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# Different practice patterns of rural and urban general practitioners are predicted by the General Practice Rurality Index

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**Introduction:** There are differences between rural and urban general medical practice. However, research in this area has been hampered by the lack of a practical and valid definition of "rural." This study attempts to validate the General Practice Rurality Index (GPRI) by showing that it can predict the fee-for-service billing patterns of general practitioners in British Columbia.

**Methods:** We obtained one year of fee-for-service billing data for all general practitioners in BC, apportioned by local health area (LHA). The total numbers of each type of service in each LHA were categorized into logical groups and expressed as a percentage of total services for that LHA. Each LHA was given a full GPRI score and a simplified GPRI (GPRI-S) score. We then compared the scores and percentage of services in each fee category.

**Results:** We found significant correlations between the degree of rurality and the percentage of certain services. The GPRI-S produced more significant correlations than the full GPRI.

**Conclusions:** This study provides evidence that both the full GPRI and a simplified version can be used to predict practice patterns of BC general practitioners. Further study is needed to prove whether either of these indices will be an accurate and reliable measure of rurality across Canada.

**Introduction :** La pratique de la médecine générale n'est pas la même en milieu rural qu'en milieu urbain. Le manque de définition pratique et valide de la «ruralité» a toutefois fait obstacle à la recherche dans ce domaine. Cette étude tente de valider l'indice de la ruralité de la pratique générale (IRPG) en montrant qu'il peut prédire les tendances de facturation des omnipraticiens rémunérés à l'acte en Colombie-Britannique.

**Méthodes :** Nous avons réuni un an de données de facturation pour tous les omnipraticiens rémunérés à l'acte en C.-B., répartis selon la région de santé locale (RSL). On a réparti en groupes logiques le nombre total de services de chaque type dans chaque RSL, et on les a exprimés en pourcentage du total des services pour la RSL en question. Nous avons attribué à chaque RSL un IRPG complet et un IRPG simplifié (IRPG-S). Nous avons ensuite comparé les résultats et le pourcentage des services dans chaque catégorie de frais.

**Résultats :** Nous avons constaté l'existence de liens importants entre le degré de ruralité et le pourcentage de certains services. L'IRPG-S a produit des liens plus significatifs que l'IRPG complet.

**Conclusions :** Cette étude démontre qu'il est possible d'utiliser à la fois l'IRPG complet et une version simplifiée de celui-ci pour prédire les tendances de la pratique chez les omnipraticiens de la Colombie-Britannique. Une étude plus poussée s'impose pour démontrer si l'un ou l'autre de ces indices constituera une mesure fiable et exacte de la ruralité partout au Canada.

## INTRODUCTION

During the last decade, rural issues have taken a higher priority in Canadian health care research, politics and economics; however, controversy remains over what "rural" actually means. Rourke summarized the extent of the problem in a 1997 editorial.<sup>1</sup> That same year, Ricketts and colleagues<sup>2</sup> published a critique of several different methods of measuring rurality in the United States and concluded that there is no single measurement adequate for all situations. They suggest that a definition of rural should be adapted to the purpose for which it is being applied. Several commentators and reviewers have subsequently come to similar conclusions.<sup>3-9</sup>

In 1997, a Canadian General Practice Rurality Index (GPRI)<sup>10</sup> was proposed. This index scores 6 community factors, remoteness from an advanced referral centre, remoteness from a basic referral centre, population size, number of general practitioners, number of specialists and presence of an acute-care hospital, to produce an aggregate rating between 0 and 100 for degree of rurality. This index is not widely used and has not been properly validated.

Some researchers have found significant differences between the practices of rural general practitioners and those of their urban colleagues. Hays and colleagues in Queensland, Australia, found that rural physicians were more likely to practise a wide range of clinical and procedural skills using a wide range of clinical equipment the farther away they were from major medical centres and the smaller the population of the local area.<sup>11</sup> Britt and colleagues surveyed Australian general practitioners and found that rural physicians were more likely to do hospital and procedural work, including surgery, anesthesia and obstetrics, write fewer prescriptions, request fewer tests and make fewer referrals.<sup>12</sup> More recently, Boerma and colleagues reported that even in densely populated Europe, rural general practitioners provided more comprehensive services, regardless of health care system and payment method.<sup>13</sup> Langley and colleagues found that decreased access to hospital facilities and remoteness from specialty care in Nova Scotia led to different referral patterns for rural family doctors.<sup>14</sup> Wetmore and colleagues surveyed family physicians in Southern Ontario and found that those working outside of London were more likely to assist at surgery and work in the emergency department.<sup>15</sup> Hutten-Czapski and colleagues, using data from the 1997 National Family Physician Survey, demonstrated that Canadian family doctors in smaller and more remote communities

performed more procedures and did more emergency department on-call work.<sup>16</sup>

Using the aforementioned evidence that differences in rural and urban general practice are real, we hypothesized that these differences would be reflected in the fee-for-service billing patterns of BC general practitioners. Comparing these patterns to an index of rurality such as the GPRI determines whether the index is valid.

## METHODS

### *Data*

The raw billing data were supplied from the Medical Services Plan database courtesy of the British Columbia Medical Association (BCMA) and consisted of a list of fee items and the number of times each item was billed by general practitioners in the fiscal year 1996-97. Services performed by general practitioners through alternate methods of payment such as salary were not included. The data excluded referrals and laboratory fee items.

### *Local health areas*

Geographic descriptions and populations of each local health area (LHA) were obtained from BC STATS, Ministry of Finance and Corporate Relations, British Columbia. The raw billing data were initially apportioned to 99 LHAs. We combined 24 metropolitan LHAs into one Vancouver City LHA. Six other LHAs had fewer than 5 general practitioners so for reasons of confidentiality the BCMA combined 2 of these into one LHA and amalgamated 4 with geographically adjacent LHAs. This resulted in the distribution of the data to 71 individual or combined LHAs covering the whole province.

The LHAs had populations ranging from 760 to 540 000 people and varied in size from a few city blocks to hundreds of square kilometres. Most of these LHAs, especially in rural areas, had only one town or city that could be considered the medical service centre. For those that had more than one centre, the largest was selected for the purposes of this study. We obtained distances between service centres from the 1996 *British Columbia Road Map and Parks Guide* published by the BC Ministry of Tourism.

### *General practitioners*

We defined general practitioners as those physicians who were not fellows of the Royal College of Physi-

cians and Surgeons of Canada and who were billing the Medical Services Plan for their services. We assumed that the practitioner was working in the same LHA as his or her billing address. If the practitioner's billing address changed during the year of the study, we used the address from which the most billing occurred. The number of general practitioners and specialists in each LHA as of July 1, 1996 was provided courtesy of the BCMA.<sup>17</sup> The presence of acute-care beds in the LHA determined the presence of a hospital.

We determined a set of factors and definitions that allowed us to assign a GPRI score and a simplified index (GPRI-S) score.

### Analysis

For the analysis, we grouped selected fee items into categories. The number of services in each category was expressed as a percentage of the total number of services provided by all the general practitioners in their specific LHA. For each fee category, we plotted the LHA service percentages against the LHA GPRI score and we derived a Pearson's correlation coefficient. We considered correlations significantly different from zero using Fisher's *t* test.

### RESULTS

Based on the factors and definitions in Table 1 and Table 2, we assigned a GPRI score to each LHA. We also assigned a GPRI-S score to each LHA

Table 1. Factors used to assign GPRI score	
Factors to sum*	Formula
Remoteness from closest advanced referral centre	Distance (in km) ÷ 50
Remoteness from closest basic referral centre	Distance (in km) ÷ 25
Drawing population	20 - (drawing population ÷ 2000)
Number of general practitioners	20 ÷ number of FTE general practitioners with main office within 25 km of the community's centre
Number of specialists	No specialists with main office within 25 km of the community's centre = 10 point score; otherwise, score = 6 points ÷ number of specialists
Presence of an acute-care hospital	No acute-care inpatient hospital beds within 25 km of the community's centre = 0 point score; otherwise, score = 10 - number of specialists; if negative, score = 0
GPRI = General Practice Rurality Score; FTE = full-time equivalent. *Sum the points for each applicable factor (maximum of 100 points). See Table 2 for definitions and see online article by Leduc. <sup>10</sup>	

using only the population and distance factors calculated according to the formula outlined in Table 3. Table 4 lists the rurality scores for the LHAs. Table 5 lists the categories of selected fee items.

The billing data comprised a total of 20.86 million services billed by 4135 fee-for-service general practitioners in the fiscal year April 1, 1996 to March 31, 1997, divided into 71 LHAs. A mean of 5080 services were provided by each general practitioner

Table 2. Definition of terms used in the GPRI <sup>10</sup>	
Term	Definition
Advanced referral centre	Closest major metropolitan area with registered subspecialists in cardiothoracic surgery, neurosurgery, paediatric surgery, radiation oncology and haematology.
Basic referral centre	Closest community with registered specialists in general internal medicine, general surgery, ophthalmology, orthopedic surgery and radiology.
Community	Any city, town or village with a centre identified on an official government road map (does not include areas, districts, counties or regions without an identifiable community centre).
Distances	Shortest route in kilometres by paved road from the centre of one community to the centre of another; if no paved road, use the shortest unpaved road multiplied by 2 or, in the case of boat or airplane travel, the water distance multiplied by 4 or the air distance as the crow flies.
Drawing population	The community population plus the area population that regularly uses the community GPs for primary care; if a community has at least one GP, the whole population of that community is assumed to see the local GP(s) for its primary care, so that population should not be included in the drawing population of any other community.
General practitioner	Any licensed physician who is not registered as a specialist by the provincial licensing authority and who is working full time.
GPRI = General Practice Rurality Index; GP = general practitioner.	

Table 3. Factors used to assign GPRI-S score	
Factors to sum*	Formula
Remoteness from closest advanced referral centre	Distance (in km) ÷ 40
Remoteness from closest basic referral centre	Distance (in km) ÷ 20
Drawing population	40 - (drawing population ÷ 2000); if negative, score = 0
GPRI-S = simplified General Practice Rurality Index. *Sum the points for each applicable factor (maximum of 100 points). See Table 2 for definitions.	

in each LHA, with a standard deviation of 1271. Two LHAs, the Queen Charlotte Islands (Masset) and the Central Coast (Bella Coola), were outside (below) 3 standard deviations from the mean. These 2 communities were exceptional in British Columbia as most of their physicians were paid through an alternative payment plan. They were therefore left out of any further analysis.

Table 6 shows the Pearson correlation coefficients between the GPRI (or the GPRI-S) and the proportion of services billed by general practitioners for each fee category. The closer the coefficient is to a value of 1 or -1, the closer the data approaches a straight-line positive or negative linear relation. A value of 0 would indicate no relation. Those coefficients that are significantly different from 0 are indicated.

The strongest correlation (coefficient 0.77) was for emergency department visits and on-call premiums (EMERG2). Figure 1 is a scatter plot of this data showing the apparent linear relation. Figure 2 shows a slightly stronger correlation using the GPRI-S. Other significant positive correlations

were found for hospital inpatient care and surgery. The GPRI-S achieved additional significance for anesthesia and orthopedics. Negative correlations were seen for all office visits, surgical assists, on-site emergency shift work, office visits by the elderly and maternity care. Correlations were not statistically significant for the remainder of the categories.

## DISCUSSION

The comprehensiveness of this billing data analysis provides a very strong case for the validity of the GPRI as a measurement of rurality. This study shows significant differences in the fee-for-service practice patterns between rural and urban general practitioners using the GPRI to rate their communities. Of course, by themselves, these patterns form a very limited picture of what it means to be a rural general practitioner.

Office visits, including those for the elderly, surgical assists and maternity care, form a greater part of the urban general-practitioner workload. This fits with the popular perception that urban general

**Table 4. Rurality scores for LHA centres in descending order by GPRI score**

LHA	Centre	GPRI	GPRI-S	LHA	Centre	GPRI	GPRI-S	LHA	Centre	GPRI	GPRI-S
055	Burns Lake	68	72	032	Hope§	38	38	015	Penticton	9	30
080	Kitimat	60	71	004	Invermere	38	49	072	Campbell River	8	29
049	Bella Coola	60	67	014	Oliver	37	44	023	Kelowna	8	10
050	Masset	60	63	018	Golden	37	49	069	Parksville	8	26
010	New Denver	59	60	088	Terrace	31	57	024	Kamloops	7	9
006	Kaslo*	57	58	060	Fort St. John¶	31	43	071	Comox	5	16
019	Revelstoke	54	56	067	Ladysmith	31	35	033	Chilliwack	3	9
029	Lillooet	54	54	028	Quesnel	29	49	068	Nanaimo	3	3
056	Vanderhoof	54	58	001	Fernie	28	44	034	Abbotsford	2	2
054	Smithers	50	70	047	Powell River	27	48	063	Saanichton	2	12
026	Clearwater	50	55	064	Ganges	24	41	065	Duncan	2	16
078	Enderby	49	50	011	Trail	23	45	035	Langley City	1	1
066	Bamfield	49	47	007	Nelson	22	44	042	Maple Ridge	1	4
052	Prince Rupert	49	75	046	Sechelt	22	39	037	White Rock	1	1
021	Armstrong	49	48	027	Williams Lake	22	42	045	West Vancouver	1	16
012	Grand Forks	48	54	059	Dawson Creek	21	40	043	Coquitlam	1	0
030	Ashcroft	48	49	048	Squamish	18	31	040	New Westmster	1	16
085	Port Hardy†	48	57	020	Salmon Arm	17	40	038	Richmond	0	0
003	Kimberley	47	47	002	Cranbrook	16	37	041	Burnaby	0	0
017	Princeton‡	47	48	057	Prince George	16	19	044	North Vancouver	0	0
031	Merrit	45	45	070	Port Alberni	15	32	036	Surrey	0	0
005	Creston	45	52	075	Mission	13	25	061	Victoria	0	0
077	Summerland	44	45	062	Sooke	10	17	039	Vancouver	0	0
009	Castlegar	44	50	022	Vernon	9	21				

LHA = local health area; GPRI = General Practice Rurality Index; GPRI-S = simplified General Practice Rurality Index.

\*Combined data from Kootenay Lake LHA and Kettle Valley LHA.

†Combined data from Vancouver Island West LHA and Vancouver Island North LHA.

‡Combined data from Princeton LHA and Keremeos LHA.

§Combined data from Hope LHA and Agassiz-Harrison LHA.

¶Combined data from Peace River North LHA and Fort Nelson LHA.

practitioners are more office-based than their rural counterparts.

The very strong correlation between rurality and the proportion of general practitioner billings for emergency department visits is not surprising in light of the aforementioned research. In more urban locations, if general practitioners are working in the emergency department, they tend to bill for on-site shifts rather than fee-per-visit.

The rural general practitioner seems to spend relatively more time providing total care to hospital inpatients. This is not an unexpected finding, but it is surprising that, although there are positive correlations for surgery (including orthopedics) and anesthesia in rural areas, these correlations are only sig-

nificant with the GPRI-S. This could be explained if some health areas with similar population and isolation have relatively better complements of trained medical staff and therefore have busier operating rooms. The GPRI would have rated these health areas lower in rurality than the GPRI-S.

No correlation is seen in the mental health, cancer chemotherapy or high-risk obstetrics fee categories for either rural or urban location. This could be owing to the relatively small number of these services billed by general practitioners, but they seemed to be spread evenly throughout the province.

Intuitively, one can argue that a definition of "rural" should be independent of the number of general practitioners and specialists already practising in the

Fee category	Description (fee code)
EMERG1 Emergency visits and call-in	All after-hours surcharges (01200, 01201, 01202, 01205, 01206, 01207, 01210, 01211, 01212), emergency visits (00123, 00111, 00112, 00113, 00081, 00082, 00083, 00084) and out-of-office visit fee items (13200, 13201, 13220, 13300, 13301, 13320), not including emergency shift fees.
EMERG2 Emergency call-in only	After-hours surcharge for coming to hospital when specially called (01200, 01201, 01202).
INPAT2 Inpatient direct care only	Inpatient care and palliative care; no supportive care (00108, 00109, 00127).
INPAT1 Inpatient and supportive care	All inpatient care including supportive visits and palliative care (00108, 00109, 00116, 00127, 00128).
ORTHO2 Minor orthopedics	Closed forearm fracture reductions only (05209, 05210, 05211, 05212, 05213).
EMERG3 Trauma procedure	Chest tube insertion only (07926).
SURG Surgery	Tubal ligation, Dilation and Curettage, breast biopsy, appendectomy, inguinal, umbilical and femoral hernia repair, vasectomy, sigmoidoscopy, tonsil and adenoidectomy, cesarean section, surgical after-hour surcharges (04213, 04500, 07476, 07656, 07657, 07605, 07611, 08345, 00716, 00718, 02401, 02402, 02403, 02404, 04105, 01210, 01211, 01212).
ORTHO Orthopedic	All orthopedic fee items (052xx – 056xx).
ANESTH Anaesthesia	All procedural anaesthesia fee items (010xx).
OBSHIGH High-risk obstetrics	All obstetrical fee items other than normal prenatal, delivery and postnatal care. Includes twin delivery, cesarean section, induction of labour, etc. (04092, 04093, 04105, 04107, 04117, 04118, 04119).
MENTAL Mental health	Investigation, documentation, committal and crisis intervention (00065, 00066, 00067, 00083).
CANCER Cancer chemotherapy	Cancer chemotherapy (00381, 00382, 00383).
OBS Obstetrics	Normal delivery and postnatal care (04104, 04108, 04109).
HOME	House calls and nursing home visits (00103, 00104, 00114, 00115).
GERI Geriatric	Complete, partial and counselling office visits for all patients aged 75 years and older after October 1996 (13100, 13101, 13120).
ER_CITY Emergency shifts	All emergency medicine fee codes for on-site shifts in the emergency department (018xx).
ASSIST Surgical assists	Surgical assists (07014, 07015, 07016, 07017, 07018).
OFFICE	All complete and partial exams, counselling and consultation for all ages in the office (00100, 00107, 00101, 00120, 00110, 13100, 13101, 13120).*

Note: In October 1996, a general practice fee schedule change took effect in BC. All existing fee codes were changed from 4 digits to 5 digits by adding a 0 to the front. New fee codes were created for complete and partial exams, counselling patients aged 75 years and older, and location of service (either in or out of the office).  
\*A small percentage of these codes were likely billed from April to October 1996 for services outside the office.

community and independent of the presence of a hospital, if community size and distance to a basic referral centre are already considered. Some rural communities of similar size and remoteness have different medical resources. These may vary over time due to economic, social or other influences. In other words, the number and type of physicians as well as the presence or absence of a hospital are determinants of "need." It would be more appropriate to include these determinants in a separate "medical neediness index" and exclude them from the medical rurality index. These 2 indices could then be used individually or in combination to provide more flexibility in rural health research, policy development and resource allocation.

It is with this idea in mind that we suggest the GPRI-S. It purposefully excludes local medical resources but includes population size and distance to medical referral centres. The GPRI-S is at least as good if not better than the unmodified GPRI at predicting billing trends.

It is possible that further refinements to the GPRI may make it more sensitive. For example, the BC Ministry of Health uses 2 additional distance parameters, degrees of latitude and radial air distance from Vancouver (the provincial tertiary referral centre for several medical specialties), in its Medical Isolation Point Rating System.<sup>18</sup> It may be possible to consider climactic conditions by incorporating a scale like the Plant Hardiness Zone.<sup>19</sup>

**Table 6. Pearson correlation coefficients for each fee category**

Fee category	GPRI	GPRI-S
EMERG1	0.73*	0.79*
EMERG2	0.77*	0.74*
INPAT2	0.66*	0.62*
INPAT1	0.57*	0.52*
ORTHO2	0.19	0.26†
EMERG3	0.17	0.14
SURG	0.27†	0.31†
ORTHO	0.22	0.27†
ANESTH	0.23	0.47*
OBSHIGH	0.07	0.11
MENTAL	0.02	0.04
CANCER	0.01	0.15
OBS	-0.24†	-0.14
HOME	-0.18	-0.18
GERI	-0.26†	-0.32*
ER_CITY	-0.42*	-0.48*
ASSIST	-0.53*	-0.45*
OFFICE	-0.49*	-0.65*

GPRI = General Practice Rurality Index; GPRI-S = simplified General Practice Rurality Index.

\* $p < 0.01$ .

† $p$  values ranged from  $p > 0.01$  to  $p < 0.05$ .

Finally, we must emphasize that billing patterns are only a crude reflection of what general practitioners do. Billing patterns will not reveal many other factors that distinguish the rural medical occupation and lifestyle from the urban. Additional ways of testing the validity of rural indices are needed.

### Limitations

The obvious advantage of using these billing data is the completeness of the data. However, there are some minor problems that must be considered.

An unknown number of nonfellowship physicians practise in restricted specialty fields in BC. They may be foreign-trained specialists or Canadian-trained fellows who have not obtained Canadian certification. These physicians would have been included in these data and could be overrepresented in rural areas of need owing to the BC College of Physicians and Surgeons temporary licensing requirements. Their presence could inflate the denominator of the service proportions in a rural

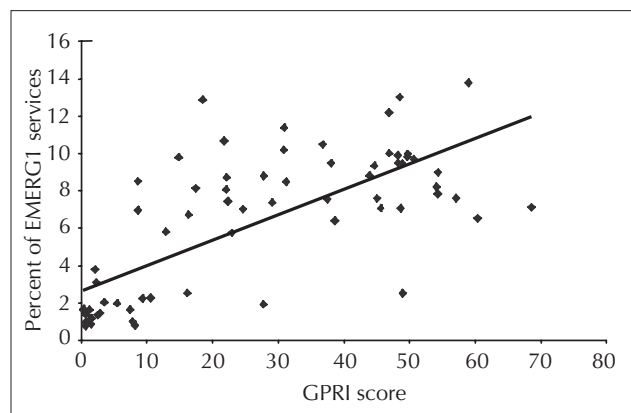


Fig. 1. Scatter plot of data for EMERG1 fee category and General Practice Rurality Index (GPRI) score, with local health area GPRI score versus percent of EMERG1 services.

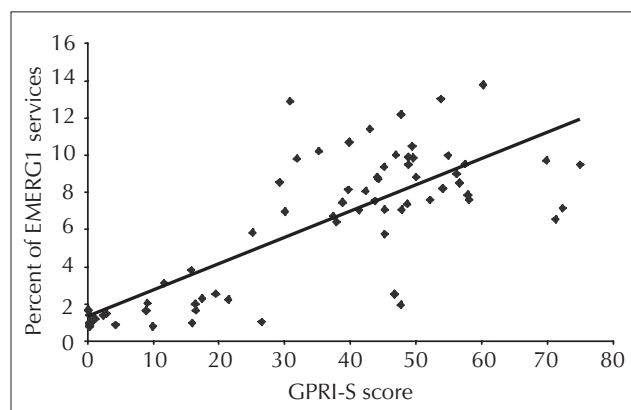


Fig. 2. Scatter plot of data for EMERG1 fee category and simplified General Practice Rurality Index (GPRI-S) score, with local health area GPRI-S score versus percent of EMERG1 services.

health area; however, the overall effect of this potential error is likely small.

These data include only fee-for-service billing information. In the 1996–97 fiscal year, 78% of general practitioners were paid solely by fee-for-service, 3.4% by sessional or salaried payments and 19% by a combination of both.<sup>20</sup> Most (at least 60%) of the full-time alternately-paid practitioners were in the urban areas of Victoria, Vancouver and the lower Fraser Valley,<sup>21</sup> approximating the rural–urban distribution of general practitioners through the province. This could create a small systematic error that should not affect the relative numbers of services between the LHAs.

We used the total number of general practitioners, rather than full-time equivalents in each health area to calculate the rurality scores. The GPRI requires full-time equivalents, but full-time equivalent data was only available for those practitioners who were paid fee-for-service. It is important that all general practitioners, no matter how they are paid, be included in a rural index. This small error is assumed to affect the scoring of all LHAs consistently and equally. It does not affect the percentage of services, as these are based on percentage of total services rather than per practitioner.

The practitioner's billing address may not have been in the same LHA as the one in which he or she was working. This could occur if the practitioner had more than one office or moved during the year. This could also occur in the case of physicians who lived in one community and did locums in another. The more common occurrence was likely an urban-based physician doing rural locums, which would result in a decrease in the numerator of the service proportions in a rural health area. However, the overall effect of this potential error is likely relatively small.

The GPRI is designed to measure individual communities, not LHAs. By applying this index to a region composed of a number of communities, some error is introduced into almost every measurement. LHA scores will be generally lower than community scores. We assumed that this error is consistent and that it would reduce the sensitivity of the assessments and systematically reduce the correlations.

In order to prevent the identification of individual physicians, the data from LHAs with less than 5 physicians were combined with nearby LHAs. This manipulation was done by the BCMA before it released the data and would obviously decrease the sensitivity of the study for the smaller communities.

Use of linear correlation assumes a linear relation. These relations may not be linear. In fact, as

communities become smaller and more remote one would logically expect the curve to level off, reaching a constant percentage of services that would be typical of the most isolated general practice. Aggregating individual community data into LHAs may conceal such a trend.

## CONCLUSION

An analysis of 20 million services billed by BC general practitioners in the fiscal year 1996–97 demonstrated that emergency department, after-hours services and hospital inpatient care were a significantly greater part of rural general practitioners' workload, compared with their urban colleagues. Conversely, office visits by all ages, including the elderly, surgical assists and emergency department shift work, were a significantly greater part of an urban general practitioner's workload, compared with that of a rural general practitioner.

The excellent correlation between the BC billing data and the GPRI, especially in service categories that have been previously associated with rural general practice, is evidence that the GPRI could be a valid measure of rurality. Modification of the GPRI to remove redundant "need" factors does not seem to reduce the sensitivity of this tool and makes it even simpler to apply. Further analysis and study are required to prove the GPRI's reliability across Canada.

**Competing interests:** None declared.

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