Use of point-of-care ultrasound in rural British Columbia

Scale, training, and barriers

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Abstract

Objective To determine the scale and scope of use of point-of-care ultrasound (POCUS) in rural British Columbia (BC).

Design Online survey.

Setting Rural BC.

Participants Physicians practising in rural BC communities.

Main outcome measures Practitioner demographic and practice characteristics, locations and frequency of POCUS use, POCUS education and training, and practitioner attitudes about and barriers to POCUS use.

Results Two hundred twenty-seven surveys were completed in fall 2021, corresponding to a response rate of 11.9% of all rural practitioners in BC. A total of 52.1% of respondents worked in communities with less than 10,000 people, while 24.9% had practices with relatively large proportions of Indigenous patients (more than 20% of the practice population). Respondents reported ease of access to local POCUS devices, with use highest in emergency departments (87.2%) followed by ambulatory care clinic (54.7%) and inpatient (50.3%) settings. Use of POCUS influenced clinical decision making in half the occasions in which it was employed, including a range of diagnostic and procedural applications. Barriers to use included lack of training, limited time to perform POCUS scans, and absence of image review or consultative support. Needed support for POCUS identified by respondents included real-time image acquisition advice and funding for both device acquisition and training. Recommendations for including POCUS training in undergraduate and residency education were strongly supported.

Conclusion Use of POCUS in BC is expanding in frequency, scope, and scale in practices serving rural areas and in rural communities with large Indigenous populations, with practitioners reporting important improvements in clinical care as a result. Future research could help improve systemic support for POCUS use, guide needed curriculum changes in medical school and postgraduate training, and be used to inform continuing professional development needs.

Utilisation de l'échographie au point de service dans des milieux ruraux de la Colombie-Britannique

Étendue, formation et obstacles

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Résumé

Objectif Déterminer l'étendue et la portée de l'utilisation de l'échographie au point de service (EGPS) dans des milieux ruraux de la Colombie-Britannique (C.-B.).

Type d'étude Un sondage en ligne.

Contexte Des milieux ruraux de la C.-B.

Participants Des médecins qui pratiquent dans des communautés rurales de la C.-B.

Principaux paramètres à l'étude Les caractéristiques démographiques des médecins et la nature de leur pratique, l'emplacement et la fréquence de l'EGPS, l'éducation et la formation relatives à l'EGPS, les attitudes des médecins concernant le recours à l'EGPS et les obstacles à son utilisation.

Résultats À l'automne de 2021, 227 sondages ont été remplis, ce qui correspond à un taux de réponse de 11,9 % de tous les médecins ruraux en C.-B. Dans l'ensemble, 52,1 % des répondants travaillaient dans des communautés de moins de 10 000 habitants, alors que 24,9 % avaient des pratiques comportant des proportions relativement importantes de patients autochtones (plus de 20 % de la population de la pratique). Les répondants ont signalé une facilité d'accès aux appareils locaux d'EGPS, dont l'accès le plus fréquent se situait dans les départements d'urgence (87,2 %), suivis par les cliniques de soins ambulatoires (54,7 %) et les milieux hospitaliers (50,3 %). L'utilisation de l'EGPS avait influé sur la prise de décision clinique dans la moitié des cas où elle avait été utilisée, notamment dans une diversité d'applications diagnostiques et procédurales. Au nombre des obstacles à son utilisation figuraient le manque de formation, le temps limité pour effectuer les échographies, et l'absence de soutien pour l'analyse de l'imagerie ou de soutien consultatif. Les soutiens nécessaires à l'EGPS qu'ont cernés les répondants incluaient des conseils sur l'acquisition d'images en temps réel, et du financement pour l'acquisition des appareils et la formation. La recommandation d'intégrer la formation sur l'EGPS dans l'éducation prédoctorale et postdoctorale a reçu un fort appui.

Conclusion L'utilisation de l'EGPS s'accroît en fréquence, en portée et en étendue dans les pratiques desservant des régions rurales et dans les communautés rurales qui ont d'importantes populations autochtones, et les médecins ont signalé des améliorations considérables aux soins cliniques qui en ont découlé. Des recherches futures pourraient contribuer à améliorer le soutien systémique à l'utilisation de l'EGPS, à orienter les changements nécessaires aux cursus durant les études de médecine et la formation postdoctorale, et à détermine les besoins en développement professionnel continu.

From its origins in emergency medicine and surgical settings, point-of-care ultrasound (POCUS) use has rapidly spread to various specialties, including critical care, internal medicine, anesthesia, and family medicine.[1-4] Point-of-care ultrasound is now widely available owing to technologic improvements, lower costs, and improved training pathways.[5] For Canadian rural clinicians practising with limited access to diagnostic imaging services such as radiology ultrasound or computed tomography scanning, POCUS equips providers with a bedside tool that can answer diverse diagnostic questions, such as causes of shock, shortness of breath, or abdominal pain, among other clinical presentations. Furthermore, POCUS use improves procedural safety, especially with the use of real-time needle guidance.[5]

Use of POCUS in rural Canada has predominantly been described from the perspective of emergency medicine (EM) providers.[6-9] Little is known about broader use of POCUS in rural settings beyond emergency departments (EDs). Common themes have arisen from previously published studies, especially regarding barriers to POCUS use in rural settings: lack of equipment, training, funding, and quality assurance as well as concerns about skill atrophy.[9] It is unclear whether these concerns apply to practitioners using POCUS in rural British Columbia, as this population of providers has not previously been specifically surveyed. Understanding POCUS use in rural British Columbia could better inform service planning and education needs, both provincially and nationally. Our objectives are to describe POCUS use among rural health care providers in British Columbia with a focus on its clinical use, provider attitudes, and barriers to its use.

Methods

This online survey study was approved by the University of British Columbia (UBC) Behavioural Ethics Research Board (No. H21-01958). The survey (Appendix A, available from **CFPlus***) was designed by the study investigators, a group of POCUS educators from western Canada, based on previously published survey studies of rural POCUS use.[6,7] This English-language survey was distributed electronically through Qualtrics (version July 2022). Prospective participants were practitioners working in rural communities as defined by the Rural Coordination Centre of British Columbia (RCCbc). Communities are considered rural in British Columbia if minimum criteria are met based on geographic isolation, number of practitioners, community size, and presence and numbers of specialists in the community.[10] Survey respondents were asked to estimate what proportion of patients in their practices were Indigenous.

Through collaboration with UBC Continuing Professional Development (UBC CPD) in the Faculty of Medicine, RCCbc and UBC CPD staff sent email invitations to rural physicians in September 2021. The survey was also distributed in newsletters and posted on the RCCbc website. Nonrespondent recipients were sent reminder emails 1 and 2 months after the initial invitation. Providers were incentivized to participate with entry in a draw for 4 prizes for successful survey completion: a Clarius C3 handheld ultrasound scanner, a free trial of a GE Vscan ultrasound system, a free trial of a Philips Lumify ultrasound device, and an Apple iPad.

The survey consisted of 50 questions assessing clinical practice characteristics, POCUS experience and training, access to an ultrasound device, scope of POCUS use, attitudes about POCUS use, and barriers to POCUS use. Respondents were not required to answer all questions and could choose to skip questions they did not wish to answer. Questions assessing attitudes were answered on a 5-point Likert scale (with 1 indicating strongly disagree, and 5 indicating strongly agree). Responses were downloaded from the Qualtrics website interface and imported into Microsoft Excel (version 16.76) for analysis. Descriptive statistics are reported using medians, interquartile ranges, and ranges or number and proportion where appropriate.

Results

While the number of physicians practising in a given jurisdiction in rural BC remains in constant flux,[11] at the time of survey distribution there were 1910 physicians in rural British Columbia working under 6 regional health authorities and composed of 1360 GPs, 547 specialists, and 3 unspecified (RCCbc, unpublished data, 2021). A total of 227 responses were received, with 214 from GPs and 13 from specialists, for an aggregate response rate of 11.9%. The GP group included 10 family medicine residents based in rural areas, 3 nurse practitioners, and 1 midwife. The specialist group (n=13) included individuals specializing in anesthesia (n=1), emergency medicine (n=2), surgery (n=1), obstetrics (n=1), orthopedics (n=1), pediatrics (n=3), and internal medicine (n=4). A review of specialist responses did not reveal a material difference in response characteristics compared with those of GPs. As the specialist cohort was small, their responses were pooled with those of the GP group for analysis.

Practice and participant characteristics

Practice and demographic characteristics of survey respondents are described in **Table 1**.

Access to and use of POCUS

Clinical use of POCUS at the time of the survey is presented in **Table 2**.

Appendices A and **B** are available from **https://www.cfp.ca**. Go to the full text of the article online and click on the **CFPlus** tab.

Table 1. Practice and demographic characteristics of survey participants: *N=227, but denominators vary owing to missing data for some survey questions.*

CHARACTERISTIC	n (%)
Age, y	
• 25 to 30	17 (7.5)
• 31 to 40	90 (39.6)
• 41 to 50	66 (29.1)
• 51 to 60	37 (16.3)
• 61 to 70	17 (7.5)
Health authority*	
• Fraser Health	12 (5.3)
• Interior Health	86 (37.9)
• Northern Health	82 (36.1)
• Vancouver Coastal Health	48 (21.1)
• Vancouver Island Health Authority	32 (14.1)
• Other	7 (3.1)
Practitioner type	
• Family medicine resident	21 (9.3)
• Nurse practitioner	3 (1.3)
• Midwife	1 (0.4)
• Family physician	189 (83.3)
• Specialist	13 (5.7)
Years in rural setting	
• <2	41 (18.1)
• 2 to 5	40 (17.6)
• 5 to 10	52 (22.9)
• >10	94 (41.4)
Consultative ultrasound available in community	
• Yes	164 (72.2)
• No	63 (27.8)
Community population size†	
• <2000	22 (9.8)
• 2000 to 5000	35 (15.6)
• 5000 to 10,000	60 (26.7)
• 10,000 to 20,000	55 (24.4)
• 20,000 to 100,000	27 (12.0)
• >100,000	26 (11.6)
Location of undergraduate medical training	
• Canada	173 (76.2)
• International	54 (23.8)
Postgraduate certification	
• Non-CCFP GP	19 (8.4)
• CCFP	134 (59.0)
• CCFP(EM)	36 (15.9)
• FRCPC	11 (4.8)
• Other	27 (11.9)
Proportion of patients in practice who are Indigenous†	
• <5%	64 (28.4)
• 5% to 10%	68 (30.2)
• 11% to 20%	37 (16.4)
• 21% to 40%	23 (10.2)
• >40%	33 (14.7)

CCFP—Certification in the College of Family Physicians of Canada, CCFP(EM)—Certification in the College of Family Physicians of Canada with a Certificate of Added Competence in Emergency Medicine, FRCPC—Fellow of the Royal College of Physicians of Canada, Division of Medicine.
*Survey participants could enter more than 1 response to this question given that they may practise in multiple locations under more than 1 health authority; thus, the percentage total exceeds 100%.
†A total of 225 respondents answered these questions.

Table 2. Survey participants' access to and use of POCUS: *N=227, but denominators vary owing to missing data for some survey questions.*

CHARACTERISTIC	n (%)
POCUS user*	
• Yes	182 (82.0)
• No	40 (18.0)
Access to machine†	
• No access	28 (12.5)
• Cart only	109 (48.7)
• Handheld only	15 (6.7)
• Both	72 (32.1)
Ease of access‡	
• Very easy	112 (60.2)
• Somewhat easy	49 (26.3)
• Neutral	15 (8.1)
• Somewhat difficult	8 (4.3)
• Very difficult	2 (1.1)
Settings of POCUS use§	
• Emergency department	156 (87.2)
• Inpatient or hospital	90 (50.3)
• Clinic	98 (54.7)
• Long-term care	12 (6.7)
• Prehospital	3 (1.7)
• Home visits	14 (7.8)
Frequency of POCUS use‖	
• Less than once per month	14 (8.0)
• A few times per month	27 (15.5)
• A few times per week	26 (14.9)
• Once per shift or day	31 (17.8)
• More than once per shift or day	76 (43.7)

POCUS—point-of-care ultrasound.
*A total of 222 respondents answered this question.
†A total of 224 respondents answered this question.
‡A total of 186 respondents answered this question.
§A total of 179 respondents answered this question. Survey participants could enter more than 1 response to this question; thus, the percentage total exceeds 100%.
‖A total of 174 respondents answered this question.

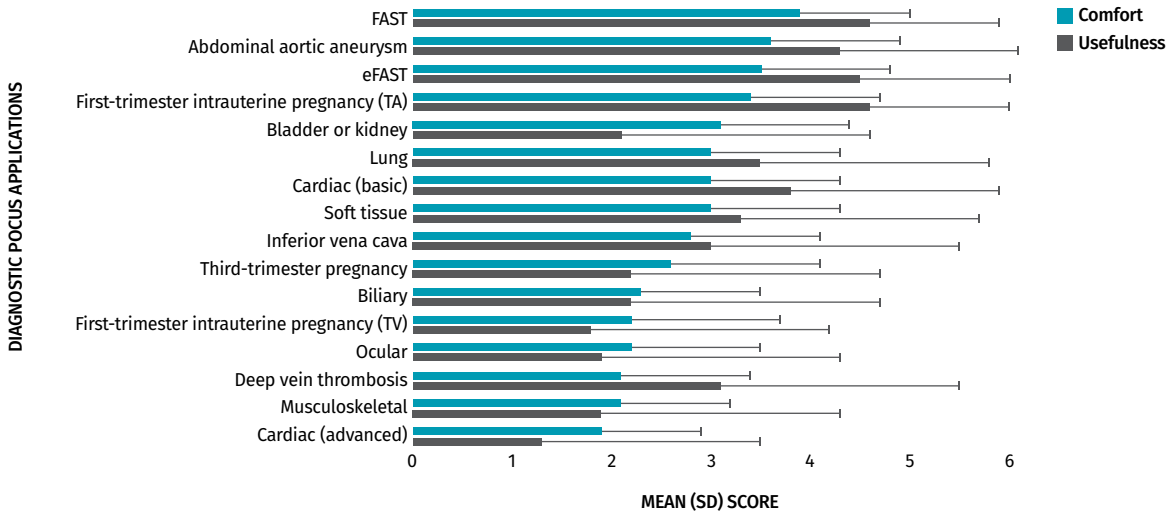
For the question, "When you use POCUS, how often does it change patient management?" of the 165 respondents using POCUS who answered this question, 1.2% (n=2) stated never, 20.0% (n=33) reported less than 25% of the time, 42.4% (n=70) reported 25% to 50% of the time, 26.7% (n=44) reported between 51% and 75% of the time, and 9.7% (n=16) reported more than 75% of the time. A total of 78.8% (n=130) reported POCUS has a meaningful impact on patient management at least 25% of the time it is used.

Figure 1 presents respondents' comfort levels with and perceptions of the clinical usefulness of various diagnostic POCUS applications. **Figure 2** provides similar responses for POCUS-guided procedures.

Education related to POCUS

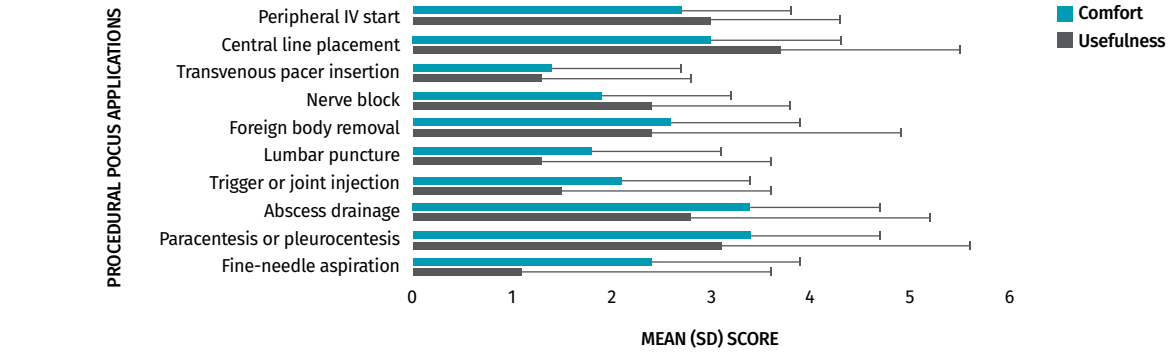
Respondents reported their exposure to POCUS during training. **Figure 3** shows the educational hours that respondents received in diagnostic and procedural

Figure 1. Survey respondents' ratings of levels of comfort with and usefulness of diagnostic POCUS applications (mean, SD): *Answers were based on Likert scales of 1 (very uncomfortable) to 5 (very comfortable) and 1 (very unuseful) to 5 (very useful), respectively.*



eFAST—extended focused assessment with sonography in trauma, FAST—focused assessment with sonography in trauma, POCUS—point-of-care ultrasound, TA—transabdominal, TV—transvaginal.

Figure 2. Survey respondents' ratings of levels of comfort with and usefulness of procedural POCUS applications (mean, SD): *Answers were based on Likert scales of 1 (very uncomfortable) to 5 (very comfortable) and 1 (very unuseful) to 5 (very useful), respectively.*



IV—intravenous, POCUS—point-of-care ultrasound.

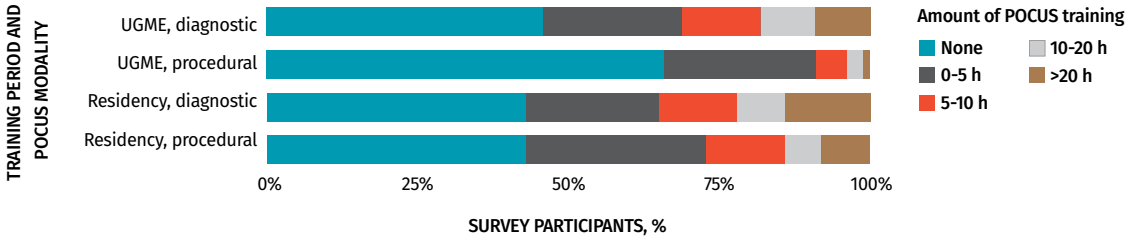
POCUS during undergraduate medical education (UGME) and postgraduate residency training.

Among respondents, 73.8% (166 of 225) had taken a POCUS course or training, but most of this group, 60.6%, reported not having acquired formal certification. Courses taken included various accredited Canadian courses (Appendix B, available from **CFPlus***), nearly all of which had been conducted in person in a 1- or 2-day format. Of the 26.2% of respondents who had not taken a POCUS course, most (74.6%) had plans to take one.

Attitudes and barriers to POCUS use

Table 3 reports respondents' opinions on barriers to using POCUS. Lack of training and time constraints were the top barriers to POCUS use reported. **Table 4** shows how respondents rated the importance of various types of support that might expand and improve POCUS use, with improved funding for training and more on-site courses identified as most important. **Table 5** illustrates respondent attitudes about aspects of POCUS in the health care system, including education and training, documentation, image archiving, and governance.

Figure 3. Hours of POCUS training received during UGME and residency training



POCUS—point-of-care ultrasound, UGME—undergraduate medical education.

Table 3. Survey participants' perceived barriers to POCUS use: *N=191.*

BARRIER	n (%)
Lack of training	115 (60.2)
Not enough time to perform	85 (44.5)
Lack of quality assurance or image review	74 (38.7)
Availability of courses	73 (38.2)
Cost of courses	64 (33.5)
Lack of rural POCUS guidelines	54 (28.3)
No local POCUS lead	49 (25.7)
Machine access challenges	35 (18.3)
No machine	33 (17.3)
Easy access to consultative ultrasound with or without computed tomography	30 (15.7)
Fear of litigation	26 (13.6)
Resistance from radiology	12 (6.3)
Not relevant to my practice	9 (4.7)

POCUS—point-of-care ultrasound.

Table 4. Survey participants' overall ranking of POCUS support strategies: *N=187, with rankings of 1 being most important and 9 being least important.*

POCUS SUPPORT STRATEGY	RANK
Funding for courses	1
On-site POCUS training	2
Funding for handheld purchase	3
POCUS billing fee code	4
More machine access provided by facility	5
One-to-one POCUS mentoring	6
Quality assurance or image review	7
More virtual education	8
POCUS guidance for rural settings	9

POCUS—point-of-care ultrasound.

Discussion

This survey is the first to assess the state of POCUS use among providers in rural British Columbia. About half of respondents (52.1%) worked in communities with fewer than 10,000 people and one-quarter (24.9%) estimated Indigenous patients composed more than 20% of their practice population. Most had been in rural practice less than 10 years (58.6%). Respondents reported high POCUS use in EDs as well as substantial use in primary care and inpatient settings. Most respondents reported at least daily use of POCUS in practices, high availability of machines, and ease of access, and most used POCUS for a range of diagnostic and procedural applications. Clinicians described POCUS as having informed clinical decisions on at least half the occasions in which it was used. Barriers to use included lack of training, funding, and availability of courses as well as lack of image feedback and review. This is consistent with other studies examining barriers to POCUS uptake,[9] with one proposed solution being courses offered to providers in their home communities.[12] These data complement a recent qualitative study of rural British Columbia clinicians by Kornelsen et al in which 21 "early adopter" POCUS users were interviewed; study participants reported that POCUS use increased job satisfaction and improved clinical decision making.[13] Participants in that study also rated real-time image acquisition advice, funding for device acquisition, and funding for training as the highest priorities among strategies to support rural practitioners.[13]

Two studies have evaluated POCUS use in EDs in rural areas of Canada. Flynn et al assessed POCUS use in EDs in rural Ontario in a 2012 study, showing that 60.6% of sites had ultrasound equipment available while only 44.4% of providers surveyed knew how to use it.[6] Léger et al published a study in 2015 of EM providers in rural Quebec, of whom 92.6% were family physicians.[7] Of these respondents, 95.4% said they had access to on-site ultrasound in their EDs and 75.9% used POCUS regularly. Our data confirm widespread availability of POCUS in rural EDs and high levels of frequency and confidence in its use.

Two studies have evaluated POCUS use in rural primary care settings in Canada. In a 2013 study Siu et al surveyed 21 family physicians practising in Yukon, and none reported using POCUS in their clinics.[14] In 2021 Sheppard et al published a mixed-methods

Table 5. Survey participants' attitudes about aspects of POCUS in the health care system: *Levels of agreement with statements were based on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).*

STATEMENT	MEAN LEVEL OF AGREEMENT WITH STATEMENT
POCUS should be embedded within UGME curricula	4.5
Residency training should have more POCUS exposure	4.5
All practising rural physicians should be using POCUS as the standard of care	4.0
I would attend virtual POCUS rounds, if available	3.8
A specialist (eg, radiologist, cardiologist) should help with image interpretation by sharing POCUS images	3.7
There should be a way to have real-time POCUS support	3.6
Image interpretation support should be available later	3.6
Written documentation for POCUS scans is mandatory	3.1
POCUS images should be stored for quality assurance	3.0
POCUS users should show proof of proficiency before using it	2.6
Clinicians using POCUS should have specific privileges for use in a facility	2.4
POCUS is risky because it leads to more false-positive and false-negative diagnoses than for those who do not use it	1.9

POCUS—point-of-care ultrasound, UGME—undergraduate medical education.

cross-sectional study based on interviews with physicians in Newfoundland and Labrador.[8] The prevalence of POCUS machines was lower in rural settings (12.6 devices per 100,000 population) compared with urban settings (20 devices per 100,000 population). General themes that emerged in interviews with rural physicians included issues related to lack of training, difficulty with maintenance of competence, lack of financial support, and patient benefit in saved patient travel when POCUS provided a clear diagnosis.[8]

Most respondents have sought POCUS training through continuing professional development ultrasound courses supplemented with online resources (Appendix B, available from **CFPlus***). Many described a paucity of POCUS exposure during UGME and residency; more than two-thirds of respondents had received at most 5 hours of training in either medical school or during residency. This is concordant with results from a survey of Canadian EM providers published in 2019 showing that 56.5% had received POCUS training entirely outside of residency and with results from a 2017 national survey of Canadian family medicine residents showing that 18.4% of respondents had received formal POCUS training during residency.[15,16] In the survey of family medicine residents, 94.3% indicated that residency programs should provide more exposure to POCUS.[16] Interestingly, these survey findings contrast with those of studies of Canadian EM training published as early as 2012 demonstrating that almost all Canadian EM residency programs, whether accredited through the Royal College of Physicians and Surgeons of Canada or through the College of Family Physicians of Canada, provided POCUS training for residents.[17,18] This discordance may be explained by the lack of graduates of EM residency programs pursuing rural practice. International studies attest to family practitioners largely being reliant on self-directed postgraduate study to achieve basic competency.[19-21] In our study, respondents had the highest level of agreement with statements recommending that POCUS be incorporated into core UGME and residency curricula. A Canadian POCUS curriculum for UGME was published in 2020, but its implementation has not yet been assessed.[22] While the American Academy of Family Physicians has developed POCUS curricular objectives,[4] the College of Family Physicians of Canada has not developed its own for Canadian residency programs.

The largest barriers to POCUS use reported in our study were lack of training (60.2%) and insufficient time to complete POCUS scans (44.5%). Possible strategies to manage these barriers include enhancing funding support for courses and running in-community POCUS courses.[12] Respondents also identified lack of quality assurance or external image review as an important barrier, with suggestions for additional support being specialist or radiologist involvement and making image archiving available for POCUS review.

Future studies are necessary to determine the impact of POCUS on how care is delivered rurally, particularly with respect to hospital admissions, intercommunity transfers, and costs. Studies are needed to understand effects on provider confidence and patient satisfaction and, ultimately, whether use of POCUS translates into improvements in care.

Limitations

The primary limitation of this study is the low response rate of 11.9%, which limits generalizability. As most respondents used POCUS frequently and had ready access to ultrasound machines, we cannot assume this group is typical of the average rural clinician. The 2.3% response rate among rural specialists limits the ability to draw any conclusions from these respondents. Finally, although respondents self-reported that POCUS was highly useful in assisting clinical decision making, there was no way to validate this or make comments on patient-oriented outcomes such as rates of morbidity, hospital admission, or interhospital transfer. As with any online survey study,

there may be the possibility of misinterpretation of questions or answer choices by respondents.

Conclusion

This study is the first in British Columbia to document the spread and scale of POCUS use in settings outside of rural EDs. Respondents expressed high agreement with the statement that POCUS should be the standard of care for rural practice and identified the greatest barriers to accessing training needed to meet that standard. Systems-level changes are necessary to support deeper POCUS integration, including UGME and residency curricular reform, better and more accessible training, and policy guidelines on training and on use in practice.

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Contributors

Drs Tracy Morton, **Daniel J. Kim**, and **Paul Olszynski** conceived and designed the study with input during the process from **Dr Virginia W. Robinson**, **Tracey Deleeuw**, and **Jason Curran**. **Dr Tracy Morton** and **Tracey Deleeuw** implemented the study and collected data. **Dr Tracy Morton**, **Dr Daniel J. Kim**, **Tracey Deleeuw**, and **Jason Curran** maintained and analyzed the data. **Drs Tracy Morton** and **Daniel J. Kim** drafted the manuscript. All authors contributed substantially to its revision. All authors have had the opportunity to review the final manuscript and have provided their permission to publish the manuscript.

Competing interests

Dr Tracy Morton, **Tracey Deleeuw**, **Jason Curran**, **Dr Paul Olszynski**, and **Dr Virginia W. Robinson** have no conflicts of interest to report. **Dr Daniel J. Kim** provides consulting services to Fujifilm Sonosite.

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