/131/283	87/4/91	336,600	67,320	403,920
Cumulative	1251	447	1,528,200	305,640	1,833,840

LHC Happy Valley-Goose Bay (25 bed hospital), LWH Labrador City (28 bed hospital). LHC: Labrador Health Centre, LWH: Labrador West Health Centre

and a partnership amongst an orthopaedic group. This ensures continuing care and deliverance of service at the home institution. An additional benefit for surgical trainees that may accompany consultants is exposure to both community-based orthopaedics and a patient population that is facing challenges unique to their particular rural community. Other cost benefits include the reduced time off to attend a clinic by the patients or family members accompanying them. These were not taken into consideration for this review.

CONCLUSION

The development of this programme has had personal and financial benefits for our Regional Health Authority and the People of Labrador. Programmes such as this help to ensure equal access to health care, especially for the local Indigenous populations. Taking down barriers will only serve to strengthen our healthcare system. Our programme and those like it represent a modern low-cost option for subspeciality care.

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ORIGINAL ARTICLE

Prevalence of obesity and elevated body mass index along a progression of rurality: A cross-sectional study – The Canadian Longitudinal Study on Aging

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Abstract

Introduction: Obesity is an important public health concern, and large studies of rural–urban differences in prevalence of obesity are lacking. Our purpose is to compare body mass index (BMI) and obesity in Canada using an expanded definition of rurality.

Methods: A cross-sectional analysis of self-reported BMI across diverse communities of Canadians aged 45–85 years was conducted using data from the Canadian Longitudinal Study on Aging (CLSA), a national sample representative of community-dwelling residents. Rurality was identified in the CLSA based on residential postal codes, which were divided into 4 categories: urban, peri-urban, mixed and rural. Logistic regression models were constructed to calculate adjusted odds ratios (aORs) with 95% confidence intervals (95% CIs) between obesity (BMI ≥30 kg/m^2 from self-reported weight and height) and rurality, adjusting for age, sex, province, marital status, number of residents in household and household income.

Results: Twenty-one thousand one hundred and twenty-six Canadian residents aged 45–85 years, surveyed during 2010–2015, were included. 26.8% were obese. Obesity was less prevalent amongst urban (25.2%) than rural (30.3%, $P < 0.0001$), mixed (28.7%, $P < 0.0001$) or peri-urban communities (28.1%, $P < 0.0001$). When compared to urban areas, the aOR (95% CI) for obesity was 1.09 (1.00–1.20) in rural regions and 1.20 (1.08–1.35) in peri-urban settings. In areas of mixed urban and rural residence, the aOR was 1.12 (0.99–1.27).

Conclusion: One in four Canadian adults were obese. Living in a non-urban setting is an independent risk factor for obesity. Rural–urban health disparities could underlie rural–urban differences, but further research is needed.

Keywords: Body mass index, Canadian Longitudinal Study on Aging, obesity, rural

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Résumé

Introduction: L'obésité est un important problème de santé publique et des études de grande envergure sur les différences de prévalence de l'obésité entre les régions rurales et urbaines font défaut. Notre objectif est de comparer l'indice de masse corporelle (IMC) et l'obésité au Canada en utilisant une définition élargie de la ruralité.

Méthodes: Une analyse transversale de l'IMC autodéclaré dans diverses communautés de Canadiens âgés de 45 à 85 ans a été réalisée à l'aide des données de l'Étude longitudinale canadienne sur le vieillissement (ELCV); un échantillon national représentatif des résidents vivant en communauté. Dans l'ELCV, la ruralité a été identifiée à partir des codes postaux résidentiels, qui ont été divisés en 4 catégories: urbain, périurbain, mixte et rural. Des modèles de régression logistique ont été construits pour calculer les rapports de cotes ajustés (RCa) avec des intervalles de confiance à 95% (95% IC) entre l'obésité (IMC ≥30 kg/m^2 à partir du poids et de la taille autodéclarés) et la ruralité, en tenant compte de l'âge, du sexe, de la province, de l'état civil, du nombre de résidents dans le ménage et du revenu du ménage.

Résultats: 21 126 résidents canadiens âgés de 45 à 85 ans, interrogés au cours de la période 2010-2015, ont été inclus. 26,8% étaient obèses. L'obésité était moins répandue dans les communautés urbaines (25,2%) que rurales (30,3%, $P < 0,0001$), mixtes (28,7%, $P < 0,0001$) ou périurbaines (28,1%, $P < 0,0001$). Par rapport aux zones urbaines, le RCa (95% IC) pour l'obésité était de 1,09 (1,00, 1,20) dans les régions rurales, et de 1,20 (1,08, 1,35) dans les milieux périurbains. Dans les zones de résidence mixte urbaine et rurale, le RCa était de 1,12 (0,99, 1,27).

Conclusion: Un adulte canadien sur quatre était obèse. Le fait de vivre dans un milieu non urbain est un facteur de risque indépendant d'obésité. Les disparités en matière de santé entre les régions rurales et urbaines pourraient être à l'origine de ces différences, mais des recherches supplémentaires sont nécessaires.

Mots-clés: Rural, Obésité, Indice de masse corporelle, ELCV

INTRODUCTION

There are many discrepancies in health status between urban and rural residents.[1-4] Some studies show that rural communities have higher rates of comorbidities and mortality.[1] Rural areas have lower availability and accessibility of healthcare services.[2,3] Overall health behaviours are different, with higher rates of smoking and sedentary activity found amongst residents in rural areas.[1] Socioeconomic factors also affect rural residents, as lower income, lower levels of educational attainment and higher unemployment rates are found amongst some rural areas.[1,2] However, there is also significant heterogeneity in rural health research, which is partly due to variations in methodology, setting and the population.

Many challenges exist in comparing rural–urban health status. First, studies vary in how 'rural' and 'urban' are defined.[5] Second, many socioeconomic discrepancies exist across countries, making rural–urban comparisons difficult across societies. Third, rural areas and urban areas are heterogeneous in terms of health status and access to health services. Examining rurality using expanded definitions or categories rather than a strict 'urban–rural' binary categorisation may lessen, but not eliminate this difficulty.[6] Furthermore, many studies focused their analyses in small geographic regions, and there are relatively few representative epidemiological studies including both large urban and rural populations. Therefore, large representative studies of rurality are important to continuously evaluate the presence of health discrepancies. It is important to continuously update findings, as socioeconomic factors and health services change continuously over time.

Obesity is a prevalent risk factor associated with an increase in morbidity and mortality.[7,8] Obesity is also associated with a diverse set of health complications, including cardiovascular disease, non-alcoholic fatty liver disease, osteoarthritis and various solid organ malignancies.[7-9] Body mass index (BMI), a metric of weight (in kilogram) divided by height (in metres squared), is commonly used to define underweight (BMI <18.5 kg/m^2), overweight (BMI 25–29 kg/m^2) and obesity (BMI ≥30 kg/m^2).[10,11] Obesity is associated with a higher all-cause mortality, with higher risks found amongst higher classes of obesity (i.e. higher BMI).[10]

The prevalence and percentage of the population with self-reported obesity are

increasing in Canada.[7] Canada has the fourth highest prevalence of obesity amongst the Organisation for Economic Co-operation and Development countries.[7] Direct and indirect costs of obesity are increasing, and obesity was estimated to cost Canadians $4.6 billion in the year 2008 alone.[7] Weight and obesity have been identified as a priority health concern amongst rural communities.[2] Over the last 30 years, BMI is rising faster in rural settings compared to urban areas in many countries.[12] In countries with emerging economies, rural areas contribute more to rising BMI than urban settings.[12] Obesity is a major public health concern and is associated with socioeconomic inequalities.[4,8,13] Therefore, it is important to understand how the social determinants of health and rurality relate to the prevalence of obesity.[4,7-9]

We conducted a study comparing BMI and the presence of obesity using an expanded definition of rurality. To address many of the previous limitations of urban–rural health studies, we used a large, nationally representative, population-based sample that includes a diverse range of rural and urban communities to address the following two objectives.

1. We examined obesity and mean BMI (using self-reported weight and height) along a progression of rurality (urban, mixed, peri-urban and rural areas)
2. We determined predictors of obesity and BMI in Canada.

METHODS

Study design, population and data sources

We used a cross-sectional design to investigate the association between rurality and BMI. Data from the Canadian Longitudinal Study on Aging (CLSA) were used for this study. The CLSA is a large, multi-faceted, prospective cohort study of community-dwelling Canadian residents aged 45–85 years at the time of recruitment between 2010 and 2015.[14-17] The sampling frame is intended to be as representative of the general population as far as possible. CLSA participants were first recruited from Statistics Canada's Canadian Community Health Survey version 4.2 on Healthy Aging.[18] CLSA then supplemented their initial cohort with a nationally representative sample using provincial healthcare registration databases and random digit dialling to obtain data through telephone interviews.[14-17] This general cohort, termed the CLSA 'tracking cohort', consisted of 21,241 study participants. For this study, we used data gathered from the initial recruitment and baseline interview of the CLSA tracking cohort. The CLSA is ongoing and will follow all participants aged ≥45 years over the next two decades.

Inclusion criteria for the CLSA tracking cohort included: community dwelling adults aged 45–85 years at the time of recruitment, understood English and/or French and resided within a Canadian province. Individuals with cognitive impairment at baseline, resided on a First Nations reserve, who were full-time members of the Canadian Armed Forces or who were not permanent Canadian residents or citizens were excluded. Patients who reported being pregnant, did not know whether they were pregnant or who declined to report their pregnancy status were excluded from our regression analyses. All participants in the CLSA provided informed consent.

Outcomes

BMI was calculated from self-reported weight and height data obtained through computer-assisted telephone interviews.[14,19] Participants were asked 'how tall you are you without shoes on?' for height and 'how much do you weigh? (specified afterwards if the reported weight was in pounds or kilograms)' for weight.[19] Self-reported height was rounded up to the nearest inch when recorded, and weight was recorded exactly as reported.[19] We then converted the data from the CLSA telephone survey to metric units and calculated self-reported BMI.

To ensure reproducibility of our results, we used two different outcome metrics. We classified our outcomes as: (1) a dichotomous variable for the presence of obesity (based on self-reported BMI ≥30 kg/m^2) versus no obesity (BMI <30 kg/m^2) or (2) BMI as a continuous variable. We defined obesity and weight classes based on BMI on the same scale used by the World Health Organization.[11]

Independent study variables of interest

Area of residence, or rurality, was classified based on CLSA and the Canadian Census definitions. We classified the nature of rural–urban communities into four categories, ranging from most rural to most urban: 'rural' (rural), 'mixed' (postal code link to dissemination area), 'peri-urban' (urban fringe, urban population outside census metropolitan areas and census agglomerations and secondary core) and 'urban' (urban core).

Confounding variables included were as follows: biological sex, age (at the time of recruitment), province of residence, education status, marital status, number of other household residents and household income. These variables were all self-reported. The variables were included in our model because sex, age and socioeconomic factors (e.g. education, marital status, income and household living arrangements) were associated with obesity.[4,13,20] These definitions and methods were consistent with our analyses of other outcomes within this data set.[21-23]

Statistical analysis

Bivariate and multivariate analyses were performed. Demographics and socioeconomic variables were compared between areas of residence with either Chi-squared tests or analysis of variance where appropriate. Inflation weights were used when mean BMI was calculated and when BMI was categorised. These weights were provided and calculated by the CLSA to create prevalence estimates that represent the Canadian population.[24] Adjusted odds ratios with 95% confidence intervals (95% CIs) were calculated using multivariate logistic regression with the presence of obesity (BMI ≥30 vs. <30 kg/m^2) as the outcome variable. To ensure the robustness of our results, multivariate linear regression was performed to investigate associations with increased BMI as a continuous outcome variable. Following CLSA protocol, inflation weights were used to portray descriptive statistics (as these weights were designed to be more representative of the general Canadian population) and analytic weights were used for all regression models (as analytic weights were better suited to evaluate the relationship between variables in regression models).[24] We used inflation and analytic weights included in the Baseline Tracking (TRM) Dataset version 3.6. The following regression models were constructed: Model 1 – socioeconomic variables were not included, Model 2 – socioeconomic variables except household income were included and Model 3 – all socioeconomic variables, including household income, were included. Age, sex and province of residence were included as confounder variables in all three adjusted models. Analyses for interactions between variables of interest and rural residence were assessed. Statistical analyses were performed using the software SAS (SAS Analytics in Cary, North Carolina, United States of America).

Ethics approval

The study adhered to the Declaration of Helsinki and these analyses were approved by the University of Manitoba Bannatyne Campus Research Ethics Board.

RESULTS

Table 1 shows the definition of rurality that we used in this study. A total of 21,241 Canadian community-dwelling residents between the ages of 45 and 85 were identified by the CLSA tracking cohort [Table 2]. Only a very small portion (n = 115, 0.5%) of individuals were excluded due to either pregnancy or insufficient data to calculate BMI. After excluding these 115 individuals, a total of 4681 (22.2%) rural, 2624 (12.4%) peri-urban, 2116 (10.0%) mixed and 11,705 (55.4%) urban residents were included in our study.

Over a quarter of Canadians were obese as calculated from self-reported height and weight, and obesity was less common in urban areas. Obesity was present amongst 30.3% of rural, 28.7% of mixed, 28.1% of peri-urban and 25.2% of urban residents (P < 0.0001). The mean self-reported BMIs in our weighted sample were as follows: rural 28.2 kg/m^2, mixed 28.0 kg/m^2, peri-urban 27.8 kg/m^2 and urban 27.4 kg/m^2 (P < 0.0001 for comparisons across geographic areas). Levels of education, household income, marital status and number of household residents [Table 2] differed between urban, peri-urban, mixed and rural communities (P < 0.0001).

Rurality was found to be independently associated with obesity [Table 3]. Higher odds of

Table 1: Definition of rurality adapted from the Canadian Longitudinal Study on Aging survey.

Definition for Analyses	Definition in CLSA	Sample Size	Definition	Examples
Rural	Rural	4707	Area that remains after the delineation of urban areas that have been delineated using current census population data. This includes rural areas inside and outside CMA or CA.	Rossland, BC Edson, AB Lac La Biche, AB Perdue, SK, Humboldt, SK Minnedosa, MB King, ON Princeville, QC Yarmouth, NS Portugal Cove, NL
Mixed	Postal code link to dissemination area	2125	If a postal code covers a large area and it is a mixture of urban and rural area.	The postal code covers rural and non-rural settings
Peri-urban	Urban fringe	445	Small urban areas within a CMA or CA that are not contiguous with the urban core of the CMA or CA.	Whiterock, BC Leduc, AB Cochrane, AB Warman, SK Halton Hills, ON Mercier, QC
Peri-urban	Urban population centre outside CMA and CA	1888	Built up areas that are not contiguous within or contiguous with the urban core of the CMA or CA.	
Peri-urban	Secondary core	304	Population centre within a CMA that has at least 10,000 persons and was the core of a CA that was merged with an adjacent CMA.	
Urban	Urban core	11772	Urban area around which a CMA or a CA is delineated. The urban core must have a population (based on the previous census) of at least 50,000 persons in the case of a CMA, or at least 10,000 persons in the case of a CA.	Kamloops, BC Calgary, AB Medicine Hat, AB Saskatoon, SK Winnipeg, MB Sault Ste. Marie, ON Timmins, ON Val-d'Or, QC Halifax, NS Charlottetown, PEI St. John's, NL

Peri-urban: Includes urban fringe, urban population centre outside CMA and CA, and secondary core. CLSA: Canadian Longitudinal Study on Aging, CMA: Census metropolitan areas, CA: Census agglomerations.

obesity were seen amongst rural and peri-urban residents compared to urban residents, even after adjusting for sociodemographic and socioeconomic variables. Residents of mixed districts were also at higher odds of obesity compared to urban residents in unadjusted and most adjusted models; however, after household income was incorporated into our multivariate logistic regression model, the association became non-significant.

Using linear regression, urban residents had a lower average BMI than rural, peri-urban and mixed communities [Table 4]. Although these associations decreased in magnitude when sociodemographic and socioeconomic variables were adjusted for, a statistically significant positive correlation between rurality and BMI remained [Table 4].

In model checking, we noted statistically significant interactions on the outcome of obesity for a rural residence and age and rural residence and sex. However, the effect size was small and of borderline significance. The interaction terms did not alter the main effect associations that we observed. We therefore presented the regression models without interaction terms.

DISCUSSION

There was a modest, but statistically significant, independent association between urban residence and lower odds of obesity (based on self-reported height and weight) amongst community-dwelling Canadians aged 45–85 years. Even after age, sex, province of residence, education, marital status, number of household residents and household income were adjusted for, both lower odds of obesity and lower mean BMI were witnessed

Table 2: Demographic and socioeconomic characteristics of a nationally representative sample of community-dwelling Canadians as stratified by rurality*

	n (%) of participants					
	Total Sample	Urban	Peri-urban	Mixed	Rural	*P*
Total Sample	21241	11772	2637	2125	4707	
Body Mass Index (kg/m^2)						<0.0001
Underweight: <18.5	186 (0.8)	119 (0.8)	17 (0.7)	11 (0.8)	39 (0.8)	
Normal: 18.5-24.99	6910 (32.7)	4073 (35.1)	779 (29.9)	610 (27.8)	1448 (28.6)	
Overweight: 25.0-29.99	8689 (39.1)	4750 (38.2)	1095 (40.7)	887 (42.4)	1957 (39.8)	
Obesity Class I: 30.0-34.99	3662 (18.0)	1882 (17.3)	506 (20.0)	411 (18.8)	863 (18.8)	
Obesity Class II: 35.0-39.99	1114 (5.8)	581 (5.0)	143 (5.0)	139 (7.3)	251 (8.2)	
Obesity Class III: ≥ 40.0	565 (3.0)	300 (2.9)	84 (3.0)	58 (2.6)	123 (3.3)	
Pregnant or At Least 1 Required Question Not Answered	115 (0.7)	67 (0.8)	13 (0.6)	9 (0.3)	26 (0.5)	
Sex						0.0874
Female	10835 (51.8)	6023 (51.4)	1360 (52.3)	1105 (53.1)	2347 (52.5)	
Male	10406 (48.2)	5749 (48.6)	1277 (47.7)	1020 (46.9)	2360 (47.5)	
Age Group						<0.0001
44-54	5832 (38.1)	3165 (38.1)	719 (37.0)	615 (40.0)	1333 (37.9)	
55-64	6564 (31.4)	3550 (30.5)	870 (35.1)	659 (31.5)	1485 (32.0)	
65-74	4634 (19.0)	2557 (18.9)	517 (16.7)	465 (18.1)	1095 (20.6)	
75-89	4211 (11.5)	2500 (12.4)	531 (11.2)	386 (10.4)	794 (9.5)	
Education						<0.0001
Less than Secondary School Graduation	1986 (20.3)	860 (17.5)	292 (21.4)	262 (28.7)	572 (25.3)	
Secondary School Graduation	2882 (14.6)	1453 (13.9)	384 (15.1)	316 (13.9)	729 (16.3)	
Some Post-Secondary Education	1623 (8.5)	847 (8.4)	237 (10.2)	178 (8.6)	361 (7.9)	
Post-Secondary Degree or Diploma	14667 (56.2)	8559 (59.8)	1714 (53.0)	1365 (48.7)	3029 (50.0)	
Don't Know or Choose Not to Answer Question	83 (0.4)	53 (0.5)	10 (0.4)	4 (0.1)	16 (0.5)	
Marital Status						N/A†
Single, never married or never lived with a partner	1698 (7.8)	1063 (9.1)	170 (5.6)	121 (4.4)	344 (5.9)	
Married or Living with a Partner in a Common-Law Relationship	14601 (75.0)	7639 (71.2)	1878 (78.8)	1588 (81.7)	3496 (81.7)	
Widowed	2361 (7.3)	1399 (7.9)	298 (6.9)	218 (7.3)	446 (5.9)	
Divorced	1995 (7.4)	1323 (9.1)	212 (6.0)	145 (4.8)	315 (4.2)	
Separated	580 (2.5)	345 (2.6)	77 (2.7)	53 (1.8)	105 (2.2)	
Don't Know or Choose Not to Answer Question	6 (0.0)	3 (0.0)	2 (0.0)	0 (0.0)	1 (0.0)	
Number of Individuals in Household						<0.0001
Living alone	4925 (83.8)	3025 (81.5)	594 (84.9)	432 (86.1)	874 (88.9)	
Not Living Alone	16316 (16.2)	8747 (18.5)	2043 (15.1)	1693 (13.9)	3833 (11.1)	
Household income						<0.0001
<$20,000	1347 (6.4)	709 (6.6)	179 (6.0)	139 (5.6)	320 (6.2)	
$20,000 to $50,000	5849 (25.3)	2922 (23.1)	793 (26.9)	666 (28.8)	1468 (29.7)	
$50,000 to $100,000	7220 (33.6)	3950 (32.9)	880 (33.6)	728 (35.7)	1662 (35.0)	
$100,000 to $150,000	3215 (16.6)	1899 (16.9)	396 (16.7)	282 (14.2)	638 (16.1)	
>$150,000	2240 (12.4)	1472 (14.3)	232 (11.4)	190 (10.3)	346 (8.4)	
Don't Know or Choose Not to Answer Question	1370 (5.7)	820 (6.2)	157 (5.3)	120 (5.4)	273 (4.8)	
Self-Reported Income Adequacy						<0.0001
Totally Inadequate	167 (0.9)	101 (1.0)	19 (1.0)	19 (1.0)	28 (0.7)	
Not Very Well	324 (1.7)	177 (2.0)	46 (1.3)	39 (1.9)	62 (1.2)	
With Some Difficulty	1450 (7.2)	748 (6.6)	197 (8.4)	158 (9.6)	347 (7.7)	
Adequately	7337 (35.7)	3866 (34.3)	954 (36.9)	766 (35.9)	1751 (38.8)	
Very Well	9593 (43.1)	5583 (44.9)	1123 (41.8)	895 (38.1)	1992 (40.4)	
Null (Individuals who did NOT complete maintaining contact questionnaire)	2190 (10.6)	1197 (10.4)	276 (10.0)	230 (12.7)	487 (10.7)	
Don't Know or Choose Not to Answer Question	180 (0.8)	100 (0.9)	22 (0.5)	18 (0.8)	40 (0.5)	

*Proportions were calculated using inflation weights as per CLSA protocol in order to be more representative of the Canadian population. Comparisons and *P* values were calculated using Chi-squared tests using analytic weights. †*P*-value cannot be calculated; one cell has a frequency of zero, thus Chi-squared test cannot be performed. BMI: Body mass index, CLSA: Canadian Longitudinal Study on Aging, N/A: Not available

Table 3: Logistic regression analysis examining the relationship between obesity (BMI ≥30) and rurality*

Variable	aOR (95%CI) for Obesity (BMI<30 vs. ≥ 30 kg/m²).			Reference Category
	Model 1†	Model 2‡	Model 3§	
Rurality				
Rural	1.18 (1.08-1.28)	1.14 (1.04-1.25)	1.09 (1.00-1.20)	Urban
Mixed	1.21 (1.08-1.37)	1.18 (1.04-1.33)	1.12 (0.99-1.27)	
Peri-urban	1.27 (1.14-1.41)	1.23 (1.10-1.37)	1.20 (1.08-1.35)	
Age	0.99 (0.99-0.99)	0.99 (0.98-0.99)	0.98 (0.98-0.98)	Continuous
Sex	1.01 (0.94-1.08)	0.99 (0.92-1.06)	0.98 (0.91-1.06)	Male
Education				
Less than secondary school graduation		1.68 (1.49-1.89)	1.52 (1.34-1.73)	Post-Secondary Degree or Diploma
Secondary school graduation		1.54 (1.39-1.71)	1.46 (1.32-1.63)	
Some post-secondary education		1.54 (1.35-1.76)	1.49 (1.30-1.71)	
Marital Status				
Single, never married or never lived with a partner		1.23 (0.95-1.57)	1.14 (0.88-1.49)	Separated
Married/Living with a partner in a common-law relationship		0.89 (0.70-1.12)	0.94 (0.73-1.20)	
Widowed		1.04 (0.81-1.34)	1.08 (0.83-1.41)	
Divorced		1.00 (0.78-1.28)	0.96 (0.74-1.24)	
Number of Individuals in Household				
Living alone		0.92 (0.65-1.29)	0.81 (0.57-1.15)	5 or More Additional People
1 Additional Person		1.00 (0.73-1.38)	0.91 (0.65-1.26)	
2 Additional People		1.03 (0.74-1.43)	0.96 (0.68-1.34)	
3 Additional People		0.91 (0.65-1.27)	0.84 (0.59-1.19)	
4 Additional People		1.11 (0.76-1.61)	1.04 (0.71-1.53)	
Household income				
<$20,000			1.69 (1.37-2.08)	>$150,000
$20,000 to $50,000			1.79 (1.54-2.09)	
$50,000 to $100,000			1.42 (1.23-1.64)	
$100,000 to $150,000			1.38 (1.19-1.61)	

* In accordance to the Canadian Longitudinal Study on Aging protocol, we used analytic weights and all adjusted models included province of residence (results not shown). †Adjusted for age, sex, and province of residence. ‡Adjusted for age, sex, education, marital status, number of individuals in household, and province of residence. §Adjusted for age, sex, education, marital status, number of individuals in household, household income and province of residence. aOR: Adjusted odds ratio, CI: Confidence interval, BMI: Body mass index, CLSA: Canadian Longitudinal Study on Aging

in urban settings compared to rural, peri-urban and mixed communities. The magnitude of associations decreased with adjustment of some socioeconomic factors, suggesting that income, education, living arrangement and marital status may have explained some (but not all) of the urban–rural differences in BMI and obesity.

Other Canadian studies also reported a lower prevalence of obesity and lower BMI within urban settings. A recently published study by Forbes *et al*. found similar results within Atlantic Canada in a slightly younger population.[25] Their study included available data collected during 2009 to 2015 from 17,054 of 31,173 possible participants. Study participants were aged 35 to 69 and resided within Canada's four Atlantic provinces. Forbes *et al*. found that urban residents had modestly lower BMIs than rural residents (mean BMIs were 28.1 in urban vs. 28.5 kg/m^2 in rural areas, $P < 0.001$). Forbes *et al*. found that mean BMIs were lower amongst urban residents than rural residents, even after age, sex, ethnicity, education and health behaviours, such as smoking and alcohol use, were adjusted for using multiple linear regression. Another study by Hajizadeh *et al*. found that obesity (based on adjusted self-reported BMI ≥30 kg/m^2) was more prevalent amongst rural areas of Canada between the fiscal years of 2000–2009.[13] Even when demographic factors, health behaviours (e.g. diet, exercise and smoking) and a variety of socioeconomic variables were accounted for, rurality remained a modest and independent risk factor for obesity.

A lower prevalence of obesity in urban settings could have several explanations. A study in the United States found that urban residents had increased leisure-time physical activity, lower levels of sedentary behaviour, more fruit

Table 4: Linear regression analysis examining the relationship between BMI and rurality*

Variable	β-coefficient for Increase in BMI with 95% Confidence Interval			Reference Category
	Model 1†	Model 2‡	Model 3§	
Intercept	28.51 (28.01 to 29.01)	28.69 (27.67 to 29.72)	28.64 (27.55 to 29.73)	
Rurality				
Rural	0.46 (0.26 to 0.66)	0.40 (0.20 to 0.61)	0.32 (0.11 to 0.53)	Urban
Mixed	0.59 (0.30 to 0.87)	0.51 (0.23 to 0.80)	0.40 (0.10 to 0.69)	
Peri-urban	0.74 (0.48 to 0.99)	0.66 (0.41 to 0.92)	0.62 (0.36 to 0.88)	
Age	-0.03 (-0.03 to -0.02)	-0.04 (-0.05 to -0.03)	-0.05 (-0.06 to -0.04)	Continuous
Sex	-0.57 (-0.73 to -0.41)	-0.65 (-0.81 to -0.49)	-0.67 (-0.84 to -0.51)	Male
Education				
Less than secondary school graduation		1.46 (1.13 to 1.78)	1.20 (0.85 to 1.54)	Post-Secondary Degree or Diploma
Secondary school graduation		1.01 (0.76 to 1.25)	0.89 (0.63 to 1.15)	
Some post-secondary education		0.79 (0.48 to 1.10)	0.71 (0.39 to 1.03)	
Marital Status				
Single, never married or never lived with a partner		0.68 (0.06 to 1.30)	0.65 (-0.02 to 1.32)	Separated
Married/Living with a partner in a common-law relationship		-0.07 (-0.62 to 0.48)	0.14 (-0.46 to 0.73)	
Widowed		0.43 (-0.17 to 1.02)	0.63 (-0.01 to 1.28)	
Divorced		0.39 (-0.20 to 0.99)	0.36 (-0.29 to 1.00)	
Number of Individuals in Household				
Living alone		-0.01 (-0.83 to 0.81)	-0.28 (-1.14 to 0.58)	5 or More Additional People
1 Additional Person		0.14 (-0.61 to 0.90)	-0.07 (-0.85 to 0.72)	
2 Additional People		0.36 (-0.41 to 1.13)	0.22 (-0.58 to 1.02)	
3 Additional People		-0.17 (-0.95 to 0.61)	-0.30 (-1.11 to 0.51)	
4 Additional People		0.26 (-0.60 to 1.13)	0.12 (-0.78 to 1.01)	
Household income				
<$20,000			1.12 (0.62 to 1.62)	>$150,000
$20,000 to $50,000			1.43 (1.11 to 1.75)	
$50,000 to $100,000			0.81 (0.54 to 1.07)	
$100,000 to $150,000			0.70 (0.41 to 0.98)	

* In accordance to the Canadian Longitudinal Study on Aging protocol, we used analytic weights and all adjusted models included province of residence (results not shown). †Adjusted for age, sex, and province of residence. ‡Adjusted for age, sex, education, marital status, number of individuals in household, and province of residence. §Adjusted for age, sex, education, marital status, number of individuals in household, household income and province of residence. CLSA: Canadian Longitudinal Study on Aging, CI: Confidence interval, BMI: Body mass index.

consumption and less consumption of sweetened beverages compared to rural residents.[26] These health behaviours might be due to differences in infrastructure or geography, as rural residents might have more limited access to nutritious foods or have to rely more heavily on vehicles for transportation rather than walking or biking. Our study was not able to account for these variables, and therefore, it is unknown how much these health behaviours may have contributed to the differences seen. Mental health may also impact health behaviours and obesity. Future Canadian studies on a change in BMI and rurality should include health behaviours, mental health and psychiatric comorbidities when examining BMI and rurality. Future studies that examine urban–rural differences in health more fully are important as the risk factors and socioeconomics effects may change differentially between urban and rural regions over time.

Limitations

Our study had strengths and limitations. We used a large and nationally representative sample that was inclusive of multiple rural and urban regions. We used an expanded definition of urbanicity and rurality, rather than a strict urban–

rural dichotomy, which accounted for some of the heterogeneity between rural communities. We were able to adjust for socioeconomic variables, such as income and household living arrangements, which is not always possible when conducting research using large population-based datasets (e.g. hospital administrative data or physician claims databases). Regarding study limitations, obesity was defined solely based on a single BMI cut-off of 30 kg/m^2, and we were unable to account for other metrics of obesity (such as waist circumference). Other nuanced factors that were limited by this definition, such as body composition (e.g. extensive muscle mass) or ethnicity, may also affect BMI interpretation in select subpopulations. Second, we used self-reported measurements of weight and height, which have inaccuracies. A Canadian study found that individuals tend to overestimate height and underestimate weight, especially amongst overweight and obese individuals.[27] This suggests that Canadians would likely have even higher BMIs than our reported findings. However, it is not clear how this misclassification is related to rural residence. Third, this cross-sectional study was only able to capture a single moment in time. Many variables are dynamic in nature, including weight, health behaviours, socioeconomic circumstance and area of residence. Future studies would benefit from examining changes in BMI over time. Fourth, the clinical interpretation of BMI amongst older adults differs from that of younger adults, especially amongst the older adult population. Other competing risks of mortality and disabilities can contribute to an individual's overall health and frailty. Fifth, the CLSA does not collect data on some important subgroups who reside in Canada, such as those residing on First Nation reserves, active armed forces personnel, non-permanent residents or recent immigrants. We therefore caution generalising results to these individuals or communities. Further studies that explore specific Canadian subgroup populations that the CLSA is unable to capture would be beneficial. Sixth, minor rank-order differences in BMI or obesity were observed between the three rural settings when our three models were directly compared. This might have been due to the adjustment of confounders. However, in all cases, obesity had the lowest prevalence in urban settings. Finally, while we indeed found differences in BMI and in obesity rates between settings, the implications regarding the magnitude of these differences for clinical and policy decisions are not clear.

CONCLUSION

Our study demonstrated that a substantial proportion of Canada's population is obese. BMIs were modestly lower in urban settings than rural, peri-urban and mixed communities. Although absolute differences in prevalence of obesity or mean BMI appeared small, individually, the effects could be magnified on a population scale. Furthermore, significant differences were seen even after adjusting for age, sex, province of residence and socioeconomic factors, which suggest the independent effects of rurality. Early interventions are needed to address the underlying social determinants that contribute to obesity. Health systems need to prepare in advance for an increasing burden of obesity-related complications. Increasing accessibility and access to healthcare, public health and social resources (e.g. parks, physical activity programmes and availability of nutritious foods) are needed. Longitudinal research studies of rural–urban differences in obesity-related interventions will be important to help guide policy and management. These studies and interventions should consider a diverse spectrum of communities.

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Review Article

The economic impact of rural healthcare on rural economies: A rapid review

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Abstract

Introduction: One critical component of any rural community is its healthcare system. Rural healthcare systems are essential as rural communities have worse health outcomes when compared to urban areas. Rural healthcare systems might also have a positive impact on rural economies. In some rural areas, these health services are threatened with a reduction or closure. This rapid review was carried out to examine the impact of rural healthcare systems' declines on rural economies.

Methods: We conducted a rapid review of peer-reviewed and grey literature sources on studies that examined the economic impact of rural healthcare on rural economies in Canada, Australia, Scandinavia and the United States of America (USA). We used a data extraction template adapted from the Centre for Reviews and Dissemination.

Results: We found 17 research papers between two databases and nine websites. Articles examined various health professions (dentist, physician assistant and pharmacist), the inclusion of family physicians, a physician with an increased scope of practice (obstetrics and surgery), the impact of a rural primary care hospital, telemedicine, a distributed medical education programme and the health care sector.

Conclusion: Rural healthcare seems to have a positive impact on jobs and labour-based wages in rural communities. There is a considerable need for research outside the USA.

Keywords: Economics, healthcare, review, rural

Résumé

Introduction: Un élément essentiel de toute communauté rurale est son système de soins de santé. Les systèmes de soins de santé ruraux sont essentiels car les communautés rurales présentent des résultats sanitaires moins bons que les zones urbaines. Ces systèmes pourraient également avoir un impact positif sur les économies rurales. Dans certaines zones rurales, ces services de santé sont menacés de réduction ou de fermeture. Cette revue rapide a été réalisée pour examiner l'impact du déclin des systèmes de soins de santé ruraux sur les économies rurales.

Méthodes: Nous avons procédé à un examen rapide de documentation évaluée par les pairs et de documentation parallèle sur les études qui ont examiné l'impact économique des soins de santé ruraux sur les économies rurales au Canada, en Australie, en Scandinavie et aux États-Unis. Nous avons utilisé un modèle d'extraction de données adapté du Centre for Reviews and Dissemination.

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Résultats: Nous avons trouvé 17 articles de recherche entre deux bases de données et neuf sites Web. Les articles portaient sur diverses professions de santé (dentiste, assistant(e) médical(e), pharmacien(ne)), l'inclusion des médecins de famille, un médecin ayant un champ d'exercice élargi (obstétrique et chirurgie), l'impact d'un hôpital rural de soins primaires, la télémédecine, un programme d'enseignement médical distribué et le secteur des soins de santé.
Conclusion: Les soins de santé en milieu rural semblent avoir un impact positif sur les emplois et les salaires basés sur le travail dans les communautés rurales. Il existe un besoin considérable de recherche en dehors des États-Unis.

Mots-clés: rural, soins de santé, économie, revue

INTRODUCTION

Many rural communities in industrialised nations are struggling to survive. They face a multitude of problems, including an ageing population, unstable economies and youth out-migration. [1,2] As well-paying jobs leave, people retire and the population declines, the tax bases in these communities shrink, and eventually, municipalities become unable to fund essential services. Once a community loses its basic services, it is nearly impossible to recruit new community members or businesses, and in the worst-case scenario, the community eventually becomes a 'ghost town'.

One essential aspect of any rural community is their healthcare system. Rural healthcare systems are imperative as rural communities may be distant from other communities, often have ageing populations, and rural communities typically report worse health outcomes when compared to urban areas. [3] The rural healthcare system impacts not only individual health but can have an economic ripple effect as quality health care is important for attracting business, industry, employees and retaining retirees. [4] In rural locations in Canada, Australia and the United States of America (USA), hospitals are experiencing service decline or even being completely shutdown, [5-7] with cost, quality and workforce needs being commonly cited for closures or reductions in services. [8] Research has suggested that rural healthcare systems are less financially stable when compared to health systems in urban areas, but these studies rarely consider the economic impact of health services on the local region. [9,10]

The healthcare sector can have a major effect on rural economies as healthcare is typically one of the three largest employer groups in a rural community[11] and the doctors, nurses, pharmacists, dentists, medical administrators and other hospital employees buy goods and use services in the rural communities where they are employed. [12] For example, one study suggested that each additional job at a rural clinic leads to an additional 0.33 jobs in the community due to the clinic's and clinic employees' spending. [12] The economic impact of a physician in rural communities is estimated to be greater than a clinic employee. In one study in the USA, a rural physician is estimated to generate approximately 1.5 million in revenue, almost 1 million in payroll and over 20 jobs. [13] These large impacts are created through clinic employment, inpatient services, outpatient activities and the multiplier effect of these contributions. [13] With decreasing health workforce being seen post-pandemic in many settings, [14] we consider it timely to review and collate both the published and grey literature on the economic impacts of the rural physician and rural healthcare system.

This study aimed to examine the impact of rural healthcare systems on rural economies.

METHODS

For this study, we undertook a rapid review of the peer-reviewed and grey literature. A rapid review is a systematic assessment of what is known about a specific topic by using a systematic review method. [15] We decided to use a rapid review approach based on the expedited timelines proposed by the overarching research committee and the potential implications of policy in this area.

Search strategy

Our search strategy is presented using the Standards for Reporting Literature searches

Table 1: STARLITE framework for rapid review

Element	Explanatory notes
S: Sampling strategy	Research papers that examine the impact of rural health care on rural economies
T: Type of paper	Quantitative studies
A: Approaches	Consultation with a research librarian, reference list searchers, grey literature search
R: Range of years (start date: end date)	2000-2021
L: Limits	English language
I: Inclusions and exclusions	Inclusion: Rural health care or rural health care services
	Exclusions: Cost-benefit analysis
T: Terms used in search	Rural: Exp* rural health care, medically underserved
	Economics: econom**$.ti. or health economics/or economics/
	Healthcare: Rural health care
	Place: Canada, United States, Australia, Scandinavia
E: Electronic sources	Databases: Ovid Medline and EMBASE
	Website: The Rural Health Information Hub, National Center for Rural Health Works, America College of Physicians, and the Canadian, Australian, Danish, Norwegian, Finnish and Swedish Medical Associations

*Exploding a term to include all narrower search terms, **$A truncation command. In this case, the database also retrieves 'economics, economies, economy, economically, etc.'

framework in Table 1.[16] Database searches were supplemented by reviewing the reference list of included research papers. Since there is no generally agreed upon definition of 'rural', articles were included if the author described the community as rural. Economic impact was considered a financial or employment effect on a state, region, or locality and healthcare was deemed a service or procedure aimed to prevent, manage, or cure some sort of injury or illness. Both peer reviewed and non-peer reviewed articles will be referred to as research paper(s) throughout this research manuscript.

Study selection

After the search had been completed, all identified research papers were uploaded into Zotero (Corporation for Digital Scholarship and Roy Rosenzweig Centre for History and New Media, VA, USA) and duplicates removed. Next, two reviewers independently screened all titles and abstracts against inclusion criteria. The reviewers erred on the side of inclusion, where there was any doubt. This strategy helped ensure that relevant retrieved studies were included. Two independent reviewers then reviewed the full-text research papers against the inclusion criteria. Throughout the process, any disagreement was resolved through a discussion or the inclusion of a third reviewer. Refer to Figure 1 for full PRISMA flow chart of the study selection.

Assessment of methodological quality

Two reviewers separately appraised each research paper for methodological quality using the Consensus on Health Economics Criteria list. [18] Authors were not contacted for missing information. Any disagreements were resolved through a third reviewer.

Data extraction

One independent reviewer extracted data, and a second reviewer checked for correctness and completeness. [19] A data extraction template was adapted from the Centre for Reviews and Dissemination guidelines for undertaking reviews in health care[20] and data extracted included author(s), year, country of origin, research question, methods (analytic approach), how economic impact was measured and outcomes of the analysis.

RESULTS

We identified 17 research papers among two databases and 9 websites. Summaries for the 17-research papers are included in Table 2.

In total, 5 were peer reviewed, 10 were from the National Centre for Rural Health Works and two grey literature research papers were retrieved. The economic analyses were from the USA (n = 15) and Canada (n = 2). The research papers used various analysis strategies, with input-output models being used most frequently, survey results and costs from certain procedures, and other strategies to model local economies. All research papers were at least moderate quality using the Consensus on Health Economics Criteria list. [18] Of the research papers that were rejected; most were a cost analysis, a cost-benefit analysis or did not examine economic gains or losses to the community.

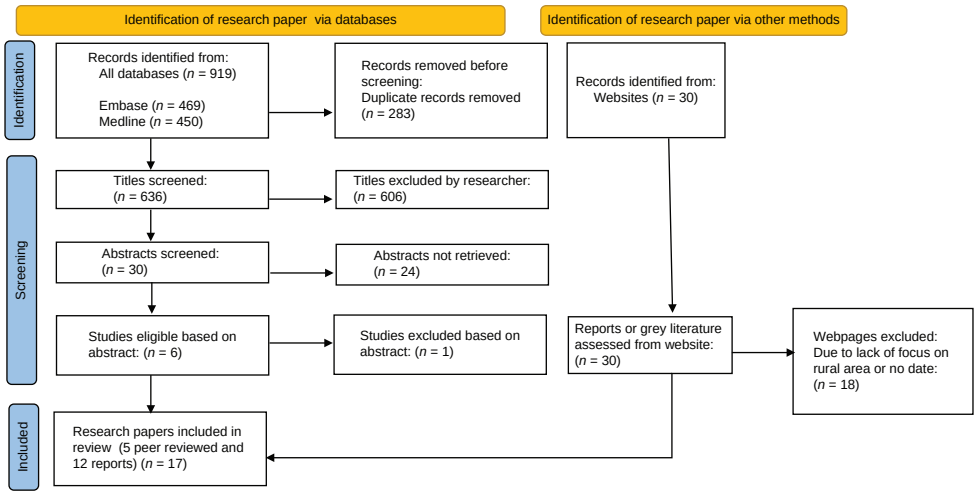

Figure 1: PRISMA flow diagram for inclusion of research papers.[17]

Research papers focused on a wide range of topics, including the inclusion of various health professionals practising in a community, the inclusion of family physicians, a physician with an increased scope of practice (obstetrics and surgery); the impact of a rural primary care hospital, telemedicine, a distributed medical education programme and the health care sector. All research papers focused on increased jobs and/or income generated/saved.

Primary care physicians

Two research papers examined the impact of primary care physicians. The results indicated that a physician creates between 22 and 26.3 local jobs, almost $1.5 million (USD) in revenue and between $0.9 million and $1.4 million (USD) in labour income. [13,21]

Specialist physicians

Two research papers examined the impact of medical doctors with specialties. For example, a rural general surgeon creates approximately $2.7 million (USD) in revenue, $1.4 million (USD) in payroll and creates 26 jobs, while a family physician practising obstetrics in a rural area adds an additional $488,560 (USD) in economic benefit to the community in addition to the $1 million (USD) from practising family medicine.[22,23]

Healthcare professionals

Three research papers evaluated the economic impact of other health professionals on rural economies. These positions included a physician assistant or nurse practitioner, a dentist and a community pharmacy. A rural physician assistant or nurse practitioner can have an employment effect of 4.4 local jobs and labour income of $280,476 (USD) from the clinic. [12] The average rural dentist has direct impacts of 5 full-time equivalent local jobs and $338,797 (USD) in labour income from the clinic. [24] For every $1 in pharmacy income, an additional $0.19 (USD) income is generated in other businesses/local economies. [25]

Medical education

Two research papers calculated the impact of distributed medical education programmes. Both were from the Northern Ontario School of Medicine. The first suggested that total economic contribution to Northern Ontario was $67.1 million (CAD) and the second suggested that the direct programme and learner spending equated to approximately $64.6 (CAD) million in spending. [26,27]

Hospitals

Three research papers explored the impact of hospitals on rural economies. Estimates varied depending on size and type of hospital but ranged from 26 jobs to 715 jobs and approximately $902,033 million to $45.4 million (USD) in labour impact. [28-30]

Healthcare sector

Two research papers examined the impact of the healthcare sector. One study, in South-eastern Oklahoma in a country with 13,879 people found

Table 2: Summary of research papers examining the impact of rural healthcare on rural economies. Currency in US dollars for US papers and in Canadian dollars for Canadian papers

Author(s)	Year	Country	Research objective/question	Modelling techniques	Outcome
			Primary care physician		
Eilrich *et al.*, National Center for Rural Health Works[21]	2016	USA	'Estimate the economic contributions of a rural primary care physician to employment and labor income in the community and surrounding area including the local hospital'	Input-output model	'A rural primary care physician practicing in a community with a local hospital creates approximately 26.3 local jobs and nearly $1.4 million in labor income (wages, salaries and benefits) from the clinic and the hospital'
Eilrich *et al.*, National Center for Rural Health Works[13]	2007	USA	'Estimate the economic activity of a rural primary care physician on the local community'	Input-output model	'The physician generates approximately $1.5 million in revenue, $0.9 million in payroll and creates 23 jobs. The relatively large impact is created through clinic employment, inpatient services, outpatient activities and the multiplier effect of these contributions'
			Increased scope physician		
National Center for Rural Health Works, Oklahoma State University, and Oklahoma Center for Rural Health, OSU Health Sciences Center, College of Osteopathic Medicine[22]	2010	USA	'Estimation of benefits generated by rural surgeon'	Needs-based approach	'A rural general surgeon generates approximately $2.7 million in revenue, $1.4 million in payroll (wages, salaries and benefits) and creates over 25 local jobs'
Avery *et al.* [23]	2014	USA	'This study examines the economic impact of family physicians practicing obstetrics in underserved, rural areas'	Questionnaires to participant in the study. 'The questions included the most common types and average annual numbers of obstetrics/gynecological procedures they performed'	'A family physician practicing obstetrics in a rural area adds an additional $488,560 in economic benefit to the community in addition to the $1,000,000 from practicing family medicine'
			Healthcare professionals		
Eilrich[12]	2016	USA	'Estimate the total (direct and secondary) economic effects to full and part-time employment and labor income that rural physician assistants and nurse practitioners have upon the clinic/ hospital and the community they serve'	Input/output model	'A rural physician assistant or nurse practitioner can have an employment effect of 4.4 local jobs and labor income of $280,476 from the clinic. The total effect to a community with a hospital increased to 18.5 local jobs and $940,892 of labor income'
Doeksen *et al.* [24]	2014	USA	Investigate the economic impact of a rural dentist	Input/output model	'The average rural dentist has direct impacts of 5 full-time equivalent local jobs and $338,797 in labor income from the clinic' 'A rural dentist has a total average of employment impact of seven jobs'

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Table 2: Contd...

Author (s)	Year	Country	Research objective/question	Modelling techniques	Outcome
			Healthcare professionals		
St. Clair *et al.*, National Center for Rural Health Works[25]	2007	USA	Quantifying economic impact of rural pharmacies via Oklahoma rural pharmacy data, USA	Survey results summary (employment, income) × multiplier (average from last ten rural community economic impact studies in Oklahoma)	'For every $1 in income in a typical rural community pharmacy, an additional $0.19 in income is generated in other businesses and industries in the local economy. The direct income is $296,268 and secondary income is $56,291, for a total income impact of $352,560'
			Medical Education		
Hogenbirk *et al.*[26]	2021	Canada	Estimate the economic impact of 'total spending in community adjusted by an economic multiplier based on community population size, industry diversity, and propensity to spend locally'	Cash-flow local economic model	'Direct program and learner spending in Northern Ontario totaled $64.6 (million) Canadian Dollars'
Hogenbirk *et al.*[27]	2015	Canada	What are 'the economic contributions of the Northern Ontario School of Medicine to Northern Ontario communities who are participating in the Northern Ontario School of Medicine medical education programs?'	Local economic model based on economic base theory	'The total economic contribution to northern Ontario was $67.1 million'
			Hospitals		
Eilrich *et al.*, National Center for Rural Health Works[28]	2015	USA	'Estimate the economic impact of recent hospital closures in rural communities'	Input/output model	'The total potential economic impacts for the 19 selected hospitals in the sample ranged from 26 to 188 jobs and $902,033-$9.5 million in labor income'
Doeksen *et al.*, National Center for Rural Health Works[29]	2016	USA	What is the economic impact of the critical access hospitals in rural communities?	Input/output model	'The total annual impact includes 170 jobs and $7.1 million in wages, salaries, and benefits from hospital operations'
Eilrich *et al.*[30]	2017	USA	'Estimate the economic contributions of a local hospital to employment and labor income in the community and surrounding area'	Input/output model	'The 26-50 bed PPS hospital sample has average total impact of 334 employees and $21.2 million labor income' 'The 51-100 bed PPS hospital sample has average total impact of 715 employees and $45.4 million labor income'

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Table 2: Contd...

Author (s)	Year	Country	Research objective/question	Modelling techniques	Outcome
			Health care sector		
Doeksen and Schott[31]	2003	USA	'Determine the importance of the health sector to the economy of a rural community?'	Input/out model	'For each dollar created in that sector an additional $0.47 is created through the area due to business (indirect) and household (induced) spending' 'The total employment impact represents 18.5% of the total non-farm employment'
Patry *et al.*[32]	2010	USA	What is the impact of the health care sector on rural communities?	Analysis technique to show spending and re-spending over multiple rounds until it is exhausted	'The total employment impact of the health services sector results in an estimated 338 jobs in the local economy' 'The total income impact of health services results in an estimated $9,603,000 for the economy'
			Nursing homes		
St. Clair *et al.*, National Center for Rural Health Works[33]	2017	USA	Examine 'the economic impact of rural nursing homes on local economies'	Input/output model	Scenario 1: 50 beds, no skilled nursing: Total impact: 70 jobs, $3,340,322 income Scenario 2: 100 beds, no skilled nursing: Total impact: 127 jobs, $5,798,206 income Scenario 3: 200 beds, no skilled nursing: Total impact: 259 jobs, $11,962,466 income Scenario 4: 100 beds with skilled nursing: 140 jobs, $6,657,698 income Scenario 5: 200 beds with skilled nursing: 280 jobs, $13,227,892 income
			Telehealth		
Whitacre *et al.*[34]	2009	USA	'Examine community-level impacts of telemedicine in a rural setting'	Five site visits to gather information	Four categories examined Hospital saved between $13,700-200,000 for using telemedicine Transportation cost savings ranged from $9600-168,000 for patients Communities obtained annual increase between $4700-77,000 in 'improved productivity in telemedicine' An extra $63,000-1,600,000 in lab and pharmacy work if procedures are kept local

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Table 2: Contd...

Author (s)	Year	Country	Research objective/question	Modelling techniques	Outcome
Health care clinic					
Eilrich *et al.*, National Center for Rural Health Works[35]	2016	USA	'Estimate the average direct and secondary employment and labor income impacts on a rural community from an independent rural health clinic'	Input/output model	'The total estimated annual economic impact of an independent rural health clinic was 12.6 local jobs and $1,009,299 in wages, salaries, and benefits' 'Smaller rural health services often contract physician services. The total estimated impact of an independent rural health clinic without a full-time equivalent employed physician was 6.3 local jobs and $454,871'

PPS: Prospective pay system

that almost 20% of non-farming employment came from the health care sector.[31] The second study, in a country with an estimated population of 3,887 people found the total employment impact (direct and indirect) on the health sector resulted in an estimated 338 jobs and $9,603,000 (USD) for the local economy.[31,32]

Telehealth/nursing home/health care clinic

One research paper examined the financial impact of Teleradiology and Telepsychiatry on the hospital, local labs and pharmacies, travel savings for community members and labour productivity. The largest financial increase was for local labs and pharmacies, as the study suggested that if patients were able to stay in their home community, they would be more likely to have tests done at the local hospital and have their prescriptions filled at the local pharmacy. Keeping this additional work local would lead to an increase of $63,000 to $1.6 million dollars (USD).[34] One research paper looked at the impact of rural nursing homes and depending on how many beds and if skilled nurses were employed, estimates ranged from 70 jobs and $3,340,322 (USD) in income to 280 jobs and $13,227,892 (USD) in income.[33] Finally, one research paper used data from 414 rural counties and estimated annual economic impact of an independent rural health clinic was 12.6 local jobs and $1,009,299 (USD) in wages, salaries, and benefits.[35]

DISCUSSION

Our review aimed to collate and examine the available evidence on the impact of rural healthcare on rural economies.

The results suggest that rural health care services can positively impact rural economies through direct jobs, indirect jobs, and labour-based wages. For example, a rural physician can order tests to be completed by local X-ray or lab technicians, prescribe medication to be dispensed at the local pharmacy, and work with nurses to provide inpatient and outpatient care-the more services provided, the greater the employment opportunities. Outside of health care, there will also be induced jobs when these employees go out and support local businesses. In Canada, for every physician employed in an office setting, almost two

jobs were needed to support their office. Nearly 289,000 jobs (direct, indirect, and induced) can be tracked back to the physician's office. [36] These findings underscore the importance of recruitment and retention efforts for both rural healthcare and communities, where physicians support care not just in the office setting, but are necessary for hospital care also, which expands the local jobs beyond those related to the office setting.

In addition to the studies presented in this research paper, a position paper by the Society of Rural Physicians of Canada found that in one small community, when doctors retired or relocated and were not replaced, nurses and lab technicians began looking for work elsewhere. With this rapid out-migration, there was little to attract new physicians to the area, and between 2005 and 2007, one particular community consumed 10%–15% of the province's locum fund. [37] These combined findings reiterate the importance of recruiting and retaining rural physicians and other healthcare professionals. One approach that some communities have used is the hiring of a specialized recruiter. Although the evidence for recruiter effectiveness is mixed, even if they can recruit and help retain a small number of physicians, nurse practitioners, or physician assistants over their career, that effort could lead to a net economic benefit for the community. [38,39] That benefit likely makes the cost of the recruiter-which is often borne by the local municipality-worthwhile.

One of the common arguments for closing local hospitals is cost. Larger hospitals can achieve economies of scale as research has shown that hospitals between 200 and 300 beds are most efficient. [40] However, this study fails to consider smaller hospitals' net effect on the local economy. For example, one study found that hospitals of 26–50 beds have a total impact of 334 employees and 21.2 million dollars (USD) in labour income. [30] Additionally, the closure of hospitals forces rural residents to travel for medical services, which takes away related services such as lab testing, medical imaging, and pharmaceutical services from the local community, with associated job loss. [34] Therefore, rural hospitals cannot be compared to their urban counterparts or simply measured in terms of efficiency at the hospital level, and policies need to be responsive to, and understand the importance of, rural healthcare services beyond efficiency and dollars spent at the hospital level.

It is well documented that improved access to care will lead to improved health. [41] For example, having a regular health care provider was associated with increased odds of receiving preventative care, including flu shots, colon cancer screening, Papanicolaou tests, and mammograms. [42] A lack of access to care is one of the reasons why people in rural areas may carry a higher burden of illness, reduced life expectancy, and tend to be sicker than their urban counterparts. [43] Improving access to care in rural communities, as well as access to acute care for urgent issues, may also have economic benefits as most rural Canadians work in physically demanding jobs, including farming, fishing, mining, or oil and gas. If rural Canadians are kept in better health, and have better access to health care locally, they would potentially lose fewer days to sickness or health-related travel; a paper from the Conference Board of Canada suggested that sick days cost the Canadian economy $16.6B.[44] Keeping Canadians in good health allows them to work better, be more efficient, and make larger contributions to the Canadian economy. [45]

Our study found that the majority of the research on the impact of rural healthcare on rural economies is from the USA, which has a different healthcare model compared to Canada. Some of the major differences between the American and Canadian healthcare systems include health care insurance, the role of private industry, types of care provided by health care, and delivery of primary care. [46] Some of these variations can lead to major differences in the costs associated with healthcare. For example, administrative costs in the USA are approximately $324 (USD) dollars per capita, while in Canada it is $107 (USD) per capita. [47] Similar large differences were found for hospitals, nursing homes, and home care administration. Another major difference is the amount physicians make in the USA. For example, orthopedic surgeons make approximately $442,450 (USD) while they make approximately half that amount in Canada. [48] The reduced costs and earnings in Canada would lead to fewer indirect and induced jobs. Therefore, when using this research to make conclusions about the impact of healthcare on rural economies in countries outside of the USA, it must be done with caution.

Beyond the hospital, rural health care workers are also a valuable part of rural communities. Some rural health care professionals feel their duty extends outside the hospital and take part in community development, local councils, and volunteer in community-based activities. [49] Therefore, when contemplating closures of rural hospitals, more than the effect on individual health care access must be considered.

Limitations

The compressed timeline potentially adds error to the project as the appraisal quality and search strategy are limited in this type of review. [15] To prevent missing relevant research papers, the research team did decide to review the reference list of all included research papers. However, there is still a chance that some relevant ones were missed. Another limitation of this study is that some research papers were based on full-time employment. Some rural areas would not be able to support a full-time physician, but it might be beneficial to compensate the physician at a full-time level because of the net effects on health care, the rural economy, and the capital they provide. Some of the research needs to be interpreted with caution. Results were extracted using a standardized form that did not leave room for contextualization of specific results, i.e., size of the community, specifics on type of practice, or how the impact might change if more than one healthcare professional is hired.

CONCLUSION

The evidence from this rapid review highlights the importance of keeping healthcare local as it positively impacts not only individual health, but also local jobs and payroll wages. It is imperative that more collaborative efforts are made across local, provincial and federal levels of government to support rural health care as local care delivery can also have positive economic effects on rural communities. Future research on the economic impact of rural health care delivery must be done in a Canadian context for relevance to Canadian policy-makers and administrators.

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Case Report

Occasional fascia iliaca nerve block

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INTRODUCTION

The majority of patients presenting with hip fractures in emergent setting are over than 85 years of age.[1] It can be difficult to choose an adequate modality of analgesia from the standard analgesic ladder in this patient population due to the high degree of pain, patient comorbidities and medication side effects.[2-5] Non-steroidal anti-inflammatory drugs (NSAIDs) can cause gastrointestinal bleeding and are associated with renal impairment or worsening existing renal impairment, and opioids can cause a host of side effects including increased risk of delirium, respiratory depression and hypotension.[3-6]

The fascia iliaca block (FIB) is a regional nerve block that provides pre- and post-operative analgesia for patients with orthopaedic trauma to the hip, knee and thigh and can also be used in patients with lower extremity pain due to cancer or burns.[7,8] The FIB has a rapid onset of adequate pain control that can limit the need for traditional systemic analgesics such as NSAIDs and opioids, thus minimising potentially harmful side effects.[2,5,6,9] It must be noted that patients with delirium or dementia may feel well enough to walk after a FIB and, thus, must be closely monitored.

Anatomy

Four main nerves innervate the lower extremity:

1. Femoral nerve
2. Lateral femoral cutaneous nerve (LFCN)
3. Obturator nerve
4. Sciatic nerve.

Above the inguinal ligament, the femoral nerve lies anterior to the iliacus muscle and lateral to the femoral artery [Figure 1].[10] The femoral nerve is separated from the femoral artery by the fascia iliaca. The femoral artery and vein, along with the sartorius muscle, are situated between the fascia lata anteriorly and the fascia iliaca posteriorly. The fascia iliaca attaches to the iliac crest laterally and the pelvic brim medially.[10] Located beneath the fascia iliaca (listed lateral to medial) are the LFCN, iliacus muscle, femoral nerve, psoas muscle, pectineus muscle, obturator nerve branches and adductor muscles. Theoretically, local anaesthetic (LA) injected into the fascia iliaca compartment can spread laterally, medially, superiorly and inferiorly to block the femoral, LFCN and obturator nerve. In reality, obturator nerve blockade can be variable due to the deep fold of the fascia iliaca between the iliacus muscle and psoas muscle, preventing the spread of LA.[2,10]

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The femoral nerve provides sensory innervation to the anteromedial thigh, patella and periosteum of the femoral head, femoral neck and femoral proximal shaft, and medial aspect of the leg until the medial malleolus [Figure 2]. The femoral nerve also provides motor innervation to muscles involved in hip flexion (pectineus, iliacus and sartorius) and knee extension (quadriceps femoris).[2,3,8,11,12] The LFCN provides sensory innervation to the skin overlying the lateral thigh.[3,12,13] The obturator nerve provides sensory innervation to the medial thigh.[3,12] The sciatic nerve innervates the posterior compartment of the thigh and will not be blocked by an anterior nerve block such as the FIB.[3,12]

During a FIB, LA is injected in the fascia iliaca compartment, a potential space between the fascia iliaca and the iliacus muscle. Major nerves in the fascia iliaca compartment are the femoral nerve and LFCN. Unlike femoral nerve blocks or LFCN blocks, the FIB simultaneously blocks the femoral and LFCN. The FIB provides better analgesia, reduces the need for multiple nerve blocks and reduces the risk of nerve injury from a needle when compared to other methods.[6,7,8,11]

Indications

The FIB can simultaneously block the femoral nerve and LFCN, making it suitable for patients with the following needs:

1. Pre-operative or post-operative anaesthesia to the knee, femoral shaft or hip[4-6]
2. Management of pain in the lower extremity from burns, cancer or inflammatory conditions of the lumbar plexus[4-6]

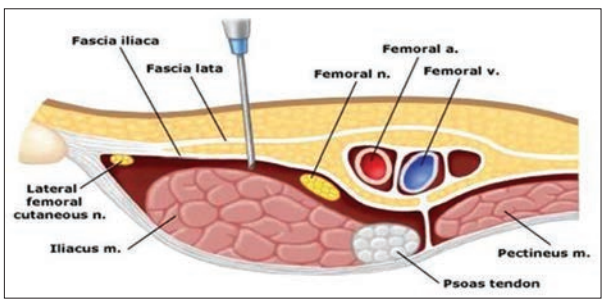

Figure 1: Cross-section of the fascia iliaca compartment illustrating the nerves and muscles housed beneath the fascia iliaca. Reproduced from Attia J, Zein, A. Effects of Adjuvant in Potentiating the Analgesic Effect of Fascia Iliaca Compartment Block. J Anesth Surg 2017, 4 (2), 86-92. Licensed under CC BY 4.0.

FIB should be considered the first line in patients with trauma to the lower extremity within the nervous distribution of the femoral nerve and LFCN, and the following comorbidities, as these patient populations are at the greatest risk of experiencing side effects of opioids:

1. Patients at risk of respiratory depression (e.g. chronic obstructive pulmonary disorder, obesity with body mass index >30 kg/m^2,[14] obstructive sleep apnoea and age ≥60)[6]
2. Patients with chronic opioid use or opioid intolerance[6]
3. Patients with pain that is being poorly managed with traditional analgesics[6]
4. Patients who would like to decrease the risks of systemic medications (e.g. pregnancy).[6]

Contraindications

Absolute contraindications for FIB include:

1. Patient refusal[3,6]
2. Patient's inability to cooperate (e.g. intoxication from alcohol or illicit drugs and severe pain).[3,6,15] In patients unable to cooperate due to severe pain, combination therapy with another approach such as NSAID and/or opioid use should be considered to relieve the patient's acute discomfort and to reduce the amount of NSAIDs and opioids required.
3. Allergy to LAs[3,6]
4. LA injection that is already close to the maximum dosage[3,6]
5. Previous femoral bypass surgery[3,8]
6. Active infection at the site of injection[3,6]

Figure 2: Distribution of sensory innervation provided by nerves housed within the fascia iliaca compartment. Source: NYSORA.com.[13] Permission to use this figure was granted by NYSORA.

7. Lack of availability of lipid emulsion therapy for the treatment of LA systemic toxicity (LAST)

Relative contraindications for FIB may include:

1. Pre-existing neural deficits in the distribution of the femoral nerve and LFCN as these conditions may predispose the patient to further neural injury and deficit post-FIB[6]
2. Trauma-related nerve injury or suspected compartment syndrome as FIB may mask these symptoms[15]
3. Multiple severe injuries. FIB may be inappropriate in this case to control pain in one extremity when systemic medications will be needed to control pain in other areas of the body.[15]

Complications

One of the possible serious adverse events of any nerve block, including FIB, is LAST. Symptoms of LAST include central nervous system (CNS) excitement (agitation, auditory changes, metallic taste and visual disturbances), seizures, CNS depression (drowsiness, coma and respiratory arrest), cardiac toxicity (hypertension, tachycardia and ventricular arrhythmias) and cardiac depression.[16] In the event that a patient experiences symptoms of LAST, guidelines from the American Society of Regional Anaesthesia and Pain Medicine recommend cardiorespiratory management and IV administration of 20% lipid emulsion therapy. Lipid emulsion therapy is often available in hospitals for nutritional support[17] and is the standard of care in the treatment of overdoses of non-dihydropyridine calcium channel blockers, beta-blockers, bupropion, lamotrigine and tricyclic antidepressants.[18]

Lipid emulsion therapy can be administered through a bolus or infusion:

- For patients >70 kg, bolus dosing is 100 mL over 2–3 min[16]
- For patients <70 kg, bolus dosing is 1.5 mL/kg over 2–3 min (based on ideal body weight).[16]

If patients are unstable after lipid emulsion treatment, administering an additional bolus of 0.5 ml/kg/min can be considered.[16]

Complications of FIB are uncommon as the needle is advanced into the fascia iliaca compartment rather than in proximity to a nerve or blood vessels. However, complications such as nerve injury, hematoma, LAST, allergic reaction to LA, myotoxicity and secondary injury can still arise due to inadvertent puncture of nerves or vessels, and exposure to LA.[6,8] These complications can be limited by the use of ultrasound guidance, administration of the smallest amounts of LA recommended to achieve analgesia and patient monitoring.[8] In addition, the practitioner should ensure that resuscitative equipment and lipid emulsion 20% are available before performing FIB.[3,19] Patients undergoing FIB should be advised to ask for help from staff before mobilising, as patients are still at risk of falls. Close monitoring is required for all patients, but especially those with dementia, delirium or lack of awareness of their surroundings, as relief of their pain may make them feel able to walk on their injured lower extremity.

Equipment: Figure 3:

- Clean gloves (1 pair)
- Sterile gloves (1 pair)
- Personal protective equipment (PPE)
- Skin marker
- Chlorhexidine sticks or chlorhexidine applied to sterile gauze
- sterile drapes
- Two 20 mL vials of 0.25% bupivacaine with 5 mcg/mL epinephrine
- Normal saline (only needed if patient <40 kg)
- Alcohol wipe
- 1.5-inch 25-gauge needle
- 3-mL syringe
- One 5-mL container of 1% lidocaine
- 1.5-inch 18-gauge needle
- 3-inch 21-gauge block needle OR 2-inch 21-gauge needle with IV-line extension set
- Two 20 mL syringes
- Dressing: 2 × 2 inches of dry gauze and a transparent adhesive film dressing such as 3M™ Tegaderm™, 6 cm × 7 cm
- Minimum 100 mL of lipid emulsion 20% on hand in case of LAST[16]
- Resuscitative equipment is available.

Additional equipment for ultrasound-guided fascia iliaca block

- An assistant wearing clean gloves will be required to perform this procedure
- Ultrasound machine with high-frequency

linear ultrasound transducer (6–14 Hz) capable of imaging to approximately 4 cm depth, or a lower frequency curvilinear probe (allowing deeper penetration in larger patients)
- Ultrasound cover: sterile ultrasound cover or sterile 3M™ Tegaderm™ [Figure 3], 6 cm × 7 cm
- Sterile ultrasound gel

Landmark-based method fascia iliaca block

1. Obtain informed signed consent. Collect equipment. Make sure the patient is in a gown with underwear removed and appropriately draped
2. Don clean gloves and PPE
3. Lay out equipment [Figure 4]. Place the patient in supine position[11]
4. Palpate for the femoral artery in the femoral triangle at the medial thigh and mark the location of the femoral artery using a surgical marking pen[8,11,20]
5. With the surgical marking pen, draw a line from the pubic tubercle to the anterior superior iliac spine (ASIS)[8,11,20]
6. With the surgical marking pen, divide the drawn line into thirds[8,11,20]
7. Mark the point 2 cm inferior to the line/border that separates the middle and lateral thirds [Figure 5]. This is the needle puncture site[8,11,20]
8. Remove the clean gloves and don sterile gloves
9. Prepare the needle puncture site. Clean the skin with an alcohol wipe. Attach the 25-gauge needle to the 3-mL syringe. Draw up 3 mL 1% lidocaine. Inject the 3 mL of 1% lidocaine under the skin, forming a bleb
10. Clean the skin around the point of insertion using chlorhexidine (×3) and drape the patient with sterile drapes
11. Prepare LA. For adults, 30–40 mL of LA is needed for nerve blockade.[4,8] For children, LA volume should be 0.7 mL/kg.[8,13,20]
    - Attach the 18-gauge needle to the 20-mL syringe and draw 20 mL of LA solution. Then, fill the second 20-mL syringe with 20 mL of LA (total of 40 mL of LA). If your patient has a low body weight of <40 kg, instead of the above, dilute 20 mL of LA with 20 mL of normal saline. As the FIB depends on the spread of LA underneath the fascia iliaca, the goal is to inject as much LA as possible (40 mL LA) while staying under 2.5 mg/kg of bupivacaine.
12. Cap the 18-gauge needle and remove it from the syringe. Attach the 2-inch 21-gauge needle and IV-line extension set onto the syringe
13. Position the 21-gauge needle at a 45° angle cephalad and insert the needle at the marked needle puncture site[11,20]
14. Advance the needle until loss of resistance is felt. This is the needle passing through the fascia lata

Figure 3: Sterile plastic covering such as 3MTM TegadermTM used as an ultrasound probe cover. Reproduced from Macias, M. Ultrasound Leadership Academy: Introduction to Procedural Ultrasound http://www.emcurious.com/blog-1/2014/12/7/ultrasound-leadership-academy-introduction-to-procedural-ultrasound (accessed Sep 6, 2021). Licensed under CC BY 4.0.

Figure 4: Photo of equipment (labelled A-M) required to perform fascia iliaca block. (A) clean gloves, (B) sterile gloves, (C) chlorhexidine sticks, (D) two 20 mL vials of 0.25% bupivacaine with 5mcg/mL epinephrine, (E) normal saline (only needed if patient <40kg), (F) alcohol wipe, (G) 1.5 inch 25-gauge needle, (H) 3 mL syringe, (I) one 5 mL container of 1% lidocaine, (J) 1.5 inch 18-guage needle, (K) 3 inch 21-gauge block needle, (L) two 20 mL syringes, (M) dressing: 2 × 2 inches of dry gauze and a 6cm × 7cm transparent adhesive film dressing.

15. Continue to advance the needle until another loss of resistance is felt. This is the needle passing through the fascia iliaca. The experience of passing through the fascia lata and fascia iliaca is often described as two "pops"[8,11,13,20]
16. Aspirate to ensure that the needle is not intravascular. Once negative aspiration is confirmed, inject 5-mL LA solution and continue to aspirate, then inject 5 mL quantities until all of the LA solution is administered from both syringes[11,20]
17. Place dressing and tape over the needle injection site and apply pressure for a few minutes

Ultrasound-guided method fascia iliaca block

1. Perform steps 1–4 as stated previously for the landmark-based FIB method

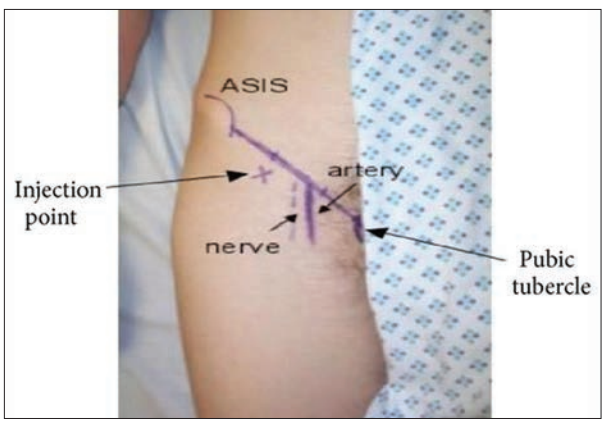

Figure 5: Marking of the line between the ASIS and pubic tubercle and location of the femoral artery and needle puncture site. Reproduced from Hanna, L.; Gulati, A.; Graham, A. The Role of Fascia Iliaca Blocks in Hip Fractures: A Prospective Case–Control Study and Feasibility Assessment of a Junior-Doctor-Delivered Service. ISRN Orthop. 2014, 2014, 1–5. Licensed under CC BY 3.0.

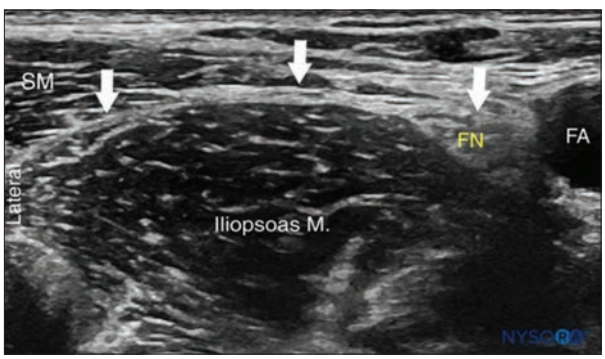

Figure 7: Ultrasound image at the level of the inguinal ligament of the femoral nerve situated lateral to the femoral artery, above the iliopsoas muscle, and beneath the fascia iliaca. Source: NYSORA.com.[13] Permission to use this figure was granted by NYSORA.

2. Use the ultrasound machine to identify the anatomy before the procedure. Place the high-frequency linear transducer (or the lower frequency curvilinear probe in patients with larger body habitus if deeper penetration is needed) in transverse position, caudal to the femoral crease and over the inguinal ligament [Figure 6][7,8]
3. Move the transducer medially into the inguinal crease and locate the femoral artery.[7] Slowly move the transducer laterally until the probe is at the line/border that separates the middle and

Figure 6: Ultrasound and needle positioning during performance of fascia iliaca block. Reproduced from Dangle J, Kukreja, P, Kalagara, H. Review of Current Practices of Peripheral Nerve Blocks for Hip Fracture and Surgery. Curr Anesthesiol Rep. 2020, 10 (3), 259-266. Licensed under CC BY 4.0.

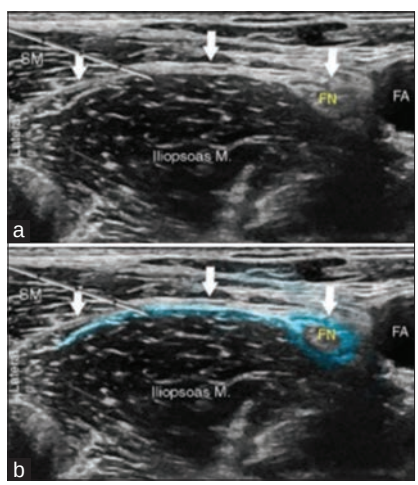

Figure 8: (a) Ultrasound image of correct needle positioning for the fascia iliaca block. The needle pierces the fascia iliaca lateral to the femoral nerve and femoral artery. The needle does not pierce through the underlying muscle. Source: NYSORA.com.[13] Permission to use this figure was granted by NYSORA. (b) Ultrasound image with a simulation of the distribution of local anesthetic administered during the fascia iliaca block. Source: NYSORA.com.[13] Permission to use this figure was granted by NYSORA.

lateral thirds of the line drawn from the ASIS to the pubic tubercle.[8,11] Locate the hyperechoic fascia lata, hyperechoic fascia iliaca and hypoechoic iliacus muscle [Figure 7][7,8]

4. Remove the clean gloves and don sterile gloves
5. Prepare the needle puncture site as stated in step 9 of landmark-based FIB method
6. Clean the skin around the point of insertion using chlorhexidine sticks ×3 and drape the patient with sterile drapes
7. Have an assistant with clean gloves take the ultrasound probe and pour some gel on the probe. In your sterile gloves, hold the sterile ultrasound cover open while your assistant places the probe into the cover. Then, have your assistant place sterile ultrasound gel on the patient
8. Prepare LA and needle as stated above in steps 10–12 of landmark-based FIB method
9. Repeat step 2 to revisualise the anatomy
10. Insert the needle in the plane with the ultrasound transducer, inferior to the inguinal ligament. Guide and visualise the needle below the fascia iliaca. Two "pops" or loss of resistance is felt as the needle advances through the fascia lata and the fascia iliaca[7,8,11] [Figure 8a and b]
11. Inject LA as stated above in step 14 for the landmark-based FIB method
12. Place dressing and tape over the needle injection site and apply pressure for a few minutes.

CONCLUSION

The FIB is a regional nerve block that serves as an effective option for pre- and post-operative analgesia in patients with orthopaedic trauma to the hip, knee and thigh and for those with burns or cancer-related pain. A particular consideration for FIB use should be given to elderly patients and patients with comorbidities for whom traditional systemic analgesics can cause problems. The FIB can be performed with equipment found in rural and emergent settings but, as with any procedure, does require training and practice. Complications from FIB are rare but the risk can be minimised with the use of ultrasound, minimal LA uses, appropriate monitoring and having resuscitation equipment readily available.[3,8]

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A privilege

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Winner of the 2021 Society of Rural Physicians of Canada Resident Essay Contest

It was morning handover at 8 A.M. on Sunday, November 21, and my 24-h call shift was almost over, or so I thought. My preceptor and I were sitting with the incoming staff physician and resident as well as the emergency room nurse. Amid giving updates on the patients in the emergency department, as well as those on the ward, we discussed the upcoming holiday parade, the latest guidelines for pneumothorax and chest tube insertion, and the new inhabitant of my preceptor's birdhouse: a screech owl. As I am almost ready to leave and say good day (or for me, goodnight), 'Code Blue 14 bed 3' calls overhead. There is no code team; stable patients in the emergency department and on the ward will have to wait. We need all hands on deck.

The Code Blue is being called for the patient I admitted to the hospital yesterday for a non-ST-elevation myocardial infarction (NSTEMI). I know this by the room number announced. We get to know all the inpatients, and their locations, through daily morning table rounds. Every patient who is admitted to the hospital is discussed every morning. The nurse looking after the patient for that day takes the lead. We then have contributions from one or two individuals who specialise in home care, social work, geriatrics nursing and physiotherapy. It is also a time that members of the team can ask others for advice. You never feel alone. We have less staff than our urban counterparts, although we make up for it in our sense of community and our sense of responsibility to each other and to each other's patients.

We arrive at the patient's room; the nurses are attaching monitors, starting intravenous lines and performing cardiopulmonary resuscitation (CPR). We quickly don our personal protective equipment, scrambling to put on our N95 masks, goggles, gowns and gloves. We enter the room. My preceptor stays out because among the Code Blue there is another patient in critical condition and my preceptor is waiting for a call back from CritiCall.

There is a patient in room 11 who is requiring increasing supplemental oxygen. He is a patient who has severe bilateral COVID-19 pneumonia. He was previously healthy, lives at home with his wife and children, has been a family practice patient of my preceptor for many years, and is unvaccinated against COVID-19. He presented to the emergency department yesterday requiring 1–2 L/min of oxygen delivered by nasal prongs. I later received a call at 5 A.M. that he was now on a non-rebreather mask with an oxygen saturation of only 89%. My preceptor and I phone CritiCall, a call centre in Ontario that provides support for urgent or emergently

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ill patients. We present this case to an intensive care unit (ICU) physician who replies that the patient is not ill enough yet for transfer. From our perspective of working in a rural hospital with one staff physician and access to only one mechanical ventilator, this quickly deteriorating patient is ill enough for transfer. However, we learn to respectfully accept one rejection, and continue to advocate until we receive the answer that gives our patient the appropriate care.

While my preceptor speaks with the next ICU physician available, the patient in 14 bed 3 experiences two rounds of CPR and then we proceed with the algorithm for bradycardia with a pulse. He has been placed on an intravenous vasopressor infusion and he has been intubated. One intubation was done, one to go, because the patient with COVID-19 pneumonia has been accepted for transfer and needs to be intubated as well. Time to do some math: two patients intubated and one ventilator. To limit exposure to infection, it is decided that the mechanical ventilator will be used for the patient with COVID-19 pneumonia. That leaves 14 bed 3 with a human ventilator.

To summarise the last hour, we now have one physician intubating the patient in room 11, one physician now attending to the remaining inpatients and the emergency department, a resident phoning CritiCall for air transfer of the patient in 14 bed 3, and myself, bag-mask ventilating until the paramedics arrive.

The patient and I were left alone in the room. My hands were placed on the self-inflating bag. An eerie peacefulness rushed over me envisioning the chaos outside those doors. While two emergencies were occurring, there were still patients presenting to the emergency room needing triage and assessment, as well as inpatients waiting for their breakfast and morning medications. I can only imagine the ongoing endurance of the healthcare staff outside the room.

I stood there for 3 hours. 'Squeeze, two, three, four, five and six. Squeeze, two, three, four, five and six.' My eyes moved from the monitor to the patient and back again. 'Squeeze, two, three, four, five and six.' It was up to me to breathe for someone who could not breath on their own. An overwhelming sense of power and responsibility. When the paramedics arrived, they said in shock 'no one switched out with you'? I laughed courteously as I thought to myself, 'Who? Who could have? There was no one else available'. It was not until I was relieved as a human ventilator that I realised the state of my body. I was working on 1 hour of sleep in the past 28 hours, my face squished by the N95 mask, my hands and forearms aching from squeezing the self-inflating bag 1800 times.

I walked with my preceptor down the hall as we finished our long, but life-changing shift. He said to me, 'I hope you did not mind being the one to do that'. I stopped and looked at him and said, 'It was an absolute privilege.' This is rural medicine.

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Erratum: Stronger together: Interprofessional collaboration and sustainability of maternity services in a small northern Ontario hospital

In the article titled Stronger together: Interprofessional collaboration and sustainability of maternity services in a small northern Ontario hospital, published on pages 99-103, Issue 3, Volume 27 in Canadian Journal of Rural Medicine[1], the lead author's Judith M. Rogers citation was incorrectly published as Rogers RM on page 99, in How to cite this article section, at bottom of page.

The correct author citation should be read as Rogers JM,

REFERENCE

1. Rogers JM, Warwick KA. Stronger together: Interprofessional collaboration and sustainability of maternity services in a small northern Ontario hospital. Can J Rural Med 2022;27:99-103.

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